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Datasheet for the decision of 17 October 2017

Case Number: T 0810/15 - 3.3.09

Application Number: 07792059.3

Publication Number: 2053078

IPC: C08J5/24, C08K7/06, C08L101/00

Language of the proceedings: EN

Title of invention:
PREPREG AND CARBON FIBER-REINFORCED COMPOSITE MATERIAL

Patent Proprietor:
Toray Industries, Inc.

Opponents:
HEXCEL CS CORPORATION (opponent 1: opposition withdrawn)
Toho Tenax Europe GmbH (opponent 2)

Headword:

Relevant legal provisions:
EPC Art. 56, 84, 100(a), 100(b), 100(c)
RPBA Art. 13(1), 13(3)

Keyword:
Main request: inventive step - (no)
New auxiliary requests 1 and 2: admittance - (no)
Auxiliary request 12: clarity - (no)

Decisions cited:

Catchword:

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Beschwerdekammern

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Case Number: T 0810/15 - 3.3.09

D E C I S I O N
of Technical Board of Appeal 3.3.09
of 17 October 2017

Appellant: (Opponent 2)	Toho Tenax Europe GmbH Kasinostrasse 19-21 42103 Wuppertal (DE)
Representative:	Manitz Finsterwald Patentanwälte PartmbB Postfach 31 02 20 80102 München (DE)
Respondent: (Patent Proprietor)	Toray Industries, Inc. 1-1, Nihonbashi-Muromachi 2-chome Chuo-ku Tokyo, 103-8666 (JP)
Representative:	Webster, Jeremy Mark Mewburn Ellis LLP City Tower 40 Basinghall Street London EC2V 5DE (GB)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 5 January 2015 rejecting the opposition filed against European patent No. 2053078 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman	W. Sieber
Members:	N. Perakis
	E. Kossonakou

Summary of Facts and Submissions

I. This decision concerns the appeal filed by opponent 2 against the decision of the opposition division rejecting the opposition filed against European patent No. 2 053 078.

Claims 1 and 6 to 8 as granted read as follows:

"1. A prepreg containing a carbon fiber [A] and a thermosetting resin [B], and in addition, satisfying the following:

a thermoplastic resin particle [C] and a conductive particle [D] are contained, and weight ratio expressed by [content of [C] (parts by weight)]/[content of [D] (parts by weight)] is 1 to 1000."

"6. A prepreg according to Claim 1, wherein for each of the above-mentioned thermoplastic resin particle [C] and above-mentioned conductive particle [D], 90 to 100 wt% of them is localized in a 20% depth range from both surfaces of the prepreg in thickness direction."

"7. A prepreg according to Claim 6, wherein 90 to 100 wt% of each of the above-mentioned particle [C] and particle [D] is localized in a 20% depth range from one surface of the prepreg in the thickness direction."

"8. A prepreg according to claim 6, wherein 90 to 100 wt% of each of the above-mentioned particle [C] and particle [D] is localized in a 20% depth range from an upper surface of the prepreg and localized in a 20% depth range from a lower surface of the prepreg."

II. With the notice of opposition opponent 1 requested the revocation of the patent in its entirety on the grounds of Article 100(a) (lack of inventive step), 100(b) and 100(c) EPC. With letter of 4 October 2013 opponent 1 withdrew its opposition. Therefore it is no longer party to the proceedings.

III. With the notice of opposition opponent 2 requested the revocation of the patent in its entirety on the grounds of Article 100(a) (lack of novelty and inventive step) and 100(b) EPC.

IV. The documents filed during opposition included the following:

D1: US 5 728 755 A;

D7: EP 0 885 704 A1;

D8: US 5 028 478 A;

D13: US 6 592 986 A;

D14: JP 2005 105152 A(abstract and translation);

D18: US 5 057 353 A;

D19: K. Nagata *et al*, *Composite Interfaces*, 1999, vol 6, No 5, pp 483-495;

D33: US 2005/0070185 A; and

D34: D. Chung, Composite Materials, Kirk-Othmer Encyclopedia of Chemical Technology, John Wiley & Sons Inc, published online 15 October 2004, p 1.

V. The opposition division rejected the opposition because it considered that:

- the claims as granted, in particular claim 7, did not contain added subject-matter;
- the claimed invention was sufficiently disclosed for it to be carried out by a person skilled in the art;
- the claimed subject-matter was novel over D1 in view of the multiple selections the skilled person would have to make in order to arrive at it; and
- starting from D8 or D18 as the closest prior art, the subject-matter of the granted claims was not obvious from D8 or D18 considered either alone or in combination with any other available prior-art document, in particular D13 and D19.

VI. On 20 February 2015 opponent 2 (in the following: the appellant) filed an appeal against the decision of the opposition division. The statement setting out the grounds of appeal was filed on 15 May 2015. The appellant requested that the decision of the opposition division be set aside and that the patent be revoked. It reiterated its objections of added subject-matter, insufficiency of disclosure and lack of inventive step. Furthermore, it filed the following documents:

D35 : S. O Daimo *et al*, "Study of Interlaminar Toughening of CFRP Laminates with Fine Titanium Particle Dispersion", Proceedings of the 46th Conference on Structural Strength © The Japan Society for Aeronautical and Space Sciences, 4-6 August 2004, pp 140-142;

D35' : English translation of D35;

D36 : WO 98/26912 A1;

D36-2: English translation of D36; and

D36-3: Marked-up version of D36.

