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Paper 94
Entered: May 9, 2014

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CORNING INCORPORATED
Petitioner

v.

DSM IP ASSETS B.V.
Patent Owner

Case IPR2013-00048
Patent 6,298,189 B1

Before FRED E. McKELVEY, GRACE KARAFFA OBERMANN, JENNIFER S. BISK, SCOTT E. KAMHOLZ, and ZHENYU YANG, *Administrative Patent Judges.*

KAMHOLZ, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

A. Background

Petitioner Corning Incorporated ("Corning") filed a petition (Paper 6, "Pet.") to institute an *inter partes* review of claims 1-52 (the "challenged claims") of U.S. Patent No. 6,298,189 B1 (Ex. 1001 (the "'189 patent")).[1] The Board instituted trial for the challenged claims on the following grounds of unpatentability asserted by Corning:

Reference(s)[2]	**Basis**	**Claims challenged**
A. Shustack	§ 102	1-3, 5-7, 9-11, 13-15, 37-39, 45-47, and 49-51
B. Shustack	§ 103	1-3, 5-7, 9-11, 13-15, 37-39, 45-47, and 49-51
C. Szum '928	§ 102	1, 5, 9, 13, 37, 45, and 49
D. Shustack and Jackson	§ 103	4, 8, 12, 16, 40, 48, and 52
Combination A, B, C, or D; and Chawla	§ 103	17-20
Combination A, B, C, or D; and Hager	§ 103	21-24
Combination A, B, C, or D; and Tortorello	§ 103	25-28

[1] Case IPR2013-00049 concerns claims 53-66 of the '189 patent.

[2] The petition relies on the following references: U.S. Patent No. 5,352,712 (Ex. 1003 ("Shustack")); WO 95/15928 (Ex. 1005 ("Szum '928")); U.S. Patent No. 4,900,126 (Ex. 1007 ("Jackson")); U.S. Patent No. 5,696,179 (Ex. 1008 ("Chawla")); U.S. Patent No. 5,182,784 (Ex. 1009 ("Hager")); U.S. Patent No. 5,847,021 (Ex. 1010 ("Tortorello")); WO 97/46380 (Ex. 1011 ("Botelho")); U.S. Patent No. 4,707,076 (Ex. 1012 ("Skutnik")); and U.S. Patent No. 5,408,564 (Ex. 1013 ("Mills")).

Combination A, B, C, or D; and Botelho	§ 103	29-32
Combination A, B, C, or D; and Skutnik	§ 103	33-36
Combination A, B, C, or D; and Mills	§ 103	41-44

Decision to Institute 3-4 (Paper 15, "Dec.").

After institution of trial, Patent Owner DSM IP Assets B.V. ("DSM") filed a Patent Owner Response (Paper 46, "Resp."), and Corning filed a Reply to the Patent Owner Response (Paper 65, "Reply"). DSM filed a Supplemental Response (Paper 74, "Supp. Resp.") with leave of the Board, and Corning filed a Supplemental Reply (Paper 75, "Supp. Reply"). DSM filed a Motion for Observations on Cross-Examination of Corning Reply Declarants (Paper 78, "Obs."), and Corning filed a Response to the Observations (Paper 86, "Obs. Resp.").

DSM also filed a Motion to Amend Claims (Paper 47, "Motion to Amend"). In it, DSM proposed claims 67, 68, 69, and 70 to substitute for patented claims 6, 7, 14, and 15, respectively. Motion to Amend 1-6. Corning filed an Opposition to the Motion to Amend Claims (Paper 64, "Opp."). DSM filed a Reply to the Opposition (Paper 76, "Motion Reply").

DSM also filed a Motion to Exclude certain of Corning's evidence (Paper 79, "PO Motion to Exclude"). Corning filed an Opposition (Paper 85, "PO Excl. Opp."), and DSM filed a Reply (Paper 89, "PO Excl. Reply"). Corning filed a Motion to Exclude certain of DSM's evidence (Paper 82, "Pet. Motion to Exclude"). DSM filed an Opposition (Paper 84), and Corning filed a Reply (Paper 90).

Corning relies upon declarations of Dr. Michael Winningham (Ex. 1014) and Ms. Inna Kouzmina (Ex. 1015) in support of its Petition. DSM relies upon declarations of Dr. Christopher Bowman (Ex. 2034) and Dr. Carl Taylor (Ex. 2032) in its Response, along with a deposition of Dr. Winningham (Exs. 2027-2031) and portions of Ms. Kouzmina's deposition (Exs. 2024-26). Corning relies upon declarations of Dr. Jiann-Wen Woody Ju (Ex. 1035) and Dr. Dotsevi Sogah (Ex. 1068), a responsive declaration of Dr. Winningham (Ex. 1078), along with depositions of Dr. Bowman (Exs. 1070-72, 1075-77) and Dr. Taylor (Exs. 1045-47) and a portion of Ms. Kouzmina's deposition (Ex. 1044) in its Reply. DSM relies upon a supplemental declaration of Dr. Bowman in its Supplemental Response (Ex. 2055). Corning relies upon depositions of Dr. Winningham (Ex. 1080)[3] and Dr. Dotsevi Sogah (Ex. 1079) in its Supplemental Reply. DSM relies upon depositions of Dr. Winningham (Ex. 2085), Dr. Sogah (Exs. 2073-74), and Dr. Ju (Exs. 2087-88) in its Motion for Observations on Cross-Examination of Corning Reply Declarants.

Oral argument was conducted on February 11, 2014. A transcript is entered as Paper 93 ("Tr."). Both parties indicated during oral argument that the oral argument in case IPR2013-00045 relates to this proceeding as well. Tr. 3:12-14; 24:19-21. The transcript for case IPR2013-00044 is entered as Paper 89 in that proceeding.

The Board has jurisdiction under 35 U.S.C. § 6(c). This final written decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73.

[3] Ex. 1080 is a rough transcript. DSM submitted an official transcript as Ex. 2088.

Corning has proved that claims 5, 13, 17, 29, 33, 37, 45, and 49 are unpatentable. Corning has not proved that claims 1-4, 6-12, 14-16, 18-28, 30-32, 34-36, 38-44, 46-48, and 50-52 are unpatentable.

DSM's Motion to Amend Claims is denied without prejudice.

Corning's Motion to Exclude Evidence is dismissed.

DSM's Motion to Exclude Evidence is dismissed-in-part and denied-in-part.

B. The Invention

The '189 patent generally relates to radiation-curable coating compositions for optical glass fibers commonly used in data transmission. Ex. 1001, 1:18-19. In particular, the patent describes optical glass fibers coated with two radiation-cured coatings. *Id.* at 1:26-27. An inner primary coating contacts the glass surface of the fiber. *Id.* at 1:28-30. An outer primary coating overlays the inner coating. *Id.* For identification purposes, the outer primary coating may include colorant or, alternatively, a third colored layer, called an ink coating, which is applied to the outer primary coating. *Id.* at 1:53-58. Figure 1, depicting such an optical glass fiber, is reproduced below.

FIG. 1

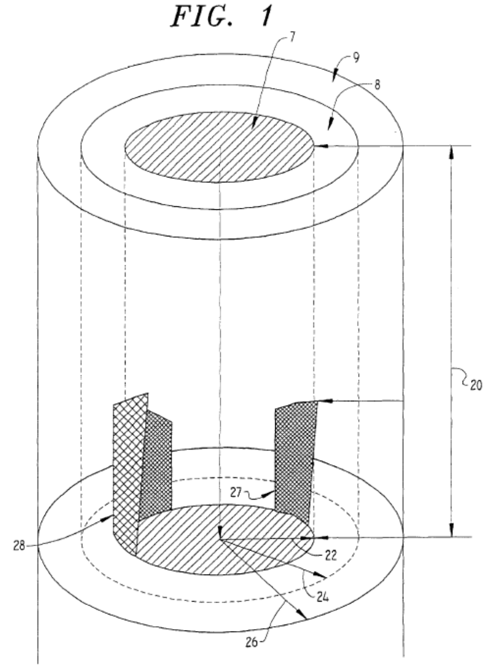


Figure 1, above, illustrates a longitudinal cross-sectional view of a coated optical glass fiber 7 coated with an inner primary coating 8 and a commercially available outer primary coating 9. *Id.* at 8:8-9, 10:7-9.

To create a cable or ribbon assembly, used in the construction of multi-channel transmission cables, a plurality of coated optical fibers are bonded together in a matrix material. *Id.* at 1:39-47. In order to connect the fibers of multiple ribbons, the surface of a glass fiber must be accessible. *Id.* at 1:53-2:6. This is often accomplished by a process known as "ribbon stripping"—removing the coatings and the matrix material, preferably as a cohesive unit. *Id.* The '189 patent is directed to a ribbon assembly having improved ribbon stripping capabilities. *Id.* at 1:21-23.

As described in the Background of the Invention, the prior art discloses ribbon assemblies composed of multiple optical glass fibers with both an inner and outer coating and an optional outer ink layer. *Id.* at 4:64-

5:4. The two compositions used as the inner and outer coatings are often modified to provide desired properties—providing bare optical glass fibers, which, when stripped, are substantially free of residue. *Id.*

Claims 2 and 5, reproduced below, are illustrative of the claimed subject matter:

> 2. A system for coating an optical glass fiber comprising a radiation-curable inner primary coating composition and a radiation-curable outer primary coating composition wherein:
>
> said inner primary coating composition comprises propoxylated nonyl phenol acrylate and an oligomer having at least one functional group capable of polymerizing under the influence of radiation, said inner primary coating composition after radiation cure having the combination of properties of:
>
> (a) a fiber pull-out friction of less than 40 g/mm at stripping temperature;
>
> (b) a crack propagation of greater than 1.0 mm at stripping temperature;
>
> (c) a glass transition temperature of below 10° C.; and
>
> (d) sufficient adhesion to said glass fiber to prevent delamination in the presence of moisture and during handling; and
>
> said outer primary coating composition comprises an oligomer having at least one functional group capable of polymerizing under the influence of radiation, said outer primary coating composition after radiation cure having the combination of properties of:
>
> (e) a glass transition temperature of above 40° C.; and

(f) a modulus of elasticity of between about 10 MPa to about 40 MPa at stripping temperature;

and wherein the ratio of the change in length of said inner primary coating composition, after radiation cure, to the change in length of said outer primary coating composition, after radiation cure, is less than 2 when said cured compositions are heated from 25° C. to stripping temperature.

5. A radiation-curable inner primary coating composition for an optical glass fiber comprising at least one oligomer having at least one functional group capable of polymerizing under the influence of radiation, said composition, after radiation cure, having the combination of properties of:

(a) a fiber pull-out friction of less than 20 g/mm at 90° C;

(b) a crack propagation of greater than 1.0 mm at 90° C;

(c) a glass transition temperature of below 10° C; and

(d) adhesion to glass of at least 12 g/in when conditioned at 95% relative humidity.

II. DISCUSSION

A. Claim Construction

In an *inter partes* review, claim terms in an unexpired patent are interpreted according to their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b); Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,766 (Aug. 14, 2012). Claim terms are also given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Any special definition for a claim term must be set forth in the specification with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). In the absence of such a definition, limitations are not to be read from the specification into the claims. *In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993).

1. "In the presence of moisture" (claims 1-4 and 9-12)

Claims 1-4 and 9-12 require an inner primary coating, or a composition after cure, that exhibits "sufficient adhesion to [a] glass fiber to prevent delamination in the presence of moisture and during handling." We refer to that property in our analysis as "the claimed adhesion property."

The parties disagree about the meaning of the term "in the presence of moisture," which appears in the limitation relating to the claimed adhesion property. Corning argues that the term is broad enough to embrace exposure to 95% relative humidity as disclosed in the '189 patent for a wet adhesion test. Pet. 17; *see* Ex. 1001, 28:50-29:5 (disclosing conditions of wet adhesion test). DSM counters that "in the presence of moisture" means exposure to liquid water—that is, 100% relative humidity—as would be present, for example, in the water soak delamination test described in the '189 patent. Resp. 15-18 (citing Ex. 2032 ¶¶ 59-66). That delamination test involves soaking a cured coating sample in a hot water bath for up to 24 hours. Ex. 1001, 27:21-37 (describing conditions of the water soak delamination test); 29:20-58 (Table 3). DSM produces evidence that under conditions of 95% relative humidity, "by definition, there will be no moisture condensation on the surface of the coating because moisture condenses at 100% relative humidity." Ex. 2032 ¶ 61; *See* Resp. 17.

The evidence supports a conclusion that the broadest reasonable interpretation of the term "moisture" is liquid water—that is, a condition of 100% relative humidity. The written description uses the term "moisture" in a context that suggests liquid water. *See, e.g.*, Ex. 1001, 28:65-67 (applying a "wax/water slurry" to surface of sample film in order "to retain moisture"); 35:17-18 (applying heat to remove "moisture" from samples, suggesting removal of liquid water). Moreover, where the written description discusses water in vapor form, the inventors use the word "humidity" or "atmospheric moisture," but not "moisture" alone. *See, e.g., id.* at 21:47 (referring to "atmospheric moisture"); 28:48, 60, 65 (referring to "humidity"). The '189 patent further discloses that a "ribbon assembly can be buried under ground or water for long distance connections, such as between cities," which is consistent with the proposition that an optical fiber coating must endure long periods of immersion in liquid water without delaminating. Ex. 1001, 67:43-45. In light of the context in which the term "moisture" appears in the specification, we conclude that the inventors used that term in its ordinary sense to refer to liquid water.

The '189 patent, thus, is directed to a coating composition that, after radiation cure, has sufficient adhesion to glass to prevent delamination in the presence of liquid water. We decline to resolve what temperature, or length of time of exposure to liquid water the coating must endure, without delaminating, in order to satisfy the claimed adhesion property. Resolving those conditions is not necessary to our analysis, which focuses on whether Corning's wet adhesion test, conducted under conditions of 95% relative humidity, is probative of the extent to which a cured coating delaminates from glass when exposed to liquid water.

2. "Stripping temperature"

Corning argues that the '189 patent describes stripping temperature as being from about 90°C to about 120°C. Pet. 16 (citing Ex. 1001, 13:32-34). DSM does not contest this construction.

We do not agree with Corning that the '189 patent defines the term "stripping temperature" as "about 90°C to about 120°C." Rather, the patent indicates that stripping temperature is "typically" within this range. Ex. 1001, 13:32-34; *accord id.* at 14:21-25 ("[F]or most coating compositions the design ribbon stripping temperatures are usually about 90° C. to about 120° C., but may be different depending on the specific design parameters for the particular coating composition."). This disclosure is too imprecise to serve as a definition. *See Paulsen,* 30 F.3d at 1480.

