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Datasheet for the decision of 21 April 2021

Case Number: T 0103/15 - 3.2.05

Application Number: 04010275.8

Publication Number: 1473132

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Language of the proceedings: EN

Title of invention:
Method for manufacturing a multiaxial fabric

Patent Proprietor:
The Boeing Company

Opponent:
Cabinet NONY

Relevant legal provisions:
EPC 1973 Art. 54(1), 54(2), 56, 100(a), 100(b), 100(c), 113(1)
RPBA Art. 12(4)

Keyword:

Right to be heard - opportunity to comment (yes)
Late-filed evidence - should have been submitted in first-instance proceedings (no)
Novelty - main request (yes)
Inventive step - main request (yes)

Decisions cited:

G 0001/12, T 0702/99

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Case Number: T 0103/15 - 3.2.05

D E C I S I O N
of Technical Board of Appeal 3.2.05
of 21 April 2021

Appellant: (Opponent)	Cabinet NONY 3 Rue de Penthièvre 75008 PARIS (FR)
Representative:	Nony 11 rue Saint-Georges 75009 Paris (FR)
Respondent: (Patent Proprietor)	The Boeing Company 100 North Riverside Plaza Chicago, IL 60606-1596 (US)
Representative:	Witte, Weller & Partner Patentanwälte mbB Postfach 10 54 62 70047 Stuttgart (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 18 November 2014 rejecting the opposition filed against European patent No. 1473132 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman	P. Lanz
Members:	B. Spitzer
	T. Karamanli

Summary of Facts and Submissions

I. The appeal by the opponent is against the decision of the opposition division to reject the opposition against European patent No. 1 473 132.

II. During the opposition proceedings, the opponent had raised the grounds for opposition under Article 100(a) in combination with Article 54 or 56 EPC (lack of novelty and lack of inventive step), 100(b) and 100(c) EPC.

III. In the statement setting out the grounds of appeal dated 30 March 2015, the appellant (opponent) requested that the decision under appeal be set aside and that European patent No. 1 473 132 be revoked. The appellant did not request oral proceedings.

IV. In its reply to the appeal, the respondent (patent proprietor) requested that the appeal be dismissed (i.e. that the patent be maintained as granted - main request). In the alternative, it requested that the decision under appeal be set aside and that the patent be maintained as amended on the basis of the claims according to any of auxiliary requests 1, 2 and 3, all filed on 22 September 2014.

V. The parties were summoned to attend oral proceedings on 18 March 2020.

VI. In a communication pursuant to Article 15(1) RPBA 2020 issued on 21 February 2020, the board expressed its preliminary opinion on the case.

VII. By letters dated 2 March 2020 and 16 March 2020, the appellant provided further arguments in support of its case.

VIII. With its letter dated 12 March 2020, the respondent filed auxiliary requests 1A, 1B and 1C and provided further arguments.

IX. By a communication dated 17 March 2020, the registrar of the board informed the parties that the oral proceedings scheduled for 18 March 2020 had been cancelled.

X. On 17 September 2020, the board issued a communication under Rule 100(2) EPC. It set out its view on the appeal case taking into account the parties' latest submissions and provisionally concluded that the appeal was likely to be dismissed without summoning them again to oral proceedings. The parties were given a period of two months to file submissions if desired.

XI. The appellant finally requested that the decision under appeal be set aside and that the patent be revoked. It did not request oral proceedings.

XII. The respondent finally requested that the appeal be dismissed (i.e. that the patent be maintained as granted - main request). In the alternative, it requested that the decision under appeal be set aside and that the patent be maintained as amended on the basis of the claims according to auxiliary request 1, filed on 22 September 2014, or according to auxiliary request 1A, 1B or 1C, all filed with the letter dated 12 March 2020, or according to auxiliary request 2 or 3, both filed on 22 September 2014. As an auxiliary

measure, it requested oral proceedings in case the appeal was not dismissed.

XIII. Reference is made to the following documents:

D1: EP 1 125 728 A1;

D3: EP 200 385 A2;

D9: "Rapport d'essais";

D13: "SP Systems Guide to Composites";

D14: "GURIT-HEBERLEIN Acquisition of SP Systems / Now among the top three advanced composite players", published on plasteurope.com on 8 August 2002;

D15: "Handbook of Thermoset Plastics", Second Edition (1998), pages 9 to 11;

D16: "An introduction to Composite Materials", Second Edition (1996), pages 30 to 33 and 270 to 277;

D17: "Department of Defense Handbook Composite Materials Handbook", Volume 3, June 2002, pages ii to iv and 2-29 to 2-32;

D18: "Handbook of Technical Textiles", Woodhead Publishing United (2000), chapter 4, pages 62 to 94;

D19: "Polymer Data Handbook", Oxford University Press (1999), preface and pages 140 to 157, 172 to 232, 279 to 287 and 706 to 710

D20: Webster's New World Dictionary (1988), page 1458;

D21: "Composite Materials Handbook", McGraw-Hill (1984), one unnumbered page;

D22: "Department of Defense Handbook Composite Materials Handbook", Vol. 2, June 2002, pages ii, iii and 1 to 52.