All references to D35 and D36 in this decision relate to their English translations D35' and D36-2.

VII. With letter dated 1 October 2015, the patent proprietor (in the following: the respondent) filed observations on the appeal together with 14 auxiliary requests. The respondent requested that the appeal be dismissed or, in the alternative, that the patent be maintained on the basis of the claims of one of the auxiliary requests.

The respondent requested further that D35 and D36 not be admitted into the proceedings and that, if these documents were admitted, the case be remitted to the opposition division for further prosecution. The respondent also filed the following documents:

D37: Experimental report detailing lightning test experiments conducted on composites of the claimed invention;

D38: G. Gardiner, "Lightning Strike Protection For Composite Structures", pp 1-6; posted on 7 January 2006, http://www.compositesworld.com/articles/lightning-strike-protection-for-composite-st... 28/09/2015; and

D39: US 2007/0093163 A1.

VIII. With letter dated 18 January 2016, the appellant requested that the respondent's request for remittal to the opposition division if D35 and D36 were admitted into the proceedings be rejected. It also requested that D37-D39 not be admitted into the proceedings.

IX. With letter of 27 January 2016, the appellant referred to parallel proceedings relating to three patents granted on divisional applications derived from the patent in suit, namely EP 2 455 418, EP 2 460 846 and EP 2 455 419, against which it had already filed oppositions.

X. With letter dated 5 July 2016, the appellant raised for the first time in appeal a novelty objection against the claimed subject-matter. This objection was based on D14, a document already on file, interpreted in the light of the following documents:

D40: Paphen™ PKHP-200-Gabriel Phenoxies - Datasheet, http://coatings.specialchem.com/product/r-phenoxy-specialties-paphen..., 22.04.2016 10:38 pp.1-2;

D41: Phenoxy Resins, phenoxy dispersions /Inchem Corp. Products, http://www.maroongroupllc.com/maroonProduct/list?manufac..., 22.04.2016 10:38 pp.1-2;

D42: News Archives - Gabriel Performance Products, http://www.gabrielchem.com/news/, 05.05.2016 13:18, pp 1-3;

D43: US 2005/0242021 A1;

D44: US 2004/0191523 A1;

D45: US 5 952 435 A;

D46: http://en.wikipedia.org/wiki/Nylon_12, 05.06 2016 16:22, pp 1-2; and

D47: M.A.Rafiee *et al.*, "Fullerene-epoxy nanocomposites - enhanced mechanical properties at low nanofiller loading, *J Nanopart Res*, published online, 16 September 2010, pp 1-5.

XI. With letter dated 16 January 2017, the appellant submitted the decision of the opposition division dated 8 December 2016 concerning patent EP 2 455 419, finding that the subject-matter of claim 1, quite similar to that of claim 1 of the patent in suit, lacked novelty in view of D14.

XII. With letter dated 5 September 2017, the respondent submitted further arguments regarding the outstanding issues. It also filed auxiliary request 1A, and the following documents:

D48 : Letter dated 18 April 2017 submitted in appeal proceedings concerning case T 573/17 (patent EP 2 455 419);

D48-1: Photograph of a prepreg prepared according to example 2 of D14;

D48-2: Experimental certificate dated 3 April 2017; and

D49 : Experimental report regarding PKHP-200.

The respondent argued on the basis of these documents that the prepreg of example 1 of D14 contained neither

thermoplastic resin particles [C] nor conductive fullerene particles [D].

XIII. With letter dated 11 September 2017, the respondent submitted:

D49': the original signed copy of D49.

XIV. By communication of 14 September 2017 the board expressed its preliminary non-binding opinion on the outstanding issues.

XV. With letter dated 22 September 2017, the appellant requested that D49 not be admitted into the proceedings. Furthermore it submitted D48', which is D48 in its entirety.

XVI. With letter dated 2 October 2017, the appellant submitted additional document D50 in order to show that, at a reasonable mixing temperature, the phenoxy thermoplastic resin of D14 neither melted nor dissolved in the epoxy thermosetting resin of that document:

D50: Experimental report dated 26 September 2017.

XVII. With letter dated 9 October 2017, the appellant submitted D51 and D52 in order to confirm that at a reasonable mixing and impregnation temperature of up to 110°C, even under unrealistically long heating times, the phenoxy thermoplastic resin used in the examples of D14 neither melted nor dissolved in the epoxy thermosetting resin:

D51: Experimental report dated 6 October 2017; and

D52: EP 2 730 914 A1.

XVIII. With letter dated 10 October 2017, the respondent provided additional arguments and submitted D53 to D56, to provide evidence of facts relating to experimental reports D49, D50 and D51:

D53: EP 0 256 130 B1;

D54: Data sheet showing particle size distribution data for PKHP-200;

D55: Data sheet illustrating the viscosity (25°C) (P/Gardner-Holdt) of jER 152 and jER 154; and

D56: partial English translation of D55.

The respondent also submitted additional auxiliary requests 1B, 6A and 7A.