The '189 patent does refer repeatedly, however, to 90°C as an exemplary stripping temperature. *E.g.,* Ex. 1001, 31:14-15, 31:41-42, 50:55. The '189 patent also identifies 100°C as an exemplary stripping temperature, particularly in the context of measuring change in length. *Id.* at 14:46-47, 18:44-45. Whatever other temperatures this term encompasses, it certainly encompasses at least the ones specifically identified. *See Oatey Co. v. IPS Corp.*, 514 F.3d 1271, 1276 (Fed. Cir. 2008) ("We normally do not interpret claim terms in a way that excludes embodiments disclosed in the specification."). The limitation requires no further construction.

3. "Fiber pull-out friction"

Every challenged claim requires that the inner primary coating, or the inner primary coating composition after cure, have a fiber pull-out friction of less than a specified amount at a specified temperature. *See*, *e.g.*, claims 2 and 5, sec. I.B, *supra*. The parties do not propose express construction of this term, but they do disagree as to certain details of the procedure for testing fiber pull-out friction. *E.g.*, Resp. 31; Reply 3.

The '189 patent describes a procedure that may be used for testing fiber pull-out friction:

> The fiber pull-out friction test can be performed as follows. The sample consists of a bare, clean optical fiber, one end of which has been embedded in a 250 micron thick sheet of cured inner primary coating to be tested. This assembly is mounted in a suitable instrument such as a Rheometrics RSA-II rheometer, and the temperature raised to a representative ribbon stripping temperature (such as 90° C.), and the fiber pulled slowly out of the sheet at a rate of 0.1 mm/sec. The instrument records and plots force vs distance. The plots typically show a linear region of negative slope, which is the result of a decreasing area of contact between fiber and coating, as the fiber is being withdrawn. The slope is measured, and is the output of the test. Low slope values correspond to a low fiber pull-out friction, and vice versa. Three test samples should be performed and their average used as the final output of the test.

Ex. 1001, 31:35-50. Although this test is not described as being the only one that can be used to determine fiber pull-out friction, it is specifically identified in the '189 patent. Consequently, we construe "fiber pull-out friction" as encompassing at least a fiber pull-out friction measurement obtained using the procedure disclosed in the above-quoted passage. *See Oatey*, 514 F.3d at 1276.

4. Other terms

Corning proposes constructions for several other terms, Pet. 16-18, none of which DSM contests. We have considered Corning's arguments but determine that the limitations discussed need not be construed in a manner that departs from their ordinary and customary meanings for purposes of this decision, and do not need to be construed expressly.

B. Reliability of Dr. Winningham's Testimony

DSM argues that Dr. Winningham's opinions are unreliable because he "fails to understand" the legal standards for obviousness. Resp. 55-57. In particular, DSM argues that Dr. Winningham gave no consideration to the relevant time period when addressing who is one of skill in the art for obviousness purposes. *Id.* DSM quotes the following portion of Dr. Winningham's deposition in support of this argument:

> Q. Does the time, does the year make any difference in terms of who that skilled scientist would be in that relevant art?
> A. I'm not making that distinction.
> Q. So at any time?
> A. Yes.

Id. at 56-57 (quoting Ex. 2029, 424:18-23).

DSM argues both that Dr. Winningham's testimony should be excluded and given little or no weight. Resp. 45-47; PO Mot. To Exclude 1-7. We address the admissibility of Dr. Winningham's testimony below in our decision on DSM's motion to exclude evidence. To the extent that

DSM's argument goes to the weight to be accorded Dr. Winningham's testimony, it is not persuasive. DSM identifies no particular instances in which Dr. Winningham's silence as to the relevant time period for determining who is one of skill in the art weakens his testimony. We agree with Corning that the thoroughness of Dr. Winningham's testimony outweighs the concern DSM expresses.

We also are not persuaded that Dr. Winningham made the admission that DSM argues. DSM's question appears to address whether Dr. Winningham made any distinctions about the qualifications and experience of a skilled scientist over time, not whether Dr. Winningham based his obviousness opinions on the knowledge of that skilled scientist at the time the invention was made. We do not find Dr. Winningham's supposed admission determinative on the issue of whether he failed to consider the relevant time period in his obviousness opinions.

DSM also argues that Dr. Winningham failed to analyze the underlying test data as rigorously as an independent expert and instead trusted Ms. Kouzmina's statements based on his experience working with her and confidence in her skills. Resp. 57-59. Corning argues that it was appropriate for Dr. Winningham to rely on Ms. Kouzmina based on their long working relationship, that Dr. Winningham had sufficient information on which to base his opinions, and that Drs. Bowman and Taylor did no better in reviewing DSM data. Reply 14-15.

DSM's assertion does not persuade us that all of Dr. Winningham's opinions should be accorded no weight for lacking a basis in underlying data. DSM identifies no evidence that refutes Dr. Winningham's statement that his confidence in Ms. Kouzmina's work is based on their long working relationship. We credit this statement and accord Dr. Winningham's opinions the weight to which they are entitled.

C. Material Property Limitations

The crux of Corning's case-in-chief is that the prior art compositions are made of the same chemical substances as are presently claimed, and that Corning's testing of those prior art compositions reveals them to possess inherently the claimed material property limitations. *See* Pet. 4-5. DSM argues, among other things, that Corning improperly tested some of the material property limitations. Resp. 26-35. DSM's arguments in this regard cut across Corning's various unpatentability challenges, so we address DSM's material property limitation arguments first.

The Board gives consideration to the arguments, and the evidence cited in support of those arguments, that the parties make. The Board will not scour the record in search of evidence relevant to a particular issue, nor will it attempt to fit evidence together into a coherent explanation that supports an argument. Such activities are the province of advocacy. *See Stampa v. Jackson*, 78 USPQ2d 1567, 1571 (BPAI 2005) (quoting *Ernst Haas Studio, Inc. v. Palm Press, Inc.*, 164 F.3d 110, 111-12 (2d Cir. 1999) ("Appellant's Brief is at best an invitation to the court to scour the record, research any legal theory that comes to mind, and serve generally as an advocate for appellant. We decline the invitation.")).

1. "Fiber pull-out friction"

As discussed above in section II.A.3, every challenged claim requires that the inner primary coating, or the inner primary coating composition after cure, have a fiber pull-out friction of less than a specified amount at a specified temperature. Claims 1, 5, 9, and 13 (and claims 17, 21, 25, 29, 33, 37, 41, 45, and 49 as they depend from claim 5 or claim 13) require a fiber pull-out friction of less than 20 g/mm, whereas all other challenged claims require a fiber pull-out friction of less than 40 g/mm. Claims 5-8 and 13-16 (and the claims dependent from claims 5 and 13) specify a temperature of 90°C,[4] whereas all other claims specify "stripping temperature." As discussed above in section II.A.2, we construe "stripping temperature" as encompassing 90°C, because the '189 patent gives this temperature as an example of a stripping temperature.

a. Summary of Parties' Arguments and Evidence

We summarize here the arguments that the parties present on the issue of the fiber pull-out friction testing, along with the supporting evidence the parties cite.

In its Petition, Corning's principal evidence concerning fiber pull-out friction is provided in Ms. Kouzmina's declaration. Ex. 1015 ¶¶ 33-37. Ms. Kouzmina states that fiber pull-out friction was measured for Shustack Example I and Szum '928 Example 5B, following the procedure described in the '189 patent at column 31, lines 35-50. *Id.* ¶ 33; Pet. 24, 36 (both citing Ex. 1015 ¶ 37). Ms. Kouzmina states that a section of bare, clean optical fiber was embedded in a film of inner primary coating, the film being about 250 microns thick. Ex. 1015 ¶ 34. The film was then cured with ultraviolet light. *Id.* The cured samples were mounted on a compumotor slide and enclosed in a heating chamber. *Id.* ¶ 35. The slide was set to a

[4] Claim 13 specifies the temperature as "at least at 90°C."

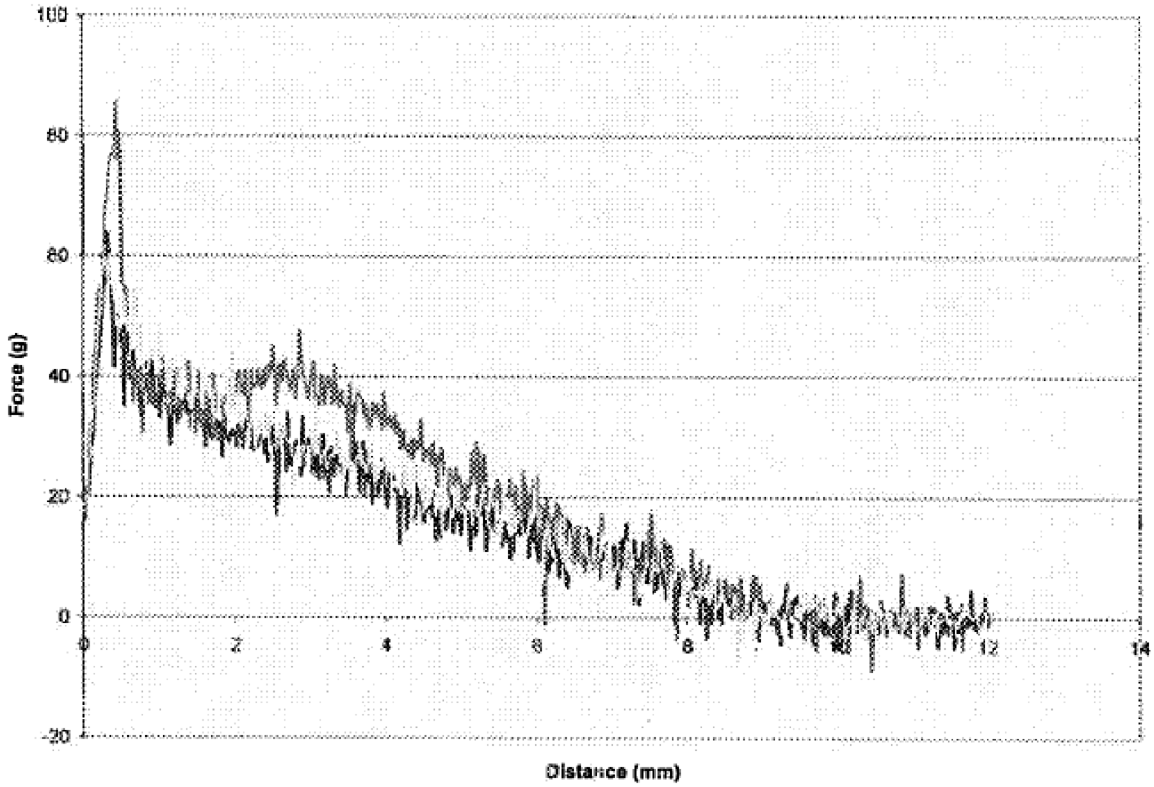
speed of 0.1 mm/s, and the instrument recorded and plotted force versus speed. *Id.* ¶ 36. Ms. Kouzmina then states:

> The plots typically showed a negative slope as a result of the decreasing area of contact between fiber and coating, as the coating was withdrawn. The slope was measured and was the output of the test. The value reported was an average of three measurements.

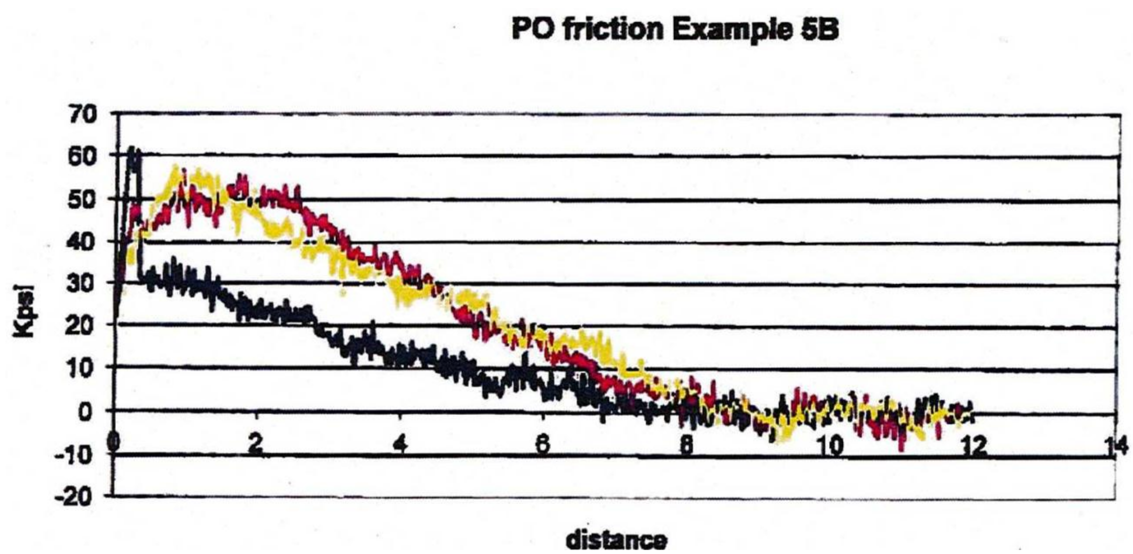
Id. The results indicate that Shustack Example I and Szum ’928 Example 5B had fiber pull-out friction measurements of 5.6 g/mm, and 6.6 g/mm, respectively. *Id.* ¶ 37. Corning argues that these results demonstrate that both Shustack Example I and Szum Example 5B meet every version of the “fiber pull-out friction” limitation. Pet. 24-26; 36-37.

DSM filed additional evidence describing Corning’s testing procedure and the data underlying Corning’s friction measurements, as part of its Response. In particular, DSM filed the procedure, plots, and results of the testing of Shustack Example I, and the plots for Szum ’928 Example 5B. Exs. 2015, 2042.

The plots from Corning’s fiber pull-out friction tests of Shustack Example I and Szum ’928 Example 5B are reproduced below:



Ex. 2015, 2.



Ex. 2042, 1.

The graphs plot force along the *y* axis and distance along the *x* axis, and each shows results for three samples. Corning's test procedure is as follows:

> Samples were prepared based on conditions stated in the patent. 15mil wet films were casted with a draw down box to cure approximately 250[µ]m film. The actual[] film thickness was approximately 260[µ]m. An arm length of fiber was cut from a reel. Approximately 3 inches in from one end a 1 inch window strip was made. The fiber was taped to a glass microscope slide, so that the window strip was approximately one quarter inch from end of slide. Another slide was positioned opposite of this slide with a one half inch gap, allowing the majority of striped fiber to rest on this slide. The fiber was lifted up and a drop of coating was placed on the slide. The window striped fiber was then placed back down on the drop of coating and taped to the glass slide. The film was cast over the striped fiber to encase the bare glass fiber. This film was then cured at 1 J/cm^2 UV dose. The striped glass fiber encased in film was cut to a 1 cm gauge length. Samples were mounted on the motorized slide for strip force test, with the 'wet pull out' sample holder. A heating chamber was mounted on the motorized slide to enclose the test sample. The temperature was controlled at 90°C by a temperature controller with a thermal couple. The slide was manually controlled by the indexer to maintain a speed of 0.1 mm/sec. Data was collected using LabNotebook software.