XIV. Claim 1 of the granted patent (main request) has the following wording (using the parties' feature designations in square brackets):

[a] A method for manufacturing a fiber reinforced composite material **[b]** using a multiaxial fabric **[c]** comprising reinforcing layers (14) of unidirectional fiber **[d]** with non-woven interlayers (12) disposed between the reinforcing layers (14), **[e]** wherein the non-woven interlayers (12) comprise a spunbonded, spunlaced, or mesh fabric of thermoplastic fibers disposed between the reinforcing layers (2; 14), **[f]** and wherein the interlayers (12) are permeable to permit the flow of resin during a liquid molding operation, **[g]** the method comprising:
melt-bonding an interlayer material (12) comprising thermoplastic fibers to one or both sides of a unidirectional dry fabric (14) to produce a dry unidirectional tape (18);
[h] building up a preform from the unidirectional tape by laying down at least four lamina of unidirectional tape (18)
[i] at angles between -90° and +90° from the warp direction of the multiaxial fabric;
[k] infusing the preform with a thermosetting resin in a liquid molding process;
[l] and heating the preform to gel and finally cure the resin,
[m] wherein the resin is gelled at a temperature below

the melting point of the fibers in the interlayers (12) in order to prevent their melting and flowing into the unidirectional fibers of the reinforcing layers (14).

XV. The appellant argued essentially as follows.

Non-consideration of document D9 by the opposition division - right to be heard (Article 113(1) EPC)

The reliability of document D9 and the fact that its author was not disclosed had not been an issue during the written phase of the opposition proceedings, but had been raised by the opposition division only at the oral proceedings. The appellant was thus taken by surprise when the opposition division announced that document D9 would not be taken into account. This was contrary to the principle of the right to be heard and constituted a substantial procedural violation. Moreover, an opponent acting as a straw man should not be put in a worse position than any other opponent, which normally would not be requested to provide the names of the persons who performed internal tests. There was therefore no legal basis for disregarding the tests of document D9, which were documented in detail.

Admittance of documents D13 to D19

Documents D13 to D19 had been filed with the statement of grounds of appeal as a basis for technical explanations and for the common general knowledge. The filing of these documents was necessary to clarify which aspects of the decision under appeal the appellant contested.

Main request - lack of novelty

The subject-matter of claim 1 of the main request was not novel over document D1. For the skilled person, the term "unidirectional fiber" in the claim feature relating to the reinforcing layers of unidirectional fiber referred to the fact that all reinforcing fibers of the layer were oriented in one and the same direction. This did not exclude the presence of thinner auxiliary fibers oriented in a different direction for holding the reinforcing fibers in place, as could be seen in Figures 3 and 4 of document D1 (see also paragraph [0022]). In such a woven structure, the crimp of the reinforcing fibers was minimal (see top of page 79 of document D18).

Moreover, regarding the common general knowledge on the gelling and curing of a thermosetting resin, reference was made to documents D13 (see page 16 for an explanation of gelling, curing and post-curing), D14 (as evidence that document D13 had been published before 2002), D15 (see pages 10 and 11 as well as Figure 1-7 on the influence of the temperature on the curing time and the exothermic nature of the curing reaction), D16 (see chapter 2.3.1) and D17 (see page 2-30). Against this background, the general teachings of paragraph [0066] of document D1 anticipated the subject-matter of claim 1. In particular, the wording "*a predetermined number of complex reinforcing layers*" in line 32 of paragraph [0066] of document D1 implied the presence of a reinforcing layer with unidirectional fibers. Moreover, the reference to the "*method of molding of the present invention*" made clear that the method of paragraph [0066] included intermediate layers such as those mentioned in paragraph [0058]. According

to the last three lines of paragraph [0066], (gelling and) curing was performed at room temperature (which was possible as confirmed by documents D15 to D17), while the thermoplastic fibers in the interlayers had a melting point of 60 to 160°C (see document D1, paragraph [0051]). Hence, the subject-matter of claim 1 was not new over the disclosure of paragraph [0066] of document D1.

Additionally, Example 5 of document D1 anticipated the contested method. In this example a unidirectional woven fabric was used as reinforcing material (see also Example 4). As stated above, the fact that it additionally comprised auxiliary fibers, which did not contribute to the mechanical properties, did not alter the unidirectional orientation of the reinforcing fibers. As acknowledged by the opposition division, in Example 5 the resin was injected at 110°C and then cured at 177°C (see also Example 1). Thus, gelling had to occur between these two temperatures. The non-woven thermoplastic fibers used in Example 5 consisted of two fiber types having a melting temperature of 140°C and 260°C, respectively. This meant that at least for a part of the fibers the gelling temperature of the resin was below the (higher) melting temperature of the fibers. The claim wording did not require that all fibers had to have a melting temperature which was higher than the resin's gelling temperature. Therefore, the subject-matter of claim 1 was not new over the disclosure of Example 5 of document D1.

Main request - lack of inventive step

On the issue of inventive step, the line of argument was based on a combination of the teachings of document D3 with document D1 (Example 5), Example 5 of document

D1 with document D3 and Example 6 of document D1 with document D3.