XIX. With letter dated 16 October 2017, the respondent also submitted:

D56a': corrected translation of D56; and

D57 : EP 1 275 674 A1.

XX. Oral proceedings were held on 17 October 2017 as scheduled. During the oral proceedings the respondent filed two new auxiliary requests 1 and 2 and withdrew all previous auxiliary requests except auxiliary request 12. The respondent also requested that the novelty attack based on D14 not be admitted into the proceedings. Lastly, it withdrew its request that the case be remitted to the opposition division if documents D35 and D36 were admitted into the proceedings.

- Claim 1 of **new auxiliary request 1** corresponds to claim 1 as granted with the following amendments (underlined):

"1. A prepreg containing a carbon fiber [A] and a thermosetting resin [B], and in addition, satisfying the following:

a thermoplastic resin particle or fiber [C] and a conductive particle or fiber [D] are contained, and weight ratio expressed by [content of [C] (parts by weight)]/[content of [D] (parts by weight)] is 1 to 1000, wherein a thermoplastic resin particle is used as [C] and a conductive particle is used as [D]."

- Claim 1 of **new auxiliary request 2** corresponds to claim 1 as granted with the following features added at the end of the granted claim:

"wherein the prepreg does not contain a thermoplastic resin fiber, nor a conductive fiber".

- Claim 1 of **auxiliary request 12** derives from the combination of granted claims 1, 4, 6 and 9 with the following feature taken from the description (underlined):

"A prepreg for use in making a carbon fiber reinforced composite material for an aircraft structural member".

XXI. The relevant arguments put forward by the appellant in its written submissions and during the oral proceedings may be summarised as follows:

The main request

- The subject-matter of claims 1 and 7 did not meet the requirements of Article 100(c) EPC. The open wording used in claim 1 to define the prepreg allowed the presence of fibres in either [C] or [D], whereas in the application as filed the prepreg contained thermoplastic resin fibres or particles as ingredient [C] and conductive fibres or particles as ingredient [D]. Regarding claim 7, there was no basis in the application as filed for the localisation of 90 to 100 wt% of the particles [C] and [D] in a 20% depth range from one surface of the prepreg in the thickness direction in combination with the localisation of 90 to 100 wt% of the particles [C] and [D] in a 20% depth range from both surfaces of the prepreg.

- The claimed invention did not meet the requirements of Article 100(b) EPC. Claim 1 did not define whether a conductive particle was an electrically or a thermally conductive particle, did not provide the absolute conductivity value for the conductive particle and did not distinguish between fibres and particles or between conductive particles and conductive fillers.

- The objection of lack of novelty based on D14 should be admitted into the proceedings, since lack of novelty had been an opposition ground before the opposition division. The objection had been filed as soon as possible, given that a change of representative had occurred. The appellant had

become aware of the relevance of D14 during parallel proceedings concerning patent EP 2 455 419 with quite similar subject-matter. D14 directly and unambiguously disclosed all the features of claim 1, in particular that the prepreg contained ingredients [C] and [D] in particulate form. This was corroborated by the additional evidence D48, D48-1, D48-2, D50, D51 and D52.

- D35 and D36 should be admitted into the proceedings since they had been filed with the grounds of appeal as a reaction to the appealed decision in order to fill gaps in the previously filed arguments.

- D37 to D39, filed by the respondent, should not be admitted into the proceedings because they were irrelevant.

- The subject-matter of claim 1 did not involve an inventive step in view of the obvious combination of D36, considered to be the closest prior art, with D35. Contrary to the assertions of the respondent, D33 was not the closest state of the art because the prepreg it disclosed did not address the problems of impact resistance (CAI) and conductivity in the thickness direction. Although D33 mentioned electrical conductivity, this was in a different technical context.

- The claimed prepreg differed from that of D36 in that it contained electrically conductive particles and these particles were present in a specific weight ratio with respect to the thermoplastic particles.

- However, the presence of conductive particles alone did not provide the alleged advantageous effects of excellent impact resistance and excellent conductivity in the thickness direction. These effects would have been obtained only if conductive paths had been formed in the thickness direction. The subject-matter of claim 1 did not contain the required features for the formation of conductive paths.

- Moreover, in view of the open wording used to define the claimed subject-matter, conductive fibres could be included, which would contribute to the conductivity of the prepreg in the thickness direction in a similar way to the conductive particles and which would render the weight ratio [C]/[D], which related exclusively to particles, technically meaningless.

- On account of this, the technical problem underlying the claimed invention in view of D36 was the provision of an alternative prepreg, or at most the provision of a prepreg combining improved electrical conductivity in the thickness direction with good impact resistance.

- The skilled person starting from D36 and aiming at an alternative prepreg would have been motivated by the teaching of D35 to add electrically conductive particles into the thermosetting resin of the prepreg of D36 and thus arrive at the claimed prepreg. The obvious combination of D36 with D35 resulted in a weight ratio [C]/[D] which lay within the claimed range of 1 - 1 000.

The auxiliary requests

- New auxiliary request 1, which had been filed very late, did not derive from the combination of granted claims and raised clarity issues, should not be admitted into the proceedings.

