

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF SOUTH CAROLINA

PRECISION FABRICS GROUP, INC.,)	
)	
Plaintiff,)	
)	
v.)	7:17-cv-3037
)	
TIETEX INTERNATIONAL, LTD.,)	
)	
Defendant.)	
)	
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)	
PRECISION FABRICS GROUP, INC.,)	
)	
Plaintiff,)	
)	
v.)	7:17-cv-3038
)	
TIETEX INTERNATIONAL, LTD.,)	
)	
Defendant.)	

MEMORANDUM OPINION AND ORDER

THOMAS D. SCHROEDER, District Judge.

These patent infringement actions are before the court on two post-trial motions filed by Precision Fabrics Group, Inc. ("PFG") for relief from a jury verdict that found that Defendant Tietex International, Ltd. ("Tietex") did not infringe its U.S. Patents Nos. 8,796,162 ('162 Patent) and 8,501,639 ('639 Patent) for flame-retardant technology for fabrics. PFG renews its prior motion for judgment as a matter of law and moves in the alternative

for a new trial. (Doc. 372.)¹ After careful consideration and for the reasons set forth below, the motions will be denied.

I. BACKGROUND

PFG filed the first of these two actions on August 6, 2013, in the Middle District of North Carolina and, with the follow-on lawsuit, alleges that certain Tietex products incorporating flame-retardant fabrics infringe PFG's U.S. Patents Nos. 8,796,162 ('162 Patent) and 8,501,639 ('639 Patent). The patents-in-suit describe lightweight materials designed to retard fire for a variety of applications, including garments, furniture, appliances, and vehicles. (Doc. 112-1 at 2; Doc. 112-2 at 2.) Tietex developed a similar fabric that would operate as a flame-retardant cloth for mattresses. Up until October 2016, Tietex applied to its fabric a solution known as SV-X41, which was manufactured by Royal Adhesives and Sealants, Inc. ("Royal Adhesives").²

Tietex concedes that for the approximately three-year period at issue, its accused fabrics met each of the limitations set forth in PFG's patents, with the exception of the claims requiring that the fabrics be coated with an "intumescent." Tietex contends that the SV-X41 coating it used is not an intumescent. The meaning of

¹ With respect to the pending motions, the docket filings are substantively identical in each case. For ease of reference, the court will refer to filings in case 1:17cv3037 unless otherwise noted.

² In October 2016, Tietex discontinued use of the SV-X41-coated fabrics in favor of a different technology for flame retardancy involving a silica rayon product. (Tr. at 1007-08.)

the term "intumescent" has been disputed throughout this litigation. After conducting a Markman hearing,³ the court adopted PFG's construction and held that "intumescent," as defined in PFG's patents, means "a substance that swells and chars upon exposure to heat or flame." (Doc. 57 at 20-21.) In so doing, the court denied Tietex's proposed claim construction based on a four-component definition. (Id. at 11.) Tietex subsequently conceded that its coating charred when exposed to heat or flame. (Doc. 133 at 7.) Thus, the parties agreed that the sole issue in PFG's infringement claims against Tietex was whether SV-X41 swells upon exposure to heat or flame.

PFG moved for partial summary judgment as to its claims against Tietex for infringement and Tietex's counterclaims alleging inequitable conduct and invalidity of PFG's patents. (Doc. 111.) PFG also moved to exclude the testimony of Tietex's expert, Dr. Richard Horrocks. (Doc. 116.) The court denied PFG's partial motion for summary judgment on its claims of infringement but granted its motion for summary judgment on Tietex's counterclaims. (Doc. 152 at 46.) After extensive consideration, the court granted in part and denied in part PFG's motion to exclude or limit the testimony of Dr. Horrocks. (Id.)

³ Markman v. Westview Instruments, Inc., 52 F.3d 967, 976 (Fed. Cir. 1995) (en banc), aff'd, 517 U.S. 370 (1996).

The parties filed a host of motions in limine prior to trial, including several directed toward the expert witnesses. Following transfer of the action to this district in the wake of TC Heartland LLC v. Kraft Foods Grp. Brands LLC, 137 S. Ct. 1514 (2017), the case was tried to a jury for five days.

Central to PFG's case was the testimony of its expert, Gajanan Bhat, Ph.D. Dr. Bhat was qualified as an expert in the field of textiles, flame retardant finishes and coatings, and intumescent finishes and coatings. (Tr. at 479.)⁴ He testified that he tested the SV-X41 coating on successive occasions by exposing it, when applied to varying substrates, to heat and flame, several in response to criticisms by Tietex's expert. Each test applied various thicknesses of the coating, and Dr. Bhat reported that each resulted in measurable swelling of the SV-X41 to some degree. (Id. at 481, 588-90, 604-06.) For his measurements he used an electronic pressure foot, which he testified is standard in the industry and applies a fixed rate pressure to measure non-uniform fabric surfaces. (Id. at 580-81.) Dr. Bhat took magnified photographs of the test samples and opined that they showed swelling and charring when exposed to heat or flame and thus showed the classic signs of an intumescent. (Id. at 480-86, 564-65, 588,

⁴ Citations to the trial transcript (Doc. 373-1) are referenced as "Tr." and refer to the original transcript page numbers, not the CM/ECF page numbers.

605, 620.)

Dr. Bhat's first round tested SV-X41 on the accused fabrics. When challenged, Dr. Bhat acknowledged that these tests did not provide an accurate assessment because the coating could have interacted with the fabric. (Id. at 589).

Dr. Bhat's second round tested SV-X41 on a stainless steel pan. For these tests, Dr. Bhat used a coating of SV-X41 that was 1,250 to 1,720 microns thick, which Tietex claims is "many times thicker" than the amount Tietex actually applied to the accused fabrics under the patents-in-suit, thus rendering the results invalid. (Id. at 668-71.)

The third round tested the coating on an aluminum pan. These tests involved levels of SV-X41 between 633 and 1,000 microns, which Tietex contended were still multiples over the amount applied to its accused fabrics under the patents-in-suit. (Id. at 671-75.)

To respond to Tietex's contention that it actually applied, and the patents called for, coating at levels of approximately 50 to 100 microns, Dr. Bhat finally conducted tests on aluminum foil with SV-X41 in thicknesses ranging from approximately 50 to 250 microns. (Id. at 594-96, 603-04.) Dr. Bhat himself eventually reviewed microscopic cross-sectional photographs of Tietex's finished accused fabrics and opined that the thickness of the SV-X41 coating was somewhere between 150 to 250 microns. (Id. at

596, 600-03.)

PFG also relied on an email dated August 6, 2013, the day the first of these two lawsuits was filed, from Stephen Holland, president of Royal Adhesives, to Wade Wallace, president of Tietex. The email responded to a question from Wallace: "I need to know if our FR [flame retardant] chemistry would meet or not meet this specific definition of an 'intumescent system,'" according to a four-part definition of intumescent Wallace provided (which was also Tietex's proposed construction of the term prior to the court's Markman hearing). (Doc. 373-10 at 2.) In the email, Holland responded in part, "Our system behaves as an intumescent but does not exactly follow the definition below." (Id.) The email then went on to explain the chemistry of the coating. (Id.)

PFG also presented the testimony of Walt Jones, its president, as to ownership of the patents. Ladson "Larry" Fraser, one of the inventors of the patents-in-suit, testified as to the benefits of PFG's flame-retardant bedding products. Doug Small, a PFG employee, testified to damages issues and to his observations of the thickness of Tietex's coatings. PFG presented testimony of Wallace via deposition about his having received the August 6, 2013 email from Holland. Finally, PFG presented a damages expert, Joel Wacek, whose testimony is not at issue in the post-trial motions.

At the close of PFG's evidence, Tietex moved for judgment as

a matter of law (Tr. at 951), and the court took the motions under advisement (id. at 970).

Tietex presented the testimony of Martin Wildeman, its chairman and chief executive officer; Holland; and Richard Horrocks, Ph.D., its expert. Wildeman testified to the history of Tietex, the fact that the company had decided not to use intumescent coatings as far back as 2003 (id. at 1002), and his observations of burn tests on Tietex's products using the patents-in-suit (describing them, without objection, as "totally different in my opinion to anything that I've seen relating to an intumescent") (id. at 1003). He also explained that he owns over 30 patents, had read the patents-in-suit and concluded that Tietex was not practicing on them (id. at 1005-06), and described his basis for that belief. Holland testified as to his explanation of his August 6, 2013 email to Wallace and his understanding of his company's SV-X41 product.

Finally, Tietex presented the testimony of Dr. Horrocks, who was qualified as an expert in the fields of flame retardant textiles, flame retardant coatings, including intumescent coatings, and the chemistry of flame retardants and intumescents. (Id. at 1089.)⁵ Dr. Horrocks is listed on the patents-in-suit as

⁵ While PFG did not challenge Dr. Horrocks's qualifications, it objected to qualifying him as an expert in the field of chemistry on the grounds that it would prejudice PFG by elevating his testimony over that of Dr. Bhat. (Tr. at 1089-91.) The court overruled PFG's objection. (Id. at 1091.)

a holder of a patent that is prior art, and the patents-in-suit cite six publications that he authored or co-authored. (Id. at 1287-88; Doc. 152 at 20-21.)

Dr. Horrocks offered two primary opinions with respect to infringement. First, he testified that, based on his training, education, and experience, the chemical composition of SV-X41 would not cause it to swell when exposed to heat or flame, in part because it contains alumina trihydrate⁶ and lacks the necessary carbonific to swell. (Tr. at 1153-59, 1103, 1187.) Rather, he explained, the chemical composition is "flame retardant chemistry" designed to "releas[e] water vapor, which will extinguish, snuff out flame." (Id. at 1158.) In this regard, he claimed, the SV-X41 coating functions differently from an intumescent coating. (Id.) Second, he testified that his testing on the coating, conducted on an inert glass fiber substrate using applications of SV-X41 in an amount he calculated as being called for in the patents-in-suit, established that the coating did not swell upon exposure to heat or flame. Unlike Dr. Bhat, who used an electronic pressure foot, Dr. Horrocks used a hand-manipulated electronic micrometer to conduct his measurements.

Dr. Horrocks offered several criticisms of Dr. Bhat's

⁶ Alumina trihydrate is referenced throughout this opinion. The few places in the trial transcript that refer to "aluminum" trihydrate (Tr. at 1157, 1194, 1196) appear to be typographical errors.

testing. With regard to each test, Dr. Horrocks noted that Dr. Bhat failed to report his results with any experimental error. (Id. at 1142-43.) As to Dr. Bhat's first test conducted on the accused fabrics themselves, Dr. Horrocks faulted the substrate as not being inert, noting that the coating would react with the underlying textile fabric. (Id. at 1142.) As to the testing on aluminum pans, Dr. Horrocks acknowledged that the photographs introduced at trial showed swelling (id. at 1199),⁷ but he attributed the result, as well as Dr. Bhat's testing on steel pans, to Dr. Bhat's use of an excessive thickness of the SV-X41 coating in the second and third tests, noting that the samples had a thickness in excess of fifteen times the thickness of the actual coating. (Id. at 1142-43.)

As for Dr. Bhat's fourth test conducted on aluminum foil, Dr. Horrocks acknowledged that at least one of the samples corresponded with the appropriate thickness of the coating on the accused

⁷ PFG's initial brief contends that Dr. Horrocks agreed that Dr. Bhat's second and third tests conducted on aluminum and steel pans showed swelling. (Doc. 373 at 9.) However, the relevant portion of the trial transcript on which PFG relies pertains only to the testing conducted on aluminum pans. (Tr. at 1199 ("Q: I want to turn to Dr. Bhat's testing that was done with aluminum pans. A: Yes, aluminum pans, yes. Q: Would you agree that under Dr. Bhat's experimental conditions that his testing showed swelling? A: According to his photographs, yes, I agree.")) PFG's reply brief appears to acknowledge as much. (Doc. 379 at 4 (noting "Dr. Horrocks's admission that Dr. Bhat's aluminum pan testing shows that SV-X41 swells".)) Nevertheless, it does not appear that Dr. Horrocks challenged Dr. Bhat's measurements in the second test apart from those noted above (thickness of the coating and failure to report results with experimental error). See (Tr. at 1142.)

fabrics. (Id. at 1144.) Drawing from his knowledge of chemistry and review of Dr. Bhat's expert report, however, he testified that aluminum foil is not an inert substrate and would react with the chemical components of SV-X41 when exposed to heat or flame.⁸ (Id.

⁸ A spate of last-minute testing by the experts led to several pretrial motions. PFG sought to offer new testing by Dr. Bhat, claiming that Dr. Horrocks had offered new opinions (as to "thermally thin" applications of SV-X41) in his deposition; Tietex sought to amend Dr. Horrocks's report in response to Dr. Bhat's proposed testing; and PFG sought to offer yet further opinions by Dr. Bhat in rebuttal. The court granted PFG's request to permit Dr. Bhat to supplement his report to include new testing of SV-X41 in response to Dr. Horrocks's deposition testimony, even though the period for discovery had long closed. But because Dr. Bhat's new testing used aluminum foil as a substrate, the court permitted Dr. Horrocks to criticize the use of aluminum as it related to the foil because it had not been used before, thus denying PFG's motion to preclude such testimony. (Doc. 330.) The court did grant PFG's motion in limine to the extent Dr. Horrocks sought to criticize Dr. Bhat's previous use of an aluminum pan in his earlier testing of SV-X41. (Doc. 318 at 36.) The court found that Dr. Horrocks failed to disclose this criticism in his earlier deposition, the discovery period had long closed, and Tietex had delayed unreasonably in disclosing Dr. Horrocks's opinion challenging aluminum pans as a proper substrate for testing SV-X41. (Id.)