Ex. 2015, 1. For Shustack Example I, the slope was "measured from the region of the graph in which the force appears to be in a linear relationship with the displacement." *Id.* That region is reported as extending from

2.76 mm to 7 mm. *Id.* The slope in that region is given as -5.625 (average of three samples), which Ms. Kouzmina reported in her declaration as 5.6 g/mm. *Id.*; Ex. 1015 ¶ 37.

DSM argues that the plot data underlying the reported friction values indicates that a "cohesive failure" occurred during testing, thereby rendering Corning's testing unreliable. Resp. 26-31. DSM explains that a cohesive failure is the separation of one portion of a coating from another, so that the pull-out friction test measures the friction between the torn surfaces of the separated coating portions, rather than the friction between the inner primary coating and the optical fiber. *Id.* at 27-28 (citing Ex. 2032 ¶¶ 77-85). Dr. Taylor states that a properly run fiber pull-out friction test should result in a plot with a "substantial linear region of negative slope." Ex. 2032 ¶ 80. DSM argues, citing Dr. Taylor, that the plots do not include any "substantially smooth linear region." Resp. 31 (citing Ex. 2032 ¶¶ 86-90; Exs. 2036-37).[5] DSM reasons that because a cohesive failure during pull-out testing would result in a plot lacking a linear region of negative slope, the absence of a linear region from Corning's data indicates that there was a cohesive failure. *Id.*

Dr. Taylor identifies several factors in Corning's test procedure that may explain what he perceives as an absence of a substantial linear region in these plots. Resp. 31 (citing Ex. 2032 ¶¶ 86-90). First, Dr. Taylor states that

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[5] Dr. Taylor does not describe Corning's plots as lacking any "substantially smooth linear region." Instead, he states that they "have no linear region from which to measure a slope" and that they lack any "substantial linear region." Ex. 2032 ¶ 86.

the Corning employee who performed the tests, Mr. Aaron Gleason, does not mention cleaning the bare optical fiber with a "solvent wipe." Ex. 2032 ¶¶ 87, 90 (citing Ex. 2015, 1). According to Dr. Taylor, a bare optical fiber must be cleaned by wiping it with a solvent capable of extracting residue left behind when the original coating on the fiber is stripped off. Ex. 2032 ¶¶ 78, 79. Dr. Taylor states that the cleaning step is necessary before the bare fiber is embedded in a test coating, because the residue could interfere with adhesion between the bare fiber and the test coating, thereby lowering the friction measurement. *Id.* ¶ 79.

Second, Dr. Taylor states that Mr. Gleason made no effort to position the bare fiber in the drop of test coating or to define the shape of the coating. *Id.* ¶¶ 88, 90 (citing Ex. 2015, 1). According to Dr. Taylor, positioning the bare fiber too close to the edge of the test coating could cause tearing during the fiber pull-out friction test. Ex. 2032 ¶ 82. Dr. Taylor states that if the fiber is positioned closer to one edge of the coating than another, the thinner side of the coating will be able to absorb less energy than the thicker side and will be more likely to tear during the test. *Id.*

Third, Dr. Taylor states that a sudden drop in force after an initial maximum indicates that the pulling force caused a tear or cohesive failure in the coating, such that the subsequent friction measurements are artificially low. *Id.* ¶ 83.

Fourth, Dr. Taylor states that Corning used an instrument that was designed for a "pull-out" test, rather than one designed for a fiber pull-out friction test. *Id.* ¶¶ 89, 90 & n.3. According to Dr. Taylor, Corning's experimental setup prevented the application of any "normal force" (i.e., clamping or squeezing) on the test sample. *Id.* ¶ 90 n.3. Dr. Taylor states that the coating must be squeezed against the fiber to an extent sufficient to ensure that the full surfaces of the coating and the fiber are in contact and therefore contribute to the friction generated during the pull-out; otherwise, the friction measured will be artificially low. *Id.* ¶¶ 85, 90 n.3. Dr. Taylor also states that an inadequate normal force may manifest itself as considerable noise in the signal, due to "slip-stick" behavior induced by inadequate clamping. *Id.* ¶ 84.

DSM also argues that it made its own preparations of Shustack Example I and Szum '928 Example 5B, tested them for fiber pull-out friction, and measured average friction values of 26 g/mm and 23 g/mm, respectively. Resp. 41-43 (citing Ex. 2032 ¶¶ 77-85, 91-98, 130-149). DSM argues that because Corning's fiber pull-out friction testing was flawed, the only reliable evidence of record concerning fiber pull-out friction is DSM's, and this data demonstrates that neither Shustack Example I nor Szum '928 Example 5B exhibits a fiber pull-out friction within the scope of claims 1, 5, 9, 13, and various claims dependent from claims 5 and 13. Resp. 44-45.

In reply, Corning argues that its test procedure followed the procedure described in the '189 patent. Reply 2-3. Corning also argues that an independent review by Dr. Ju, a new reply witness for Corning, confirms that Corning's fiber pull-out friction plots exhibit a linear region of negative slope indicating a friction of less than 20 g/mm, and that there is no evidence of cohesive failure during the tests. *Id.* at 3 (citing Ex. 1035 ¶¶ 16, 32-39). In response to DSM's own testing of Shustack Example I and Szum '928 Example 5B, Corning argues that DSM's measurements are artificially high, because DSM's testing employee clamped the samples with an unspecified and unmeasured force, thereby imposing an external normal force that exaggerated the friction measurement. *Id.* at 4-5 (citing Ex. 1035 ¶¶ 40, 50, 52, 53, 57-77; Ex. 1045, 160:8-17, 163:20–164:7, 170:16–171:10, 212:25–213:21, 250:15–253:10, 258:8–259:3; Ex. 1046, 365:17-23).

In its Motion for Observations on cross-examination of Corning reply declarants, DSM cites numerous passages from its deposition of Dr. Ju to attack Dr. Ju's declaration testimony concerning fiber pull-out friction testing in general, and Corning's and DSM's testing in particular. Obs. 1-8.

b. Analysis

The issue between the parties as to Corning's fiber pull-out friction plots is whether they exhibit a linear region of negative slope. Corning argues that they do, and the description in Exhibit 2015 that a region of the Shustack Example I plot showing a "linear relationship" was used to calculate slope bears out this argument. *See* Ex. 2015, 1. DSM, in contrast, argues that Corning's plots lack "a substantially smooth linear region" but offers little evidence to support this assertion beyond Dr. Taylor's statements that the plots "have no linear region from which to measure a slope" and that they lack any "substantial linear region." *See* Resp. 31; Ex. 2032 ¶ 86. Dr. Taylor gives no credible explanation for the basis on which he reaches these conclusions. Even if Dr. Taylor provided some underlying facts or data for this conclusion, Dr. Taylor's statements do not support DSM's argument that there is no substantially *smooth* linear region.

As between the conflicting evidence on this point, we credit Corning's evidence, particularly from Exhibit 2015, in which Corning's Mr. Gleason identifies the region of linear relationship as extending between displacements of 2.76 mm and 7 mm. DSM does not explain why this determination is invalid. We agree with Corning that the plots for Shustack

Example I show a linear region of negative slope from 2.76 mm to 7 mm. To be sure, the signal is noisy, and the plots are jagged, but that does not mean that a linear relationship is not discernible in that region.

All of DSM's critiques of the Corning test procedure hinge on its assertion that Corning's plots lack a linear region. *See* Resp. 31. Because we determine that DSM has not provided credible evidence showing that Corning's plots lack a linear region, we determine that DSM has not shown that its critiques of Corning's procedure are relevant.

Moreover, even when we consider the merits of DSM's critiques, we do not find them persuasive. DSM's argument that the bare fiber must be wiped with a solvent to remove residue is unsupported. Dr. Taylor simply asserts this to be the case, without providing credible support. *See* Ex. 2032 ¶ 78. The '189 patent says simply that the fiber must be clean. Ex. 1001, 31:36. Ms. Kouzmina says that the fiber was clean. Ex. 1015 ¶ 34. DSM has not explained how Ms. Kouzmina's evidence fails to show that Corning followed the '189 patent's instructions.

DSM's critique of Corning's positioning of the fiber in the test coating similarly is based on silence in Corning's evidence, rather than evidence that Corning did not comply with the test procedure described in the '189 patent. Corning's technician "encased" a section of bare fiber in the test coating. Ex. 2015, 1. DSM does not explain credibly how "encasing" the fiber in the coating is inferior to, or even materially different from, "embedding" the fiber, as indicated in the '189 patent.

DSM's argument that a "sudden drop" in measured force after the initial maximum indicates a torn coating or cohesive failure is not persuasive because it is not directed to Corning's test data. *See* Ex. 2032 ¶ 83. It is instead a theoretical statement by Dr. Taylor. Dr. Taylor does not state that he observes a sudden drop in Corning's plots. *See id.* Even if we were to infer that Dr. Taylor considers the Corning plots to exhibit sudden drops, DSM's argument is not persuasive, because Dr. Taylor does not explain what he means by a "sudden drop," in terms of either timing or magnitude (i.e., how sudden is "sudden," and how far is a "drop"). Dr. Taylor also does not identify underlying facts or data to support his assertion that a sudden drop is indicative of a torn coating or cohesive failure. Although we have no reason to doubt that Dr. Taylor's knowledge and experience in the relevant art qualify him as a credible expert witness, we assign little or no weight to assertions of his that are not substantiated by some evidence—such as citation to a scholarly work or to his own experience—concerning how he knows or believes the assertions to be true.

DSM's argument that insufficient normal force results in artificially low friction measurements similarly is not persuasive because it is supported by no more than Dr. Taylor's assertions to that effect. *See* Ex. 2032 ¶¶ 84-85, 90 & n.3. Dr. Taylor does not provide any credible basis for his conclusion that some degree of clamping is necessary to ensure complete engagement of the friction-bearing surfaces and to avoid slip-stick behavior. Although Dr. Taylor points out that Corning used a sample holder for a pull-out test (as opposed to a fiber pull-out friction test), and that no normal force is applied during a pull-out test (*id.* at 90 & n.3), it does not follow from this that some normal force is required to be applied during a fiber pull-out friction test. Again, we assign little or no weight to Dr. Taylor's assertions in this regard because they are unsupported by some evidence of how he knows or believes them to be true.

Regarding DSM's own fiber pull-out friction testing, we agree with Corning that DSM's use of an unquantified clamping force brings the reliability of DSM's results into doubt. Dr. Taylor describes the clamping process as follows:

> The sample was placed into a DMA instrument with the embedded fiber end in the lower clamp, which was tightened to firmly hold the coating film in the clamp during the test and apply an adequate level of normal force to the coating film.

Ex. 2032 ¶ 95. Dr. Taylor does not explain how firmly the clamp was tightened or how much normal force would be considered "adequate." DSM argues that the amount of normal force has no effect on the measurement of fiber pull-out friction and that Dr. Ju admitted as much in deposition. Tr. 43:22-44:9; Obs. ¶ 6 (citing Ex. 2090, 164:23–168:2). We do not agree that Dr. Ju admits that normal force has no effect on friction under the conditions of the fiber pull-out friction test. The cited passage of Dr. Ju's deposition largely involves DSM's counsel reading passages from various scientific papers to Dr. Ju and eliciting agreements from Dr. Ju that the papers' statements are correct. Dr. Ju qualifies each of his agreements by saying "[w]ithin the scope of that paper" or something similar. *E.g.*, Ex. 2090, 166:3. The last of these exchanges concerns the following statement from page 19 of Exhibit 2095, following an equation giving a relation between contact area and load: "This explains that for soft rubber sliding on a smooth surface, perfect contact, the frictional force is more or less constant, independent of the load, W." Ex. 2090, 167:10-13. Dr. Ju states: "Within this specific condition as stated in that statement after equation 3.5, within the context of the consideration in this report, I think I would agree. But you must satisfy those conditions that [are] described following this -- the sentence after equation 3.5." *Id.* at 167:17-22. We read Dr. Ju's answer as an agreement to the findings in Exhibit 2095, but as not an admission that the conclusion given applies to the conditions of Corning's testing. DSM does not identify other, credible, evidence to show that frictional force is independent of load under the conditions of Corning's fiber pull-out friction test.

For these reasons, we credit Corning's testing evidence over DSM's. We are persuaded that Corning has shown that Shustack Example I and Szum '928 Example 5B each inherently possess a fiber pull-out friction within the scope of every challenged claim.

2. "Sufficient Adhesion"

As discussed above in section II.A.1, each of claims 1-4 and 9-12 requires an inner primary coating, or a composition after cure, that exhibits "sufficient adhesion to [a] glass fiber to prevent delamination in the presence of moisture and during handling." Corning argues that the prior art compositions disclosed in Shustack (Example I) and Szum '928 (Example 5B) meet this limitation. Corning bases this argument on the results of wet adhesion tests carried out under conditions of 95% relative humidity on coatings prepared according to Shustack Example I and Szum '928 Example 5B. Pet. 24-26 (citing Ex. 1014 ¶¶ 119, 121; Ex. 1015 ¶ 51), 36-37 (citing Ex. 1014 ¶¶ 141, 144; Ex. 1015 ¶ 51).

DSM responds that the wet adhesion test does not evaluate for delamination, which is caused by exposure to liquid water, and that a different test—the water soak delamination test—is the only method disclosed in the ’189 patent for assessing delamination. Resp. 15-16 (citing Ex. 2032 ¶¶ 59-66). DSM also comes forward with its own test results, which allegedly show that the Szum coating, in fact, delaminates when subjected to the conditions of the water soak delamination test disclosed in the ’189 patent. Resp. 43-44.

A dispositive question thus arises: Does Corning show by a preponderance of evidence that the Shustack and Szum coatings exhibit sufficient adhesion to prevent delamination from glass in the presence of liquid water? For the reasons set forth below, we answer that question in the negative. We first address the conditions set forth in the ’189 patent for the wet adhesion test and the water soak delamination test. We then consider whether the wet adhesion test, which Corning performed on the Shustack Example I and Szum ’928 Example 5B coatings, is probative of the claimed adhesion property. Finally, we explain why an evaluation of DSM’s water soak delamination test data is not necessary to our analysis.

a. The Wet Adhesion Test

The ’189 patent describes a wet adhesion test for evaluating a cured coating sample on a glass substrate. Ex. 1001, 28:50-58. The wet adhesion test is conducted “at a temperature of 23±2° C. and a relative humidity of 50±5% for a time period of 7 days.” *Id.* at 28:59-61. A portion of the sample film is then “further conditioned at a temperature of 23±2° C. and a relative humidity of 95% for a time period of 24 hours.” *Id.* at 28:62-65. During that step, “[a] layer of polyethylene wax/water slurry [is] applied to the surface of the further conditioned film to retain moisture.” *Id.* at 28:65-77.