The subject-matter of claim 1 differed from document D3 by the steps of building up a preform from unidirectional tape by laying down at least four lamina of unidirectional tape (feature [h]) at angles between -90 and +90° from the warp direction of the multiaxial fabric (feature [i]), and heating the preform to gel and finally cure the resin (feature [l]), wherein the resin is gelled at a temperature below the melting point of the fibers in the interlayers in order to prevent their melting and flowing into the unidirectional fibers of the reinforcing layers (feature [m]). According to paragraph [0011] of the patent in suit, the technical problem could be seen in providing an improved manufacturing method, in which the reinforcing fibers are held tightly in relative orientation to each other. The skilled person would consult document D1, which was concerned with the improvement of the CAI (compression-after-impact) strength or the stabilisation of the fibers. The claimed solution to this problem was rendered obvious by Example 5 of document D1, where the fabric was bonded by heating. Document D19 confirmed that polyamide fibers, which were mentioned in document D3 (see Example 1), did not have a melting temperature below 178°C independently of the exact polyamide type. Consequently, feature [m] was implicitly known from document D1.

Also, Example 6 of document D1 was a valid starting point, since it disclosed the best results for the mechanical properties (see document D1, Table 2) irrespective of the use of adhesive bonding instead of melt-bonding. Document D3 emphasised that the porous

film had to be lifted from the fibers so that it did not prevent the fibers from being impregnated with resin (document D3, page 3, column 4, lines 15 to 24). Thus, a skilled person starting from Example 6, which had superior results in terms of CAI strength, and searching for an alternative manufacturing method would turn to document D3 (see page 2, column 2, lines 1 to 5, column 2, lines 25 to 28, column 4, lines 15 to 24 and column 3, line 26), which generally mentioned that the unidirectional fiber layers could be stabilised by melt-bonding.

Finally, the subject-matter of claim 1 of the main request was not inventive over a combination of Example 5 of document D1 with document D3.

XVI. The respondent's arguments can be summarised as follows.

Non-consideration of document D9 by the opposition division - right to be heard (Article 113(1) EPC)

Document D9 was a test report of unknown origin. During the oral proceedings, the opposition division had given the appellant the opportunity to indicate the name of the author of the report. However, the opponent declined to provide this information. The fact that the present opposition had been filed by a straw man made no difference, since any opponent would be required to provide evidence on the origin of the test reports they submit. Moreover, the appellant could have rerun the tests by a neutral institute and disclosed the name of the persons responsible for the repeated tests. As it has not provided such evidence, document D9 should not be considered.

Non-admittance of documents D13 to D19

These late-filed documents should not be admitted into the proceedings, because they were not highly relevant. Furthermore, the justification for the late filing of these documents was not sufficient.

Main request - novelty

The subject-matter of claim 1 was new vis-à-vis document D1. The feature of the unidirectional fiber required that all the fibers were oriented in one direction. It was not sufficient that they were unidirectional in terms of their mechanical behaviour. The wording "unidirectional" was clear in a linguistic sense. The above interpretation was supported by documents D20 to D22. By contrast, the use of the term "unidirectional" in document D1 was unclear and in contradiction with its regular use in the relevant literature. Furthermore, the term "unidirectional" had to be interpreted in the light of the patent itself. In the examples, the unidirectional layer was made of unidirectional T700 carbon fibers, as produced by Toray (see paragraph [0055] of the patent specification). There was no mentioning whatsoever of individual fibers oriented in a different direction. The terms "weft" and "warp" were not used in the contested patent. The structure of Figure 4 of document D1 included warp reinforcing yarns 4 and auxiliary weft yarns 5. Figure 4 of document D1 clearly taught that at least some of the warp directed reinforcing yarns were bent, which decreased the strength of the layer. In summary, none of the fiber arrangements in Figures 3, 4 and 5 of document D1 showed the claim features of a reinforcing layer of unidirectional fiber and a dry unidirectional tape. Document D1 additionally failed to disclose the

use of a dry unidirectional tape (used in features [g] and [h]) but instead disclosed the use of sheets. A tape was ribbon-like and much smaller in width than a sheet. Besides, according to the embodiment of paragraph [0066] of document D1, curing was done at room temperature, whereas the method of claim 1 required the heating of the preform.

The disclosure of Example 5 of document D1 related to a woven fabric (see D1, paragraph [0131] and Table 2). Additionally, Example 5 of document D1 disclosed the use of blended fiber in the non-woven fabric, wherein at least 40% of the fibers of Example 5 had a melting point of 140°C, while curing took place at 177°C. Therefore, at least this part of the non-woven fabric melted and could flow into the unidirectional fibers of the reinforcing layers, while another part of the fabric did not melt. However, claim 1 was directed to the specific teachings that the resin was gelled at a temperature below the melting point of the fibers (in the sense of "all fibers") in the interlayer to prevent their melting and flowing into the unidirectional fibers of the reinforcing layers.

For these reasons, the subject-matter of claim 1 of the main request was new over both paragraph [0066] and Example 5 of document D1.