Finally, the court denied PFG's motion, filed a week before trial, to permit Dr. Bhat to further supplement his supplemental report to respond to Dr. Horrocks's criticisms of Dr. Bhat's use of aluminum foil as a testing substrate. (Doc. 319.) Even though discovery had closed, the court had earlier granted PFG leave to file Dr. Bhat's supplemental report for the limited purpose of responding to Dr. Horrocks's tests using a "thermally thin" application of SV-X41. (Doc. 174 at 9-10.) Dr. Bhat's proposed testing to rebut Dr. Horrocks's criticisms of his supplemental testing was outside the scope of the court's order. (Id.) Moreover, PFG had the opportunity to do all the testing it deemed necessary and should have included or anticipated these additional tests. Contributing to the problem, PFG had unreasonably delayed in disclosing Dr. Bhat's new round of rebuttal testing, failing to provide Tietex with Dr. Bhat's proposed supplemental report even though it had been prepared six months earlier. (Doc. 319 at 5.) The court found that to allow Dr. Bhat to supplement his report at that late date on the eve of trial would unfairly prejudice Tietex, which would have to conduct additional discovery and adjust its trial strategy. (Doc. 330 at 2; Doc. 325 at 6-9); see (Tr. at 1302-03.) The failure to disclose the new testing was not harmless. It presented surprise to Tietex, would have required additional testing to address, and threatened to disrupt the trial preparation. It also related to the central issue in the case, although

at 1144, 1151-53, 1197-99, 1206-08.) Dr. Horrocks testified that he analyzed the microscopic photographs of the samples and observed a gray layer between the substrate and the coating, which he determined provided evidence of the reaction. (Id. at 1208-10.) He further testified that he had conducted measurements using the microscopic photos that indicated that the aluminum foil substrate had decreased in thickness after exposure to heat and flame. (Id. at 1211-12.)⁹ Dr. Horrocks testified that he could not determine whether the swelling was attributable to the coating and offered no opinion regarding the quantum of swelling attributable to the reaction between the SV-X41 and the aluminum foil substrate. (Id. at 1152.)

PFG presented rebuttal evidence from Dr. Bhat, challenging

Dr. Bhat had been provided multiple prior opportunities to conduct testing and offer his opinions. PFG offered no persuasive explanation for not disclosing the testing and proposed rebuttal report to Tietex months earlier, even though it was available. Thus, PFG's explanation for the failure was also not substantially justified. Preclusion of the proposed rebuttal supplemental report was thus proper. See S. States Rack & Fixture, Inc. v. Sherwin-Williams Co., 318 F.3d 592, 596-97 (4th Cir. 2003); Hill v. Coggins, 867 F.3d 499, 508 (4th Cir. 2017). The court stated it would consider revisiting the ruling if Tietex purposefully opened the door at trial. (Doc. 330 at 2.) At trial, PFG requested that Dr. Bhat be allowed to testify to the testing he conducted in response to Dr. Horrocks's final report and which the court had precluded. (Tr. at 1300-03.) The court denied the request, rejecting any claim that the door had been opened or that PFG had demonstrated grounds to justify its request. (Id. at 1302-03.)

⁹ PFG moved to strike this testimony at trial on the grounds that it constituted a new opinion not disclosed in Dr. Horrocks's expert report. (Tr. at 1256.) The court denied PFG's motion, finding that Dr. Horrocks adequately disclosed this testimony in his prior deposition, about which PFG had ample time to examine him, and that his opinion was based on and consistent with his expert report. (Id. at 1303-05.)

Dr. Horrocks's use of a glass fiber substrate for testing, opining that it was not inert. Dr. Bhat also testified that based on his examination of the SV-X41 coating, he concluded it was 150 to 250 microns thick, and he defended his calculation of error for his testing. (Id. at 1308-14.) Plaintiff also called Jones to deny that he broke any promise to Wildman not to sue Tietex for infringement.

At the conclusion of its rebuttal case, PFG moved for judgment as a matter of law on literal infringement, infringement under the doctrine of equivalents, and willful infringement pursuant to Federal Rule of Civil Procedure 50(a). (Id. at 1332.) The court reserved ruling on PFG's motions. (Id. at 1333, 1351.)

After five days of trial, the jury returned a verdict of non-infringement of the patents-in-suit. (Doc. 350.)

Pursuant to Rule 50(b), PFG now renews its motion for judgment as a matter of law on the issues of literal infringement, infringement under the doctrine of equivalents, and willful infringement. (Doc. 372.) PFG also moves in the alternative for a new trial under Rule 59 of the Federal Rules of Civil Procedure. (Id.); see Fed. R. Civ. P. 50(b). The motions are fully briefed and are ready for resolution.

II. MOTION FOR JUDGMENT AS A MATTER OF LAW

A. Standard of Review

"A determination of infringement is a question of fact,

reviewed for substantial evidence when tried to a jury." Verizon Servs. Corp. v. Cox Fibernet Va., Inc., 602 F.3d 1325, 1340 (Fed. Cir. 2010) (citing Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1309 (Fed. Cir. 2009)). In a patent infringement action, the law of the regional circuit applies to a motion for judgment as a matter of law or a motion for a new trial. Id. at 1331. "Entry of judgment as a matter of law is appropriate only if the evidence is legally insufficient to support the jury's verdict." Bresler v. Wilmington Tr. Co., 855 F.3d 178, 196 (4th Cir. 2017) (citing Dennis v. Columbia Colleton Med. Ctr., Inc., 290 F.3d 639, 645 (4th Cir. 2002)). The court must determine "whether there was a legally sufficient evidentiary basis for a reasonable jury, viewing the evidence in the light most favorable to the prevailing party, to find for that party." King v. McMillan, 594 F.3d 301, 312 (4th Cir. 2010) (quoting ABT Bldg. Prods. Corp. v. Nat'l Union Fire Ins. Co. of Pittsburgh, 472 F.3d 99, 113 (4th Cir. 2006)). The grant of judgment as a matter of law is improper "[i]f reasonable minds could differ about the verdict." Id. (quoting ABT Bldg. Prods. Corp., 472 F.3d at 113). When ruling on a motion for judgment as a matter of law, "the district court is fully empowered to reverse its evidentiary rulings post-trial and to reconsider that evidence's effect on the trial." Conner v. Schrader-Bridgeport Int'l, Inc., 227 F.3d 179, 194 (4th Cir. 2000) (citing Weisgram v. Marley Co., 528 U.S. 440, 453-54 (2000)).

A party seeking judgment as a matter of law who also bears the burden of proof faces a formidable burden. Gilliam v. Montgomery Ward & Co., Inc., No. 96-1210, 1997 WL 429454, at *8 (4th Cir. 1997) (noting judgment as a matter of law should be granted in favor of the party bearing the burden of proof only in "extreme cases," citing 9A Charles Alan Wright & Arthur R. Miller, Federal Practice & Procedure: Civil § 2535 (2d ed. 1995)).¹⁰ The court must determine whether "the effect of the evidence is not only sufficient to meet his burden of proof, but is overwhelming, leaving no room for the jury to draw significant inferences in favor of the other party." Radtke v. Lifecare Mgmt. Partners, 795 F.3d 159, 165-66 (D.C. Cir. 2015) (quoting Gay v. Petsock, 917 F.2d 768, 771 (3d Cir. 1990)); Southern v. Agricraft Co., Inc., No. 89-2437, 1990 WL 133114, at *1 (4th Cir. 1990) ("When reviewing an order granting judgment n.o.v. to a party having the burden of proof, the standard to be applied is whether the evidence is 'so overwhelming that [the court] cannot uphold the jury's rejection of that defense.'" (quoting Thornhill v. Donnkenny, Inc., 823 F.2d 782, 786 (4th Cir. 1987))).

¹⁰ This section is now found at 9B Wright & Miller, Federal Practice & Procedure: Civil § 2535 (3d ed. 2018). Unpublished opinions of the Fourth Circuit are not precedential but "are entitled only to the weight they generate by the persuasiveness of their reasoning." See Collins v. Pond Creek Mining Co., 468 F.3d 213, 219 (4th Cir. 2006) (citation omitted).

B. Literal Infringement

PFG contends that it is entitled to judgment as a matter of law as to literal infringement because, based on the evidence presented at trial, no reasonable jury could find that SV-X41 does not swell upon exposure to heat or flame. (Doc. 373 at 3.) PFG's arguments can be grouped into the following general categories: (1) PFG's evidence established that SV-X41 swells when exposed to heat or flame, entitling PFG to judgment in its favor; (2) Tietex's evidence improperly redefined the court's claim construction for "intumescent"; (3) testimony of Holland, president of Royal Adhesives, the maker of SV-X41, constituted improper lay opinion; and (4) certain of Dr. Horrocks's opinions were unreliable and untested. Tietex responds that irrespective of Dr. Horrocks's opinions, (1) the jury was free to reject Dr. Bhat's opinions claiming to measure swelling in his testing; (2) Tietex did not redefine the court's construction of "intumescent"; (3) Tietex's examination of Holland was proper because PFG put his email into evidence and opened the door to examination of it, which nevertheless remained within the contours of the court's claim construction; and (4) Dr. Horrocks's testimony was proper. In sum, Tietex contends that PFG fails to demonstrate that its evidence of infringement was so overwhelming that a reasonable jury could only find in its favor, even if the challenged evidence were excluded. Many of these issues overlap, as will the court's

discussion of them, but the court will attempt to address each in turn.

1. PFG's Evidence and Dr. Bhat's Unrebutted Opinions

PFG notes that Dr. Bhat testified that he measured swelling to some degree in every one of his several test samples. (Doc. 373 at 3.) PFG contends that no reasonable jury "unaffected by irrelevant and prejudicial evidence and argument" could find otherwise. (Id.) PFG also points to Holland's email that noted that SV-X41 "behaves as an intumescent" (id. at 4 (citing Doc. 373-10)) and contends that Dr. Horrocks admitted at trial that Dr. Bhat's testing showed swelling. (Id.) According to PFG, Tietex's evidence failed to overcome this conclusion. (Id.) Tietex responds that PFG had the burden of proof and the jury was free to reject Dr. Bhat's opinions. (Doc. 376 at 7.) Moreover, it contends, Dr. Horrocks rebutted Dr. Bhat's conclusions, creating fact issues for the jury. (Id. at 8.)

As PFG bore the burden of proof on the question of literal infringement, to be entitled to judgment as a matter of law it must establish that the evidence was not only sufficient to meet this burden, but is "overwhelming, leaving no room for the jury to draw significant inferences in favor of the other party." Radtko, 795 F.3d at 165-66 (quoting Gay, 917 F.2d at 771). For the reasons noted below, PFG fails to do so.

Most notably, the jury was free to disbelieve Dr. Bhat's

testimony, particularly based on Tietex's cross-examination of him. For example, Dr. Bhat conceded that the results of his first tests were not reliable because of the testing conditions. (Tr. at 589.) Dr. Bhat also conceded that many of his tests involved applications of SV-X41 that were multiples over the amount he believed was contemplated by the patents. (Id. at 595-96.) Dr. Horrocks also provided several reasons to question Dr. Bhat's conclusions, leaving the jury free to question and reject Dr. Bhat's testing results.¹¹ Principal among the deficiencies noted were the following: Dr. Bhat's alleged use of applications of SV-X41 that were significantly greater than the proper amount for testing and that the coating would behave differently based on the applied thickness (id. at 1116-18); use of improper substrates that were not inert but allegedly interacted with the coating to skew the results; and the chemical composition of SV-X41 that is not expected to swell.

Moreover, PFG's representation of Dr. Horrocks's alleged admission is not accurate. The cited testimony, which related only to Dr. Bhat's testing on aluminum pans, provided:

Q: Would you agree that under Dr. Bhat's experimental conditions that his testing showed swelling?

A: According to his photographs, yes. I agree.

¹¹ The agreed upon jury instructions charged the jury that it could disregard any opinion of either expert witness entirely should it conclude that the reasons given in support "are not sound, or if you feel that it is outweighed by other evidence." (Tr. at 1409.)

(Id. at 1199.) Thus, Dr. Horrocks conceded only that Dr. Bhat's photographs showed swelling; he did not agree with the methodology used. Quite the opposite, Dr. Horrocks disputed that the experimental conditions employed by Dr. Bhat (who himself conceded he was far less experienced in the field of intumescent than Dr. Horrocks (id. at 667)) were appropriate, especially as to the amount of coating he applied, and thus did not accept Dr. Bhat's conditions as correct. True, Dr. Horrocks offered no opinion as to whether a coating of SV-X41 in excess of 100 microns swelled upon exposure to heat or flame. (Id. at 1194 ("Q: And my question is, is it correct that in this case, if Tietex's coatings are thicker than a hundred microns, you have no opinions; is that correct? A: I have no opinion if they're over a hundred microns.")).) But it was not Tietex's burden to establish the absence of swelling at any level; rather, it was PFG's burden to establish swelling at a proper level. These challenges therefore fall far short of constituting overwhelming evidence necessary to justify judgment in PFG's favor.

