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Datasheet for the decision of 29 September 2023

Case Number: T 0117/22 - 3.3.09

Application Number: 11186744.6

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

Language of the proceedings: EN

Title of invention:
An epoxy resin composition, prepreg and carbon fiber reinforced composite materials

Patent Proprietor:
Toray Industries, Inc.

Opponent:
Teijin Carbon Europe GmbH

Headword:
Epoxy resin composition/TORAY

Relevant legal provisions:
EPC Art. 56, 111(1), 113(1), 114(2)
EPC R. 103(1)(a), 111(2)
RPBA 2020 Art. 11

Keyword:
Inventive step - main request (no) - auxiliary requests (no)
Right to be heard - substantial procedural violation (no)
Appeal decision - remittal to the department of first instance (no)

Decisions cited:
T 0570/18, T 0690/06

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Case Number: T 0117/22 - 3.3.09

D E C I S I O N
of Technical Board of Appeal 3.3.09
of 29 September 2023

Appellant: (Opponent)	Teijin Carbon Europe GmbH Kasinostr. 19-21 42103 Wuppertal (DE)
Representative:	Henkel & Partner mbB Patentanwaltskanzlei, Rechtsanwaltskanzlei Maximiliansplatz 21 80333 München (DE)
Respondent: (Patent Proprietor)	Toray Industries, Inc. 1-1, Nihonbashi-Muromachi 2-chome Chuo-ku Tokyo 103-8666 (JP)
Representative:	Mewburn Ellis LLP Aurora Building Counterslip Bristol BS1 6BX (GB)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 4 November 2021 concerning maintenance of the European Patent No. 2460846 in amended form.**

Composition of the Board:

Chairman	F. Rinaldi
Members:	C. Meiners
	N. Obrovski

Summary of Facts and Submissions

I. This decision concerns the appeal filed by the opponent (appellant) against the opposition division's interlocutory decision that, on the basis of the main request, the patent in suit (hereinafter "the patent") met the requirements of the EPC.

II. In its notice of opposition, the appellant had requested that the patent be revoked in its entirety, among other things on the ground for opposition under Article 100(a) EPC in combination with Article 56 EPC (lack of inventive step).

III. In its decision, the opposition division found that the subject-matter of the main request, which had been filed on 8 February 2019, involved an inventive step in view of document D33 as the closest prior art.

IV. The following documents, submitted by the parties in the opposition proceedings, are relevant to the present decision:

D12-2 WO 98/26912

D26 Daimo et al. "Study of Interlaminar Toughening of CFRP Laminates with Fine Titanium Particle Dispersion", 46th Conference on Structural Strength, August 4th to 6th, 2004 (and English translation)

D32 US 5,057,353

D33 US2005/0070185 A1

D35 First declaration of Prof. Kishi

D36 Second declaration of Prof. Kishi

V. In preparation for oral proceedings, which were scheduled at the parties' request, the board issued a communication pursuant to Article 15(1) RPBA 2020 (hereinafter "the communication").

VI. Oral proceedings before the board were held by videoconference in the presence of the patent proprietor (respondent). The appellant advised the board beforehand that it would not attend the oral proceedings.

VII. Wording of the relevant claims

Claim 1 of the main request reads as follows.

"An epoxy resin composition for use in a carbon fiber reinforced composite material, the epoxy resin composition consisting of an epoxy resin [B], and satisfying the following (1):
(1) a thermoplastic resin particle or fiber [C] and a conductive particle or fiber [D] are contained, and the weight ratio expressed by [content of [C] (parts by weight)]/[content of [D] (parts by weight)] is 1 to 1000;
wherein the epoxy resin composition is for making a laminate with conductivity in the thickness direction by being laminated between two carbon fiber layers constituted with carbon fiber [A]."