Main request - inventive step

In document D3, before the impregnation with resin, the porous polymer film was bonded to the reinforcing fibers at discrete locations and, during impregnation, the porous polymer film was lifted from the fibers by melting or dissolving (see document D3, column 4, lines 47 to 53). The subject-matter of claim 1 differed from

document D3 by the features of building up a preform from the unidirectional tape by laying down at least four lamina of unidirectional tape (feature [h]) at angles between -90 and +90° from the warp direction of the multiaxial fabric (feature [i]), and heating the preform to gel and finally cure the resin (feature [l]), wherein the resin is gelled at a temperature below the melting point of the fibers in the interlayers in order to prevent their melting and flowing into the unidirectional fibers of the reinforcing layers (feature [m]). The problem to be solved was to provide an improved method which particularly allowed keeping the reinforcing unidirectional fibers stable during resin infusion (see paragraph [0011] of the patent specification). If the skilled person considered document D1 when looking for a solution, they would realise that there were several ways of integrating the fiber reinforcing material with non-woven fabrics and that Example 6 (see document D1, Table 2), which favoured adhesive bonding over the claimed melt-bonding, provided the best results. Moreover, while document D3 suggested keeping the reinforcing fibers as free as possible from other material, document D1 went in the opposite direction, in particular in view of the needle punching suggested in Example 5 (see paragraph [0130]). Neither of documents D3 and D1 pointed to the claimed relation between the gelling of the resin and the melting point of the fibers. Thus, a combination of documents D3 and D1 was based on hindsight.

Combining Example 6 of document D1 with document D3 would not result in the claimed invention either, since in Example 6 adhesion bonding instead of melt-bonding was used. It even taught away from using melt-bonding

(see Table 2 of document D1).

Finally, considering a combination of Example 5 of document D1 with document D3, in both of these disclosures the fibers were partially melted so that the molten thermoplastic material would flow into the unidirectional fibers. Therefore, it could not render obvious the subject-matter of claim 1 of the main request.

Reasons for the Decision

1. Non-consideration of document D9 by the opposition division - right to be heard (Article 113(1) EPC 1973)

1.1 The opposition division decided not to take the test report D9 ("Rapport d'essais") into account, which the opponent (now appellant) had filed in order to demonstrate that the disclosure of the claimed invention in the patent was insufficient and that the subject-matter of claim 1 was not based on an inventive step. Since the name and qualification of the author of the test report were unknown, the test report was not considered to be sufficiently reliable (see contested decision, point 3 of the Reasons).

1.2 Neither in the EPC nor in the case law of the boards of appeal are formal rules laid down for the evaluation of evidence. The Enlarged Board of Appeal has recalled that proceedings before the EPO are conducted in accordance with the principle of free evaluation of evidence (see G 1/12, OJ EPO 2014, A114). Thus, the departments of the EPO have the power to assess whether the alleged facts are sufficiently established on a case-by-case basis. Under the principle of free

evaluation of evidence, each piece of evidence is given an appropriate weighting according to its probative value. The deciding body takes its decision on the basis of all evidence available in the proceedings and in the light of its conviction arrived at freely on the evaluation of the submitted evidence.

1.3 In the case in hand, the name and the qualification of the person responsible for performing the tests, drawing conclusions from their results and finally drafting the test report are important elements for assessing the probative value of document D9 in view of the appellant's allegation that the disclosure of the invention in the patent was insufficient and that the subject-matter of claim 1 lacked inventive step.

In accordance with established case law of the boards of appeal, it is naturally essential for comparative tests like the present "rapport d'essais" (D9) to be made under conditions which ensure maximum objectivity on the part of those conducting the tests (Case Law of the Boards of Appeal of the European Patent Office, 9th edition 2019, I.D.10.9 and III.G.4.2.2 a)).

On this issue, decision T 702/99 held that "*[t]he use of independent persons would naturally tend to carry more weight but would understandably be more difficult to arrange. While the employment relationship means that the testers cannot be described as independent witnesses, the use of employees may not be objectionable per se as long as the test conditions are designed to ensure that, just as if independent persons were used, the employees are not biased by prior knowledge of either the products under test or of their employer's expectation of the result of their tests. Thus it is always desirable that such tests can be*

shown to be "blind"; that the testers have had no part in the making of the claimed invention or research leading up to the invention or the patenting procedure; and that the tests have been conducted in the strictest conditions – for example that no-one has given any or all of the testers any advance information, that each tester performs his or her test in the absence of the other testers, and that their opinions are accurately recorded. Since such evidence is opinion evidence and thus inherently subjective, its value lies in the number of similar or same opinions and the tribunal faced with such evidence will naturally be seeking to judge the objective value of a number of subjective opinions" (Reasons for the decision, point 3; see also Headnotes 2 and 3).

It follows from the above that, with respect to the probative value of test evidence, it is important not only to indicate the conditions under which these tests have been conducted, but also to specify the name of the testers and their employers so that the relationship between the testers and the party can be established if necessary. This also applies in cases where the opponent is acting as a straw man on behalf of a company, because then the relationship between that company and the testers could be a factor in the decision on the probative value of the test evidence filed by the straw man.

In view of the above and given the fact that the appellant explicitly refused to disclose information on the author of the test report, the opposition division's doubts regarding the probative value of the test report D9 and its subsequent conclusion not to consider it when deciding on the validity of the patent are not objected to. Contrary to the appellant's view,

it is not apparent that the fact that the appellant admittedly acts as a straw man puts it in a worse position compared to an "ordinary" opponent acting in their own name. The importance of indicating the identity and qualification of the author of a test report for judging its probative value does not normally depend on whether the opposition and the subsequent appeal were filed by a straw man. Generally, a straw man acting as opponent cannot derive any advantage from their position with regard to the evaluation of the evidence they have submitted. In the present case a neutral institute could have been assigned to perform the tests of document D9. This would have allowed the opponent to provide all necessary information for assessing the probative value of the test results without disclosing the identity of the client on behalf of which the opposition was filed.