2. Claim Construction

As PFG urged, the court construed the claim term intumescent as "a substance that swells and chars upon exposure to heat or flame." (Doc. 57 at 20-21.) PFG contends that Tietex introduced evidence that limited and thus impermissibly redefined the court's

claim construction, pointing at times to actual testimony. (Doc. 373 at 5-6.) Tietex responds that its evidence properly fell within the court's claim construction and the scope of the patent. (Doc. 376 at 18-20.)

PFG's first area of contention relates to testimony as to the visibility and size of any swelling. For example, PFG points to testimony by Tietex's CEO, Wildeman, that during the "early days" of its product development in approximately 2003, Tietex's burn testing of its products in its laboratory demonstrated "there was no visible swelling" (Tr. at 973), which contrasted with his experience of having observed "very significant swelling" that was "highly visible" during burn tests of other products. (Id. at 999-1004.) While PFG contends this limited the claim construction, this testimony actually related to Tietex's defense of PFG's claim of willfulness. In fact, based in part on this testimony, Wildeman, who holds some 30 patents of his own, concluded, without objection, that Tietex did not believe it was infringing the patents-in-suit. (Id. at 1004, 1006-07.)

PFG next points to portions of Dr. Horrocks's testimony. As to nearly all of the complained of testimony, however, when PFG objected, the court sustained PFG's objections. E.g., (Doc. 373 at 5-6 (citing Tr. at 1132-33 (sustaining objection to Dr. Horrocks's testimony that "we have to agree what is [an] acceptable level of swelling" and noting that his own patent had swelling

"somewhere between 50 percent and a hundred percent"); Tr. at 1131-32 (sustaining objections to testimony regarding "swelling more than a little" and to a lengthy answer that included the terms swelling "more than a little"); Tr. at 1136 (sustaining objection to phrasing "significant swelling"); Tr. at 1205 (sustaining objection to testimony including the phrase "swells and chars more than a little"); Tr. at 1128-1129 (sustaining objection about his expectation that his testing would reveal a "heavy char" or "char formation of a swelling character" as non-responsive to the question seeking an explanation of his test protocols)).) Plaintiffs never moved to strike any of this testimony or requested any limiting instruction. Thus, PFG cannot complain where its objections were sustained and the court precluded questioning based on it.

PFG also cites testimony by Wildeman relating to the presence or absence of carbon in the coatings, objecting to his testimony that a "large amount of carbon" is required to achieve an intumescent swell. (Doc. 373 at 5 (citing Tr. at 1001-1002).) Similarly, it cites Holland's testimony that "in an intumescent, you have a very high level of carbon that's added to the system[,] [a]nd when that burns it chars and it swells up," that his company's products (SV-X41) do not have any added carbon, and that burn tests of intumescents produce swelling "you actually see" and "can actually touch [] and feel." (Id. (citing Tr. at 1051,

1054).) However, like much of PFG's complained of evidence, this testimony was admitted without objection. Moreover, it was relevant insofar as a key component of Tietex's defense was its contention that the chemistry of SV-X41 prevented it from swelling like an intumescent.

PFG next cites testimony by Dr. Horrocks who, when asked if he knew what an intumescent is, responded: "An intumescent is a material which swells and chars to form a thermal barrier once it's been exposed to heat or flame." (Doc. 373 at 5 (citing Tr. at 1083).) PFG contends that the court permitted Tietex to add a limitation to the claim - that it form a thermal barrier. What PFG fails to note is that upon PFG's objection, the court reminded the jury of the court's definition of an intumescent to be applied for purposes of the case. (Tr. at 1083-84.) Moreover, PFG's own patents-in-suit state they provided flame retardancy by producing a thermal barrier to protect the underlying product. See (PFG Exh. 1 at 5 ('639 patent describing the flame retardant mechanism in the fabric as "barrier chemistry that causes the fabric to char and swell when exposed to flame to provide an insulating thermal barrier"), Exh. 2 at 6 (identical language in the '162 patent).) And more to the point, PFG itself introduced, through its direct examination of its company witness, Larry Fraser, the proposition that an intumescent in the patents-in-suit works by forming a thermal barrier:

Q: And what is an intumescent?

A: An intumescent is a material that swells and chars upon exposure to heat or flame.

Q: Just in general terms, how does an intumescent work?

A: Well, when an intumescent is – comes into contact with a – with extreme heat or flame, it swells and chars. It actually – it actually swells and chars and – make – into a flame-preventive-type barrier with the material it's used with. It helps the fabric become a thermal barrier.

Q: You said a thermal barrier?

A: Yes.

Q: And what do you mean by thermal barrier?

A: Thermal barrier is what would keep the insult or the attack of a flame or extreme heat from further damaging things on the other side of it.

(Tr. at 246-47 (emphasis added).) Under these circumstances, it is difficult to say that Dr. Horrocks misled the jury into redefining the claim construction.

PFG also points to a portion of Dr. Horrocks's testimony that it characterizes as modifying the claim to "require a particular 'thickness'" of the coating. (Doc. 373 at 5 (citing Tr. at 1113).) However, what PFG cites to is a question to Dr. Horrocks whether he was aware of whether Dr. Bhat had performed any calculations to determine whether the thickness of his coatings he tested were within the requirements of the patents-in-suit, to which Dr. Horrocks answered, "I'm not aware of that." (Tr. at 1113.)

Immediately following that, Dr. Horrocks testified, without objection, to the results of his calculations to confirm the thickness of the coatings contemplated by the patents-in-suit for purposes of his testing. (Id.)

Frequently, both before and during trial, the court advised the parties that they could not attempt to add limitations to the claim that were not approved by the court. E.g., (Tr. at 630-33, 1055, 1097-98, 1101.) The court also instructed the jury more than once on the court's construction of the claim and that the jury was bound by it. E.g., (Tr. at 1083-84, 1415.) Based on the trial record, PFG's contentions that the cited testimony added an impermissible claim limitation lacks merit.

3. Testimony of Holland and Wildeman

PFG challenges a portion of testimony by Holland and Wildeman that it characterizes as improper lay opinion testimony that was irrelevant and prejudicial. (Doc. 373 at 7-9.) More specifically, PFG argues that testimony by Holland that his company's product, SV-X41, does not swell (Tr. at 1067-68) was unreliable because it was not supported by scientific evidence where he only tested the product on coated fabrics and does not know how to measure swelling. (Doc. 373 at 8.) PFG contends that Wildeman's statements as to his visual observations of the accused fabrics, rather than quantitative measurements, are unreliable and inadmissible for purposes of determining literal infringement.

Tietex responds that Holland's testimony that SV-X41 does not swell upon exposure to heat or flame and is not an intumescent constitutes a sufficient evidentiary basis upon which a reasonable jury could find that PFG failed to carry its burden of proving literal infringement. (Doc. 376 at 22-23.) Tietex argues that Holland's lay opinion testimony was properly admitted as a direct response to PFG's introduction of Holland's August 6, 2013 email which opened the door to his testimony. (Id. at 22 n.8 (citing Tr. at 1046-47).) Tietex further argues that the jury could reach a reasonable conclusion that Tietex did not infringe based on Wildeman's testimony that he did not observe visible swelling of the SV-X41 coating when he observed burn tests. (Id. at 23.)

As to Holland, context is necessary. His testimony was the subject of significant discussion with the court. During Holland's direct examination, PFG's objection was initially on the ground of relevance. (Tr. at 1040.) PFG ultimately agreed with Tietex's assessment that Holland could testify as to "the bases for what he said there [in his August 6, 2013 email to Mr. Wallace] and if he changed his opinion on it." (Id. at 1041.)¹² The court also found that by introducing the August 6, 2013 email, PFG had opened the

¹² In a March 1, 2018 pretrial hearing and during trial, PFG agreed to Tietex's legal arguments, contained in a memorandum (Doc. 329; Doc. 329-1 (PFG statement)), that Holland could testify about the August 6, 2013 email pursuant to Federal Rule of Evidence 701. (Doc. 327; Tr. at 1032-33, 1042-46, 1056-57). Both PFG and Tietex listed Holland on their trial lists.

door to Tietex's examination of Holland about the email. (Id. at 1046-47.) The court also noted that Holland could testify as to his perceptions as it related to a defense of the claim of willfulness and explained that, while it would consider the testimony on a question-by-question basis, it would sustain PFG's objections if Tietex's counsel strayed from these areas. (Id. at 1045-46, 1056-57.) Even in the absence of objection, the court interjected itself, *sua sponte*, to ensure that the testimony did not conflict with the court's claim construction. E.g., (Tr. 1054-56.) As to the limited testimony to which PFG now complains, PFG raised no objection at trial. Therefore, any objection has been waived. Further, to the extent PFG argues that Holland was not qualified to explain whether he believed his company's product was an intumescent, it opened the door to that testimony by introducing Holland's August 6, 2013 email on that very issue. (Tr. at 1041-46.)¹³

As to Wildeman, PFG objects to what it describes generally, without record citation, to be testimony about his visual observations of the accused fabrics. (Doc. 373 at 7-8.) It contends that Wildeman's testimony was inadmissible lay opinion but acknowledges in its reply (citing to Tr. 1021-22, 1032) that

¹³ Holland, who testified he holds both a bachelor's degree and a master's degree in chemistry from the University of Massachusetts, has not been shown to have lacked any qualification to so testify. (Doc. 373-1 at 1037.)

it was admissible on the issue of willfulness. (Doc. 379 at 13.) This is just how the court limited his testimony.

When PFG raised the issue at trial, it argued that Wildeman should be precluded from testifying as to his visual observations of swelling because the court had earlier ruled that Dr. Horrocks was prevented from opining as to swelling of SV-X41 tested on steel pans based on his unaided, visual observation. (Tr. at 897-98.) The court drew a distinction between Dr. Horrocks's opinion offered for literal infringement (because it was *ipse dixit*), and Wildeman's testimony offered to rebut willfulness. (Id. at 899.) The court stated it would proceed question by question and directed PFG to object if it concluded that any question strayed into an impermissible area. (Id. at 898-901.) PFG made but one objection about Wildeman's visual observations of fabric testing – on the ground of relevance, which was overruled. (Id. at 1000.) The testimony PFG actually complains of came in on cross-examination in response to questions by PFG's counsel, and PFG never moved to strike any part of any response it now claims is objectionable.¹⁴ However, because Wildeman's testimony was admitted as it related

¹⁴ On cross-examination, PFG examined Wildeman as to his company's efforts to test the coating on the accused fabrics, inquiring whether it was a visual observation and whether he took any measurements. Wildeman responded that he examined the coating under a microscope but took no measurements because he saw no visual swelling. (Tr. at 1021.) Even in the absence of any objection by PFG, the court sustained its own objection and reminded the jury that Wildeman's testimony was admitted only on the issue of willfulness. (Id. at 1022.)

to Tietex's defense of PFG's claim of willful infringement, the court need not consider Tietex's attempt to rely on this testimony to support the merits of its literal infringement defense (see Doc. 379 at 13-14). (Doc. 376 at 23). Ultimately, the court expressed frustration over the absence of objections and remonstrated counsel on both sides that it was their duty to object and not to assume the court would do so *sua sponte*. (Tr. at 1032-33.)

On this record, PFG fails to establish entitlement to relief.

4. Admissibility of Dr. Horrocks's Testimony

The remainder of PFG's arguments relate to the testimony of Tietex's expert, Dr. Horrocks.

PFG first argues that any criticism regarding the thickness of the samples was irrelevant and inadmissible because it improperly added a limitation to the claim and was directly undermined by Dr. Horrocks's admission that Dr. Bhat's aluminum pan testing showed swelling. (Doc. 379 at 5.) PFG contends that Dr. Horrocks superimposed a thickness requirement on the court's claim construction, noting that the patents-in-suit have a separate claim limitation governing the amount of coating applied to the patented fabrics. (Doc. 373 at 6 n.1.) Tietex argues that "[i]t is axiomatic that, if the SV-X41 coating is not an 'intumescent' as it is actually applied on Tietex's fabrics, Tietex's fabrics would not be treated with an intumescent coating,

and could not have been found to infringe PFG's patents." (Doc. 376 at 18-19 (emphasis omitted).) Tietex argues that "Dr. Horrocks's opinion and Tietex's criticism of Dr. Bhat simply recognizes that, if the SV-X41 coating does not meet the definition of an 'intumescent' at the thicknesses in which it is applied on Tietex's fabrics, those fabrics cannot infringe PFG's patents." (Id. at 19.)

Claim construction is a matter of law for the court to decide. Markman, 52 F.3d at 979. Once the court has construed a claim, the parties may not seek to contradict, or further construe, the court's claim construction to a jury. Exergen Corp. v. Wal-Mart Stores, Inc., 575 F.3d 1312, 1321 (Fed. Cir. 2009); Tinnus Enters., LLC v. Telebrands Corp., No. 6:16-CV-00033-RWS, 2017 WL 3457104, at *2-4 (E.D. Tex. Aug. 11, 2017).