Claim 1 of auxiliary request 1 specifies, as a first limitation over claim 1 of the main request, that the weight ratio between the aforementioned thermoplastic particles or fibres [C] and conductive particles or fibres [D] is 1 to 500. Moreover, claim 1 contains the additional limitation:

"[,] wherein each of the thermoplastic resin particle or fiber [C] and the conductive particle or fiber [D] has an average diameter of 1 to 150 µm".

Claim 1 of auxiliary request 2 corresponds to claim 1 of the first auxiliary request, with the following additional limitation (amendment underlined):
"An epoxy resin composition for use in a carbon fiber reinforced composite material for an aircraft structural member selected from a main wing, tail wing, flap, aileron, cowl, fairing, or rocket motor case [...]".

By contrast, claim 1 of auxiliary request 3 contains the following alternative additional limitation over claim 1 of auxiliary request 1:
"[...] and wherein a thermoplastic resin is dissolved in the epoxy resin [B]".

This last limitation has also been inserted into claim 1 of auxiliary request 4, of which the wording is otherwise identical to that of claim 1 of auxiliary request 2.

VIII. The appellant's arguments, where relevant to the present decision, can be summarised as follows.

(a) In the decision under appeal, the opposition division had not dealt with the opponent's request that the proprietor's submission of 17 September 2021 not be admitted into the proceedings. That submission had been filed late. By contrast, in point 5.2 of its decision the opposition division had decided on a request to reject arguments because they had been filed late. Hence, the

opposition division had decided on a request that had never been filed by either of the parties.

What was more, in the oral proceedings before the the opposition division the opponent had been intentionally forbidden to make observations on inventive step based on a combination of documents D12-2 and D26. Surprisingly, however, that aspect had been dealt with in the decision under appeal. A problem-solution approach starting from document D12-2 was discussed on page 13, penultimate paragraph, to page 14, first paragraph of that decision.

Thus, the opposition division had violated both the opponent's right to be heard and Rule 111(2) EPC.

In view of these fundamental deficiencies in the proceedings before the opposition division, the case had to be remitted to a different opposition division from the one that had issued the decision under appeal. In accordance with Rule 103(1)(a) EPC, the appeal fee had to be reimbursed.

(b) The subject-matter of claim 1 of the main request was obvious to a skilled person in view of document D33 as the closest prior art. That document already disclosed resin compositions for use in (carbon) fibre reinforced composite materials having a good impact resistance and good conductivity in the thickness direction. The addition of thermoplastic particles such as nylon (which were known to absorb water) led to a reduction in the hot-wet compression strength of the laminate interlayers. The opposition division had disregarded the fact that the compositions of claim 1, including such

thermoplastic particles/fibres [C], must necessarily have the same disadvantage when compared with the compositions of document D33. Consequently, the objective technical problem was to provide a composition suitable for use in carbon fibre-reinforced composites having a reduced hot-wet compression strength. If a reduced hot-wet compression strength was accepted, it would have been obvious either to add - as well as shape memory alloy (SMA) particles - thermoplastic particles, or to partially replace the SMA particles with thermoplastic particles. The selection of epoxy resins as a specific thermosetting resin matrix did not confer an inventive step.

IX. The respondent's arguments, where relevant to the present decision, can be summarised as follows.

(a) The proceedings before the opposition division were fair and did not violate the opponent's right to be heard, or Rule 111(2) EPC. Thus, the opponent's request for remittal to a different opposition division should be dismissed.

(b) The opposition division had correctly decided that document D33 was the closest prior art for the assessment of inventive step, and that the claims of the main request were inventive over D33. By contrast, document D12-2 did not have the same objective as the patent, namely to obtain both good lightning protection and compressive strength after impact (CAI), and was thus an unsuitable starting point for the assessment of inventive step.