The written description makes plain that the wet adhesion test assesses a cured coating that is conditioned at 95% relative humidity. *Id.* at 28:62-65. Corning acknowledges that fact. *See, e.g.*, Pet. 17 (citing Ex. 1015 ¶ 107) ("The term 'wet adhesion' is described in the '189 patent at col. 28, lines 46-51 as adhesion at 95% relative humidity."). Corning raises no argument that application of a layer of "wax/water slurry" to the surface of the coating represents an exposure to 100% relative humidity. Ex. 1001, 28:65-67; *see* Reply 6 (stating that the wet adhesion test described in the '189 patent relates to conditioning "at 95% relative humidity—not liquid water immersion." (citing Ex. 1001, 28:65-67)).

After conditioning the sample at 95% relative humidity, the sample that appears "uniform and free of defects" is "peeled back from the glass." Ex. 1001, 29:6-10. The wet adhesion test is performed on the peeled-back sample using a device that includes "a horizontal support and a pulley." *Id.* at 29:1-5. With the glass secured to the horizontal support, a wire is "attached to the peeled-back end of the sample, run along the specimen and then run through the pulley in a direction perpendicular to the specimen." *Id.* at 29:9-14. A wet adhesion value is determined by clamping the free end of the wire "in the upper jaw of the testing instrument," which is activated "until the average force value, in grams force/inch," becomes "relatively constant." *Id.* at 29:14-17. The '189 patent discloses that "[t]he preferred value for wet adhesion is at least about 5 g/in." *Id.* at 29:17-18.

On this record, we find that the wet adhesion test assesses the mechanical force required to peel a cured coating away from a glass substrate, after conditioning the coating at 95% relative humidity.

b. The Water Soak Delamination Test

The ’189 patent also discloses a water soak delamination test in which “coated microscope slides [are] soaked in [] water.” *Id.* at 27:32, 43. The samples are soaked in a beaker of deionized water that is placed in a 60° C. hot water bath. *Id.* at 27:43-45. The samples are “observed for delamination periodically. The time when the first signs of delamination” appear is recorded. *Id.* at 27:45-47.

Table 2 in the ’189 patent specification describes a “hot water soak” in which samples are “aged for 4 hours at 60° C.,” the water bath is “shut-off for about 70 hours,” and then the temperature is “brought back to 60° C. for an additional 48 hours.” *Id.* at 28:8-10, 14-16. The degree of delamination observed after the hot water soak is reported in Table 2 as “none” or “delam. [a]fter 1 hour at 60° C.” *Id.* at 27:66; 28:8-10. Table 3 similarly reports results for a delamination test that is described as a “60[°] C Water Soak.” *Id.* at 29:45. Delamination results are reported in terms such as “No Delamination After 24 Hours,” “Slight Delamination After 15 Minutes,” and “No Delamination After 8 Hours; Slight Delamination After 24 Hours.” *Id.* at 29:45-52.

On this record, we find that the water soak delamination test assesses the ability of a cured coating to withstand the hydrodynamic forces that cause delamination of a cured coating from a glass substrate in the presence of liquid water.

c. Corning Fails to Establish that the Szum Coating Inherently Exhibits the Claimed Adhesion Property

The ’189 patent discloses that the wet adhesion test evaluates the force required to peel a coating away from a glass substrate, after the coating has been conditioned at 95% relative humidity. Ex. 1001, 29:1-18. The ’189 patent identifies a different test—a water soak delamination test—for evaluating the extent of delamination that occurs when a cured coating is exposed to liquid water. *Id.* at 27:21-37. In DSM’s view, Corning fails to establish sufficiently that the wet adhesion test, or “[p]eel test,” can “be used to reliably determine what the results of a delamination test would be.” Resp. 32. We agree.

Corning prepared the Szum coating and subjected it to substantially the same wet adhesion test that is described in the written description of the ’189 patent. *Compare* Ex. 1015 ¶¶ 48-51 (describing the wet adhesion test procedure performed on the Shustack Example I and Szum ’928 Example 5B coatings) *with* Ex. 1001, 28:50–29:18 (describing a wet adhesion test procedure performed on an inventive example). The ’189 patent instructs, however, that coating samples are subjected to a water soak test and “examined for delamination” prior to conducting the wet adhesion test. Ex. 1001, 28:45-46. Specifically, the wet adhesion test is performed “[i]n addition” to the water soak delamination test.” *Id.* at 28:44-48. It is the delamination test that ascertains “[t]he time when the first signs of delamination” appear in a coating sample that is immersed in water. *Id.* at 27:22-37.

Although the ’189 patent describes a sequence of testing that includes both a delamination test and a wet adhesion test, Corning comes forward with no evidence that the Szum coating was subjected to a delamination test. *Id.*; *see* Ex. 1015 ¶¶ 48-50 (Corning’s test procedures). Dr. Winningham was unaware of any delamination test performed by Corning on the Szum coating. Resp. 33 (citing Ex. 2029, 469:17–471:17). Corning relies on wet adhesion values for the Shustack Example I and Szum ’928 Example 5B coatings that are expressed as a grams-per-inch mechanical force required to peel each coating away from a glass substrate after conditioning at 95% relative humidity. Ex. 1015 ¶¶ 51.

On this record, we find that Corning relies on test results obtained for the Szum coating after exposure to conditions of 95% relative humidity, but not to liquid water. As explained in our claim construction analysis, exposure to 95% relative humidity is not “in the presence of moisture” (i.e., liquid water) as specified in the challenged claims. Corning argues that the Shustack Example I and Szum ’928 Example 5B coatings exhibit wet adhesion values of 77 g/in and 44 g/in, respectively, “when conditioned at 95% relative humidity,” but does not explain how those results are probative of adhesion in the presence of liquid water—that is, 100% relative humidity. *See, e.g.*, Pet. 26 (citing Ex. 1014 ¶ 121); *see* Ex. 2032 ¶ 48 (moisture condenses at 100% relative humidity). On that basis, we determine that Corning fails to show by a preponderance of evidence that the Szum and Shustack coatings meet the claimed adhesion property.

A second independent basis supports our determination. Corning comes forward with evidence insufficient to support an inference that the results of a 95% relative humidity wet adhesion test correspond to an ability to withstand the hydrodynamic forces that effect delamination. Corning argues that Dr. Winningham “has confirmed that a coating composition with an adhesion to glass of either 23 g/in or 44 g/in, as in Szum, would have sufficient adhesion to the glass fiber to prevent delamination in the presence of moisture and during handling." Pet. 26 (citing Ex. 1014 ¶ 121), 37 (citing Ex. 1014 ¶ 144).[6] Dr. Winningham's opinion on that point is unsupported and, therefore, unpersuasive. *See* Ex. 1014 ¶¶ 121, 144 (reciting opinion without objective proof).

In that regard, Dr. Winningham repeats, verbatim, attorney argument set forth in the petition, but identifies no objective evidence explaining how a wet adhesion value, which indicates a mechanical force required to peel a coating away from a glass substrate, correlates to an ability to withstand the hydrodynamic forces that effect delamination. *Id.* Dr. Winningham's bare opinion is entitled to little weight in the absence of objective, evidentiary support. *See Ashland Oil, Inc. v. Delta Resins & Refractories, Inc.*, 776 F.2d 281, 294 (Fed. Cir. 1985) (finding lack of factual support for expert opinion "may render the testimony of little probative value in a validity determination").

During cross-examination, Dr. Winningham testified about the differences between a water soak delamination test and a wet adhesion test, which he refers to in his testimony as "a peel test":

> Q. If one was concerned about the ability of a coating to delaminate from a substrate when exposed to water, would performing a peel test not give sufficient information to satisfy the interested person?

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[6] In addition to the experimental test results tending to establish a wet adhesion value of 44 g/in for the Szum coating, Corning points to the reference itself for a teaching that the Szum coating exhibits "an adhesion to glass at 95% relative humidity of 23 g/in." Pet. 37 (citing Ex. 1005, 25:12).

> A. I think those tests measure — are looking at different things or measuring different things, so I'm not sure if — I can't say categorically that a peel test is going to tell you what's going to happen in a water delamination test. Different tests.

Ex. 2029, 460:12-21; *see* Resp. 32 (citing this testimony).

Dr. Winningham also testified that the water soak delamination test evaluates the "hydrodynamic forces" that work to delaminate a coating from a glass substrate, whereas "a peel test" evaluates the "mechanical forces" exerted, where "one is applying a — mechanical force to a film and pulling the film off a substrate." Ex. 2029, 459:3-18. That testimony of Corning's witness is consistent with the explanation of the relevant hydrodynamic forces that is provided by DSM's witness, Dr. Taylor. *See* Ex. 2032 ¶¶ 65-66.

At the oral hearing, Corning's counsel directed our attention to test results reported in Table 3 of the '189 patent and, for the first time, argued that those results establish "a clear correlation between the films that passed the hot water soak test . . . and films that have a certain wet adhesion." IPR2013-00045, Paper 89, 10:15-17 (Transcript). That argument, and Corning's reliance on Table 3, is not set forth in the petition or the reply. *See* Pet. 26, 37; Reply 5-7. We deem Corning to have waived that argument raised by counsel for the first time at the oral hearing. *Cf. Cross Med. Prods., Inc. v. Medtronic Sofamor Danek, Inc.*, 424 F.3d 1293, 1320-21 n.3 (Fed. Cir. 2005) (arguments not raised in an opening brief are deemed waived).

That argument also is unpersuasive because it is unsupported by convincing, objective evidence that explains a relationship between the wet adhesion values and the water soak delamination results reported in Table 3. In that regard, Corning asks us to infer a relationship between wet adhesion values (reported as a grams-per-inch mechanical force) and water soak delamination results (reported as an observation, for example, of slight delamination after 15 minutes) from Table 3. *See* IPR2013-00045, Paper 89 10:15-17; Ex. 1001, 29:43-52 (Table 3). That is a leap we will not undertake in the absence of persuasive evidence, such as a technical article or expert testimony, explaining some relationship between those disparate tests. Pet. 26, 37; Reply 5-7 (identifying no such evidence).

Because the issue is not discussed in the briefs, moreover, we have no evidence as to how the wet adhesion value obtained for the Szum coating, which never endured a hot water soak, is comparable to the wet adhesion values reported in Table 3, which appear to relate to coating samples that endured both a hot water soak and the wet adhesion test. *See* Ex. 1001, 28:45-59 (wet adhesion test is performed "[i]n addition" to water soak delamination test); *see also id.* at 29:6-8 (after conditioning, "samples that appeared to be uniform and free of defects" were selected for the wet adhesion test, implying that samples that delaminated were excluded from such testing).

In sum, two independent reasons support our determination that the wet adhesion test results advanced by Corning fail to show adequately that the Szum coating has "sufficient adhesion . . . to prevent delamination in the presence of moisture" within the meaning of the challenged claims. First, the wet adhesion test assesses a property of the coating after conditioning at 95% relative humidity, which is not "in the presence of moisture." Second, Corning identifies no persuasive evidence from which we reasonably can discern that the wet adhesion test evaluates for "delamination."

d. DSM's Delamination Test Results are Not Necessary to our Analysis

DSM presents evidence that the Szum '928 Example 5B coating exhibits insufficient adhesion to prevent delamination in the presence of liquid water. Specifically, DSM contends that it formulated a coating according to Szum '928 Example 5B and subjected it to the water soak delamination test described in the '189 patent. Resp. 43-44 (citing Ex. 2032 ¶¶ 104-07). DSM reports that the Szum coating "experienced delaminations, visible to the unaided eye," and that those "delaminations appeared as water-filled voids or 'blisters' between the inner primary coating and the glass." *Id.*[7]

Corning bears the burden of showing by a preponderance of evidence that the Shustack Example I and Szum '928 Example 5B coatings inherently disclose the claimed adhesion property. We need not resolve whether DSM properly formulated the Szum '928 Example 5B coating or whether DSM's test results accurately reflect the ability of that coating to withstand

[7] Corning does not discuss DSM's adhesion testing of Szum '928 Example 5B in its Reply. Corning argues, in case IPR2013-00049, that DSM's results are unreliable because DSM failed to follow the correct procedure for preparing the Szum coating. IPR2013-00049, Paper 68 (Reply) 7-8. In particular, Corning argues that DSM used the wrong photoinitiator in its formulation, which negatively affected the ability of the Szum coating to withstand delamination. *Id.* (citing Ex. 1068 ¶¶ 95-105).

delamination in the presence of moisture. Our decision rests on Corning's failure to show sufficiently that its wet adhesion test results, which relate to the mechanical force sufficient to peel a coating away from a glass substrate after conditioning at 95% relative humidity, are probative of whether either of the Shustack or Szum coatings has "sufficient adhesion . . . to prevent delamination in the presence of moisture" (i.e., liquid water).

Based on the record developed at trial, Corning fails to show by a preponderance of evidence that either Shustack Example I or Szum '928 Example 5B inherently discloses the claimed adhesion property. Because each of claims 1-4 and 9-12 includes a limitation directed to that property, each claim survives Corning's challenge based on anticipation by, or obviousness over, Shustack, obviousness over Shustack and Jackson, and anticipation by, or obviousness over, Szum '928.

3. "Adhesion to glass of at least 12 [or 5] g/in when conditioned at 95% relative humidity"

Claims 5-8 each require that the inner primary coating, or the inner primary coating composition after cure, have an "adhesion to glass of at least 12 g/in when conditioned at 95% relative humidity." Claims 13-16 have the same limitation, except the numerical value is 5 g/in instead on 12 g/in.[8]

Unlike the "sufficient adhesion" limitation discussed above, this limitation is directed unambiguously to the wet adhesion test described in the '189 patent at column 28, line 50, to column 29, line 18. Corning argues that Shustack Example I and Szum '928 Example 5B exhibit wet adhesion

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[8] Claim 13 has an apparent typographical error of "which conditioned" instead of --when conditioned--.

values, when tested in accordance with the procedure described in the ’189 patent, of 77 g/in and 44 g/in, respectively. Pet. 24, 26, 36-37; Ex. 1015 ¶¶ 48-51. DSM does not challenge Corning’s evidence as to the wet adhesion levels of Shustack Example I and Szum ’928 Example 5B.

Upon consideration of Corning’s evidence, we are persuaded that Shustack Example I and Szum ’928 Examples 5B inherently possess the adhesion to glass property recited in claims 5-8 and 13-16.