Here, neither party challenges the court's construction of the claim term intumescent as "a substance that swells and chars upon exposure to heat or flame." (Doc. 57 at 20-21.)¹⁵ During trial, Dr. Horrocks raised a factual dispute regarding the appropriate method of testing whether the SV-X41 coating applied to the accused fabrics swells upon exposure to heat or flame. He opined that the coating would behave differently at different thicknesses (i.e., "thermally thin" versus "thermally thick"),

¹⁵ To be sure, Tietex unsuccessfully urged a different construction at the Markman hearing.

testified that it was important to test the coating at the thickness actually contemplated by the patents-in-suit, and explained his testing at that level.

Dr. Horrocks's testimony did not impermissibly add limitations to the claim. At a minimum, it reflects a reasonable dispute over the appropriate method, scientifically, to test the SV-X41 to determine whether it, as called for in the patents-in-suit and thus as applied on the accused products, infringes PFG's patents. Dr. Horrocks based his opinion on his knowledge of the applicable science, the chemical composition of the SV-X41 coating, the amount of coating called for in the patents-in-suit, and his calculations of the amount of SV-X41 applied on the accused fabrics by Tietex. Based on these considerations, he testified that the SV-X41 coating applied on the accused products did not swell upon exposure to heat or flame. He also testified that testing the proper amount was critical because it is commonly known that too much of any substance, even though not an intumescent, could swell upon exposure to heat or flame. (Doc. 119-1 at 214-15 (observing during deposition that a thicker coating of nylon, which is not an intumescent, would swell and char when exposed to heat or flame).) To adopt PFG's position - to bar Dr. Horrocks from responding to an opposing expert's testing that employed amounts of SV-X41 at multiples over that ever contemplated by the patents-in-suit - would impermissibly extend the coverage of the

patents-in-suit beyond the scope of the claim limitation. See Aqua-Aerobic Sys., Inc. v. Aerators Inc., 211 F.3d 1241, 1245 (Fed. Cir. 2000) (affirming the district court's rejection of the patentee's proposed claim construction that would broaden the claims beyond the scope of the claim limitations and specification description).

PFG next argues that Dr. Horrocks's testing is unreliable because it was not scientifically valid and, therefore, is inadmissible under Federal Rule of Evidence 702 and Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579 (1993), and its progeny. (Doc. 379 at 7.) Relying on this court's prior order denying PFG's motion for partial summary judgment, Tietex contends that this court has already rejected PFG's arguments in considering the same evidence it introduced at trial. (Doc. 376 at 2-3, 11-17; see Doc. 152 at 22.) PFG responds that the court's prior motion does not conclusively resolve the issue and contends that the evidence presented at trial was different from that considered in PFG's prior motion. (Doc. 379 at 8-10.)

Under Rule 702, an expert witness is permitted to offer opinion testimony if he "is qualified as an expert by knowledge, skill, experience, training, or education." The witness's knowledge must help the trier of fact understand the evidence or determine a fact in issue, the testimony must be based on sufficient facts or data, the testimony must be the product of

reliable principles and methods, and the witness must reliably apply the principles and methods to the facts of the case. Fed. R. Evid. 702(a)-(d). This rule "imposes a special obligation upon a trial judge to 'ensure that any and all [expert] testimony . . . is not only relevant, but reliable.'" Kumho Tire Co. v. Carmichael, 526 U.S. 137, 147 (1999) (quoting Daubert, 509 U.S. at 589).

Under Rule 702, expert testimony is admissible if it "rests on a reliable foundation and is relevant." E.E.O.C. v. Freeman, 778 F.3d 463, 466 (4th Cir. 2015) (quoting Westberry v. Gislaved Gummi AB, 178 F.3d 257, 260 (4th Cir. 1999)). The overall focus is on scientific validity, based on the principles and methods used. Daubert, 509 U.S. at 592-93. Thus, the court must "ensure that the proffered expert opinion is 'based on scientific, technical, or other specialized knowledge and not on belief or speculation, and inferences must be derived using scientific or other valid methods.'" Nease v. Ford Motor Co., 848 F.3d 219, 229 (4th Cir. 2017) (quoting Oglesby v. Gen. Motors Corp., 190 F.3d 244, 250 (4th Cir. 1999)). The district court has "broad latitude" to take into account any "factors bearing on validity that the court finds to be useful." Freeman, 778 F.3d at 466 (quoting Westberry, 178 F.3d at 261). The court makes its determination under Federal Rule of Evidence 104(a), assessing whether the preponderance of the evidence demonstrates the admissibility of

the evidence under Rule 702's standards. Daubert, 509 U.S. at 592-93 & n.10. If that is met, questions as to the weight of the evidence are for the factfinder to resolve under Rule 104(b).

At the outset, it bears noting that the court entertained an extensive pretrial challenge to Dr. Horrocks's opinion testimony and issued a detailed analysis, which granted the motion in part and denied it in part.¹⁶ (Doc. 152.) To a large extent, PFG's challenges seek to re-litigate those issues. The court also notes that PFG does not challenge Dr. Horrocks's qualifications to offer any opinion at issue. Indeed, Dr. Horrocks is listed in the patents-in-suit as a holder of a patent that is prior art, and the patents-in-suit favorably cite six publications he authored or co-authored. (Tr. at 1087-89; Doc. 152 at 20-21.) Moreover, PFG's expert, Dr. Bhat, conceded that Dr. Horrocks had more experience in the field of intumescent. (Tr. at 667.)

PFG contends that the evidence presented at trial supports several arguments as to why Dr. Horrocks's testing is unreliable and therefore inadmissible.

First, PFG contends that Dr. Horrocks's calculation of the coating thickness on the accused products was unreliable. (Doc. 379 at 6.) It cites Dr. Horrocks's acknowledgment that he never

¹⁶ The court granted the motion in part and excluded Dr. Horrocks from testifying as to his opinion that he observed no swelling of the exposed SV-X41 coating on a steel substrate with his unaided visual examination. (Doc. 152 at 22-24.)

inquired of Tietex as to the thickness of the coating on its fabrics and never personally examined the fabrics to determine it. (Id.) PFG further represents that Dr. Horrocks conceded it would have been more accurate to ascertain the thickness by examining the actual fabrics under a microscope, which he did not do. (Id. (citing Tr. at 1192-93).)

Dr. Horrocks testified that he determined the thickness of Tietex's coating based on his prior experience working with similar fabrics, flame retardants, and intumescent coatings. (Tr. at 1109-10, 1116-18.) He also testified that he performed an analysis and determined that the coating used on Tietex's fabrics was 25 to 53 microns thick. (Id. at 1113.) As to whether he could have observed the coating on the Tietex fabrics under a microscope, Dr. Horrocks stated that it would not have been feasible to do so because the coating permeates the fabric, thus attempting to distinguish a contrary response in his deposition.¹⁷ (Id. at 1191, 1193 ("So if this [deposition answer] is relating to the fabric samples I produced, then it is a feasible way of determining the thickness because you don't get the penetration here that you do on a Tietex fabric. So we have to understand the context you asked that question and the context of the answer I gave you.")) Dr.

¹⁷ PFG cross-examined Dr. Horrocks with his agreement in his deposition to a question that "it would have been more accurate to get the thickness of the coating on the actual Tietex fabrics to examine them under a microscope." (Tr. at 1191-93.)

Horrocks did allow that he could have used a microscope to determine the coating thickness on the glass woven fabrics used in his testing, rather than the accused fabrics. (Id. at 1193 (“Q: And is it correct that based on the answer that you gave me, that that was all something you could have done? A: I could have done with the experimental fabrics I had.”)) In the end, PFG does not directly dispute calculations performed by Dr. Horrocks or otherwise argue that he lacked the relevant qualifications or expertise to perform such calculations, relying instead on the analysis of its expert, Dr. Bhat. So, while this criticism affects Dr. Horrocks’s credibility, it does not render his testimony inadmissible. See Syngenta Crop Protection, LLC v. Willowood Azoxystrobin, LLC, 267 F. Supp. 3d 649, 655 (M.D.N.C. 2017) (noting that “Daubert and Rule 702 are safeguards against unreliable or irrelevant opinions, not guarantees of correctness[,]” and that “the fact finder, not the court, must determine whether an expert is credible and whether the expert’s opinions are correct.” (quoting i4i Ltd. P’ship v. Microsoft Corp., 598 F.3d 831, 854 (Fed. Cir. 2010), aff’d, 564 U.S. 91 (2011))).

Second, PFG relies on Dr. Horrocks’s testimony that in a previous study he had determined that a glass woven fabric “was not as inert as anticipated.” (Doc. 373 at 11; Doc. 379 at 6.) Dr. Bhat also testified in rebuttal, relying at least in part on this prior study by Dr. Horrocks, that the “E-glass” substrate Dr.

Horrocks used was not inert. (Tr. at 1310.) Dr. Horrocks testified that his glass fabric was inert (Id. at 1121-22) and that the chemical composition of the intumescent in that study differed significantly from SV-X41 and thus this prior study could not serve as a proper basis to predict how the glass fabric would react. (Id. at 1204 ("So you cannot compare the results of what I did 20 years ago for a particular situation with what I have done here when the situation is completely different.")) Thus, this was a disputed fact issue. Moreover, even if the glass fibers he used were not fully inert, there is no showing how their use would have rendered Dr. Horrocks's opinion unreliable. As such, this criticism goes to the weight rather than the admissibility of Dr. Horrocks's testing. See United States v. Baller, 519 F.2d 463, 466 (4th Cir. 1975) ("Unless an exaggerated popular opinion of the accuracy of a particular technique makes its use prejudicial or likely to mislead the jury, it is better to admit relevant scientific evidence in the same manner as other expert testimony and allow its weight to be attacked by cross-examination and refutation.").

Third, PFG raises several issues with regard to Dr. Horrocks's testing methods. It notes that Dr. Horrocks designed his test protocol for this litigation and never used it previously. (Doc. 373 at 12; Doc. 379 at 7 (citing Tr. at 1175).) It further notes that he admitted he had never used a caliper to measure intumescent

materials and contends that his testimony demonstrated that his measurements were unreliable. (Doc. 373 at 11; Doc. 379 at 7-8 (citing Tr. at 1172).) Further, PFG argues, Dr. Horrocks disregarded the variations in thickness on the glass fabric he used as a substrate and compared measurements from different locations as if the coated fabric was uniform. (Doc. 373 at 11-12; Doc. 379 at 7.) PFG also claims that Dr. Horrocks testified that he could have measured the same location before and after the testing, but did not. (Doc. 373 at 12; Doc. 379 at 7 (citing Tr. at 1185).) Finally, PFG contends that Dr. Horrocks admitted that his testing was incapable of detecting swelling of less than 22 percent, due to his calculated margin of error. (Doc. 373 at 11; Doc. 379 at 7 (citing Tr. at 1186).)

One consideration in determining admissibility is "whether experts are testifying 'about matters growing naturally' out of their own independent research, or if 'they have developed their opinions expressly for purposes of testifying.'" Wendell v. GlaxoSmithKline LLC, 858 F.3d 1227, 1232 (9th Cir. 2017) (quoting Daubert v. Merrell Dow Pharm., Inc., 43 F.3d 1311, 1317 (9th Cir. 1995)). "While independent research into the topic at issue is helpful to establish reliability, its absence does not mean the experts' methods were unreliable." Id. at 1235. Here, PFG's criticism that Dr. Horrocks developed this test for this litigation carries little persuasiveness where PFG's own expert acknowledged

that there was no established industry test to measure swelling in intumescent. (Tr. at 663-64); see Wendell, 858 F.3d at 1235 (noting that "expert testimony may still be reliable and admissible without peer review and publication," particularly "when dealing with rare diseases that do not impel published studies").

This court previously found that Dr. Horrocks's testing methods are well supported within the relevant scientific community. See, e.g., (Doc. 152 at 17 ("Whatever the criticisms of Horrocks' techniques in performing his measurements, it is clear that his methods of testing flame-retardant fabrics have been peer-reviewed and published approximately 200 times."))¹⁸ At trial, Dr. Horrocks opined that there was no established test protocol within the industry for determining whether a coating swelled. (Tr. at 1105.) On this point, Dr. Bhat agreed. (Id. at 663-64.) Dr. Horrocks outlined three considerations he identified in designing and performing his test on the coating. (Id. at 1106.)

First, he considered the proper thickness of the coating, opining that it was important to test the coating at the thickness as applied to the allegedly infringing fabric, which he determined to be approximately 25 to 53 microns, as noted above. Drawing from his extensive experience in flame retardant chemistry, he

¹⁸ What may have differed is the use of microscopy for some measurements in prior peer-reviewed studies. (Doc. 119-1 at 74.)

testified that the coating would function as a "thermally thin" material at a thickness of 50 microns and "would behave quite differently" from thicker applications. (Id. at 1117-18.)¹⁹

Second, Dr. Horrocks testified that he analyzed the appropriate substrate on which to test the coating, noting that it

¹⁹ Dr. Horrocks testified in relevant part:

In fire science, flame retardant chemistry, we talk about thermally thick and thermally thin materials. That's a scientific way of saying a thin material on one hand can be defined what it is, and a thick material on another, made from the same material, whatever it is.

[. . . .]