- New auxiliary request 2, which had been filed very late, did not derive from the combination of granted claims and raised issues of clarity and added subject-matter, should also not be admitted into the proceedings.

- The subject-matter of claim 1 of auxiliary request 12 did not meet the requirements of clarity and added subject-matter.

XXII. The relevant arguments put forward by the respondent in its written submissions and during the oral proceedings may be summarised as follows:

The main request

- The subject-matter of claim 1 met the requirements of Article 100(c) EPC. Compared with that of claim 1 as filed, it was limited to one of the options regarding the ratio [C]/[D] which was disclosed in the application as filed (page 5, lines 16-17). The "or" language used in claim 1 as filed was not exclusionary and, in the usual way, the prepreg could include other components.

- The subject-matter of claim 7, dependent on claim 6, also complied with Article 100(c) after careful consideration of the relevant passages of

the application as filed and of the meaning of claims 6 and 7.

- The claimed invention met the requirements of Article 100(b) EPC since the description provided sufficient guidance to the skilled reader and enabled him to put the invention into practice. The appellant had not submitted any evidence that there was an area where no prepreg could be obtained.

- The lack of novelty objection based on D14 should not be admitted into the proceedings because it was not *prima facie* relevant. D14 did not disclose all the features of claim 1, in particular that the prepreg contained ingredients [C] and [D] in particulate form. This was corroborated by the additional evidence D48, D48-1, D48-2, D49, D53-D56, D56' and D57.

- D35 and D36 should not be admitted into the proceedings because they were late-filed and not *prima facie* relevant, or at least no more relevant than the other documents cited before the opposition division.

- On the other hand, D37-D39 should be admitted into the proceedings since they had been filed in response to the appellant's assertions that no technical effect had been demonstrated.

- The subject-matter of claim 1 involved an inventive step. D33 was the closest prior art because it was the only document on file which addressed the combined problems of compressive strength after impact (CAI) and lightning protection of aircraft primary structures. D33 disclosed that use of

titanium-nickel alloy eliminated the need for thermoplastic particles in the interlayer. Thus the skilled person starting from D33 and seeking to provide an improved or even alternative prepreg would not have mixed thermoplastic particles with titanium-nickel alloy particles and would not have arrived at the claimed prepreg.

- Even if D36 was considered the closest prior art, the objective technical problem underlying the claimed invention would be the provision of a prepreg and carbon reinforced composite material having an excellent compressive strength after impact (CIA) and improved conductivity properties (lightning protection properties). The appellant had not provided any experimental evidence to show that a technical effect could not have been achieved across the scope of claim 1. The weight ratio [C]/[D] defined an area in which an impressive combination of results was achieved; it was not meaningless, as asserted by the appellant.

- The skilled person starting from D36 and seeking to solve the above technical problem would not have been motivated to include the titanium particles of D35 into the prepreg of D36, in particular because it led to poorer mechanical properties, namely lower interlaminar fracture toughness, making the prepreg unacceptable for aircraft use.

The auxiliary requests

- New auxiliary requests 1 and 2 should be admitted into the proceedings. The amendments were directly and unambiguously derived from the application as

filed, taking into consideration its entire technical content.

- Claim 1 of auxiliary request 12 specified that the prepreg was suitable for an aircraft structural member. In this manner it distinguished the claimed prepreg from those disclosed in D35, which were unsuitable for such use.

XXIII. The appellant requested that the decision under appeal be set aside and that European patent No. 2 053 078 be revoked in its entirety.

XXIV. The respondent requested that the appeal be dismissed (main request), or that the patent be maintained on the basis of the claims of any one of new auxiliary requests 1 and 2 (filed during the oral proceedings before the board) or of auxiliary request 12 (filed with the reply to the grounds of appeal of 1 October 2015).

Reasons for the Decision

Main request (claims as granted)

1. Added subject-matter

The appellant raised objections under Article 100(c) EPC against claims 1 and 7.

1.1 Claim 1

1.1.1 Claim 1 as granted (see point I above) is based on claim 1 as filed which reads as follows:

"1. A prepreg containing a carbon fiber [A] and a thermosetting resin [B], and in addition, satisfying at least one of the following (1) and (2).
(1) a thermoplastic resin particle or fiber [C] and a conductive particle or fiber [D] are contained, and weight ratio expressed by [content of [C] (parts by weight)]/[content of [D] (parts by weight)] is 1 to 1000.
(2) a conductive particle or fiber of which thermoplastic resin nucleus or core is coated with a conductive substance [E] is contained."

The subject-matter of claim 1 as granted is limited to alternative (1) of claim 1 as filed, which has been further restricted with regard to the options for ingredients [C] and [D], namely that [C] is a thermoplastic resin particle and [D] a conductive particle.

This embodiment is directly and unambiguously derivable from the application as filed, which discloses (see page 5, lines 16-17):

"In this embodiment, it is preferable to use a thermoplastic resin particle as [C] and a conductive particle as [D]".

1.1.2 According to the appellant the "or" language of claim 1 as filed as well as the application as a whole specified that the prepreg contained a thermoplastic particle **or** fibre [C] and a conductive particle **or** fibre [D], wherein the weight ratio expressed by [content of [C] (parts by weight)]/[content of [D] (parts by weight)] was 1 to 1 000. Thus, the application as filed excluded a prepreg containing a

thermoplastic particle **and** fibre [C] and/or a conductive particle **and** fibre [D].