Document D33 taught away from integrating thermoplastic polymer particles/fibres into the resin compositions described therein. D33 disclosed two distinct embodiments:
- first, a conductive "particle-rich" interlayer approaching the morphology of a continuous metal ply was described in paragraph [0038]. Taking into account the difference in density between the conductive Nitinol® [a titanium-nickel alloy] particles and nylon particles, it would be impossible to accommodate the sixfold excess of thermoplastic particles in the laminate interlayer in order to arrive at the weight ratio recited in claim 1;
- secondly, D33 disclosed a "resin-rich" embodiment in paragraph [0038] as an alternative variant. Starting from the "resin-rich" embodiment in D33 (comprising, for example, 3 weight% of conductive Nitinol® particles) and replacing 50 weight% of Nitinol® particles with thermoplastic particles, or adding 100 weight% of the latter, would have the effect that insulating nylon particles became the major component of the particles. Replacing some of the Nitinol® particles with thermoplastic particles would also mean ignoring the lower limit of the former particles described in paragraph [0038], namely 3 volume%. Furthermore, it had to be expected that the excluded volume established by the thermoplastic particles would hinder the formation of a conductive path by the conductive particles. A skilled person would assume that satisfactory lightning protection would no longer be achieved by such embodiments. The surprising effect achieved, of maintaining good CAI and good lightning protection, thus conferred an inventive step.

X. Final requests

The appellant requested in writing that the decision under appeal be set aside, that the case be remitted to a different opposition division from the one that had issued the decision under appeal, and that the appeal fee be reimbursed. As an auxiliary measure, the appellant requested that the decision under appeal be set aside and that the patent be revoked.

The respondent requested that the appeal be dismissed (main request). As an auxiliary measure, it requested that the patent be maintained on the basis of one of auxiliary requests 1 to 4, filed with the letter dated 31 August 2023.

Reasons for the Decision

1. Admittance of documents D35 and D36

Asked about this point in the oral proceedings before the board, the respondent's representative clarified that the respondent neither requested that Mr Kishi be heard nor that document D35 be admitted. Rather, he himself - in his role as representative - then made submissions on a hypothetical composite containing thermoplastic and metal particles such as titanium particles, without relying on D35 or related document D36. The admittance of these documents does not therefore need to be addressed.

2. Request for remittal and reimbursement of the appeal fee (Article 11 RPBA 2020, Articles 111(1) and 113(1) EPC and Rule 103 EPC)

2.1 In its aforementioned communication, the board set out its preliminary opinion on the appellant's requests for remittal of the case to a different opposition division and reimbursement of the appeal fee. No further arguments were presented by the parties in relation to this point after the communication was issued. Consequently, the board sees no reason to deviate from its preliminary assessment, which is essentially reproduced below.

2.2 The appellant-opponent argued that the opposition division had decided, in point 5.2 of the Reasons for the decision under appeal, on a request that had never been made by either of the parties. The opponent had requested that the submission of 17 September 2021 not be admitted into the proceedings, and not that the arguments contained therein not be admitted. The decision under appeal was incomplete and not reasoned within the meaning of Rule 111(2) EPC. The opposition division had effectively decided during the oral proceedings to admit said submission into the proceedings.

However, contrary to the appellant's allegation, it follows from the decision under appeal that the opposition division took into account the request to disregard (or not to admit) the submission dated 17 September 2021. The board notes that section 5 of the decision under appeal is entitled "Admissibility of late filed evidences". Further, section XVIII of the decision mentions the request to disregard the submission of 17 September 2021. The latter submission

comprises arguments made in response, rather than new facts or evidence, and addresses objections that were presented by the appellant-opponent in its submission of 11 August 2021. In any case, the parties were heard on the matter, and the opposition division made its decision on the correct request. The opposition division's statement in the decision under appeal that it has no power under Article 114(2) EPC to disregard late-filed arguments is merely an expression of its understanding that the submission of 17 September 2021 contained only arguments. No procedural violation arises from providing this reasoning in relation to the appellant's request not to admit the respondent's submission of 17 September 2021.