And a scientist will carry out experiments, and you'll say for this sort of material, that's thermally thin, and for another one, it's thermally thick and there's a boundary between the two.

So now you can see if we've got a coating on a Tietex fabric of 50 microns, that is definitely thermally thin. You can't get much thinner than 50 microns. Anything higher than that is taking you into the thermally thick zone. And so it would behave quite differently.

So this is why you have to use the same thickness, the proper thickness in the item you are trying to analyze. Had we been looking at a bolt plastic with that thick[ness] with the same material in it, it would have been a different experiment. But we're dealing with a textile, which itself is probably about 250 microns thick. The top layer is a 50-micron film. We have to replicate exactly the conditions that that flame retardant material is within that fabric counting.

(Tr. at 1116-18.) The court previously addressed Dr. Horrocks's explanation of thermally thin coatings in connection with PFG's prior motion to exclude his testimony. (Doc. 152 at 7-8.) In short, Dr. Horrocks described a thermally thin substance as "one which when heated on the surface it is so thin that there is no heat gradient" and "[t]he back of it is assumed to be the front temperature." (Id. at 7 (alteration in original) (quoting Doc. 119-1 (Horrocks deposition) at 89).) He distinguished this from a thermally thick coating, "where you have a hot surface, a cool back and you have a thermal gradient." (Id. (quoting Doc. 119-1 (Horrocks deposition) at 89).))

must be inert so as not to react with the coating when exposed to heat or flame and thus render the measurement of swelling unreliable. (Id. at 1119.) Based on this consideration, he chose to perform the experiment on a glass woven fabric, which he contended would mimic the textile surface of the accused fabrics while providing an inert surface. (Id. at 1118-23.)

Third, he considered the proper testing protocol and procedures. (Id. at 1123-26.) He selected a hand-adjustable electronic micrometer (also referred to as a caliper) to measure the coating because the glass fabric was a hard surface. (Id. at 1123.) He explained his prior experience using this measurement tool and believed it was appropriate based on the potential increases in thickness that he would have expected with an intumescent coating. (Id. at 1133-35.) He testified that it was a device a person of ordinary skill in the art would have found acceptable in this application and noted that he rejected the pressure foot used by Dr. Bhat because, he claimed, it was too large to measure the small areas at issue and because a caliper was, in his view, more reliable for this application. (Id. at 1180-82.) Dr. Horrocks also responded to Dr. Bhat's "valid criticism" that the design of his testing with an electronic caliper did not permit him to measure the coating thickness in the same area before and after application of heat and flame. (Id. at 1130, 1182.) According to Dr. Horrocks, had he measured the

thickness first, he would have had to cut the sample, which would have destroyed it and compromised the accuracy of the measurement. (Id. at 1130.) Finally, he highlighted the importance of determining experimental error and discussed his calculation and use of experimental error. (Id. at 1126, 1139-41.)²⁰

PFG challenges Dr. Horrocks's use of an electronic caliper purchased approximately fifteen years ago from a company specializing in selling equipment for hand loading ammunition and which he stored in a non-climate-controlled garage in the summer months. (Doc. 373 at 11 (citing Tr. at 1171-72).) Dr. Horrocks testified that he was highly proficient in using a caliper and was "confident that [he] could get the maximum accuracy out of the measurements that [he] was using." (Tr. at 1133-34.) He further disputed Dr. Bhat's testimony that calipers were not used to measure fabrics and testified that this method of measurement was acceptable to an expert in the relevant field. (Id. at 1134-35.)

The court addressed challenges to the use of the electronic

²⁰ Dr. Horrocks also testified, in response to PFG's criticisms at trial, that he did not "foam" the coating before applying it. Dr. Small, PFG's Global Business Director (who is also a trained chemist), testified that PFG does so, which he said would have changed the coating's density and made it thicker – between 160 and 250 microns. (Tr. at 373, 396-97.) Acknowledging he did not do so, Dr. Horrocks noted that there is no evidence that Dr. Bhat did so, either. (Id. at 1124-25.) He further opined that not having done so would not affect the validity of his results, noting that upon drying the foamed coating would nevertheless collapse to form a thin film, which is what he measured. (Id. at 1124-25 ("So foaming is a process. It will have no influence on the nature of the film that is deposited on the surface.").)

caliper in its earlier opinion. In particular, the court noted that according to Dr. Horrocks, a thumbwheel micrometer is highly sensitive, using a digital readout measuring increments of 2.5 microns – that is, one tenth of one thousandth of an inch – and is sufficiently objective for his purposes to conduct such miniscule measurements.²¹ (Doc. 152 at 15.) Dr. Horrocks contested PFG's claim that the fact the handwheel must be manipulated by hand rendered it too unreliable. (Id.) Rather, in one of his depositions, Dr. Horrocks testified that the micrometer can be reliably operated on the surfaces at issue with "quite reproducible" results and for present purposes the caliper was more reliable than the pressure foot used by Dr. Bhat because, Dr. Horrocks contended, the pressure foot was too large to adequately measure the areas being tested. (Id. at 15-16.) Dr. Horrocks had concluded that the slight variability of results was inherent in the ordinary application of the instrument and the swelling of the material itself. (Id. at 15-17.)

The court allowed that PFG's criticisms about the use of the micrometer were valid. (Id. at 17.) No doubt, the fact that the instrument is hand-manipulated interjects an element of subjectivity into the measuring process. But a micrometer is a

²¹ A micron is one thousandth of a millimeter. By comparison, the width of a human hair is 40 to 80 microns. (Doc. 133-7 at 115; Doc. 133-6 at 8 (citing Robert R. Ogle, Jr. & Michelle J. Fox, Atlas of Human Hair: Microscopic Characteristics 28 (CRC Press 1999)).)

scientific instrument used for measuring, and it is accurate to the nearest 2.5 microns, which is an extremely small unit of measure. Here, Dr. Horrocks testified it was calibrated to within 10 microns. (Tr. at 1132-33.) Dr. Horrocks's measurements using this device could have been tested and either reproduced or challenged by Dr. Bhat, had he wished to do so. While Dr. Bhat offered his own testing and results, he did not attempt to replicate Dr. Horrocks's testing on a glass substrate and measure the results using the pressure foot. See (Doc. 151-1 at 5-6 (acknowledging Dr. Horrocks's testing but declining to conduct his own on the fiberglass fabric); Doc. 319; Tr. at 606, 612-13.) At trial, Dr. Horrocks again explained his use of the caliper and opined, without objection, that a person of ordinary skill in the art would find it acceptable. (Tr. at 1135.)

Under these circumstances, especially where Dr. Horrocks has a criticism that the pressure foot was too large to accurately test the area at issue, PFG has not demonstrated a basis to reverse the court's previous ruling denying PFG's motion to exclude Dr. Horrocks's opinion testimony for a jury's consideration. (Doc. 152 at 14-15, 22 (finding that, as long as the methods have scientific validity and are reliable, the accuracy of his method of measurement using a caliper goes to the weight of the testimony rather than its admissibility)); see Heller v. Shaw, Inc., 167 F.3d 146, 160 (3d Cir. 1999) (holding that expert testimony cannot

be excluded simply because the expert uses one test rather than another, when both tests are accepted in the field and both reach reliable results).

Dr. Horrocks testified that he accounted for the variations in thickness as well as the potential for human error by calculating experimental error.²² He stated that because the uncoated glass fiber had natural undulations, he conducted several measurements of it and determined that on average its thickness was .30 millimeters, with a deviation of ± 20 microns. (Tr. at 1174-75.) He then applied a 45-micron layer of SV-X41 coating to this substrate. (Id. at 1177.) This produced an uneven surface. (Id. at 1178.) After exposure to heat and flame, he cut the samples and measured the thickness on various places of the exposed

²² Dr. Horrocks had explained in more detail in his deposition how he calculated his experimental rate of error. His testing involved coating glass fabric samples with SV-X41 before exposing them to heat. (Doc. 119-1 at 160-77, 234-37, 258, 260-62.) He used the electronic micrometer to measure the thickness on each surface. He rounded his measurements to the nearest hundredth of a millimeter, rounding down if the caliper recorded a measurement of five thousandths of a millimeter (*i.e.*, a measurement of .365 millimeters was recorded as .360). (Id. at 37, 75-77.) Dr. Horrocks then added his sixteen measurements (Doc. 119-2 at 14-15) and divided the sum by sixteen to calculate an average measurement. (Doc. 119-1 at 160-77, 234-37, 258, 260-62.) He then calculated the differences between his 16 measurements and the mean. (Id.) He added those figures and divided by 16 to calculate the average deviation in his measurements, equaling .02 millimeters, or 20 microns. (Id.) The coating thickness in the unexposed areas of the substrate measured 45 microns, and the coating thickness in the exposed areas of the substrate measured 55 microns. (Id. at 164.) He concluded that the error rate of ± 20 microns in the unexposed coated regions was greater than the error rate of ± 10 microns in the heat/flame-exposed regions. (Id.) Dr. Horrocks repeated this explanation, in more truncated form, at trial. (Tr.at 1130-31.)

coating. (Id. at 1178-79.) He measured the deviations on the exposed coating, which he termed his error rate, of ± 20 microns. (Id. at 1185.) He concluded that the measurements of the exposed coating fell within his deviations noted on the unexposed coating; in other words, he found no swelling within his rate of error of 22 percent. (Id. at 1131, 1135-36, 1186.) Dr. Horrocks acknowledged that he "cannot say there was zero swelling because there's always uncertainty in any measurement." (Id. at 1131.) But he did testify, without objection, that he expected to see swelling of 70 or 80 microns, which he did not observe. (Id. at 1133.) He concluded that, based on his knowledge of intumescents, his measurements, and the swelling he would have expected to see, there was no scientifically significant swelling (or increase in thickness) in his test results. (Id. at 1136.)²³

While Dr. Bhat criticized the rate of experimental error, he did not dispute Dr. Horrocks's calculation of it. (Id. at 712-13.) In fact, Dr. Bhat conceded that if Dr. Horrocks's calculations of his rate of error were correct, then Dr. Horrocks was correct that his test results were the statistical equivalent of no swelling. (Id. at 712-13.) This would be sufficient for a

²³ The parties agreed before trial that a proper interpretation of the court's pretrial order, to which PFG did not object, permitted Dr. Horrocks to opine that "any increase in thickness is not swelling as one of ordinary skill in the art would understand it." (Tr. at 34-35.)

jury, if believed, to conclude that the SV-X41 applied during the testing did not swell.

As this court previously found, Dr. Horrocks's calculated rate of error was sufficient to survive the admissibility requirements of Rule 702. (Doc. 152 at 20 (finding that Dr. Horrocks's calculated rate of error met the third factor under Daubert)); see Banks v. United States, 75 Fed. Cl. 294, 301 (2007) (holding that "[t]he potential rate of error need not be completely accurate," but based on sufficient evidence, and any disagreement with the expert's calculated rate of error may be raised during trial and presented on cross examination). Moreover, PFG's expert did not dispute his calculation. The question is whether Dr. Horrocks's opinions he draws from his calculations are reasonably drawn from his methods and principles. Dr. Bhat concluded that the experimental error was "too high an experimental error to trying [sic] to determine the small change in difference." (Tr. at 713.) But Dr. Horrocks did make clear the limits of his testing: that it showed no swelling within the limits of his experimental error rate and that he "cannot say there was zero swelling because there's always uncertainty in any measurement." (Id. at 1131.) Dr. Horrocks opined that this was the equivalent of no swelling, given his knowledge of how intumescent materials behave, noting that any error in his calculations would not have been the result of intumescent swelling. (Id. at 1131, 1133-36.)

Fourth, PFG contends that Dr. Horrocks's aluminum foil reactivity theory is "entirely unreliable," irrelevant, and unsupported by sufficient facts.²⁴ (Doc. 373 at 13). At trial, Dr. Horrocks limited his opinion to the criticisms of Dr. Bhat's use of an aluminum substrate and offered no opinion as to the quantum of swelling associated with any purported reaction between SV-X41 and the aluminum foil substrate. (Tr. at 1151-52.) The court previously considered and denied PFG's motion to exclude Dr. Horrocks's aluminum opinions insofar as they describe criticisms of the aluminum foil substrate used in Bhat's supplemental testing. (Doc. 318 at 36.) As the court previously noted, "Dr. Horrocks's opinions regarding the general chemical principles and reactivity of aluminum is well supported by scientific literature." (Id. at 34.) PFG offers no persuasive evidence that such testimony is inadmissible. See (Id. at 36.)

Finally, PFG contends that Dr. Horrocks failed to support his "thermally thin/thermally thick opinion with any testable reliable science" or testing regarding the thermal thickness boundary of SV-X41. (Doc. 379 at 10; see Doc. 373 at 9-10.) Furthermore, it argues that Dr. Horrocks failed to provide testimony regarding any standards, methodology, or support within the scientific

²⁴ PFG again does not challenge Dr. Horrocks's qualifications to evaluate the potential for a chemical reaction between SV-X41 and an aluminum substrate.

literature to support this theory and failed to apply any such analysis to the coating at issue. (Doc. 379 at 11.) Dr. Horrocks offered his opinions based on his substantial knowledge of flame retardant materials. See (Doc. 152 at 10 (noting that Dr. Horrocks's curriculum vitae lists previous peer-reviewed publications he has authored on thermally thin coatings).) As Dr. Horrocks acknowledged, "a scientist will carry out experiments, and you'll say for this sort of material, that's thermally thin, and for another one, it's thermally thick and there's a boundary between the two." (Tr. at 1117.) PFG overlooks the fact that Dr. Horrocks did in fact perform a test using what he determined to be a thermally thin coating of SV-X41 with a thickness of 50 microns. (Id. at 1113, 1118.) In the final analysis, whether or not the coating of SV-X41 is thermally thin or where the line between thermal thinness and thickness lies does not undermine Dr. Horrocks's opinions; his testing provided support for his opinion that SV-X41 was applied at a thickness of approximately 50 microns and that he observed no measurable swelling.