By contrast, claim 1 as granted allowed for the additional presence of fibres of [C] and/or fibres of [D] in view of its open wording, namely the use of the expression "a prepreg containing" to define the prepreg.

1.1.3 The board does not agree.

The ratio [C]/[D] of claim 1 as filed is so defined as to comprise four embodiments:

fibre [C] - fibre [D],
fibre [C] - particle [D],
particle [C] - fibre [D] and
particle [C] - particle [D].

Claim 1 of the main request is limited to the last of these embodiments.

The board agrees with the appellant that claim 1 as granted allows for the additional presence of fibres of [C] and/or fibres of [D]. However, claim 1 as filed uses exactly the same open wording as claim 1 as granted to define the prepreg, namely "a prepreg containing". In fact, claim 1 as filed allows for the presence of further components for the embodiments comprised within the definition of the ratio [C]/[D], i.e. for the embodiment particle [C] - particle [D] the presence of fibres of [C] and/or fibres of [D]. Thus, claim 1 as filed and claim 1 as granted have the same degree of "openness" with regard to the presence of further components.

This was in fact also the respondent's position expressed both in writing and at the oral proceedings, namely that neither claim 1 as granted nor the application as filed, in particular the embodiment referred to on page 5, lines 16-17, excluded other particular components such as fibres of [C] and/or fibres of [D].

1.1.4 In view of the above, the subject-matter of claim 1 as granted does not extend beyond the application as filed.

1.1.5 The appellant argued that claim 1 as granted defined the weight ratio [C]/[D] in relation to the particles [C] and [D] only; any fibres of [C] and/or of [D] present were not taken into account for calculating the weight ratio [C]/[D]. Nevertheless, the fibres of [C] and [D] had the same properties as the particles of [C] and [D], so a weight ratio [C]/[D] defined only in relation to the particles of [C] and [D] would in the end be meaningless if fibres of [C] and [D] were additionally present. This would also support its view that claim 1 as granted contained added matter.

However, Article 100(c) EPC is purely a matter of disclosure. Since there is disclosure for the subject-matter of claim 1 as granted in the application as filed, the technical meaning of this disclosure may be examined at another stage, for example when assessing inventive step of the subject-matter of claim 1. In fact, this was also the position of the respondent at the oral proceedings.

1.2 Claim 7

1.2.1 Claim 7 as granted depends on claim 6, which depends on claim 1 (see section I above). According to the appellant, claim 7 combines the features of claims 6 and 7 for which there is no basis in the application as filed. In particular, the appellant objected to the combination of the localisation of 90 to 100 wt% of [C] and [D] in a 20% depth range from both surfaces of the prepreg in the thickness direction (claim 6) in combination with the localisation of 90 to 100 wt% of [C] and [D] in a 20% depth range from one surface of the prepreg in the thickness direction (claim 7).

1.2.2 The board does not agree.

As pointed out by the respondent, the specific embodiment of claim 6 defines the region of the prepreg which is to be occupied by particles [C] and [D]. This region is defined by the outer surfaces of the prepreg and by lines parallel to those surfaces located at 20% depth, with respect to the thickness, from the respective surfaces. This region is in two parts: a first 20% depth region associated with one surface and a second 20% depth region associated with the opposite surface. Thus, claim 6 covers arrangements in which [C] and [D] are present in only one of the regions or shared between both regions.

Claim 7, on the other hand, covers the arrangement in which [C] and [D] are present only in one of the regions. Therefore, claim 7 merely limits the feature of claim 6.

In the board's view, this reading of claim 6 is also the only meaningful one in view of the claim structure.

Claim 6 sets out the arrangements of particles [C] and [D] in broad terms, whereas the claims referring back to claim 6 set out specific arrangements, namely particles [C] and [D] present in one region (claim 7) or both regions (claim 8).

If one were to follow the appellant's line of argument that already in claim 6 particles [C] and [D] have to be present in both regions, claim 8 would be completely superfluous.

1.2.3 In view of the above, there is no unallowable combination of features due to the dependency in claim 7, so that the objection of added matter to claim 7 has to be rejected.

2. Sufficiency of disclosure

2.1 The appellant contested the clarity of the terms "particle" and "conductive" used in the expression "conductive particle", and argued that since these terms were unclear, the skilled person was unable to carry out the claimed invention. The appellant also referred to paragraph [0035] of the patent in suit which mentioned the addition of a conductive filler in the form of a particle or a fibre. The skilled person would be unable to distinguish between a conductive particle and a conductive filler.

2.2 The board acknowledges that the patent in suit does not provide a clear definition for the term "particle". However, in the absence of any technical evidence to the contrary, the board concurs with the respondent that in most cases the skilled person can distinguish a particle from a fibre. In the particular case where the dimensions of a particle and a fibre converge, this

appears not to affect the core of the invention but rather to create uncertainty at the "edges" of the dimensions for particle and fibre. In other words, this amounts to lack of clarity and not insufficiency.