2.3 Alleged violation of the right to be heard in relation to D12-2

2.3.1 The appellant further argued that the opposition division had made its decision on inventive step starting from document D12-2 without having heard the appellant (at that stage, the opponent) on that matter. First, the board notes that, according to points 3.3.2 to 3.3.5 of the minutes of the oral proceedings before the opposition division, the appellant was heard on whether D12-2, D32 or D33 represented the closest prior art. Secondly, the passage of the decision under appeal spanning from the last paragraph on page 13 to the first paragraph on page 14 only sets out why document D12-2 is, in the opposition division's opinion, not a suitable starting point for developing a problem-solution approach. It follows from the reasoning in the decision under appeal that, in the view of the opposition division, the technical problem of providing a composite material having good impact resistance and good conductivity in the thickness direction has been

solved by the subject-matter of claim 1 of the main request. The first paragraph on page 14 explicitly sets out that, starting from D12-2 as the closest prior art, a skilled person would have to draw on knowledge of the opposed patent in order to consider the issue of providing a material with good conductivity. The effect was to pose a problem that was not mentioned in D12-2. The penultimate sentence of that paragraph merely refers to the combination of the teaching of documents D12-2 and D26 in respect of the conclusion already drawn in the preceding text, and states: "The OD is therefore of the opinion that the combination of the teaching of D12-2 and D26 would be based upon an unadmissible *ex post facto* analyses" (emphasis added by the board). This statement is followed by the opposition division's conclusion that "neither D12-2 nor D26 are suitable closest prior art documents [...]" (emphasis added by the board).

2.3.2 Hence, the question of which document could be taken as the closest prior art was discussed during the oral proceedings before the opposition division, and the parties were heard on that matter. Clearly, however, the opponent failed to convince the opposition division that document D12-2 represented just as suitable a starting point for the assessment of inventive step as document D33.

2.3.3 The argument put forward in point II.2.d) of the grounds of appeal, that the opponent had also considered good conductivity in the thickness direction in its written submissions, citing in this context D26, does not change this conclusion. This line of argument is based on the content of D26 as a secondary source of information. However, the opposition division clearly took the view that the problem to be addressed by the

closest prior art - in order to qualify as a suitable starting point for analysis of inventive step - was to provide both good impact resistance and good conductivity in the thickness direction. Whether or not this conclusion was correct is a substantive issue, and does not concern a possible procedural violation (see Case Law of the Boards of Appeal, tenth edition, 2022, V.A.11.6.1, first paragraph; T 690/06, Reasons 13).

2.4 Hence, the decision under appeal is both sufficiently reasoned and based on grounds and evidence on which the parties have had an opportunity to present their comments (see Case Law of the Boards of Appeal, tenth edition, 2022, IV.C.6.5, first paragraph).

2.5 Consequently, the board refused the appellant's requests for remittal of the case to a different opposition division from the one that had issued the decision under appeal and for reimbursement of the appeal fee.

3. Inventive step - main request

3.1 The patent is directed towards an epoxy resin composition, a prepreg impregnated with the epoxy resin, and a carbon fibre reinforced composite material having excellent impact resistance and conductivity in the thickness direction (see paragraphs [0001] and [0006] of the patent). Good conductivity in the thickness direction of the cured laminate materials formed is associated with lightning strike protection (see paragraph [0104] of the patent).