4. “Crack propagation”

Every challenged claim requires that the inner primary coating, or the inner primary coating composition after cure, have a crack propagation of greater than 1.0 mm (claims 1-8) or 0.7 mm (claims 9-16) at stripping temperature (claims 1-4, 9-12) or 90°C (claims 5-8, 13-16). As discussed above in section II.A.2, we construe “stripping temperature” as encompassing 90°C, because the ’189 patent gives this temperature as an example of a stripping temperature.

Corning argues that Shustack Example I and Szum ’928 Example 5B exhibit crack propagation values, when tested in accordance with the procedure described in the ’189 patent at column 31, lines 7-20, of 1.5 mm and 1.3 mm, respectively. Pet. 24, 36; Ex. 1015 ¶¶ 38-42. DSM does not challenge Corning’s evidence as to the crack propagation property of Shustack Example I and Szum ’928 Example 5B.

Upon consideration of Corning’s evidence, we are persuaded that Shustack Example I and Szum ’928 Examples 5B each inherently possesses a crack propagation within the scope of every challenged claim.

5. "Glass transition temperature" of inner primary coating

Every challenged claim requires that the inner primary coating, or the inner primary coating composition after cure, have a glass transition temperature of below 10°C (claims 1-8) or 0°C (claims 9-16). Corning argues that Shustack Example I and Szum '928 Example 5B exhibit glass transition temperatures, when tested in accordance with the procedure described in the '189 patent at column 34, line 57 to column 35, line 24, of -38.9°C and -34.9°C, respectively. Pet. 24, 36; Ex. 1015 ¶¶ 43-47. DSM does not challenge Corning's evidence as to the glass transition temperature of the inner primary coating for Shustack Example I or Szum '928 Example 5B.

Upon consideration of Corning's evidence, we are persuaded that Shustack Example I and Szum '928 Examples 5B each inherently possesses a glass transition temperature for the inner primary coating within the scope of every challenged claim.

6. "Glass transition temperature" of outer primary coating

Each of claims 2-4, 6-8, 10-12, and 14-16 requires that the outer primary coating, or the outer primary coating composition after cure, have a glass transition temperature of above 40°C. Corning argues that Shustack Examples X and XI have glass transition temperatures of 48.5°C and 46.8°C, respectively, when measured according to the procedure described in the '189 patent at column 34, line 57 to column 35, line 24. Pet. 28;

Ex. 1015 ¶¶ 43-47.[9,10] DSM does not challenge Corning's evidence as to the glass transition temperature of the outer primary coating for Shustack Examples X or XI.[11]

Upon consideration of Corning's evidence, we are persuaded that Shustack Examples X and XI each inherently possesses a glass transition temperature for the outer primary coating within the scope of claims 2-4, 6-8, 10-12, and 14-16.

7. "Modulus of elasticity" of outer primary coating

Each of claims 2-4, 6-8, 10-12, and 14-16 requires that the outer primary coating, or the outer primary coating composition after cure, have a modulus of elasticity of either (a) between about 10 MPa to about 40 MPa (claims 2-4 and 6-8) or (b) greater than 25 MPa (claims 10-12 and 14-16), at either (1) stripping temperature (claims 2-4 and 10-12) or (b) 100°C (claims 6-8 and 14-16). As discussed above in section II.A.2, we construe "stripping

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[9] Corning conceded at oral argument that it no longer bases any challenges on Shustack Example IX. IPR2013-00048, Paper 93, 3:3-10. We give that example no further consideration.

[10] Corning also argues that Szum '928 Example 2 meets the recited glass transition temperature of the outer primary coating (Ex. 1015 ¶ 47), but Corning does not challenge any of claims 2-4, 6-8, 10-12, or 14-16 for anticipation by Szum '928.

[11] DSM's experts argue that the glass transition temperatures of Corning's reproductions of Shustack Examples X and XI may have been affected by Corning's choice of oligomer. *E.g.*, Ex. 2034 ¶¶ 65-76; Ex. 2032 ¶¶ 131-132. We address that argument in the context of the "modulus of elasticity" limitation discussion in section II.C.7.

temperature" as encompassing 100°C, because the '189 patent gives this temperature as an example of a stripping temperature.

Corning argues that Shustack Examples X and XI meet this limitation. Pet. 28; Ex. 1015 ¶ 52-55. Corning's expert, Dr. Winningham, acknowledges, however, that the express disclosure in Shustack does not identify what oligomer is used to make those examples. Ex. 1014 ¶ 74 n.5. Shustack describes the oligomer used in Example X as "aliphatic urethane acrylate oligomer with polyester backbone (I) (used as a mixture containing 12% hexanediol acrylate)." Ex. 1003, 30:32-36. Dr. Winningham states that EBECRYL® 284 aliphatic urethane acrylate oligomer was disclosed in EP 0 407 004, prior to publication of Shustack, as having all the properties specified by Shustack, including preparation in 12% hexanediol acrylate. Ex. 1014 ¶ 74 n.5.[12] Dr. Winningham states that EBECRYL® 284 oligomer would have been "suitable" for use in Shustack Example X. *Id.*

Corning argues that Shustack Examples X and XI, as synthesized using the EBECRYL® 284 oligomer, have moduli of elasticity of 30 MPa and 18 MPa at about 100°C, respectively, when measured according to the procedure described in the '189 patent at column 34, line 57 to column 35, line 24. Pet. 28; Ex. 1015 ¶¶ 52-55.

DSM argues that Corning's reproductions of Shustack Examples X and XI are not reliable indicators of the inherent modulus of elasticity in the prior art compositions, because Corning arbitrarily selected EBECRYL® 284 urethane acrylate as the oligomer it used to synthesize them.

[12] EP 0 407 004 is of record as Exhibit 1018. EBECRYL® 284 oligomer is disclosed at, e.g., page 12, lines 34-35.

Resp. 37-40, 47-49. In particular, DSM argues that Shustack does not specify which oligomer was used to make Examples X and XI and that Corning's selection of EBECRYL® 284 aliphatic urethane oligomer was arbitrary. *Id.* According to DSM, "many possible oligomers . . . fall within the broad category" that could be used in Shustack Examples X and XI. *Id.* at 40. DSM argues that Shustack's disclosure of a genus does not amount to disclosure of the species within that genus. *Id.* at 39-40 (citing *Metabolite Labs., Inc. v. LabCorp*, 370 F.3d 1354, 1367 (Fed. Cir. 2004)). Dr. Bowman opines:

> Within these large classes of oligomers, there are almost infinite possible combinations of structures. For example, there is no disclosed range of molecular weight for the oligomer. (*See* [Ex. 1003] at 18:35–19:41, 29:30–31:30). There is no disclosure regarding the number of acrylate functionalities. (*See id.*) There is also no discussion of the kind of polyester or polyether repeat units that should be used or whether the oligomers should be branched or not. (*See id.*) These variables have significant effects on the glass transition temperature and the modulus, and would, in many cases, affect the thermal expansion characteristics of these coatings. Molecular weight and functionality, in particular, would have a significant effect on glass transition temperature and modulus.

Ex. 2034 ¶ 65. Dr. Bowman also argues that were "many aliphatic urethane oligomers with polyester backbones known to a person of ordinary skill in the art at the time that would have resulted in a coating with a modulus of greater than 40 MPa at 100°C." Ex. 2034 ¶ 74. DSM concludes that following Shustack's express disclosure for Examples X and XI does not lead unavoidably to a coating composition having the recited modulus of elasticity upon cure. Resp. 40. For these reasons, argues DSM, Shustack Examples X and XI do not inherently disclose this property. *Id.*

Corning argues, in reply, that Dr. Bowman concedes that EBECRYL® 284 oligomer is an acceptable choice for synthesizing Shustack Examples X and XI, and that Corning's reply expert, Dr. Sogah, can identify no other commercially-available oligomer that meets the criteria specified in Shustack. Reply 10 (citing Ex. 1068 ¶¶ 86-88; Ex. 1070, 433:13-24).

Upon consideration of the parties' arguments and evidence, we agree with DSM that Corning has not shown that Shustack Examples X and XI inherently possess the claimed modulus of elasticity. Shustack does not identify EBECRYL® 284 aliphatic urethane acrylate as the oligomer to be used, and we agree with DSM that Corning has not shown that one of ordinary skill in the art would have interpreted Shustack's description of the oligomer as unambiguously identifying the EBECRYL® 284 oligomer.

Corning's argument that Shustack inherently discloses the modulus of elasticity limitations is predicated on the assertion that Shustack Examples X and XI necessarily possess moduli of elasticity within the scopes of claims 2-4, 6-8, 10-12, and 14-16. *See* Pet. 28. But the only evidence Corning offers in support of this argument is modulus testing upon versions of Shustack Examples X and XI made with the EBECRYL® 284 oligomer. Corning's evidence is persuasive to show that Examples X and XI formulated with the EBECRYL® 284 oligomer possess the required modulus. It is not persuasive, however, to show that Examples X and XI, *as disclosed in Shustack*, inherently disclose this property. We reach this conclusion because Corning has not shown that either (a) one of ordinary skill in the art would have, at once, envisaged EBECRYL® 284 oligomer from the disclosure in Shustack, or (b) every oligomer that meets the requirements specified in Shustack Example X would, if used to make that example, result in a coating with the required modulus of elasticity.

As to issue (a), Corning does not address expressly in its Petition the issue of what oligomer Shustack discloses for Examples X and XI. Instead, Corning argues (through Dr. Winningham and Dr. Bowman) that EBECRYL® 284 oligomer is a suitable choice because it meets Shustack's requirements. *See* Ex. 1014 ¶ 74 n.5; Ex. 1070, 433:13-24. But suitability, without more, does not establish that EBECRYL 284 oligomer is the oligomer Shustack discloses for Examples X and XI. Dr. Sogah's evidence that he is unaware of any other suitable oligomers that are commercially available (Ex. 1068 ¶¶ 86-88) does not address the question of whether any other suitable oligomers exist or have been disclosed by Shustack.

The disclosure of a genus may be read as a disclosure of the constituent species if one of ordinary skill in the art could "at once envisage" them from the generic disclosure. *In re Petering*, 301 F.2d 676, 681 (CCPA 1962). We credit Dr. Bowman's testimony that the class of oligomers that would meet Shustack's criteria is "almost infinite," because Shustack does not specify details such as molecular weight for the oligomer, the number of acrylate functionalities, the kind of polyester repeat units, and whether the oligomers should be branched. *See* Ex. 2034 ¶ 65. Corning has not come forward with sufficient evidence to show that one of ordinary skill in the art would have interpreted Shustack's disclosure as identifying the EBECRYL® 284 oligomer uniquely or as one of a sufficiently small and closely related set of oligomers as to be, at once, envisaged from the generic disclosure.

As to issue (b), we further credit Dr. Bowman's testimony that the unspecified details in Shustack's oligomer description may have substantial effects on the material properties that a resulting coating would possess, including glass transition temperature and modulus of elasticity. *See* Ex. 2034 ¶¶ 65-76. Put another way, Corning has not shown that the properties of a coating made with the EBECRYL® 284 oligomer is indicative of the properties that would result from making Shustack Example X or XI with another oligomer. Without such a showing, Corning has not established that the properties it relies upon from Shustack are inherent in Shustack.

For these reasons, we determine that Corning has not shown that Shustack discloses the modulus of elasticity limitations of claims 2-4, 6-8, 10-12, and 14-16.

8. "Ratio of the Change in Length"

Each of claims 2, 6, 10, and 14 requires that "the ratio of the change in length of said inner primary coating composition, after radiation cure, to the change in length of said outer primary coating composition, after radiation cure, is less than 2 when said cured compositions are heated from 25° C. to stripping temperature." Claims 3, 4, 7, 8, 11, 12, 15, and 16 require the same ratio but refer to the inner primary coating and outer primary coating directly, rather than to the coating compositions after cure. Every challenged claim requires, therefore, a ratio of the changes in length of less than 2 between 25°C and stripping temperature. As discussed above in section II.A.2, we construe "stripping temperature" as encompassing 100°C, because this temperature is given as an example of a stripping temperature.

a. Summary of Parties' Arguments and Evidence

In its Petition, Corning's principal evidence concerning the change-in-length ratio is provided in Ms. Kouzmina's declaration. Ex. 1015 ¶¶ 56-61. Ms. Kouzmina states that change in length was measured for each of Shustack Examples I, X, and XI, and Szum '928 Examples 2 and 5B, following the procedures described in the '189 patent at column 14, lines 42-57. *Id.* ¶¶ 56-59; Pet. 29 (citing Ex. 1015 ¶ 60). Ms. Kouzmina states that the testing was carried out using an optical microscope with a heated stage. Ex. 1015 ¶ 57. Ms. Kouzmina then explains the process used to test the samples and to obtain images of the samples at 25°C and 100°C. *Id.* ¶ 58. In particular, Ms. Kouzmina explains that each test sample film was lightly coated with talc particles to prevent sticking, placed on a microscope slide, and then on the heated microscope stage. *Id.* The sample was held at 25°C for ten minutes, and then an image of the sample was captured through the microscope's objective lens. *Id.* The image had a resolution of 2080×1536. *Id.* The sample was then heated to 100°C and imaged again. *Id.*

Ms. Kouzmina then addresses how change in length of each sample was calculated. *Id.* ¶ 59. The entirety of Ms. Kouzmina's evidence as to how the change in length was calculated is contained in paragraph 59 of her declaration:

> 59. Change in length of the sample was calculated by comparing the length between two points on the sample when the sample was at two different temperatures.

Id. The changes of length thus calculated for each sample are reported in paragraph 60, and the ratios between the changes of length of various samples are reported in paragraph 61. Ms. Kouzmina reports that the ratio of changes in length is less than 2 for all combinations in which Shustack Example I or Szum '928 Example 5B provides the inner primary coating, and Shustack Example X or XI, or Szum '928 Example 2, provides the outer primary coating. *Id.* ¶ 61; Pet. 22, 30, 40 (citing Ex. 1015 ¶ 61).

DSM argues the procedure Corning followed for determining the change in length was unreliable and scientifically unsound, because it relied on "subjective 'eyeballing'" by Earl Sanford, the Corning microscopist who performed the work.[13] Resp. 34. DSM cites the following deposition testimony of Ms. Kouzmina:

> Q. Do you know how [Mr. Sanford] chose the two points on the film?
> **A. I do not know which specifically points were used for each photograph. But I have a general idea.**
> Q. What's your general idea?
> **A. A general idea is that you would choose a point that is easy to track and that is represented by a marked, you know, particle or a part of the top particle that you would record the coordinates off, and then you would follow that spot as a sample is being heated.**
> Q. So do you know how the precise spots were chosen and how they were tracked?
> MR. McGUIRK:· Objection to form.

[13] Mr. Sanford's first name is indicated at Ex. 1035 ¶ 80.