In sum, Dr. Horrocks's opinion testimony satisfied the preponderance of the evidence standard to be admissible. While the case presented unique questions and Dr. Horrocks's testing methods differed from those of Dr. Bhat, the weight of the differences goes to their credibility - a consideration quintessentially within the role of the jury. "Vigorous cross-

examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky but admissible evidence.” Daubert, 509 U.S. at 596; see Baller, 519 F.2d at 466 (“Unless an exaggerated popular opinion of the accuracy of a particular technique makes its use prejudicial or likely to mislead the jury, it is better to admit relevant scientific evidence in the same manner as other expert testimony and allow its weight to be attacked by cross-examination and refutation.”). While Horrocks’s testing methods differ from Bhat’s, that does not render his results inadmissible.

5. Sufficiency of the Evidence

PFG argues that even if Dr. Horrocks’s testimony is admissible, it fails to rebut Dr. Bhat’s finding of infringement. (Doc. 373 at 12.) PFG cites to Dr. Horrocks’s admission that Dr. Bhat’s aluminum pan testing shows that SV-X41 swells (Doc. 373 at 13; Doc. 379 at 4) and contends that Dr. Horrocks’s reported experimental error rate of 22 percent fails to rebut Dr. Bhat’s findings of swelling (Doc. 373 at 12). PFG points out that while Dr. Horrocks challenged Dr. Bhat’s use of aluminum foil as a substrate, Dr. Horrocks could not attribute an amount of swelling to it. (Id. at 13.) PFG concludes that Dr. Horrocks’s admission that SV-X41 does swell at higher thicknesses renders his opinion

about the chemical composition "manifestly incredible." (Doc. 379 at 5.)

A party is entitled to judgment as a matter of law when no reasonable jury could have found infringement under the proper construction of the relevant claims at issue. Eon Corp. IP Holdings v. Silver Spring Networks, 815 F.3d 1314, 1320 (Fed. Cir. 2016) (holding district court erred in failing to construe the claim terms "portable" and "mobile" and defendants were entitled to judgment as a matter of law as to all claims because "when the claim terms are properly construed, no reasonable jury could have found that Silver Spring's electric utility meters infringe."), cert. denied sub nom. EON Corp. IP Holdings LLC v. Silver Spring Networks, Inc., 137 S. Ct. 640 (2017); Dominion Energy, Inc. v. Alstom Grid LLC, 725 F. App'x 980, 986 (Fed. Cir. 2018) (reversing district court and granting judgment as a matter of law in favor of defendant, holding that plaintiff failed to present substantial evidence to support jury's verdict, where plaintiff's expert testimony "was conclusory, unsupported, contrary to the evidence in the case, or not directed to the claim limitation at issue."); see MobileMedia Ideas LLC v. Apple Inc., 780 F.3d 1159, 1172 (Fed. Cir. 2015) (holding that defendant was entitled to judgment as a matter of law as to patent invalidity, where defendant presented unrebutted testimony at trial regarding invalidity and plaintiff's expert only offered conclusory statement that "I don't see evidence

for that").

Here, PFG fails to demonstrate that this is an "extreme case" in which judgment as a matter of law should be entered in its favor, where it bears the burden of proof. See Gilliam, 1997 WL 429454 at *8; Nobelpharma AB v. Implant Innovations, Inc., 141 F.3d 1059, 1065 (Fed. Cir. 1998) (holding that defendant was entitled to judgment as a matter of law as to issue of invalidity despite bearing the burden of proof on this issue, where plaintiff disclosed admissions by the inventor that he possessed a preferred method of making the claimed invention and failed to adequately disclose it). Indeed, PFG fails to identify a single case in which a court overturned a jury verdict of non-infringement and granted judgment as a matter of law in favor of the plaintiff. Contrary to PFG's representations in its initial brief (Doc. 373 at 7), the Federal Circuit in Eon Corp. IP Holdings v. Silver Spring Networks reversed a jury verdict of infringement and granted judgment as a matter of law in favor of the defendants. Eon Corp. IP Holdings, 815 F.3d at 1316.

PFG, not Tietex, bore the burden of proving infringement by the preponderance of the evidence. During PFG's cross examination, Dr. Horrocks admitted that SV-X41 applied to aluminum pans showed swelling under Dr. Bhat's experimental conditions based on the photographs of the testing introduced at trial. (Tr. at 1199 ("Q: Would you agree that under Dr. Bhat's experimental conditions that

his testing showed swelling? A: According to his photographs, yes, I agree.".) Contrary to PFG's assertion, however, Dr. Horrocks did in fact criticize this testing – principally the failure to use a "realistic thickness" of the coating used (which he stated was many times the amount called for in the patents and thus "wholly inappropriate") as well as Dr. Bhat's failure to calculate experimental error for his results. (Id. at 1142-43.)²⁵

In addition, as noted elsewhere in this opinion, Dr. Horrocks opined that SV-X41 lacked a carbonific, such that its chemistry prevented it from swelling, but rather relied on "flame retardant chemistry" that "snuffed out" the flame. (Id. at 1154-59, 1187.) This was a sufficient ground, if believed by the jury, to support the conclusion that SV-X41 could not swell when properly applied and thus a finding of no literal infringement.²⁶

In the end, Dr. Horrocks and Dr. Bhat presented conflicting expert testimony as to the issue of literal infringement.

²⁵ PFG misconstrues this court's statement during a side bar that "right now as I understand it, there's no evidence in the record that he had any criticism of the aluminum pans." (Tr. at 1201.) This statement was made with reference to the fact that Tietex had offered no criticism regarding Dr. Bhat's use of an aluminum substrate during his third round of testing (in accordance with the court's previous ruling precluding it), rather than any indication that Dr. Horrocks failed to offer any criticism of the parameters used generally in those tests. (Id.)

²⁶ Throughout this case, Tietex has consistently maintained that the amount of intumescent to be applied to the fabric was material, noting that many items that are not intumescent (such as nylon) will exhibit some swelling and charring when exposed to heat or flame. The court has previously articulated the analysis relating to the permissible scope of the experts' opinions in this regard and will not repeat it here. (Doc. 333.)

Resolution of these factual issues was properly for the jury to resolve. The jury was entitled to disbelieve Dr. Bhat and/or credit Dr. Horrocks's testimony over that of Dr. Bhat and, therefore, it was not unreasonable for the jury to find that PFG's patents were not infringed. See Verizon Servs. Corp., 602 F.3d at 1341.²⁷

C. Doctrine of Equivalents

PFG contends that it is entitled to judgment as a matter of law as to infringement under the doctrine of equivalents because no reasonable jury could find that SV-X41 was not the substantial equivalent of an intumescent coating. (Doc. 373 at 15.) Tietex contends that a reasonable jury could have found that PFG failed to carry its burden based on the "function, way, result" test. (Doc. 376 at 24). Tietex also relies on the court's prior order denying PFG's motion for summary judgment in which the court found that Tietex presented sufficient evidence for a reasonable jury to find in its favor on the question of infringement under the doctrine. (Id. at 26-27 (citing Doc. 152 at 44-45).)

"An accused device that does not literally infringe a claim

²⁷ PFG also contends that the lay testimony offered by Messrs. Holland and Wildeman is not admissible and therefore insufficient to support a finding of non-infringement. (Doc. 379 at 11-14.) As noted elsewhere herein, Holland's testimony was proper, as it related to his email and perceptions, and Wildeman's testimony was admitted to rebut PFG's claim of willfulness. Having determined that Dr. Horrocks's expert testimony was sufficient to support the jury's verdict, the court need not consider PFG's alternate argument as to these witnesses.

may still infringe under the doctrine of equivalents if each limitation of the claim is met in the accused device either literally or equivalently." Cybor Corp. v. FAS Techs., Inc., 138 F.3d 1448, 1459 (Fed. Cir. 1998) (en banc) (citations omitted), abrogated on other grounds by Teva Pharm. USA, Inc. v. Sandoz, Inc., 789 F.3d 1335 (Fed. Cir. 2015). In applying the doctrine of equivalents, it is the equivalency to a limitation of a claim, and not a comparison of the allegedly infringing and patented products themselves, that is the focus of the inquiry. Read Corp. v. Portec, Inc., 970 F.2d 816, 822 n.2 (Fed. Cir. 1992), abrogated on other grounds by Markman, 52 F.3d at 975. "An element in the accused product is equivalent to a claim limitation if the differences between the two are 'insubstantial' to one of ordinary skill in the art." Amgen Inc. v. F. Hoffman-La Roche Ltd., 580 F.3d 1340, 1382 (Fed. Cir. 2009) (citing Warner-Jenkinson Co. v. Hilton Davis Chem. Co., 520 U.S. 17, 40 (1997)). "Insubstantiality may be determined by whether the accused device performs substantially the same function in substantially the same way to obtain the same result as the claim limitation." Id. (citing Graver Tank & Mfg. Co. v. Linde Air Prods. Co., 339 U.S. 605, 608 (1950)).

A patent holder must provide "particularized testimony and linking argument as to the 'insubstantiality of the differences' between the claimed invention and the accused device or process,

or with respect to the function, way, result test when such evidence is presented to support a finding of infringement under the doctrine of equivalents." Texas Instruments, Inc. v. Cypress Semiconductor Corp., 90 F.3d 1558, 1567 (Fed. Cir. 1996). As this court has previously noted, "the case law is clear that evidence of equivalence must be from the perspective of one of ordinary skill in the art." (Doc. 318 at 43); AquaTex Indus., Inc. v. Techniche Sols., 479 F.3d 1320, 1329 (Fed. Cir. 2007) ("[T]he difficulties and complexities of the doctrine require that evidence be presented to the jury or other fact-finder through the particularized testimony of a person of ordinary skill in the art, typically a qualified expert, who (on a limitation-by-limitation basis) describes the claim limitations and establishes that those skilled in the art would recognize the equivalents.").

In this case, the parties agree that the "function, way, result" test for the doctrine of equivalents applies. In ruling on PFG's motion in limine to limit evidence related to the doctrine of equivalents, the court described the relevant inquiry as follows: "Whether a component in the accused subject matter [SV-X41] performs substantially the same function as the claimed limitation [intumescent, by charring and swelling] in substantially the same way to achieve substantially the same result [flame retardancy]." (Doc. 318 at 50 (alterations in original).) For purposes of the trial, the parties stipulated that SV-X41

achieved substantially the same result as the claimed limitation. (Tr. at 67, 1422.) Thus, the relevant inquiry was whether the coating performs substantially the same function in substantially the same way. (Id. at 1422.)

Throughout this litigation, the parties have shifted litigation positions as to infringement under the doctrine of equivalents. See, e.g., (Doc. 318 at 42-43, 46-50.) Even now, they continue to offer conflicting interpretations of the proper inquiry under this theory of infringement. Nevertheless, the court finds that substantial evidence supported the jury's verdict of non-infringement.

Both parties offered testimony from experts they agreed possessed ordinary skill in the art regarding infringement under the doctrine of equivalents. Dr. Bhat testified that SV-X41 performs substantially the same function, in substantially the same way, to achieve the same result as the claimed intumescent. (Tr. at 614-15, 617-18.) Based on the results of his own testing, he opined that the coating performed substantially the same function as an intumescent, acting as a thermal insulator, in substantially the same way "[b]y forming a char which acts as an insulator." (Id. at 615.) He testified that the coating achieves the same result, which he defined as forming "a thermal barrier." (Id.) In addition to his own testing, he relied on Wallace's communication with Royal Adhesives about the coating as well as

Holland's email in which he wrote that the coating "behaves as an intumescent." (Id. at 616-18.) According to Dr. Bhat, Tietex's coating would be considered an intumescent if it both swelled and extinguished a flame. (Id. at 618.)²⁸

Dr. Horrocks testified regarding what he characterized as two "very different" ways of achieving flame retardancy, distinguishing between an intumescent, which relies on "barrier chemistry," and SV-X41, which relies on "flame retardant chemistry." (Id. at 1154, 1157-58) He stated that intumescent use "barrier chemistry" to swell and form a thermal barrier. (Id.

²⁸ PFG's counsel had the following exchange with Dr. Bhat:

Q: All right. During opening statements, did you hear a statement that Tietex's coatings do not infringe because it extinguishes or snuffs out the flame?

A: Yes, I did hear that.

Q: Can a coating that extinguishes a flame also swell?

A: Yes, it can.

Q: Can a coating that snuffs out a flame also swell?

A: Sure, it can.

Q: If Tietex's coating extinguishes a flame and also swells, what is your opinion?