3.2 Closest prior art

3.2.1 Document D33 has been selected as the closest prior art in the decision under appeal. D33 is directed towards the same purpose as the patent in suit, namely providing a reinforced composite material having good impact resistance in terms of compressive strength after impact (CAI) and good conductivity in the thickness direction/lightning strike protection. The resin compositions used for fibre impregnation in D33 comprise shape memory alloy (SMA) metal particles, preferably formed from Nitinol® (a titanium-nickel alloy). The particles present in the resin matrix interlayers of the composite material are also electrically conductive. Hence, the resin compositions in D33 also confer protection from lightning strike and thus conductivity in the thickness direction in laminates comprising them. This is particularly important in aerospace applications, where the resin composite structures are used to form a portion of an aircraft that could experience a lightning strike during operation (see paragraph [0032] of D33). D33 also discloses that the *SMA particles* are preferably used in combination with a *thermosetting* matrix resin. This combination is said to provide a composite having *improved mechanical properties* (paragraph [0039]). Furthermore, paragraph [0044] and, for example, claim 7 feature *carbon fibres* in the prepregs prepared in D33. As pointed out in point 23 of the respondent's submission of 31 August 2023, such carbon fibre reinforcing fibres are electrically conductive. Consequently, document D33 is directed to the same purpose as the patent under appeal, and thus represents a suitable starting point for the assessment of inventive step.

3.2.2 The respondent identified two separate embodiments in paragraph [0038] of document D33. The board agrees with this assessment. First, D33 discloses "resin-rich" interlayers, i.e. interlayers comprising from 3 to 30 volume% SMA particles. Secondly, composite materials having SMA "particle-rich" matrix resin interlayers are described. The latter embodiment relates to interlayers comprising significantly higher concentrations of SMA particles. The resulting morphology is similar to a discrete, continuous metal ply.

The respondent argued that this "particle-rich" embodiment of D33, and not the "resin-rich" variant, was the realistic starting point for a skilled person seeking to provide resin compositions that achieved lightning strike protection and conductivity in the thickness direction in resin composites. That embodiment conveyed to the skilled person that the SMA particles were in contact with each other and the carbon fibre layers.

However, the board sees no reason to assume that interlayer resin compositions comprising, for example, 3 volume% SMA particles would not provide electrical conductivity in the thickness direction and lightning strike protection. Paragraph [0038] of D33 proposes such an SMA level in general terms, without making any restrictions for specific purposes. In the next paragraph [0039], D33 states: "The Nitinol® alloy, as mentioned in the foregoing, also provides significantly improved electrical conductivity for the composite structure to thus improve its durability relative to repeated lightening strikes."

Therefore, the board concludes that the "resin-rich" embodiment in paragraph [0038] is a suitable starting

point in D33 for the assessment of inventive step. This will be used in the following.

3.3 Distinguishing features

The subject-matter of claim 1 differs from the embodiments disclosed in D33 in respect of the presence of thermoplastic particles or fibres [C] and the corresponding weight ratio of particles or fibres [C] to conductive particles or fibres [D]. Furthermore, D33 does not mention epoxy resins as a specific thermosetting resin.

3.4 Technical effect and objective technical problem

3.4.1 In its statement of grounds of appeal, the appellant argued that the addition of thermoplastic particles, such as nylon particles, led to increased water absorption in the resin matrix and thus to a reduction in the hot-wet compression strength of the laminate interlayers comprising such particles. SMA/Nitinol® particles, however, did not absorb water and therefore did not negatively impact hot-wet compression strength. Compared with the resin compositions of D33, the compositions of claim 1 of the patent - including such thermoplastic particles or fibres - necessarily had the same disadvantage of reduced hot-wet compression strength. The resulting objective technical problem was thus the provision of a resin composition having *worse properties*.

3.4.2 The respondent disagreed with the appellant's formulation of the objective technical problem. The provision of a resin composition having worse properties was not a problem that the skilled person would wish or might be asked to solve. It was thus

unrealistic to pose such a problem. Doing so meant not taking the problem addressed in the patent into account. The latter was to provide an epoxy resin composition having both excellent thickness direction conductivity and excellent impact resistance.

As these two effects had been surprisingly achieved by the claimed subject-matter, the addition of thermoplastic particles to compositions corresponding to the embodiments of D33 did indeed provide an *unexpected benefit*, as had been shown in the patent in suit. This benefit demonstrated that the objective technical problem was the provision of an alternative (resin) composition maintaining *both excellent thickness direction conductivity and excellent impact resistance*.