> **A. I don't know exactly how the precise paths were chosen. It was Mr. Sanford's discretion, and tracked just visually following the selected spot in the microscope and then recording its position.**

Ex. 1044, 123:18–124:12.[14]

DSM also relies on declaration testimony from Dr. Taylor, who dismisses the measurement procedure as "an unmitigated exercise of human discretion (*e.g.*, eye-balling specific pixels . . .)." Ex. 2032 ¶ 111. Dr. Taylor states further that the quality of the measurement is "entirely dependent on the test operator's precision (or lack thereof) in identifying the same two points in two different images in which all the points have moved. In my opinion, such a test is unreliable at best and unacceptable as a[n] art-recognized methodology." *Id.*

Dr. Taylor also argues that Corning's data is unreliable because the samples were not completely free to expand. *Id.* ¶ 115. Dr. Taylor reasons that the samples would have adhered to the microscope slides on which they were placed during testing, because the samples become tacky when heated. *Id.*

Finally, Dr. Taylor argues that Corning's measurements suffer from a relative error of at least 75%. *Id.* ¶ 122. Dr. Taylor reaches this conclusion based on the following facts:

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[14] Corning does not seek to exclude testimony elicited from the objected-to question. The objection is dismissed as moot.

1. The change in length observed in each test was on the order of 20 pixels. *Id.* ¶ 117 (citing Ex. 2050).
2. In the PDF file format images provided by Corning, features that might be used as landmarks for measuring length are about 8×8 pixels. *Id.* ¶¶ 119-121.
3. The microscopist's measurement is subject, therefore, to an uncertainty of ±4 pixels on each end, for a total of ±8 pixels per measurement. *Id.* ¶ 122.
4. Because two measurements are compared to determine the change of length, the uncertainty is doubled to ±16 pixels. *Id.*
5. 16 pixels is 75% of the 20-pixel change noted in most experiments. *Id.*

Corning argues, in reply, that neither the challenged claims, nor any other part of the '189 patent, specifies the proper way in which to conduct a change-in-length test. Reply 7-8 (citing Ex. 1046, 563:13–564:17; Ex. 1035 ¶¶ 78-90). Corning also argues that its measurement procedure was sound. *Id.* at 8 (citing Ex. 1035 ¶ 82). In particular, Corning argues that (a) the samples were not constrained from free expansion, because the talc dusting prevented sticking (*id.* (citing Ex. 1035 ¶ 82)); and (b) Dr. Taylor's error estimation of 75% is grossly exaggerated, because the PDF file format images he used had far lower resolution than the original TIF file format images (*id.* at 8-9 (citing Ex. 1035 ¶¶ 84, 85, 88)). Corning's reply expert, Dr. Ju, estimates the error rate for an experienced microscopist, such as Mr. Sanford, to be on the order of 2-5%. Ex. 1035 ¶ 89.

Corning also argues that Dr. Taylor failed to consider that specific talc particles, which are distinguishable on the high-resolution TIF file format images, were used as reference points for determining change in length.

Reply 4 (citing Ex. 1035 ¶¶ 84-88).[15]

Dr. Ju states as follows in paragraphs 86 and 87 of his declaration:

> 86. Further, Dr. Taylor fails to recognize that Corning utilized distinct talc particles as the reference points for determining the change in length value, as explained by Ms. Kouzmina in her deposition:
>
> > Q. What was done to ensure that the same spots were being measured at the different temperatures?
> >
> > A. (Kouzmina). Precision of picking the spot and the talc particles or ink were assisting in that task.
> >
> > Q. So the talc and the ink were used to help pinpoint the spots?
> >
> > A. (Kouzmina). Correct.
>
> [Ex. 1044] at 126:24–127:7.
>
> 87. As noted in Dr. Taylor's own testimony, talc particles vary in size and shape ("some pictures I've seen of individual talc particles appear that they're not necessarily just round, you know, they can be elongated structures and so forth," [Ex. 1046] at 548:5–8). Corning was able to use these distinct particles or specific features in these particles in the high-resolution .tif images as reference points for determining change in length when heated.

Ex. 1035 ¶¶ 86, 87.

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[15] Corning does not cite paragraph 87, but the context makes clear that paragraph 87 is also relied upon.

In its Motion for Observations on Cross-Examination, DSM cites Exhibit 2090 (deposition of Dr. Ju) as relevant to Dr. Ju's declaration testimony. Obs. ¶ 15 (citing Ex. 2087, 17:12–19:1). In particular, DSM points out that Dr. Ju's understanding of Corning's measurement procedure was based on his observation by videoconference of a demonstration of the procedure that Mr. Sanford performed. Ex. 2090, 17:12–19:1. DSM suggests that Dr. Ju would have been able to judge neither the precision of Mr. Sanford's measurements nor his ability to distinguish talc particles over a videoconference connection. Obs. ¶ 15. Corning responds with other citations to Dr. Ju's deposition, in which Dr. Ju states that he could see the image pixels and talc particles and that he asked Mr. Sanford, Ms. Kouzmina, and others questions about the testing procedure, including "how they were sure that the pixel that they were identifying could be found with the assistance of [a] talc particle." Obs. Resp. ¶ 11 (quoting Ex. 2090, 17:23-24; 19:13-19).

b. Analysis

Upon consideration of the evidence summarized above in section II.C.8.a, we determine that Corning has not shown that the various asserted prior art coating compositions, when cured, necessarily would have possessed the recited ratio of changes of length. Corning has not cited sufficient evidence demonstrating that its change-in-length measurements were performed in a manner sufficiently rigorous and reliable to prove unpatentability of the challenged claims by a preponderance of the evidence.

As noted above, the only evidence in the Petition concerning how changes in length were calculated is provided in paragraph 59 of Ms. Kouzmina's declaration. Ms. Kouzmina does not explain what points were selected on each sample for each length measurement, how those points were selected, or how the points were tracked between images at different temperatures, in order to be certain that the same points on the sample were measured.

An explanation of the experimental methods used to generate results is an essential part of experiment-based expert testimony. It forms part of the "underlying facts or data" on which the expert testimony should be based. *See* 37 C.F.R. § 42.65(a). Those underlying facts or data were not supplied in the relevant portion of Ms. Kouzmina's declaration—paragraph 59—and Ms. Kouzmina's testimony on that issue is, therefore, entitled to little or no weight. No Petition evidence other than paragraph 59 of Ms. Kouzmina's declaration addresses the change-of-length calculation. Consequently, we determine that the Petition evidence is insufficient to show that the prior art composition inherently exhibit the claimed change-in-length property.[16]

Consideration of further evidence developed and cited during the trial underscores the gaps in Corning's proofs. First, none of Corning's witnesses actually performed the change-in-length experiments or saw them performed first-hand. *See* Ex. 2022, 124:9-12; Ex. 1035 ¶¶ 80-82. At best, Ms. Kouzmina's knowledge of how the experiments were conducted was

[16] Dr. Winningham addresses the change-in-length determination in his declaration. Ex. 1014 ¶¶ 100-04. Corning does not cite to this evidence in its Petition or other briefing, therefore, we do not give it further consideration. Even if considered, it would not be persuasive, because Dr. Winningham provides no more detailed explanation of the measurement and calculation procedures than does Ms. Kouzmina.

based on her incomplete understanding of Mr. Sanford's work. *See* Ex. 2022, 124:9-10.

Dr. Ju observed a demonstration by Mr. Sanford, but the evidence Corning cites does not indicate that the procedure Dr. Ju observed during the demonstration was the same procedure that Mr. Stanford used when making the measurements Corning relies upon in the Petition. Corning thus cites no credible evidence to show that Ms. Kouzmina's and Dr. Ju's testimony accurately portray the procedure actually used by Mr. Sanford.

But even if we were to accept that the testimony evidence of Ms. Kouzmina and Dr. Ju in fact describes the process that Mr. Sanford actually used to calculate change in length, we are not provided enough information to permit us to assess the reliability of the measurements produced by Mr. Sanford. In particular, the cited evidence does not make clear how points on each sample were selected or how they were tracked. Although both Ms. Kouzmina and Dr. Ju refer to the use of talc particles or ink as reference points, they do not explain with any precision how the talc or ink is used for this purpose. *See* Ex. 1035 ¶ 86 (quoting Ex. 1044, 126:24-127:7).[17] Dr. Ju testified that he asked Mr. Sanford and Ms. Kouzmina how they could be sure that a pixel being identified could be found with the assistance of a talc particle (*see* Ex. 2090, 19:13-19), but Corning cites no credible evidence as to whether Dr. Ju received an answer to that question, what the answer was, or whether Dr. Ju considered the answer reasonable. Questions remain, consequently, about precisely what

[17] Exhibit 1044 is identical to Exhibit 2022.

Mr. Sanford did. Conspicuously absent is any evidence from Mr. Sanford himself on these crucial points of fact.

For example, even if we were to accept that talc particles were used for identification and tracking, it is still not clear from the cited evidence how reliable that method would be. According to Corning, the talc was applied to prevent the sample from sticking to the microscope slide. Reply 3 (citing Ex. 1035 ¶ 82). It is not clear from this evidence whether the talc particles would have served as faithful position markers, by adhering to the sample, or would have skidded about as the sample expanded against the microscope slide. Corning has not pointed us to credible evidence from which we can understand how the talc particles in fact behaved during this testing or how Mr. Sanford perceived them to behave.

Because the cited evidence does not provide a clear explanation of how the change-in-length measurements were made, we cannot assess its reliability. We find Corning's evidence concerning the change-in-length measurement to be not credible. For these reasons, Corning fails to show by a preponderance of evidence that any combination of coatings, in which Shustack Example I or Szum '928 Example 5B provides the inner primary coating, and Shustack Example X or XI, or Szum '928 Example 2, provides the outer primary coating, meets the "ratio of the change in length" limitation. Because each of claims 2-4, 6-8, 10-12, and 14-16 recites this limitation, each of these claims survives Corning's challenges.

D. Supplemental Response and Reply

In its Supplemental Response, DSM asserts that "Corning's GPC [gel permeation chromatography] data does not prove that Corning properly synthesized the prior art oligomers." Supp. Resp. at 5. DSM argues that the

GPC data is relevant to this challenge, because Corning used oligomer RT-38 to replicate Szum ’928 Example 5B. *Id.* at 6 (citing Ex. 2075).

According to Dr. Bowman, when synthesizing an oligomer, the presence of a significant amount of low molecular weight starting materials would indicate an incomplete synthesis. Ex. 2052 ¶ 7. Dr. Bowman also states that unreacted starting materials can detrimentally impact the functional properties of the resulting coating composition. *Id.* In Dr. Bowman’s view, the starting materials of Corning’s sample co-eluted with the tracer, which made it “difficult, if not impossible, to determine from these [GPC] spectra whether the oligomer functionalization reaction is complete in Corning’s oligomer compositions.” *Id.* ¶ 12. Dr. Bowman estimates “there might be 30 or 40 percent of small molecular weight compounds that are present in those [Corning oligomers].” Ex. 1071 171:16-19.

Corning disagrees. Supp. Reply 3. Dr. Sogah, an expert for Corning, explains: “The main purpose of analyzing a GPC chromatogram that is run on a GPC designed to assess oligomer formation is to see if oligomer peaks appear in the high molecular-weight region of the chromatogram.” Ex. 1068 ¶ 56. Dr. Sogah states that a skilled polymer chemist would not analyze the low molecular-weight region to confirm oligomer formation. *Id.* ¶ 57. “Even if a skilled scientist were to focus on the low molecular-weight region of the GPC chromatogram[,] . . . there is no information available in the Corning GPC chromatograms in this region to indicate that the oligomer has not been properly formed.” *Id.* ¶ 58; *see id.* ¶¶ 59-60. In Dr. Sogah’s opinion, given the highly reactive nature of the reagents used in the oligomer formation, together with the long reaction time Corning used to prepare the oligomers, it would be "highly unlikely" that the unreacted starting materials would be present in amounts of 30-40%, as Dr. Bowman alleges. *Id.* ¶¶ 64-66. Dr. Sogah further points out:

> Additionally, oligomers in general are fairly viscous, to the point that this viscosity is observable to the naked eye. Having 30-40% unreacted HEA [the starting material], or any other liquid, in the final product of an oligomer synthesis would certainly affect the viscosity of the resulting product. A skilled chemist with experience synthesizing oligomers would immediately recognize that such a resulting product does not have the viscosity and other physical attributes associated with a typical oligomer. For example, HEA is volatile and has a very strong, pungent odor which a skilled chemist would almost certainly notice when handling this material. For all the reasons stated above, I think it would be highly unlikely that a skilled chemist with experience in synthesizing oligomers would be confused into thinking that the final "oligomer" product being synthesized actually contained 30-40% small molecular weight compounds, such as unreacted HEA.

Id. ¶ 68.

We find Dr. Sogah's explanation more persuasive. First, after Corning submitted Dr. Sogah's declaration rebutting Dr. Bowman's opinion, DSM cross-examined Dr. Sogah extensively, *see* Exs. 2076-77, but did not call our attention to any of his deposition testimony in its Motion for Observations on Cross-examination of Corning Reply Declarants. *See* Paper 63.

More importantly, DSM's scientists do not appear to have given consideration to the low-molecular-weight region of the GPC spectrum. *See*

Ex. 1075, 144:6-147:22. Indeed, when DSM's scientist presented the oligomer test data to Dr. Bowman, she did not include data of the low-molecular-weight region. *See id.* at 146:12-15 ("So the one that I'm sure had been done before it was the di -- the diisocyanate diacrylate. They had run that before. She thought she knew where it should show up, but couldn't pull out that data."); *id.* at 146:20-25 ("And I think the same thing was true of the lauryl acrylate as was true of the diisocyanate diacrylate. She knew from her experience where it would show up, but I again indicated I needed more than her experience, that I wanted see that run as a sample itself . . . ."). Dr. Bowman's account confirms Dr. Sogah's position, i.e., when analyzing a GPC chromatogram to assess oligomer formation, a skilled polymer chemist would focus on the oligomer peaks in the high-molecular-weight region, and not the peaks of the starting materials or tracer in the low-molecular-weight region. Ex. 1068.

We find that Corning has established that it prepared the oligomer it used for testing properly. DSM has not presented enough evidence to lead us to doubt the quality of Corning's oligomer preparation.

E. Unpatentability Challenges

1. *Anticipation of claims 1-3, 5-7, 9-11, 13-15, 37-39, 45-47, and 49-51 by Shustack*

a. *Claims 1-3, 6-7, 9-11, and 14-15*

Shustack does not anticipate claims 1-3 and 9-11, because Corning has not shown that Shustack Example I possesses the "sufficient adhesion" limitation, as discussed above in section II.C.2.