2.3 Regarding the meaning of the term "conductive", it is beyond doubt in the light of the patent specification as a whole that it refers to electrical conductivity. The patent in suit explicitly discloses conductive particles to be used in the prepreg of the claimed invention (paragraph [0139] and tables 1, 3 and 4) to assure the conductive path between the fibres and the surface of the prepreg and to disperse the electrical charge from lightning also in the thickness direction (avoid insulation).

2.4 With respect to the contested distinction between a filler particle and a conductive particle, the skilled person finds appropriate guidance in the description (paragraph [0035]), which discloses that "The conductive filler mentioned here is a conductive particle or fiber having an average diameter smaller (generally 0.1 times or less) than the average diameters of the conductive particle [D]". It follows from this passage that the optional conductive filler, if present, is different from the conductive particle [D] of the claimed invention, otherwise the requirement for it to have a smaller (generally much smaller) average diameter would be meaningless.

2.5 In view of the above, the claimed invention is sufficiently disclosed.

3. Novelty

3.1 With its letter of 5 July 2016, in the appeal proceedings the appellant raised for the first time a novelty objection based on D14, which until then had never been used in the appeal proceedings.

During the opposition proceedings, only a novelty objection in view of D1 had been raised. Consequently, the decision under appeal dealt only with this novelty objection.
Thus the novelty objection based on D14 is late-filed and an amendment to the appellant's case.

3.2 The board notes that the novelty objection based on D14 triggered the filing of a great deal of contradictory evidence as to whether the prepreg disclosed in D14 ultimately contained thermoplastic particles [C] and/or conductive particles [D] (appellant: D50, D51 and D52; respondent: D48, D48-1, D48-2, D49, D49', D53 to D56, D56a', D57). At the oral proceedings the appellant even requested time to file a response to the evidence filed by the respondent on the day before the oral proceedings.

3.3 In view of the complexity of the novelty issue and the ramifications arising from this issue at a very late stage in the proceedings, and which could not be dealt with without adjournment of the oral proceedings, the board decided under Article 13(1) and (3) RPBA not to admit this objection into the proceedings.

3.4 The appellant argued that it had become aware of the relevance of D14 only during parallel opposition proceedings on a divisional application stemming from the patent in suit. However, this argument had to be

disregarded, in particular because D14 was in the present opposition proceedings from the outset. Nor is a change of the representative in the appeal proceedings a valid argument.

4. Admissibility of D35 to D39

4.1 The appellant filed D35 and D36 as early as possible in the appeal proceedings, namely with the statement setting out the grounds of appeal. Both D35 and D36 relate to prepregs used in the field of aerospace technology and thus are more relevant than the other documents on file, taking into account the technical problem as defined by the respondent (see the section below concerning inventive step).

D35, in contrast to D13 which was filed with the notice of opposition, was explicitly directed to prepregs which were to be used in aerospace (page 140, left column, point 1, first to third paragraphs). Accordingly, D35 was filed in reaction to the argumentation of the opposition division, namely that the skilled person would not combine D13 with D8/D18 (the then closest prior art) because D13 did not relate to aerospace.

D36 was the PCT application corresponding to D7, filed with the notice of opposition. The content of D36 was identical to that of D7, except the passage concerning the amount of thermoplastic particles (page 10, second full paragraph) in the prepreg, namely 2 wt% or more, and a few other text passages. In view of this additional feature, D36 was more relevant than D7, as it suggested in combination with D35 the weight ratio specified in claim 1, namely [C]/[D] of 1 to 1 000,

which the respondent considered a prerequisite for obtaining the alleged effects.

All in all, the filing of these documents was an immediate reaction to developments in the previous proceedings in order to support the reasoning to date and to fill gaps in the previously filed arguments. In view of the above, the board admitted these documents into the proceedings.

4.2 The respondent filed D37 to D39 in its observations on the grounds of appeal, in response to the appellant's argument, submitted with the grounds of appeal, that no technical effect had been demonstrated. D37 was submitted in order to show the excellent lightning protection provided by composites formed from the prepreg of claim 1 - i.e. containing conductive particles - compared with composites lacking conductive particles. D38 and D39 were submitted in order to provide evidence of the common general knowledge concerning lightning protection at the priority date of the patent. As these documents were filed in response to the appeal, they were also admitted into the proceedings.

5. Inventive step

5.1 According to the patent in suit, the prior art had difficulties in preparing carbon-fibre-reinforced materials having at the same time high impact resistance and conductivity in the thickness direction (paragraphs [0002] and [0003]). Therefore the purpose of the patent is to provide a prepreg and a carbon-fibre-reinforced composite having excellent impact resistance and (electrical) conductivity in the thickness direction (paragraph [0005]).

5.2 Closest prior art

The parties differed as to which document constituted the closest prior art: the appellant considered D36 and the respondent D33 to be the closest prior-art document.

5.2.1 D36 discloses a carbon fibre prepreg, wherein a carbon fibre bundle is impregnated with a base resin mainly composed of a thermosetting resin. Thermoplastic resin particles with a particle size of 150 µm or less, which account for 20 wt% or less, preferably 2-10 wt%, based on the weight of the entire prepreg, are distributed at a higher concentration in the surface zone of the prepreg than in the inside (claim 1; page 10, second full paragraph). Such a prepreg has excellent compression interlaminar shear strength (CILS) whilst maintaining good impact resistance (CAI), and can preferably be used as a structural member in aerospace, sport, civil engineering and architecture (page 23, "Industrial Applicability").