A: Then it is an intumescent.

Q: And if Tietex's coating snuffs out a flame and also swells, what is your opinion?

A: It is an intumescent coating.

(Tr. at 618.)

at 1158.) However, SV-X41, he said, uses flame retardant chemistry, first developed in World War II, through the use of alumina trihydrate and the combination of urea and ammonium polyphosphate, which "form[s] a powerful flame retardant action" that extinguishes or "snuff[s] out" the flame. (Id. at 1156-58.) He noted that the chemicals in the SV-X41 coating also promote a char formation within the coating. (Id. at 1158.) So, while he appeared to agree that the accused coating functioned like an intumescent by charring and acting as a flame retardant, he distinguished the way in which it did so, noting that the alumina trihydrate releases a water vapor "which will extinguish, snuff out flame." (Id.) He concluded that this process did not function in substantially the same way as an intumescent. (Id. at 1158-59.)

PFG first contends that Dr. Horrocks's opinion regarding the doctrine of equivalents is inadmissible because it was not adequately disclosed in his expert report. (Doc. 373 at 16.) The court previously denied PFG's motion in limine on this ground, finding that his report adequately described the characteristics that he maintained distinguish SV-X41 from an intumescent, particularly in the way it functioned. (Doc. 318 at 51-52 (e.g., opining that SV-X41 did not swell at thermally thin applications, but that the alumina trihydrate gave off moisture that had a "flame-diluting effect").) PFG now points to Dr. Horrocks's

testimony at trial: namely, his statement that "I've only met this equivalence and I can't say in the last two days, so I'm not too clear about it." (Doc. 373 at 17 (quoting Tr. at 1160).)²⁹ Tietex points to the court's previous rejection of these arguments, including PFG's motion to strike Dr. Horrocks's testimony at trial. (Doc. 376 at 24 n.10 (citing Doc. 318 at 50-52; Tr.at 1163-69).)³⁰

²⁹ The relevant exchange between Tietex's counsel and Dr. Horrocks is reproduced below for reference:

Q: All right. And then let's split out the doctrine of equivalents. Is it your understanding that it relates to substantially same function and substantially same way?

A: No, it doesn't.

Q: No, I'm sorry, I'm talking about just in general the doctrine of equivalents. Is it your understanding the doctrine of equivalents involves a comparison of the ways and the functions and the results of the intumescent coating set forth in the patent versus the SV-X41 coating?

A: I've only met this equivalence and I can't say in the last two days, so I'm not too clear about it. If you're asking me is the SV-X41 an equivalent to the intumescent coating cited in the patent, then the answer is no, it is not equivalent. That's my interpretation of the meaning of equivalent, correct.

(Tr. at 1160.)

³⁰ PFG also argues that Dr. Horrocks's testimony as to non-infringement under the doctrine of equivalents should have been precluded as not being disclosed as a contention under the Middle District of North Carolina's local patent rules when the case was pending there. (Doc. 373 at 17.) Yet PFG acknowledges that Tietex did contend that as to the intumescent finish limitation "no element which is absent literally is present under the doctrine of equivalents." (Id.) Moreover, while Dr. Horrocks's opinions were offered in his depositions, fully litigated at the summary judgment stage, and the subject of great discussion both before and during the trial, this objection was never raised. See (Doc. 152 at 4-11; Doc. 288 at 50-52.) The court can discern neither surprise nor prejudice and declines to find Dr. Horrocks's testimony inadmissible on this basis at this stage.

The court finds that Dr. Horrocks's testimony does not alter the court's earlier conclusion. Whether Dr. Horrocks fully understood the names of the legal doctrines applicable in this case is not the issue. The question is whether his earlier reports setting forth reasons there was no infringement in his view adequately provided notice of his opinions. The court found they were sufficient, and he was made available for deposition conducted by experienced counsel. For the reasons given in the court's prior rulings on this issue, therefore, PFG's motion on this basis is denied.

PFG next contends that even if Dr. Horrocks's testimony is admissible, no reasonable jury could find in favor of Tietex as to the question of infringement under the doctrine of equivalents. (Doc. 373 at 17-18.) PFG argues that should SV-X41 extinguish or "snuff out" flame, as Dr. Horrocks opined, it nevertheless is the substantial equivalent of an intumescent because it "function[s] as a thermal insulator by forming a char which acts as an insulator to form a thermal barrier." (Id.) PFG claims that Tietex admits that SV-X41 acts as a thermal barrier (id. at 18 (citing Doc. 347 at 16)) and notes that Holland's August 6, 2013 email states that the coating "acts as an intumescent" and "forms an intumescent char" (id. (citing Doc. 373-10; Tr. at 616-17)). PFG contends that Dr. Horrocks's testimony that SV-X41 does not use barrier chemistry (Tr. at 1154) is a conclusory statement inconsistent

with the admissible evidence. (Doc. 373 at 18.)

This is yet another example of the parties either shifting their positions or failing to use clarity in their terminology. Earlier in the case, PFG argued that the function of an intumescent was to form an intumescent char (Doc. 114 at 19) but later contended and agreed it was flame retardancy (Doc. 223 at 16). Tietex similarly appears to have conflated the function and results prongs of the test, describing the function as "promoting char formation" as well as forming a "barrier". See (Tr. at 1023, 1158.)³¹ Whatever the potential overlap in the parties' analysis, Dr. Horrocks did testify that the way SV-X41 functioned was substantially different from that of an intumescent, thus creating a fact issue for the jury on the doctrine of equivalents.

PFG's reliance on the statements in Holland's August 6, 2013 email are similarly unavailing. To the extent PFG seeks to treat them as admissions or unchallenged facts, the court has previously rejected this argument (Doc. 152 at 45) insofar as Royal Adhesives is not a party to this litigation and the meaning of the statements was explained by Holland's testimony. Moreover, it is curious that PFG relies on these statements now as fact, given that Holland has not been qualified as a person of ordinary skill in the art,

³¹ During PFG's cross examination, Tietex's chief executive officer, Wildeman, conceded that SV-X41 "forms a char, which to some degree forms a thermal insulation barrier." (Tr. at 1023.)

and its contentions about what he should not have been permitted to testify about. See (Doc. 373 at 7-9, 18.)³² In any event, these prior statements are insufficient to compel a finding of infringement under the doctrine of equivalents. AquaTex, 479 F.3d at 1329.³³

In sum, at a minimum there was a factual dispute as to whether SV-X41 functioned in substantially the same way as an intumescent. This was sufficient to support the jury's verdict regarding infringement under the doctrine of equivalents. See Mikohn Gaming v. Acres Gaming, Inc., No. CV-S-97-1383-EJW, 2001 WL 34778689, at *13 (D. Nev. Aug. 2, 2001) (finding that the evidence produced at trial was sufficient to support the jury's verdict under the doctrine of equivalents).

D. Willful Infringement

PFG argues that the evidence presented at trial establishes that Tietex willfully infringed as a matter of law. (Doc. 373 at

³² PFG argues that the lay opinion testimony of Wildeman and Holland is unreliable, irrelevant, and inadmissible as to infringement under the doctrine of equivalents. (Doc. 373 at 18.) PFG cannot have it both ways; once it opened the door to the testimony by introducing the August 6, 2013 email, testimony related to the email was admissible for the limited purpose of willfulness. The court rejects this argument for the same reasons as discussed on the question of whether this testimony was admissible on the issue of literal infringement.

³³ Tietex also relies on the testimony of Holland, Wildeman, and Fraser in support of the jury's verdict. (Doc. 376 at 25-26.) Even though Tietex does not bear the burden of proof as to this issue, this evidence provides little support for a finding of non-infringement under the doctrine of equivalents because none of these witnesses qualified as a person of ordinary skill in the art. See AquaTex, 479 F.3d at 1329.

19.) Having determined that a reasonable jury could find that Tietex did not infringe PFG's patents, there is no basis on which to grant PFG's motion for judgment as a matter of law on the issue of willful infringement.

III. MOTION FOR A NEW TRIAL

PFG requests in the alternative that the court grant a new trial as to the issue of infringement based on trial misconduct. (Doc. 373 at 21-22.) PFG claims that Tietex repeatedly violated the court's instructions and confused the jury with irrelevant, prejudicial, and unreliable evidence and arguments. (Id. at 22.) Even if these individual acts of misconduct do not warrant a new trial, it contends, Tietex's conduct, when viewed in the aggregate, was prejudicial to PFG and rendered the trial unfair. (Id. at 31.)

A. Standard of Review

Pursuant to Federal Rule of Civil Procedure 59, a district court may grant a new trial if "(1) the verdict is against the clear weight of the evidence, or (2) is based upon evidence which is false, or (3) will result in a miscarriage of justice, even though there may be substantial evidence which would prevent the direction of a verdict." Bilenky v. Ryobi Techs., Inc., 115 F. Supp. 3d 661, 668 (E.D. Va. 2015) (quoting Atlas Food Sys. & Servs., Inc. v. Crane Nat'l Vendors, Inc., 99 F.3d 587, 594 (4th Cir. 1996)), aff'd, 666 F. App'x 271 (4th Cir. 2016). "The

decision to grant or deny a motion for a new trial lies at the heart of the district court's sound discretion and 'will not be disturbed absent a clear showing of abuse of discretion.'" Gibson v. Total Car Franchising Corp., 223 F.R.D. 265, 276 (M.D.N.C. 2004) (quoting Wilhelm v. Blue Bell, Inc., 773 F.2d 1429, 1433 (4th Cir. 1985)).

"A court may grant a new trial based on misconduct where there is a reasonable probability that the jury was improperly influenced by that conduct." Bilenky, 115 F. Supp. 3d at 677 (citation omitted). The party seeking relief bears the burden of demonstrating harmful error. Gibson, 223 F.R.D. at 276. It is entitled to a new trial "[o]nly when there is a 'reasonable probability' that improper arguments effectively subverted 'the jury's reason or [] its commitment to decide the issues on the evidence received and the law as given it by the trial court.'" Verizon, 602 F.3d at 1335 (quoting Arnold v. E. Air Lines, Inc., 681 F.2d 186, 197 (4th Cir. 1982)). "[T]he crucial inquiry is whether an error occurred in the conduct of the trial that was so grievous as to have rendered the trial unfair." Id. at 1331 (quoting Bristol Steel & Iron Works, Inc. v. Bethlehem Steel Corp., 41 F.3d 182, 186 (4th Cir. 1994)). The court must consider "the totality of the circumstances, including 'the nature of the comments, their frequency, their possible relevancy to the real issues before the jury, the manner in which the parties and the

court treated the comments, the strength of the case (e.g., whether it is a close case), and the verdict itself.'" Id. at 1334-35 (quoting Arnold, 681 F.2d at 197).

B. Analysis

PFG moves for a new trial on the grounds that Tietex's counsel: (1) violated the court's order by criticizing Dr. Bhat's testing of SV-X41 on an aluminum pan substrate; (2) attempted to add limitations to the court's claim construction; (3) improperly injected evidence of silica rayon fabric into the case in violation of the court's order; and (4) relied on irrelevant and prejudicial evidence regarding PFG's alleged motive for bringing the suit. (Doc. 373 at 22-27.) The court will address each of these claims in turn.

1. Testimony Regarding Dr. Bhat's Aluminum Pan Testing

PFG contends that Dr. Horrocks repeatedly violated the court's in limine ruling prohibiting him from testifying about the general reactivity of aluminum, which led the court to threaten to hold him in contempt. (Doc. 373 at 23.) PFG argues that Dr. Horrocks continued to "blur the line" between aluminum and aluminum foil even after the court expressly warned Tietex's counsel. (Id. at 23-24 (citing Tr. at 1196, 1206, 1210-11).) It contends that Tietex's counsel encouraged this misconduct, citing repeated references to "aluminum" rather than "aluminum foil." (Id. at 24

(citing Tr. at 677, 679, 682-683).) Tietex responds that Dr. Horrocks was entitled to testify as to the reactivity of aluminum and properly limited his testimony to the reactivity of the aluminum foil substrate. (Doc. 377 at 10-11.) It further contends that counsel respected the court's order in its cross examination of Dr. Bhat. (Id. at 8.) Finally, Tietex argues, there is no indication that the jury was improperly influenced by any allegedly improper testimony because the verdict did not hinge on the jury inferring that the aluminum pans were inert. (Id. at 11-12.)

Prior to trial, the court granted PFG's motion in limine in part to exclude Dr. Horrocks's testimony regarding the reactivity of the aluminum pan substrate that was used in Dr. Bhat's testing. (Doc. 318 at 36.) The court did so, not because it was unreliable under Daubert, but because it was disclosed only in a subsequent deposition by Dr. Horrocks that was limited to criticisms of Dr. Bhat's last round of testing that was performed on aluminum foil. (Id. at 31.) The court held that any criticisms of the aluminum foil used in the last round of testing was timely, but that any criticism of "aluminum" used in the aluminum pans in the previous rounds of testing was untimely. The court "directed [the parties] to instruct their witnesses in conformance with this court's order." (Id. at 52.)