Even though this issue had not been raised in the opposition division's communication, the appellant was given the opportunity to provide the relevant information concerning the authorship of the test report D9 during the oral proceedings, which it refused (see minutes, bottom of page 1, and contested decision, point 3 of the Reasons). Since the opposition division additionally indicated the implications of this refusal for its conclusion on the probative value of document D9 (see minutes, bottom of page 1), the appellant's right to be heard was not violated concerning this issue.

1.4 Finally, the reasons for not considering document D9 during the first-instance opposition proceedings still apply at the appeal stage. Therefore, in view of its limited probative value, this document is not taken into account by the board when reviewing the opposition

division's decision.

2. Admittance of documents D13 to D19

2.1 Documents D13 to D19 were filed with the statement of grounds of appeal as a basis for technical explanations and as evidence for the common general knowledge. In the present case, the statement of grounds of appeal was filed before the date on which the revised version of the Rules of Procedure of the Boards of Appeal (RPBA 2020) entered into force, i.e. 1 January 2020 (see Article 24(1) RPBA 2020). Hence, in accordance with Article 25(2) RPBA 2020, Article 12(4) to (6) RPBA 2020 does not apply. Instead, Article 12(4) of the Rules of Procedure of the Boards of Appeal in the version of 2007 (RPBA 2007 - see OJ EPO 2007, 536, and EPC, 16th edition, June 2016, pages 601 to 629) continues to apply.

2.2 According to Article 12(4) RPBA 2007, everything presented by the parties under Article 12(1) RPBA 2007 has to be taken into account by the board if and to the extent it relates to the case under appeal and meets the requirements in Article 12(2) RPBA 2007. However, the board has the power to hold inadmissible facts, evidence or requests which could have been presented or were not admitted in the first-instance proceedings.

2.3 Applying these provisions to the present case, it has to be examined whether documents D13 to D19 could (and should) have been filed during the first-instance proceedings.

In its communication annexed to the summons to oral proceedings, the opposition division did not give a preliminary opinion on novelty or inventive step.

Therefore, there was no specific reason apparent for the appellant to present these documents already during the first-instance opposition proceedings. Moreover, the documents represent the common general knowledge relating to thermosets, gelation and curing (documents D13, D15 to D17), with respect to crimped fibers (document D18) and the melting point of polyamide fibers (document D19). Generally, the skilled person's common general knowledge has to be considered when assessing inventive step.

2.4 Therefore, the board has no power under Article 12(4) RPBA 2007 to hold documents D13 to D19 inadmissible. Since the requirements of Article 12(2) RPBA 2007 are met, the board takes documents D13 to D19 into account in accordance with Article 12(4) RPBA 2007.

3. *Main request - granted patent - ground for opposition under Article 100(a) in combination with Article 54(1) EPC 1973 (lack of novelty)*

3.1 Interpretation of features

3.1.1 Interpretation of "unidirectional dry fabric" (features [c] and [g])

It is undisputed that in document D1 the fabrics shown in Figures 3 and 4 are designated as "unidirectional woven fabric" and "unidirectional non-crimped woven fabric" (see paragraphs [0017] and [0022] to [0024]). However, it is contested between the parties whether the designation as "unidirectional" in document D1 is in fact erroneous and whether, for a skilled person, the wording "reinforcing layers of unidirectional fiber" and "unidirectional dry fabric" in claim 1

excludes the presence of a woven fiber structure with auxiliary fibers oriented in the weft yarn direction.

Mechanical properties of fiber reinforced plastics are known to have great anisotropy as they primarily depend on the orientation of the reinforcing fibers. In view of that, the indication of the fiber orientation in any composite part primarily relates to the orientation of the reinforcing fibers, as they determine the mechanical properties. In that respect, it is noted that the patent in suit also refers to unidirectional reinforcing fibers (see first lines of paragraphs [0003] and [0025]). In the fabrics shown in Figures 2, 3 and 4 of document D1, the reinforcing fibers are exclusively oriented in one direction so that their consistent denomination in the description of document D1 as unidirectional is not incorrect. This is not altered by the fact the unidirectional fabrics of Figures 3 and 4 and of Example 5 of document D1 further comprise auxiliary yarns oriented in a perpendicular direction, which do not substantially alter the primary load bearing direction of the fabric (see document D1, paragraph [0115], for the details of the fiber properties). In view of that, the skilled person would not depart from the explicit teachings of document D1 and interpret these fabrics as non-unidirectional.

It is added that the use of the term "unidirectional" in document D1 is not in contradiction with documents D20 to D22 submitted by the respondent. In particular, the right drawing of Figure 3.3. of document D21 does not, as such, make it possible to draw any conclusions on the load bearing properties of the fibers oriented in parallel and perpendicular directions. Moreover, in the definition of document D22 ("*Unidirectional Fiber-Reinforced Composite -- Any fiber-reinforced composite*

with all fibers aligned in a single direction"), the wording "all fibers" relates to the reinforcing fibers, which are the only fibers mentioned.

3.1.2 Interpretation of "tape" used in features [g] and [h]

The respondent argued that document D1 additionally failed to disclose the use of a dry unidirectional tape (used in features [g] and [h]) but instead disclosed the use of sheets. A tape was ribbon-like and much smaller in width than a sheet.