5.2.2 D33 discloses a polymer composite structure having an interlayer which is reinforced with shape memory alloy (SMA) particles, the use of which enhances the damage resistance and damage tolerance (i.e. compression after impact (CAI) strength) of the interlayer without negatively affecting its hot-wet compression. Such polymer composite materials are suitable for various applications, such as primary structure application in the manufacture of aircraft. However, D33 makes no use of thermoplastic particles dispersed on surface regions of the prepreg in order to improve its mechanical properties. D33 uses SMA particles for this purpose, which eliminate the need to use elastomeric resin

particles. Additionally, the use of SMA serves to disperse the energy of an electric charge, such as from a lightening strike, more evenly throughout the composite structure. Reference is made to paragraphs [0004], [0009], [0031] and [0032].

5.2.3 D36, which - like the patent in suit - discloses the use of thermoplastic resin particles in order to provide excellent mechanical properties of the prepreg, such thermoplastic resin particles being distributed at a higher concentration within the surface zone of the prepreg than in the inside, is considered to be the closest prior art. In fact, D36 is quite similar to the prior art mentioned as the starting point for the inventors of the patent in suit.

The prepreg of claim 1 of the main request differs from the prepreg disclosed in D36 in that it contains (electrically) conductive particles and by consequence the weight ratio expressed by particles [C]/particles [D] is from 1 to 1 000.

5.3 Technical problem

5.3.1 The patent in suit discloses that the technical problem is to provide a prepreg and carbon-fibre-reinforced composite material having both excellent impact resistance and conductivity in the thickness direction (see paragraph [0005]). It further discloses that the above effects are achieved by the presence of conductive particles [D] in a specific weight ratio to the thermoplastic resin particle [C], which is expressed by [content of [C] (parts by weight)]/ [content of [D] (parts by weight)] 1 to 1 000 (see paragraph [0006] and figure 2).

5.3.2 However, the desired technical effects of excellent impact resistance and conductivity in the thickness direction are not obtained over the whole breadth of the claimed subject-matter. As already observed above (see section 1.1.2), the claimed prepreg is defined in an open manner which allows thermoplastic resin fibres of [C] and conductive fibres of [D] to be present in its composition.

Such fibres will necessarily contribute to the impact resistance and conductivity of the prepreg in the thickness direction, similarly to the thermoplastic resin particles and conductive particles, and possibly render meaningless a ratio of [C]/[D], which relates to particles only. Reference is made to the application as filed (see table 5, examples 26 and 27), which shows that thermoplastic resin fibres [C] and conductive fibres [D] have a similar influence on impact resistance (CAI) and conductivity in the thickness direction as thermoplastic resin particles [C] and conductive particles [D] (see table 5, examples 1-6, 8-23). Table 5 shows that the compressive strength after impact (CAI) is 271 and 269 MPa for examples 26 and 27 respectively, which involve conductive fibres and thermoplastic resin fibres, while that of examples 1-6 and 8-23, which involve conductive particles and thermoplastic resin particles, varies between 265 and 343 MPa. Volume resistivity is 4.1×10^4 and 4.7×10^4 Ωcm for examples 26 and 27 respectively, while for examples 1-6 and 8-23, which involve conductive particles and thermoplastic resin particles, it varies between 1.1×10^5 and 2.0×10^3 Ωcm.

The apparent consequence of the presence of thermoplastic resin fibres and conductive fibres in addition to the conductive particles and thermoplastic

resin particles in the prepreg is that the relationship between compressive strength after impact (CAI) and volume resistivity will not fall within the outlined area of the graph of figure 2 any longer, the latter having been drawn on the basis of prepregs containing exclusively thermoplastic resin particles and conductive particles, so that the claimed weight ratio, relating only to particles, will no longer have any technical relevance.

5.3.3 In view of the above considerations, the technical problem underlying the claimed invention in view of D36 has to be reformulated in a less ambitious manner, namely as merely the provision of an alternative prepreg.

5.4 Obviousness

5.4.1 The skilled person starting from the prepreg of D36 and aiming at an alternative prepreg would find in D35 the motivation to add electrically conductive particles in the thermosetting resin of the prepreg.

D35 relates to carbon-fibre-reinforced prepregs with an epoxy resin as thermosetting resin, like the prepregs of D36, and discloses that these prepregs are particularly useful in aerospace, again like the prepregs of D36. It further discloses that electrical conductivity is improved by dispersing fine metal particles between the layers of prepreg laminates (abstract; page 140, left column, lines 2-3 and 11-13; page 140, sentence bridging left/right columns; page 141, lines 3-6). Consequently, the skilled person confronted with the objective technical problem of providing an alternative to the prepreg of D36 would be motivated to combine D36 with D35 and would arrive at

the subject-matter of claim 1 without the need to exercise inventive skill.