3.4.3 The board agrees with the appellant that the addition of thermoplastic water-absorbing particles, such as nylon, to resin compositions of document D33 can be expected to reduce the hot-wet compression strength of the laminate interlayers. This effect is described in D33 itself, e.g. in paragraph [0031]. The resins of claim 1, comprising thermoplastic particles such as nylon, can thus be expected to bring about inferior hot-wet compression strength compared with, for example, the "resin-rich" embodiment in D33 using SMA particles. The nylon particles described in D33 qualify as thermoplastic particles [C], whereas the Nitinol® particles are conductive particles [D] within the meaning of claim 1.

3.4.4 The respondent argued that the patent's figure 2 demonstrated that the weight ratio called for in claim 1 provided a balance of good CAI and good electrical conductivity appropriate for aerospace

applications. However, the experiments used to produce the data in figure 2 are not based on the metal particles of the closest prior art. Furthermore, the values shown in figure 2 for the weight ratio between thermoplastic resin particles/fibres [C] and conductive particles/fibres [D] at the lower range of that ratio (e.g. at a ratio of 1:1) are not suitable for showing that an unexpected effect is achieved for that weight ratio. This point was made by the board in the oral proceedings. Nitinol® particles bring about good impact resistance in terms of CAI and electrical conductivity *at the same time* in resin composites. Thus, figure 2 of the patent does not represent the situation encountered in D33.

The board also observed at the oral proceedings that some of the specific values for the electrical volume resistance shown in figure 2 of the patent correspond to those of semiconducting materials. These values are associated with [C]/[D] weight ratios falling within the scope of claim 1. Hence, as also noted by the board at the oral proceedings, the embodiments of claim 1 are not limited to resin compositions giving "good" or "excellent" electrical conductivity, but include embodiments that merely impart reasonable electrical charge dissipation (including semiconducting variants). Therefore, the respondent's argument that the distinguishing feature "weight ratio of [C]/[D]" brings about an unexpected technical benefit is not persuasive.

The respondent's argument that the patent had many possible applications, and that embodiments for the aerospace industry would also exhibit good conductivity for providing lightning strike protection, is not convincing either. The board concedes that claim 1

requires the resin to be suitable for providing conductivity in the thickness direction to at least some extent (including, in light of the above, semiconducting electrical conductivity). But according to the respondent, volume resistivity values falling within the claimed ratio of [C]/[D] as recited in claim 1 correlate with acceptable electrical conductivity for aerospace applications (see point 33 of the submission of 31 August 2023).

3.4.5 Clearly, the addition of thermoplastic particles to the resin compositions of D33 would result in good CAI: nylon particles were known to increase the CAI of laminate resin interlayers.

3.4.6 Consequently, the objective technical problem arising from the disclosure of D33 is to provide *alternative* resin compositions for use in carbon fibre reinforced composite materials having good CAI and electrical conductivity (at least semi-conductivity).

3.5 Obviousness

3.5.1 According to the respondent, on applying the two-part test for the assessment of inventive merit of modifications that were predicted to be disadvantageous, the subject-matter of claim 1 was *not obvious* in view of the *surprising and unexpected* balance in both good CAI and good thickness direction conductivity/lightning strike protection.

3.5.2 As explained above, the "resin-rich embodiment" described in paragraph [0038] of D33 is the starting point for assessing inventive step. In this context, the respondent referred, among other things, to a resin matrix interlayer comprising 3 volume% SMA particles.

3.5.3 Taking into account the specific density differences between nylon particles (described in D33 as thermoplastic polymer particles) and Nitinol® particles, about 18 volume% thermoplastic particles would have to be added to the matrix resin interlayer to arrive at an embodiment of claim 1. This would lead to a particle weight ratio of 1:1 in the interlayer and also in the resin composition used for impregnating the (carbon) fibre layers.