However, the board observes that the width of a tape is not specified in claim 1. In addition, the method of claim 1 is not restricted to the process as explained in paragraph [0048] and Figure 4 of the patent in suit. Due to the missing specification of the term "tape" in the patent in suit, and due to the longitudinal dimensions of the sheet disclosed in document D1 (see reference sign 2 in Figures 2 to 5), the sheet of document D1 can be considered as corresponding to the tape of claim 1 of the patent in suit.

3.1.3 Interpretation of feature [m]

According to feature [m], "the resin is gelled at a temperature below the melting point of the fibers in the interlayers (12) in order to prevent their melting and flowing into the unidirectional fibers of the reinforcing layers (14)".

The parties' views on the interpretation of this feature differ substantially. In Example 5 of document D1, 40% of the fibers of the non-woven fabric have a melting point of 140°C (see paragraph [0081]), which is below the resin's curing temperature of 177°C (see

paragraph [0088]), while 60% of the fibers of the non-woven fabric have a melting point of 260°C, which is higher than the mentioned curing temperature. According to the respondent, the claim feature that the resin is gelled at a temperature below the melting point of the fibers in the interlayer means that all the fibers have to have a melting point above the gelling temperature, while the appellant argued that the feature required that at least a part of the fibers of the non-woven fabric meets this condition.

The board interprets this feature as meaning that the gelling temperature of the resin is lower than the melting points of all or each of the fibers. For a layer comprising two types of fibers, with one fiber type having a melting point T_1 and the other a higher melting point T_2 ($> T_1$), this means that the gelling temperature of the resin is lower than T_1 and lower than T_2. Only under these conditions is the functional feature "in order to prevent their melting and flowing into the unidirectional fibers of the reinforcing layers" fulfilled. Otherwise, if the gelling temperature were only lower than T_2 but higher than T_1, the fibers of one type would melt and flow into the unidirectional fibers.

3.2 Novelty in view of document D1 - general disclosure / paragraph [0066]

Claim 1 requires that the preform is heated to gel and finally cure the resin. According to paragraph [0066] of document D1, gelling and curing are done at room temperature, i.e. without heating the preform.

The appellant cited several documents, i.e. D13, D15, D16 and D17, to present the common general knowledge in

the field of thermosetting resins. From document D13 (see page 16, second paragraph), it is known that a resin gels faster at higher temperatures. Document D15 discloses on page 10 that cross-linking is influenced by temperature and that with increasing temperature the rate of reaction increases. Due to the fact that the cross-linking reaction is an exothermic reaction and that the heat cannot be discharged because polymers are insulating, the heat developed by the reaction accelerates the gelling. Document D16 (see chapter 2.3.1) summarises that curing can be achieved at room temperature but that it is usual to use a cure schedule which involves heating the resin at one or more temperatures for predetermined length of times to achieve optimal cross-linking and, hence, optimum properties. In document D17 (see page 2-30, chapter 2.4.2.3.) curing temperatures of polyesters from room temperature to approximately 180°C are mentioned. The appellant summarised that temperature influences the time and degree of cross-linking and that thermosetting resins can cure at room temperature.

This common general knowledge is not disputed. However, document D1 does not disclose that the preform is heated to gel and to finally cure the resin. In contrast, the resin in document D1 is cured at room temperature (see paragraph [0066]). Although it is generally known that cross-linking can be increased at elevated temperatures, the process of document D1 does not involve a heating of the preform to gel and finally cure the resin according to feature [l].

With regard to the disputed features [c], [g] and [h] concerning unidirectional fibers and a unidirectional tape, reference is made to points 3.1.1 and 3.1.2 above.

To summarise, the general disclosure of document D1 is not novelty-destroying for the subject-matter of claim 1 of the patent in suit, as feature [l] is not anticipated.

3.3 Novelty in view of Example 5 of document D1

The non-woven fabric of Examples 1 and 5 of document D1 is the same. This means that in Example 5, high-melting-point nylon short fibers having a melting point of 260°C and low-melting-point nylon short fibers having a melting point of 140°C mixed at a ratio of 60:40 are used (see paragraph [0081]). According to paragraph [0088], an epoxy resin is injected under heating to 110°C and cured at 177°C for four hours. The exact gelling temperature is not disclosed in document D1. However, gelling will occur when the injected resin is heated to the curing temperature of 177°C. Since the melting point of the low-melting-point fiber type is 140°C, these fibers will melt during gelling of the resin. Consequently, feature [m] as understood by the board (see point3.1.3) is not anticipated by Example 5.

For this reason alone, the subject-matter of claim 1 is novel over the disclosure of Example 5 of document D1 (Article 54(1) and (2) EPC 1973).

Referring to the disputed features [c], [g] and [h] concerning unidirectional fibers and a unidirectional tape, reference is made to points 3.1.1 and 3.1.2 above.

3.4 Therefore, the ground for opposition under Article 100(a) in combination with Article 54(1) EPC

1973 (lack of novelty) does not prejudice the maintenance of the patent as granted.