Shustack does not anticipate claims 2, 3, 6, 7, 10, 11, 14, and 15, because Corning has not shown that Shustack's inner and out coatings possess the "change in length" limitation, as discussed above in section II.C.8.

Shustack also does not anticipate claims 2, 3, 6, 7, 10, 11, 14, and 15, because Corning has not shown that Shustack Examples X and XI possess the modulus of elasticity limitations recited in these claims, as discussed above in section II.C.7.

b. Claims 38, 39, 46, 47, 50, and 51

Shustack does not anticipate claims 38, 39, 46, 47, 50, and 51, because these claims depend from claims that Shustack does not anticipate.

c. Claims 5 and 13

Shustack anticipates claims 5 and 13. Corning has shown that Shustack Example I possesses all the structural limitations and material property limitations of these claims, as discussed above in sections II.C.1, II.C.3, II.C.4, and II.C.5.

d. Claims 37, 45, and 49

Each of these multiple dependent claims depends from claim 5 or claim 13.

(1) Claim 37

Claim 37 requires that at least one oligomer be a radiation curable oligomer comprising at least one terminal linear moiety. Corning argues that the hydroxyethyl acrylate (HEA) end groups, which Shustack discloses may be used as end groups in Example I (Ex. 1003, 10:42), are terminal linear moieties, because they do not contain cyclic or branched units. Pet. 29 (citing Ex. 1014 ¶ 129). The '189 patent identifies HEA as a radiation-curable oligomer. Ex. 1001, 53:40-42. DSM does not challenge Corning's evidence as to this claim.

Upon consideration of Corning's argument and evidence, we are persuaded that Shustack Example I anticipates claim 37, because the oligomer used in Example I may be terminated with HEA end groups, which are terminal linear moieties.

(2) Claim 45

Claim 45 requires that "at least one oligomer is a urethane oligomer having at least one polymeric block linked to at least one functional group capable of polymerizing under the influence of radiation via a urethane group, wherein the concentration of said urethane groups is about 4% by weight or less, based on the total weight of said inner primary coating composition." Corning argues that the HEA end groups are radiation-curable (i.e., polymerizable) and are linked to the polybutadiene polymeric block of the urethane acrylate oligomer. Pet. 29-30 (citing Ex. 1014 ¶ 130). Ms. Kouzmina reports that the concentration of urethane groups of the Shustack Example I coating composition is 2.6% by weight. *Id.* at 30 (citing Ex. 1015 ¶ 66). DSM does not challenge Corning's evidence as to this claim.

Upon consideration of Corning's argument and evidence, we are persuaded that Shustack Example I anticipates claim 45, because the chemical structure of the Shustack Example I oligomer, and the composition's urethane concentration, are within the scope of the claim.

(3) Claim 49

Claim 49 requires that "at least one oligomer is comprised of at least one polymeric block linked to at least one functional group capable of polymerizing under the influence of radiation via a linking group, and wherein said at least one polymeric block has a calculated molecular weight of at least about 2000."

Corning's argument for this claim is similar to that for claim 45. Pet. 30. Corning argues further that Shustack discloses a hydrocarbon polyol molecular weight range of 500 to 4000. *Id.* (citing Ex. 1003, 9:29-34). Corning argues that one of ordinary skill in the art would have selected a polyol with a molecular weight of about 3000 in order to achieve a soft inner primary coating. *Id.* (citing Ex. 1014 ¶ 130). DSM does not challenge Corning's evidence as to this claim.

We are not persuaded by Corning's argument that the claim is anticipated because one of ordinary skill would have selected a molecular weight of 3000. Corning offers no credible evidence to support this argument beyond an unsupported assertion of its truth by Dr. Winningham. *See* Ex. 1014 ¶ 130. We conclude, therefore, that Corning has not demonstrated that Shustack anticipates claim 49.

In summary, we conclude that Shustack anticipates claims 5, 13, 37, and 45, but not claims 1-3, 6, 7, 9-11, 14, 15, 38, 39, 46, 47, and 49-51.

2. Obviousness of claims 1-3, 5-7, 9-11, 13-15, 37-39, 45-47, and 49-51 over Shustack

Corning argues that, to the extent different coatings disclosed in Shustack are not expressly disclosed as combinable as inner and outer primary coating compositions, it would have been obvious to combine them. Pet. 31.

As discussed above in section II.E.1.a, we have determined that claims 1-3, 6, 7, 9-11, 14, 15, 38, 39, 46, 47, and 49-51 are not anticipated by Shustack because of deficiencies in Corning's evidence supporting that challenge. Those deficiencies taint Corning's obviousness challenge and are not remedied by the combinations of different coatings in Shustack. We determine that Corning has not demonstrated that claims 1-3, 6, 7, 9-11, 14, 15, 38, 39, 46, 47, and 49-51 would have been obvious over Shustack.

Claims 5, 13, 37, and 45 relate only to an inner primary coating composition and, as such, do not rely on combination with an outer primary coating composition. Corning's challenge in this regard appears to be misplaced. Nevertheless, as anticipation is the "epitome" of obviousness, *In re McDaniel*, 293 F.3d 1379, 1385 (Fed. Cir. 2002), and we have determined that Corning has proved the anticipation of these claims by Shustack, we also determine that claims 5, 13, 37, and 45 would have been obvious over Shustack, for the reasons given above with regard to anticipation.

3. *Anticipation of claims 1, 5, 9, 13, 37, 45, and 49 by Szum '928*

Szum '928 does not anticipate claims 1 and 9, because Corning has not shown that Szum '928 Example 5B possesses the "sufficient adhesion" limitation, as discussed above in section II.C.2.

Szum '928 anticipates claims 5 and 13. Corning has shown that Szum '928 Example 5B possesses all the structural limitations and material property limitations of these claims, as discussed above in sections II.C.1, II.C.3, II.C.4, and II.C.5.

Szum '928 anticipates claim 37, because the oligomer of Example 5B includes HEA end groups, which, as discussed above, are terminal linear moieties within the scope of claim 37.

Szum '928 anticipates claim 45. Corning argues that the radiation-curable HEA groups are linked to a polypropylene polymer block of the oligomer, and that the coating is calculated to have a urethane concentration of 3.2% by weight. Pet. 38 (citing Ex. 1014 ¶ 153; Ex. 1015 ¶ 68). DSM does not challenge Corning's argument or evidence.

Szum '928 anticipates claim 49. Corning argues that Szum '928 discloses that the molecular weight of the polypropylene glycol polymeric block in the urethane oligomer is "about 2000." *Id.* (citing Ex. 1005, 23:16-17). DSM does not challenge Corning's argument or evidence. The claim requires a molecular weight of "at least about 2000." We determine, under the facts of this case, that the disclosure of "about 2000" meets the limitation of "at least about 2000."

In summary, we conclude that Szum '928 anticipates claims 5, 13, 37, 45, and 49, but not claims 1 and 9.

4. *Obviousness of claims 4, 8, 12, 16, 40, 48, and 52 over Shustack and Jackson*

Claims 4, 8, 12, 16, 40, 48, and 52 relate to ribbon assemblies. Corning relies on Shustack for disclosure of all limitations except those relating to the ribbon assembly structure and argues that it would have been obvious to form a ribbon assembly as taught by Jackson using individual fibers configured as taught by Shustack. Pet. 39-41.

Corning has not shown that Shustack Example I possesses the "sufficient adhesion" limitation of claims 4 and 12, as discussed above in section II.C.2.

Corning has not shown that Shustack's inner and out coatings possess the "change in length" limitation of claims 4, 8, 12, and 16, as discussed above in section II.C.8.

Corning has not shown that Shustack Examples X and XI possess the modulus of elasticity limitations recited in claims 4, 8, 12, and 16, as discussed above in section II.C.7.

Because Corning relies on Shustack to teach these limitations, the deficiencies noted above undermine Corning's obviousness challenge and are not remedied by the combination with Jackson. We determine that Corning has not demonstrated that claims 4, 8, 12, and 16 would have been obvious over Shustack and Jackson. Claims 40, 48, and 52 each depend from claim 8 or claim 16 and are not unpatentable over Shustack and Jackson, as well.

5. *Obviousness of claims 17-20 over Chawla in combination with Shustack, or with Szum '928, or with Shustack and Jackson*

Claims 17-20 each require that at least one inner primary coating composition oligomer is radiation-curable and comprises at least one glass coupling moiety, at least one slip agent moiety, and at least one radiation-curable moiety. The claims are each multiple dependent claims and differ in their dependencies. Claim 17 depends from claim 5 or claim 13, claim 18 depends from claim 6 or claim 14, claim 19 depends from claim 7 or claim 15, and claim 20 depends from claim 8 or claim 16.

Corning acknowledges that Shustack, Szum '928, and Jackson do not disclose an oligomer with the features of claims 17-20. Pet. 42. Corning argues that Chawla discloses silane-oligomers that meet the limitations of claims 17-20, and also that the silane-oligomers are useful on optical fibers and have good strength and water-resistance characteristics. *Id.* at 42-45 (citing Ex. 1008, 2:1-12; 2:67–3:17; 3:34-40; 7:42-47; 8:59-67; 9:10-13; 12

tbl.4; 9:57-65; 10:12-19; Ex. 1014 ¶¶ 182, 183, 187). Corning also argues that Chawla discloses inclusion of as little silane-oligomer as about 5% by weight. *Id.* at 44 (citing Ex. 1008 7:42-44). Corning argues that it would have been obvious to include Chawla's silane-oligomers in a small amount (about 5% by weight) in Shustack's or Szum '928's coating compositions to obtain these benefits, and that inclusion of a small amount of them would not be expected to change the resulting material properties. *Id.* at 43-44 (citing Ex. 1014 ¶¶ 183-186).

DSM argues, in response, that Chawla discloses including silane-oligomers in coating compositions at preferably above 15% by weight, and up to 95% by weight, and that none of Chawla's examples includes silane-oligomers at less than 10% by weight. Resp. 51.

Upon consideration of the parties' argument and evidence, we agree with Corning that it would have been obvious to include a small amount of Chawla's silane-oligomer in the coating composition of Shustack Example I or Szum '928 Example 5B in order to improve strength and water resistance, without otherwise significantly affecting the compositions' other material properties. DSM's argument does not address Chawla's disclosure that as little as 5% silane-oligomer may be added. Even if inclusion of larger amounts of silane-oligomer might not have been obvious, due to effects on the claimed material properties, the claims encompass small additions that would have been obvious. *See In re Lintner*, 458 F.2d 1013, 1015 (CCPA 1972) ("Claims which are broad enough to read on obvious subject matter are unpatentable even though they also read on nonobvious subject matter."); *In re Muchmore*, 433 F.2d 824, 826 (CCPA 1970) (affirming obviousness rejection where claim "reads on both obvious and unobvious subject matter.").

We determine that Corning has demonstrated the unpatentability of claim 17, as dependent from claim 5 and from claim 13, for obviousness over Shustack and Chawla and over Szum '928 and Chawla. Claims 18-20 depend from claims that Corning has not shown to be unpatentable over Shustack, over Shustack and Jackson, or over Szum '928. We determine that Corning has not shown that claims 18-20 are unpatentable.

6. Obviousness of claims 21-24 over Hager in combination with Shustack, or with Szum '928, or with Shustack and Jackson

Claims 21-24 each require that the inner primary coating composition further include a soluble wax that is soluble in the inner primary coating composition. The claims are each multiple dependent claims and differ in their dependencies. Claim 21 depends from claim 5 or claim 13, claim 22 depends from claim 6 or claim 14, claim 23 depends from claim 7 or claim 15, and claim 24 depends from claim 8 or claim 16.

Corning acknowledges that Shustack, Szum '928, and Jackson do not disclose a soluble wax as recited in claims 21-24. Pet. 45. Corning argues that Hager discloses a soluble wax that one of ordinary skill in the art would expect to be soluble in the claimed inner primary coating compositions. Pet. 45-46 (citing Ex. 1014 ¶¶ 190-194). Corning further argues that one of ordinary skill in the art would have included Hager's soluble wax in an in inner primary coating composition of Shustack or Szum '928 because Hager teaches that such waxes are "useful on optical fibers and improve the water resistance of the coating against wicking to the coated fiber strand." Pet. 45-46 (citing Ex. 1009, 1:19-21, 4:18-19; Ex. 1014 ¶ 191).

DSM argues that Hager's coatings are directed to use on fibers that are used as overwraps for optical fiber cables, not to the optical fibers themselves. Resp. 51-52 (citing Ex. 1009, 1:5-10).

We agree with DSM that Hager is directed to coatings for overwrap fibers, not optical fibers. The portions of Hager that Corning cites do not indicate that Hager's waxes are useful when coated directly onto optical fibers. Hager consistently distinguishes fibers used as protective overwraps from optical fibers. *See* Ex. 1009, 1:5-10, 4:63-68. Corning has not explained why it would have been obvious to incorporate Hager's waxes into inner primary coating compositions for optical fibers.

For these reasons, we determine that Corning has not shown that claims 21-24 are unpatentable for obviousness over Shustack and Hager, Szum '928 and Hager, or Shustack, Jackson, and Hager.

7. Obviousness of claims 25-28 over Tortorello in combination with Shustack, or with Szum '928, or with Shustack and Jackson

Claims 25-28 each require that at least one inner primary coating composition oligomer is a radiation-curable silicone oligomer and comprises a silicone compound and at least one radiation-curable moiety. The claims are each multiple dependent claims and differ in their dependencies. Claim 25 depends from claim 5 or claim 13, claim 26 depends from claim 6 or claim 14, claim 27 depends from claim 7 or claim 15, and claim 28 depends from claim 8 or claim 16.

Corning acknowledges that Shustack, Szum ’928, and Jackson do not disclose an oligomer with the features of claims 25-28. Pet. 48. Corning argues that Tortorello discloses the claimed silicone oligomers, and that one of ordinary skill in the art would have incorporated Tortorello’s oligomers in the inner primary coating compositions of Shustack or Szum ’928 in order to be able to adjust various properties, including the glass transition temperature. Pet. 48-49 (citing Ex. 1010, 2:24-38, 5:9-16; Ex. 1014 ¶¶ 197-199, 202). Corning argues that one skilled in the art would not have expected inclusion of Tortorello’s oligomer to affect the claimed properties of the inner primary coating compositions, because Tortorello indicates that even small amounts (as little as 5%) can be introduced. *Id.* at 50 (citing Ex. 1010, 7:30-31; Ex. 1014 ¶ 201).

Corning’s argument does not persuade us that the claims are unpatentable. Corning argues that it would have been obvious to add Tortorello’s silicone to be able to adjust glass transition temperature, yet Corning also argues that adding Tortorello’s oligomer would *not* change the glass transition temperature so as to move it outside the claimed range. Corning has not explained why it would have been obvious to add an ingredient to a coating composition in so a small quantity as to have little or no effect on precisely the property that the ingredient is intended to change.