3.5.4 The respondent asserted that the *addition* of thermoplastic particles in amounts, for example, of 18 volume% was incompatible with the aim of D33. A significant reduction in hot-wet compression strength had to be expected in this case. D33 thus taught away from such a modification, which went against the core teaching of that document. This was indicative of an inventive step.

3.5.5 As the hypothetical embodiment referred to in point 3.5.3. would also fall within the scope of claim 1, however, this line of argument is not persuasive. The alternatives to be provided vis-à-vis D33 by the addition of nylon particles can, in any case, be expected to bring about *inferior* hot-wet compression strength. SMA/Nitinol® particles eliminate the *need* to use thermoplastic particles such as nylon particles, conventionally used to toughen the laminate interlayers (see paragraph [0031] of D33). However, a skilled person merely wishing to provide further/alternative resin compositions for making laminates with good CAI and conductivity in the thickness direction would have taken the known disadvantage associated with hydrophilic thermoplastic particles into account. Such a scenario is realistic and is in line with the

technical results that have - in an *objective* assessment - been achieved by the feature combination of claim 1.

The predictable disadvantage of a reduction in hot-wet compression strength on adding (hygroscopic) thermoplastic particles to the resin compositions for (carbon) fibre composites, as explicitly disclosed in paragraphs [0004] and [0031] of D33, cannot simply be "compensated for" by arguing that D33 taught away from adding such particles or fibres and thus from achieving the obvious result of this step (see Case Law of the Boards of Appeal, tenth edition, 2022, I.D.9.21.1). Hence, the respondent's argument, presented by referring to T 570/18 (Reasons 2.8.7), that the skilled person was constantly looking at further developing the closest prior art while maintaining its advantageous properties cannot change the conclusion that the result of that modification is predictable.

3.5.6 The reason is that, for the embodiment referred to in point 3.5.3 above, there is no *compensation* of the expected deterioration of the material properties either, such as the *alleged surprisingly* good balance of both good CAI and conductivity:

(a) For the reasons given above, it is *not surprising* that said hypothetical embodiment based on D33 would show good CAI.

(b) It can also be expected that such a resin composition, derived from D33 by the addition of the same mass of thermoplastic nylon particles as the mass of Nitinol® particles, would also result in *interlayer conductivity*. In this context, the

following aspects were discussed during oral proceedings before the board.

i) Both the thermosetting resin (such as an epoxy resin) and the thermoplastic particles are uncontestedly electrical insulators. In the given embodiment of D33, the resin matrix interlayer consists of 97 volume% insulating material and 3 volume% Nitinol® particles. Substituting some of the electrically insulating resin matrix by an equal volume of another insulating material should not thus have a significant impact on the material's conductivity and therefore should not lead to a significant decrease in conductivity, if any.

ii) The respondent argued that the (rigid) thermoplastic particles excluded the conductive particles from a significant volume of the interlayer. It could be expected that thermoplastic particles surrounding a conductive metal particle would inhibit its contact with other conductive particles. Thus, it could also be expected that the electrical conductivity of the interlayer would be markedly reduced by the incorporation of 18 volume% thermoplastic particles.

The board does not find this line of argument convincing. The rather moderate excluded volume of about 18 volume% that is not accessible for the conductive particles in fact excludes them from a certain volume of the interlayer and confines them to the remaining volume (about 80 volume%). Therefore, it is to be expected that imposing such a moderate excluded volume gives an *increased contact probability* between conductive SMA particles (and thus the establishment of a conducting path through the interlayer). Hence, contrary to what was argued by the

respondent, the addition of about 18 volume% of thermoplastic particles would not be expected to lead to a significant decrease in electrical conductivity and would not likely impede the formation of conductive paths (across the interlayers).