4. Main request - granted patent - ground for opposition under Article 100(a) in combination with Article 56 EPC 1973 (lack of inventive step)

4.1 Document D3 combined with the teachings of document D1

4.1.1 Document D3 discloses a method for stabilising woven, knitted and non-woven fabrics. In order to have maximum strength and elastic modulus, it is a prerequisite that strict parallelism of the reinforcing fibers is maintained throughout the impregnation and laying up processes (see column 1, lines 25 to 31 and 49 to 53, and column 5, lines 1 to 10). The object is the same as in the patent in suit where the filaments should be kept in strict parallelism (see paragraphs [0007] and [0011]).

Therefore, document D3 is a suitable starting point for the discussion of inventive step. Claim 1 of the patent in suit differs from document D3 in that this prior-art document does not disclose feature [h] ("at least four lamina"), feature [i] "at angles between -90° and +90°", feature [l] "heating to gel and cure the resin" or feature [m] "resin gelled at temperature lower than melting point". The foregoing is undisputed.

4.1.2 In document D3, the strict parallelism of the reinforcing fibers is achieved by bonding the porous web to the assembly of filaments at discrete locations and by keeping the reinforcing layer as free as possible from other material except for the resin, so that the whole surface of the reinforcing fibers interacts with the resin matrix on impregnation (see

column 4, lines 15 to 21). It is even preferable to lift the porous film "*from the fibre or filament surfaces by the liquid resin on impregnation as by melting or dissolving thereinto*"(see column 4, last paragraph).

Consequently, the objective technical problem to be solved can be considered as finding an alternative method in order to tightly hold the reinforcing fibers in relative orientation to one another.

4.1.3 As document D1 (see paragraphs [0008] to [0011]) teaches that an integration between the reinforcing layer and the non-woven web is important for stability of the reinforcing fibers and that disturbance of the fibers results in a lower tensile strength, the skilled person would consult document D1 to look for a solution to the above-mentioned problem.

The solution proposed in document D1 is the integration of the reinforcing layer and the non-woven web by needle punching, needle punching and heat bonding, or adhesive bonding (see Tables 1 and 2).

Heat bonding for a unidirectional woven web is only disclosed for Example 5 and comparative Example 7 of document D1.

Example 5, which is based on Example 4, discloses features [h] and [i] (see paragraph [121]). In Example 5 integration by heat bonding is disclosed in combination with 5% to 50% of low-melting-point nylon fibers (see Table 2, paragraph [0081]). As Example 5 uses the same non-woven web as Example 1 (see paragraphs [0131] and [0117]), the low-melting-point nylon fibers having a melting point of 140°C (see

paragraph [0081]) will melt during gelling of the resin (see paragraph [0088]). Feature [m], hence, is not disclosed in the context of Example 5 of document D1.

Document D19 was filed by the appellant to show that melting points of polyamide fibers are not lower than 178°C and that, consequently, feature [m] was disclosed in document D1, where the gelling of the resin takes place between 110°C and 177°C (see paragraph [0088]). However, document D1 itself discloses a melting point of 140°C for low-melting-point nylon fibers (see paragraph [0081]).

A combination with other examples disclosed in document D1 would also not lead the skilled person to the claimed invention, as document D1 is concerned with a bidirectional web in Examples 1 to 3 and comparative Examples 1 to 4. In Example 4 and comparative Examples 5 and 6, which use a unidirectional woven web, integration is not done by heat bonding. The non-woven fabric of comparative Example 7 consists of 100% low-melting-point fibers. Thus, Example 7 does not disclose feature [m]. In Example 6, where the reinforcing layer is a unidirectional woven web and the non-woven fabric consists of 100% high-melting-point fibers, the integration is done by adhesive. For this reason, the skilled person would not take this example into account.

A combination with the teachings of paragraph [0066] of document D1 would not result in the claimed invention either, as the curing of the resin takes place at room temperature and, consequently, feature [l] is not disclosed.

4.1.4 To conclude, starting from document D3 and combining it with the teachings of document D1, the skilled person would not arrive at the claimed invention.

4.2 Example 6 of document D1 combined with the teachings of document D3

4.2.1 Example 6 of document D1 is a suitable starting point for examining inventive step because document D1 is concerned with the same problem as the patent in suit (see point 4.1.3 above) and because Example 6 reveals the best results for the CAI value (see Table 2 of document D1). The latter is also discussed in the patent in suit (see Table 2 of the patent in suit).

The distinguishing feature in view of Example 6 of document D1 is feature [g] because in Example 6 the integration of the reinforcing fibers and the non-woven web is not achieved by heat bonding but by adhesion (see paragraph [0134]). Example 6 discloses a unidirectional woven web as fiber reinforcing material (see paragraphs [0133] and [0115] and point 3.1.1 above) and a non-woven web of high-melting-point fibers having a melting point of 260°C (see paragraph [0133]). Feature [m] is disclosed because the web of Example 6 comprises only the high-melting-point fibers. The resin is gelled between 110°C and 177°C (see paragraph [0088]). Feature [h] is disclosed by Example 6, the cured plate is formed by the same method as for Example 4 (see paragraphs [0133] and [0121] and point 3.1.2 above).

4.2.2 The objective technical problem could be formulated as providing an alternative method for integrating the reinforcing layer and the non-woven web so that the

reinforcing fibers still remain stable.

4.2.3 The skilled person would consult document D3, as it is concerned with the same problem (see point 4.1.1 above). However, the solution proposed in document D3 is different from the claimed subject-matter (see point 4.1.2 above).