For these reasons, we determine that Corning has not shown that claims 25-28 are unpatentable for obviousness over Shustack and Tortorello, Szum ’928 and Tortorello, or Shustack, Jackson, and Tortorello.

8. *Obviousness of claim 29-32 over Botelho in combination with Shustack, or with Szum '928, or with Shustack and Jackson*

Claims 29-32 each require that the inner primary coating composition include a non-radiation-curable, silicone compound. The claims are each multiple dependent claims and differ in their dependencies. Claim 29 depends from claim 5 or claim 13, claim 30 depends from claim 6 or claim 14, claim 31 depends from claim 7 or claim 15, and claim 32 depends from claim 8 or claim 16.

Corning acknowledges that Shustack, Szum '928, and Jackson do not disclose a non-radiation-curable, silicone compound. Pet. 51. Corning argues that Botelho discloses inclusion of silicone in an inner primary coating composition. Pet. 52 (citing Ex. 1011, 5:18-21, 10:15-21, 11:24-28; Ex. 1014 ¶¶ 205-07, 209). Corning argues that it would have been obvious to include silicone in an inner primary coating composition because Botelho suggests this and "attributes several benefits of the disclosed primary coatings." *Id.* (citing Ex. 1011, 5:22-35; Ex. 1014 ¶¶ 206-07). Corning does not identify in its petition what benefits Botelho attributes to the inclusion of silicone in an inner primary coating composition. Corning argues that Botelho discloses adding silicone in an amount as little as 2% by weight, an amount that would not be expected to alter the claimed material properties so that they were outside the claimed ranges. *Id.* at 51-52 (citing Ex. 1011, 11:3-13; Ex. 1014 ¶ 208).

DSM argues that Botelho does not disclose "any metrics for evaluating stripping performance." Resp. 53 (citing Ex. 1011 in its entirety).

Upon consideration of the parties' arguments and evidence, we agree with Corning that it would have been obvious to include a small amount of silicone compound in Shustack's or Szum '928's inner primary coating composition to improve, e.g., strippability. We agree with Corning that Botelho discloses inclusion of silicone compound for this purpose. *See* Ex. 1011, 5:22-35, 24:2-3. Whether Botelho discloses metrics for evaluating stripping performance is of little moment to the obviousness determination.

We determine that Corning has demonstrated the unpatentability of claim 29, as dependent from claim 5 and from claim 13, for obviousness over Shustack and Botelho and over Szum '928 and Botelho. Claims 30-32 depend from claims that Corning has not shown to be unpatentable over Shustack, over Shustack and Jackson, or over Szum '928. We determine that Corning has not shown that claims 30-32 are unpatentable.

9. Obviousness of claims 33-36 over Skutnik in combination with Shustack, or with Szum '928, or with Shustack and Jackson

Claims 33-36 each require that the inner primary coating composition include a radiation-curable fluorinated oligomer, a radiation-curable fluorinated monomer, or a non-radiation-curable fluorinated compound. The claims are each multiple dependent claims and differ in their dependencies. Claim 33 depends from claim 5 or claim 13, claim 34 depends from claim 6 or claim 14, claim 35 depends from claim 7 or claim 15, and claim 36 depends from claim 8 or claim 16.

Corning acknowledges that Shustack, Szum ’928, and Jackson do not disclose the fluorinated materials recited in claims 33-36. Pet. 54.[18] Corning argues that Skutnik discloses use of radiation-curable fluorinated monomers, specifically, a fluorinated monoene. *Id.* (citing Ex. 1012, 1:67–2:19, 2:29-34; Ex. 1014 ¶¶ 213, 217). Corning argues that Skutnik discloses several benefits of including a fluorinated monoene in an inner primary coating composition, such as improved thermal stability, electrical resistivity, mechanical and moisture protection, and refractive index control. *Id.* at 55 (citing Ex. 1012, 2:34-41, 11:59-63; Ex. 1014 ¶ 214). Corning argues that Skutnik discloses inclusion of fluorinated monoenes at a level of as little as 10%, a level at which one of ordinary skill would not expect the claimed material properties to exceed the claimed ranges. *Id.* at 55-56 (citing Ex. 1012, 2:19-22; Ex. 1014 ¶ 216).

DSM argues that Corning bases its assertions on the extreme low end of fluorinated monoene concentration disclosed in Skutnik, and that the claimed material properties would be altered significantly at the higher concentrations Skutnik discloses. Resp. 54 (citing Ex. 2032 ¶¶ 234-236). Dr. Taylor states that “if the [weight percent] of the fluorinated monomer were increased above the extreme low end of the disclosed range, a person of ordinary skill in the art would expect the properties of the coating to change in unpredictable ways.” Ex. 2032 ¶ 236.

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[18] Corning states only that Shustack, Szum ’928, and Jackson fail to disclose the radiation-curable, fluorinated monomer. For purposes of this decision, we interpret Corning’s argument as acknowledging that Shustack, Szum ’928, and Jackson do not disclose any of the materials listed in claims 33-36.

Upon consideration of the parties' arguments and evidence, we agree with Corning that it would have been obvious to include a small amount of fluorinated monoene in Shustack's or Szum '928's inner primary coating composition to improve various properties. DSM asserts that inclusion of fluorinated monoene above 10% by weight would have undesirable effects. Even if it were the case that inclusion of larger amounts of fluorinated monoene would not have been obvious, due to effects on the claimed material properties, the claims encompass small additions that would have been obvious. *See In re Lintner*, 458 F.2d at 1015.

We determine that Corning has demonstrated the unpatentability of claim 33, as dependent from claim 5 and from claim 13, for obviousness over Shustack and Skutnik and over Szum '928 and Skutnik. Claims 34-36 depend from claims that Corning has not shown to be unpatentable over Shustack, over Shustack and Jackson, or over Szum '928. We determine that Corning has not shown that claims 33-36 are unpatentable.

10. Obviousness of claims 41-44 over Mills in combination with Shustack, or with Szum '928, or with Shustack and Jackson

Claims 41-44 each require that the inner primary coating composition include a solid lubricant. The claims are each multiple dependent claims and differ in their dependencies. Claim 41 depends from claim 5 or claim 13, claim 42 depends from claim 6 or claim 14, claim 43 depends from claim 7 or claim 15, and claim 44 depends from claim 8 or claim 16.

Corning acknowledges that Shustack, Szum '928, and Jackson do not disclose a solid lubricant. Pet. 57. Corning argues that Mills discloses the use of a solid lubricant in an interfacial layer outside the inner and outer primary coatings, though not within the inner primary coating. *Id.* at 57-58.

Corning argues that it would have been obvious to include a small amount of solid lubricant in an inner primary coating composition of Shustack or Szum ’928 in view of Mills’s disclosure that lubricant improves strippability of coatings on optical fibers. *Id.* at 58 (citing Ex. 1013, 3:10-28; Ex. 1014 ¶¶ 222, 223). Corning argues that other references disclose the desirability of including lubricants in coatings. *Id.* (citing, e.g., Ex. 1008, 7:37-41; Ex. 1010, 14:66–15:12; Ex. 1014 ¶ 222).

DSM argues that Mills addresses use of solid lubricant only in an interfacial layer, not in the glass-contacting inner primary coating. Resp. 55 (citing Ex. 2032 ¶¶ 237-239). According to Dr. Taylor, Mills’s focus is on strippability of outer coatings from a fiber, not the glass-contacting inner primary coating. Ex. 2032 ¶ 239. DSM also argues, through Dr. Taylor, that introducing solid lubricant into the inner primary layer would not have been obvious because the particles of solid lubricant may harm the glass fiber. *Id.*

Corning’s argument and evidence do not persuade us that the claims are unpatentable. We agree with DSM that Mills’s solid lubricants are intended specifically for use in an interfacial layer that overlies the inner primary and outer primary coatings. *See* Ex. 1013, 2:65-3:3 (first protective layer is made of low-modulus inner coating and higher-modulus outer coating). Corning identifies no disclosure in Mills to indicate that solid lubricants are suitable additives to the first protective layer. Corning relies instead on generic disclosure in other references that the primary layer may include lubricants. But these other references do not address solid lubricants in particular. Corning’s argument is not directed, therefore, to the particular feature claimed. We credit Dr. Taylor’s testimony that solid lubricant may not be a suitable additive in an inner primary coating because of damage it may cause to the glass fiber. *See* Ex. 2032 ¶ 239.

For these reasons, we determine that Corning has not shown that claims 41-44 are unpatentable for obviousness over Shustack and Mills, Szum ’928 and Mills, or Shustack, Jackson, and Mills.

III. MOTION TO AMEND

“A motion to amend may cancel a challenged claim or propose a reasonable number of substitute claims.” 37 C.F.R. § 42.121(a)(3). DSM moves to substitute claims 67, 68, 69, and 70 for original claims 6, 7, 14, and 15, respectively. Mot. to Amend 1-6. The overall framework of our amendment process is geared towards deciding motions to amend where the claims sought to be replaced are under a continuing threat of cancellation by virtue of the patentability challenge upon which trial is instituted. *See* 35 U.S.C. § 316(d) (tethering amendments to “challenged” patent claims and contemplating amendments that “materially advance” settlement of an ongoing dispute); *see also* 37 C.F.R. § 42.121(a)(2)(i) (an amendment may be denied where it “does not respond to a ground of unpatentability involved in the trial”). Absent some showing of special circumstances, we are not convinced that our charter of deciding cases quickly and efficiently favors dedicating our limited resources to evaluating the patentability of DSM’s proposed substitute claims, after we have resolved the main controversy in DSM’s favor.

Having determined that none of DSM’s claims 6, 7, 14, and 15 is proved unpatentable, we deny without prejudice the motion to amend. *See* Office Patent Trial Practice Guide, 77 Fed. Reg. at 48,767 (indicating that a motion to amend may be denied, without prejudice, if it is determined that patent owner's original claims are not unpatentable).

IV. MOTIONS TO EXCLUDE EVIDENCE

A. DSM's Motion

DSM moves to exclude Dr. Winningham's testimony as unreliable, based on an argument that he failed to review data underlying his opinions and, further, failed to apply the correct legal standard for obviousness. PO Mot. to Exclude 1-6. Whether a witness's testimony fails to include underlying facts or data on which an opinion is based goes to the weight that should be accorded the testimony, and not its admissibility. *See* 37 C.F.R. § 42.65(a). DSM's arguments concerning the legal standard for obviousness that Dr. Winningham applied is not persuasive, for reasons discussed above in section II.B. We deny the motion to exclude as to Dr. Winningham's evidence.

DSM also moves to exclude certain test results and testimony relating to fiber pull-out and change-in-length testing. *Id.* at 7-12. As to the fiber pull-out friction testing, DSM argues that Corning failed to explain how the test was performed. *Id.* at 7-9. We disagree with DSM. Again, whether a witness's testimony fails to include underlying facts or data on which an opinion is based goes to weight, not admissibility. DSM's motion to exclude is denied as to this evidence. As to the change-in-length measurements and calculations, *id.* at 9-11, we explain above in section II.C.8.b that Corning's evidence is not persuasive. Because we consider that evidence on its merits and decide the issue in DSM's favor, we need not reach the question of admissibility. The motion is dismissed as to the change-in-length evidence.

DSM also moves to exclude paragraphs 10-39 and 60-91 of the declaration of Dr. Ju (Ex. 1035), and paragraphs 16-30, 86-89, and 95 of the declaration of Dr. Sogah (Ex. 1068) that Corning submitted with its Reply, along with the Reply itself for its reliance on that evidence. PO Mot. to Exclude 12-15. We do not rely on the challenged reply evidence to reach our final decision. Therefore, we dismiss as moot the motion to exclude as to the Reply and the challenged reply evidence.

On this record, DSM's motion to exclude evidence is dismissed-in-part and denied-in-part.

B. Corning's Motion

Corning also moves to exclude evidence. Pet. Mot. to Exclude 1-14. Specifically, Corning seeks to exclude testimony relating to the water soak delamination tests that DSM performed on prior art coatings, as well as opinions relating to DSM's fiber pull-out friction tests. *Id.* We rely on none of that evidence to reach our final decision. Here again, we decline to exclude evidence that does not underlie our decision.

On this record, Corning's motion to exclude evidence is dismissed as moot.

V. CONCLUSION

Corning has proved, by a preponderance of the evidence, that claims 5, 13, 17, 29, 33, 37, 45, and 49 of the '189 patent are unpatentable. Corning has failed to prove, by a preponderance of the evidence, that claims

1-4, 6-12, 14-16, 18-28, 30-32, 34-36, 38-44, 46-48, and 50-52 are unpatentable.

In particular, we determine that:

1. Shustack anticipates and renders obvious claims 5, 13, 37, and 45, but not claims 1-3, 6, 7, 9-11, 14, 15, 38, 39, 46, 47, and 49-51;
2. Szum ’928 anticipates claims 5, 13, 37, 45, and 49, but not claims 1 and 9;
3. Claims 4, 8, 12, 16, 40, 48, and 52 are not unpatentable for obviousness over Shustack and Jackson;
4. Claim 17, but not claims 18-20, is unpatentable for obviousness over Shustack and Chawla and over Szum ’928 and Chawla;
5. Claims 21-24 are not unpatentable for obviousness over Shustack and Hager, Szum ’928 and Hager, or Shustack, Jackson, and Hager;
6. Claims 25-28 are not unpatentable for obviousness over Shustack and Tortorello, Szum ’928 and Tortorello, or Shustack, Jackson, and Tortorello;
7. Claim 29, but not claims 30-32, is unpatentable for obviousness over Shustack and Botelho and over Szum ’928 and Botelho;
8. Claim 33, but not claims 34-36, is unpatentable for obviousness over Shustack and Skutnik and over Szum ’928 and Skutnik; and
9. Claims 41-44 are not unpatentable for obviousness over Shustack and Mills, Szum ’928 and Mills, or Shustack, Jackson, and Mills.

VI. ORDER

For the reasons given, it is

ORDERED that claims 5, 13, 17, 29, 33, 37, 45, and 49 of U.S. Patent No. 6,298,189 B1 are determined to be UNPATENTABLE;

FURTHER ORDERED claims 1-4, 6-12, 14-16, 18-28, 30-32, 34-36, 38-44, 46-48, and 50-52 of U.S. Patent No. 6,298,189 B1 are not determined to be unpatentable;

FURTHER ORDERED that DSM's motion to amend claims is *denied*, without prejudice;

FURTHER ORDERED that DSM's motion to exclude evidence is *dismissed-in-part* and *denied-in-part*;

FURTHER ORDERED that Corning's motion to exclude evidence is *dismissed*; and

FURTHER ORDERED that because this is a final decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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