5.4.2 The respondent objected to the combination of these two documents because D35 was an academic paper with no specific experimental evidence regarding electrical conductivity. That is, however, no reason to disregard this disclosure: firstly, the EPC does not draw any distinction between various types of prior art; secondly, the experimental evidence of the patent in suit and of D37, filed by the respondent, corroborates the disclosure of D35, namely that the dispersion of metallic particles between prepreg layers increases the electrical conductivity of the laminate.

The respondent also argued that the disclosure of D35 contained a prejudice against the use of fine titanium particles in carbon-fibre-reinforced prepregs, and referred in this context to the tests carried out in D35 to evaluate the interlaminar fracture toughness. However, the respondent itself stated that the interlaminar fracture toughness is different from the CAI, the mechanical property of the prepregs of D36. Furthermore, the majority of the tests (three out of four) carried out in D35 to evaluate the interlaminar fracture toughness show that adding titanium particles in the prepreg has either an improved impact on the interlaminar fracture toughness or no impact at all (figure 7; page 142, right column, lines 30-32). More precisely, the experimental data of D35 show that prepregs with titanium particles compared with prepregs without such particles lead to improved composites in terms of mode I interlaminar fracture toughness G_{IC} and G_{IR}. In terms of mode II, this comparison shows that the composites are almost the same for the G_{IIC} value. Regarding the insufficient interlaminar fracture

toughness G_{IIR}, D35 attributes it to poor adhesion between the fine titanium particles and the thermosetting resin (page 142, right column, lines 9-14 and 32-36). However, such insufficient adhesion of the conductive particles may also be detected in the prepregs of the patent in suit, which in such a case envisages a surface treatment as a possible remedy (see paragraph [0080]). All in all, D35 does not disclose that the presence of fine titanium particles in the prepreg renders it unacceptable and possibly even dangerous for aircraft use, contrary to the assertion of the respondent.

5.5 But even assuming, in favour of the respondent, that the objective technical problem underlying the claimed invention in view of D36 was the provision of a prepreg with electrical conductivity in the thickness direction while maintaining excellent impact resistance (CAI), for the reasons given above the skilled person would also find in D35 the motivation to add titanium particles (i.e. electrically conductive particles) to the prepreg known from D36 and thus improve the electrical conductivity of the prepreg in the thickness direction (page 140, left column, lines 24-30 and sentence bridging left/right columns) without reducing the impact resistance (CAI) of the prepreg of D36.

In this case, the claimed weight ratio of the thermoplastic resin particles [C] and the conductive particles [D] would be the unavoidable result of the the combination of D36 with D35. The appellant explained, without being contradicted by the respondent, that, when titanium particles with an average diameter of about 45 µm in an amount of 1.814 wt% or 1.663 wt%, as disclosed in D35 (page 141, left column, lines 3-6), are added to the carbon-fibre-

reinforced prepreg of D36 with an epoxy thermosetting matrix and thermoplastic particles in its surface area in an amount of 2-20 wt% (page 10, lines 6-16), the ratio will lie within the claimed range of 1 to 1 000.

5.6 In view of the above, the subject-matter of claim 1 of the main request does not involve an inventive step.

New auxiliary request 1

6. This request was submitted during the oral proceedings before the board. Claim 1 of this request differs from claim 1 of the main request in that it specifies that the thermoplastic resin particle [C] is selected from the group of a thermoplastic resin particle or fibre and the conductive particle [D] is selected from the group of a conductive particle or fibre (see point XX above). This amendment introduced issues regarding clarity of the claim, at a very late stage in the proceedings, in view of the meaning of the terms "particle" (see patent in suit, page 6, lines 1-2; page 9, lines 1-3) and "fiber" (see patent in suit, page 69-10, lines 1-3), in particular as regards a precise distinction between the two terms. Consequently, this request was not admitted into the proceedings under Article 13(1) RPBA.

New auxiliary request 2

7. This request was also submitted during the oral proceedings before the board. Claim 1 of this request differs from claim 1 of the main request in that it requires that the prepreg does not contain a thermoplastic resin fibre or a conductive fibre (see point XX above). This additional limitation increased the complexity of the case in terms of clarity and

added subject-matter at a late stage in the proceedings, with the consequence that this request was likewise not admitted into the proceedings under Article 13(1) RPBA.

Auxiliary request 12

8. As already mentioned above (see point VII), claim 1 of auxiliary request 12 comprises a feature taken from the description as filed (see page 35, lines 17-24) which reads:

"A prepreg for use in making a carbon fiber reinforced composite material for an aircraft structural member ...".

According to the case law of the EPO boards of appeal this is understood to mean a prepreg suitable for use in making a carbon-fibre-reinforced composite material for an aircraft structural member. However, as the appellant correctly observed during the oral proceedings, it is unclear for which structural member of an aircraft the prepreg is suitable, let alone for which type of aircraft, and which criteria the prepreg has to fulfil in order to be suitable for such a use. It is therefore unclear how this additional feature further limits the claimed prepreg. Under these circumstances, the board finds the subject-matter of auxiliary request 12 to be unclear, with the consequence that this request is not allowable.

9. Since none of the requests is allowable, the patent has to be revoked.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is revoked.

The Registrar: The Chairman:

M. Cañueto Carbajo W. Sieber

Decision electronically authenticated