The question arises whether the skilled person would replace the bonding by pressure sensitive adhesive known from Example 6 in document D1 with melt-bonding as disclosed in document D3. Document D3 discloses both possibilities as being equivalent (see column 2, lines 25 to 29).

The skilled person does not get any incentive from document D3 to replace the adhesive bonding by melt-bonding. Document D3 discloses that preferably the bonding is at discrete locations in order to leave the entire structure open to the influx of the resin (see column 4, lines 15 to 20). Document D1 teaches away from using melt-bonding (see paragraphs [0114], [0137], [0138]) because the fibers of the non-woven fabric were melted in the resin. In document D3, there is no indication that melt-bonding should be preferred over adhesive bonding.

4.2.4 For these reasons, starting from Example 6 of document D1 and combining it with the teachings of document D3, the skilled person would not arrive at the claimed invention.

4.3 Example 5 of document D1 combined with document D3

4.3.1 Example 5 of document D1 could also be considered as a suitable starting point because document D1 is

concerned with the same problem as the patent in suit (see point 4.1.3 above). In addition, Example 5 uses a unidirectional woven web (see point 3.1.1 above) as fiber reinforcing material which is bonded to the non-woven fabric by heating the low-melting-point fibers of the non-woven fabric (see paragraphs [0131], [0115]).

Therefore, the distinguishing feature in view of Example 5 of document D1 is feature [m].
Feature [m] is not disclosed, as the web of Example 5 also comprises low-melting-point fibers having a melting point of 140°C (see paragraph [0081]) and the resin is gelled between 110°C and 177°C (see paragraph [0088]). Reference is made to points 3.1.3 and 3.3 above.

4.3.2 The objective technical problem to be solved is considered to be finding an alternative method in which the reinforcing fibers are held tightly in relative orientation to one another (see paragraph [0011] of the patent specification).

4.3.3 Document D3 is concerned with the same problem (see point 4.1.1 above) and provides as a solution the bonding at discrete locations by heat or adhesive bonding. Therefore, the skilled person would take the teachings of document D3 into account. However, document D3 does not disclose a relationship between the melting point of the fibers of the non-woven fabric and the gelling temperature of the resin. It is disclosed in column 4, lines 21 to 24, that - during heat bonding - the material of the non-woven web should not melt down and cover substantial portions of the assembly of the reinforcing fibers. This passage refers to the method step of heat bonding (feature [g]) but not to the method step of resin impregnation (features

[l] and [m]). In a preferred embodiment of document D3 (see column 4, lines 47 to 53), it is disclosed that "*the porous film is lifted from the fiber or filament surfaces by the liquid resin on impregnation as by melting or dissolving thereinto, so as to free all of said fibrous or filament surfaces from any manner of covering so that they are all available to contact and interact with the resin matrix*". Document D3 does not disclose that the "*resin is gelled at a temperature below the melting point of the fibers*" (feature [m]). The preferred embodiment even teaches the contrary.

4.3.4 For these reasons, a combination of Example 5 of document D1 with document D3 does not lead to the claimed invention.

4.4 When discussing inventive step, the appellant stated that none of the examples in the patent in suit disclosed the gelling temperature of the resin. Therefore, the contribution of feature [m] to the proposed solution could not be verified. In addition, the example with polyester did not achieve the desired effect because of the low CAI value. The appellant thus concluded that feature [m] was not essential or did not contribute to the solution of the problem, and that the objective technical problem was not solved over the whole range.

In this context, the board refers to the established case law that comparative tests are not essential to establish inventiveness if it was not *prima facie* obvious to make the claimed compounds (see Case Law of the Boards of Appeal of the European Patent Office, 9th edition 2019, I.D.10.9). In the present case, feature [m] is not obvious from the cited prior-art documents (see points 4.1, 4.2, 4.3 above). This finding is

sufficient for justifying the presence of an inventive step. Moreover, it is generally accepted that the strict parallelism of the reinforcing fibers is an important factor for the mechanical properties of the composite material (see paragraphs [0008] to [0011] of document D1; see column 1, lines 25 to 31 and 49 to 53, and column 5, lines 1 to 10 of document D3). Due to the fact that the thermoplastic fibers do not melt during resin impregnation of the non-woven interlayer material, the orientation of the reinforcing fibers is not disturbed. The negative effects of low-melting-point fibers in the non-woven fabric are also recognised in document D1 (see paragraph [0138]), which, due to this reason, preferred needle punching over melt-bonding(see point 4.1.3 above).

4.5 To sum up, none of the combinations discussed above renders the claimed solution obvious. The subject-matter of claim 1 thus involves an inventive step (Article 56 EPC 1973). Therefore, the ground for opposition under Article 100(a) in combination with Article 56 EPC 1973 (lack of inventive step) does not prejudice the maintenance of the patent as granted.

5. In appeal proceedings, the appellant did not raise the grounds for opposition under Article 100(b) or (c) EPC 1973 against the patent as granted.

6. In view of the above, none of the grounds for opposition under Article 100 EPC 1973 prejudices the maintenance of the patent as granted and therefore there is no reason to set aside the opposition division's decision to reject the opposition pursuant to Article 101(2), second sentence, EPC. Consequently, the appeal has to be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

N. Schneider P. Lanz

Decision electronically authenticated