3.5.7 At the oral proceedings, the board also noted that a single SMA/Nitinol® particle could, depending on the particle size, be sufficient to bridge the insulating resin interlayer between neighbouring carbon fibre layers (as in figure 1 of the patent). In such a scenario, every SMA/Nitinol® particle would establish a conductive path, irrespective of the neighbouring thermoplastic particles present.

The respondent countered that the figures in D33 did not support such an embodiment but showed smaller SMA particles dispersed in the interlayers, rather than a single SMA particle bridging the interlayers. Referring to figure 1 of the patent involved hindsight and information that was not available to the skilled person studying D33.

This line of argument is not convincing. As discussed in the oral proceedings, the figures of D33 are *schematic*. In the view of the board, the skilled person would thus not necessarily adhere to their teaching (which represent a merely schematic representation of the particles in the interlayers and their size in relation to the interlayer thickness).

3.5.8 As correctly pointed out by the appellant, the selection of a specific thermosetting resin matrix known from the prior art, namely epoxy resins, does not confer an inventive step either. It is common ground

between the parties that epoxy resins are thermosetting resins.

3.5.9 For these reasons, a skilled person confronted with the objective technical problem would arrive at the subject-matter of claim 1 in an obvious way. This conclusion would also hold true if the additional considerations outlined in point 3.5.7 were disregarded.

3.5.10 The respondent correctly argued that composite systems are complex and that aerospace materials must meet a challenging set of requirements. A solution that solves one aspect may negatively influence another aspect. In this context, the respondent presented the argument that one would not know how thermoplastic particles and nylon particles would interact and whether useful composites would result when replacing metal particles with nylon particles, in view also of their differences in density.

3.5.11 This argument is not convincing. First, replacement of metal particles is not the issue here. Rather, it is the replacement of the corresponding volume of the insulating matrix resin with insulating nylon particles. Secondly, in light of the above, the concerns presented do not outweigh the conclusion that the skilled person would consider the aforementioned modification of the teaching of D33 with a reasonable expectation of success. The measure to be implemented in order to arrive at the alternative composites and resin compositions is expected to contribute to the mechanical properties (providing good CAI) and lightning strike resistance (associated with conductivity in the thickness direction).

3.5.12 The subject-matter of claim 1 thus lacks an inventive step in light of document D33 as the closest prior art. Thus, claim 1 does not meet the requirement of Article 56 EPC.

4. Inventive step - auxiliary requests 1 to 4

4.1 At the oral proceedings the board asked whether the additional features of auxiliary requests 1 to 4 would bring about any additional contributions in relation to inventive step. The respondent's representative stated that the respondent had no specific comments to make. The arguments relating to inventive step were the same as for the main request.

4.2 In view of this, the board sees no reason to deviate from its assessment of the inventive step of previous auxiliary requests 1 to 10, as set out in its communication under Article 15(1) RPBA 2020. Previous auxiliary requests 5, 7, 8 and 10 are identical to present auxiliary requests 1 to 4. The board's preliminary opinion is thus essentially reproduced below.

The additional features incorporated into claim 1 of auxiliary requests 1 to 4 concern known features in the technical field concerned and thus do not confer an inventive merit over D33 as the closest prior art. They concern usual (average) particle sizes of thermoplastic and conductive particles present in the interlayers of reinforced composite laminates, usual application areas in the aircraft industry for laminates prepared by using the resin compositions, and/or the presence of a further polymer component already disclosed in D33 (see for example paragraph [0031], describing the composition of the resin materials).

In the absence of a substantiated technical effect that could be found to be caused by these additional features, the assessment of inventive step provided in section 3 above for the main request applies equally to the subject-matter of claim 1 of auxiliary requests 1 to 4. Thus, the subject-matter of claim 1 of auxiliary requests 1 to 4 does not involve an inventive step either (Article 56 EPC).

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

3. The request for reimbursement of the appeal fee is refused.

The Registrar: The Chairman:

H. Jenney F. Rinaldi

Decision electronically authenticated