At trial, during cross examination of Dr. Bhat with respect

to his testing of SV-X41 on an aluminum foil substrate, Tietex's counsel questioned him several times regarding the reactivity of "aluminum," without specifically referencing "aluminum foil." (Tr. at 677-83.) At no point during this examination did PFG object to any of the statements it now challenges as improper. (Id.) At the conclusion of this questioning, Tietex's counsel then posed the following question:

Q: Okay. So the question was, So do you believe that aluminum is one of the most reactive metals in existence? I'm talking about the element aluminum. What was your answer?"

(Id. at 683.) Despite PFG's failure to lodge any objection, the court intervened, called the parties to the sidebar, and raised its concern that the question was not limited to aluminum in aluminum foil. (Id. at 683-86.) During the sidebar, PFG's counsel stated that "I'm not sure it's over the line yet." (Id. at 684.) Had PFG concluded that any of this questioning was improper and unfairly prejudicial, it should have raised an objection at trial. See Verizon, 602 F.3d at 1335 (holding district court did not abuse its discretion in denying plaintiff's motion for a new trial based on allegedly improper arguments regarding the claim construction during the defendant's closing argument, noting that plaintiff failed to object to any of the allegedly improper statements or attempt to rebut them in its own closing argument). Moreover, any claim of prejudice is suspect, as PFG conceded at trial that the

element of aluminum is reactive. (Tr. at 684 ("And that's true and we'd admit that.").)

PFG also objects to statements Dr. Horrocks made during his direct examination. (Doc. 373 at 23.) Tietex's counsel asked whether he agreed with Dr. Bhat that aluminum foil is inert. (Tr. at 1144.) Dr. Horrocks responded:

Well, aluminum, as we use it in pots and pans, and aluminum foil, we use in every day life, gives the impression of being extremely unreactive, otherwise we wouldn't be using it to our cooking utensils. But once you expose it to higher temperatures and certain chemicals, the small oxide layer, which is protecting the metal aluminum underneath there, is attacked.

For instance, steam, when you boil water in your pan, that's having no effects on the aluminum pan at all. But if you expose the oxide layer to high pressure steam, high temperature steam from 120, 130, 140-degrees, it goes straight through the aluminum oxide coating into the aluminum and attacks the aluminum. And the products are more aluminum oxide plus hydrogen gas. So efficient is that reaction, that currently researchers on fuel gas, on hydrogen gas production for the automobile are looking at steam on molten aluminum as a way of producing hydrogen very cheaply. It's such an efficient reaction. And that occurs as soon as you put steam as opposed to water into contact with the aluminum or aluminum foil.

And when we heat the SV-X41 -

(Id. at 1144-45 (emphasis added).) Tietex contends that this response did not violate the court's order, but this contention strains credulity as Dr. Horrocks went well beyond merely discussing the reactivity of elemental aluminum and explicitly referenced aluminum pots or pans on several occasions. As the court noted in sustaining PFG's objection, Dr. Horrocks's

testimony ignored the court's order. (Id. at 1145 ("I'm going to hold him in contempt if he doesn't stop. He's violating my motion in limine order. He's talked about aluminum pans and pans on stoves and his answer would suggest that steel pans is a problem. And I'm not happy with him. I'm going to say it out loud in front of the jury.")) Contrary to PFG's assertion, however, any other blurring of the lines between aluminum and aluminum foil provides little evidence of trial misconduct, particularly where PFG failed to object or otherwise move to strike all but one of the challenged statements. (Id. at 1196, 1206, 1210, 1211.) When PFG did object to one of these challenged statements at trial, the court sustained its objection. (Id. at 1211.)

Despite Horrocks's violation of this court's order, the court does not find that this instance of trial misconduct warrants a new trial. See Waddington N. Am., Inc. v. Sabert Corp., No. 09-4883 GEB, 2011 WL 3444150, at *5 (D.N.J. Aug. 5, 2011) ("Generally, individual elements of misconduct of counsel are insufficient to justify a new trial where they are not objected to or where the Court gives a curative instruction upon the request of counsel."). When Tietex's counsel walked Dr. Horrocks through his criticisms of Dr. Bhat's testing, there was no mention of aluminum as a criticism as to any of the testing conducted on aluminum pans. (Tr. at 1142-43.) Rather, Dr. Horrocks offered independent criticisms of the testing conducted on the aluminum pans based on

the thickness of the coating and Dr. Bhat's failure to use experimental error. (Id.) Dr. Horrocks's exhibits outlining those criticisms also carefully omitted any reference to aluminum. (Id.) Moreover, Dr. Horrocks offered no opinion as to the quantum of swelling associated with any potential reaction between SV-X41 and any aluminum substrate. (Id. at 1152.) PFG previously acknowledged as much (Doc. 373 at 13), just as it acknowledged at trial that aluminum is reactive (Tr. at 684).

Under these circumstances, the court does not find that "there is a reasonable probability that the jury was improperly influenced" by any trial misconduct arising from the testimony regarding Dr. Bhat's aluminum pan testing. Bilenky, 115 F. Supp. 3d at 677.

2. Testimony Regarding the Court's Claim Construction

PFG also contends that Tietex offered evidence and arguments that contradicted the court's claim construction in contravention of the court's prior ruling. (Doc. 373 at 24-26); see (Doc. 318 at 37; Doc. 331 (text order).) PFG argues that "despite numerous objections by PFG throughout trial, Tietex repeatedly asserted that literal infringement required something more than 'swelling.'" (Doc. 373 at 5.) In support of its motion for a new trial, PFG cites a host of examples of representative statements that it alleges contradicted the court's claim construction. (Doc.

373 at 25-26; Doc. 380 at 6-7.) PFG claims that it did object frequently at trial, noting that the parties spent nearly three hours in sidebars with the court and even more time outside the presence of the jury. (Doc. 380 at 5.) Within this context, PFG argues that its failure to object to some of the statements should not prevent any finding of prejudice. (Id. at 6.)

Tietex responds that the challenged statements do not represent violations of the court's order when properly considered in the context in which they were made. (Doc. 377 at 12-17.) Tietex acknowledges that Dr. Horrocks did contradict the court's claim construction when he stated, "[a]n intumescent is a material which swells and chars to form a thermal barrier once it's been exposed to heat or flame." (Id. at 16 (citing Tr. at 1083).) However, it notes that the court sustained PFG's objection and immediately instructed the jury regarding the proper definition of intumescent. (Id.) Moreover, PFG's own expert, Dr. Bhat, himself stated virtually the same thing earlier in the case. (Tr. at 615 ("Q: And what is the result of the claimed intumescent? A: The result is a thermal barrier."), 660-661 (stating that for literal infringement, the issue "is whether the coating swells and acts as a thermal barrier – swells and chars and acts as a thermal barrier or not").) In light of the court's curative instruction and the court's instructions to the jury at the conclusion of the case, Tietex contends, there is no basis for finding that the jury

applied an inappropriate definition of "intumescent" in its deliberations. (Doc. 377 at 17.)

As Tietex correctly notes, many of these statements were in fact admissible for another purpose or did not in fact contradict the court's claim construction. For example, PFG relies on the fact that "Tietex contended repeatedly that the coating had to swell and char at a specific thickness," citing to Dr. Horrocks's testimony regarding the importance of testing the coating using the thickness applied to the accused fabrics. (Doc. 373 at 25 (citing Tr. at 1118).) PFG similarly relies on the statement by Tietex's counsel during his closing argument that "there's also no evidence that this thickness [Dr. Bhat tested] was consistent with the requirements of the claim in the patent." (Id. at 26 (alteration in original) (citing Tr. at 1383).) PFG did not object to either of these statements at trial. As previously discussed, this testimony does not add a limitation to the claim, but rather raises a factual dispute regarding the proper method of testing. As the court addressed extensively before trial, it was permissible for the competing experts to testify to the proper conditions for testing for swelling without impermissibly limiting the claim construction. (Doc. 333 at 4-12 (citing cases).)

PFG also cites Dr. Horrocks's testimony that he did not believe SV-X41 would swell because its chemical composition did not contain a "swelling agent." (Doc. 373 at 25 (citing Tr. at

1154).) PFG did not object to this testimony at trial, nor can the court discern why it should not be considered as to the issue of literal infringement. PFG also challenges Dr. Horrocks's testimony that a coating using barrier chemistry "swells and chars and it promotes that char formation, but in doing so, swells and puts a barrier on the surface of whatever it's covering." (Id. (citing Tr. at 1158).) Again, PFG did not object to this statement, and its expert, Dr. Bhat, said virtually the same thing. Moreover, it is relevant to the issue of infringement under the doctrine of equivalents.

PFG also challenges Tietex's counsel's use of the phrases "significant swelling" and "scientifically significant swelling" when questioning Dr. Horrocks. (Id. (citing Tr. at 1136).) But, as Tietex points out, PFG cannot claim prejudice. These phrases use the exact same language that PFG used during its opening statement. (Doc. 377 at 15-16 (citing Tr. at 103).) Moreover, the phrasing "scientifically significant" or "significant" related to whether any observed expansion of the coating was outside the range of experimental error Dr. Horrocks calculated. In addition, PFG's objections to both of these questions were sustained and thus, pursuant to the pretrial charge, the jury was instructed to ignore these questions. (Id. at 75, 77.) Similarly, PFG takes issue with statements by Tietex's counsel that PFG's coating "swells to form a thermal barrier" and "swells and chars to form

a thermal barrier." (Doc. 373 at 25 (citing Tr. at 135, 428).) As Tietex correctly points out, not only is the discussion of a thermal barrier relevant to PFG's claim of infringement under the doctrine of equivalents, but PFG's counsel and witnesses themselves repeatedly discussed a "thermal barrier" or "insulating barrier." (Doc. 377 at 14 (citing Tr. at 83-84, 89, 96, 116, 118, 119, 128, 203, 205, 239, 247, 249, 250, 252, 253, 298, 308, 326, 615, 813).)

In addition, PFG relies on several statements from Wildeman and Holland regarding intumescent coatings, (Doc. 373 at 25 (citing Tr. at 1053); Doc. 380 at 6-7 (citing Tr. at 1000, 1020, 1040, 1051, 1054)), as well as statements by Tietex's counsel during its closing argument characterizing some of this testimony. (Doc. 373 at 25-26 (citing Tr. at 1387, 1392).) At the outset, it bears noting that the admission of many if not all of these statements was a direct result of PFG's litigation strategy to pursue a claim of willful infringement at trial and its own failure to object. See Verizon, 602 F.3d at 1334 (noting one relevant factor for consideration is "the manner in which the parties and the court treated the comments"); see also Bilenky, 115 F. Supp. 3d at 677 (finding that, based on the totality of the circumstances, including the court's *sua sponte* admonitions, counsel's conduct did not rise to the level that would merit granting a new trial). Indeed, PFG failed to object at trial to all but two of these

challenged statements. Notably, one of the challenged statements by Wildeman was elicited during PFG's own cross examination of the witness, and PFG failed to move to strike the testimony. (Tr. at 1020.)

For purposes of proving willful infringement, PFG presented deposition testimony from Wallace that Royal Adhesives, the manufacturer of SV-X41, informed the company on the day the lawsuit was filed that the coating "behaves as an intumescent." See (Id. at 965.) The court instructed the jury to consider this testimony on the limited issue of PFG's claim of willful infringement. (Id. at 434.) Tietex offered testimony from Wildeman, which the court deemed admissible for the limited purpose of rebutting PFG's claim of willful infringement. See (Id. at 1032.) PFG now challenges Wildeman's testimony regarding his observation of tests Tietex performed on intumescent coatings, claiming that it contradicted the court's claim construction. (Doc. 380 at 7 (citing Tr. at 1000, 1020).)³⁴ However, the jury was repeatedly instructed as to the court's claim construction, and this testimony was

³⁴ PFG argues that Wildeman's testimony should have been excluded as "significantly prejudicial," relying on the Federal Circuit's decision in SSL Servs., LLC v. Citrix Sys., Inc. (Doc. 379 at 14-15); SSL Servs., LLC v. Citrix Sys., Inc., 769 F.3d 1073, 1092-93 (Fed. Cir. 2014) (holding that district court did not err in excluding testimony regarding good faith belief as to issue of willfulness by Chief Engineer who was a lay person without the benefit of the court's claim construction). This case is distinguishable, as Wildeman had extensive experience with patents (holding over 30 patents personally (Tr. 1004)), and the court made repeated efforts to instruct the jury that his testimony was limited to the issue of willfulness.

admissible as to the limited issue of willfulness, not to proof of whether SV-X41 was in fact an intumescent. See (Doc. 318 at 40-41); Adrea, LLC v. Barnes & Noble, Inc., 227 F. Supp. 3d 303, 312 (S.D.N.Y. 2017); Halo Elecs., Inc. v. Pulse Elecs., Inc., 136 S. Ct. 1923, 1935 (2016).

During its cross examination of Wildeman, PFG also questioned him regarding his prior investigation into whether the accused fabrics infringed PFG's patents. (Tr. at 1018-29, 1034-36.) Over Tietex's objection, PFG introduced the August 6, 2013 email from Holland of Royal Adhesives to Wallace of Tietex. (Id. at 1027-34; Doc. 373-10.) The document contained a detailed description of the four-component definition of an intumescent, which this court rejected during its claim construction. (Doc. 373-10 at 2; see Doc. 57 at 11.) In the email, Holland states that "[o]ur system behaves as an intumescent but does not exactly follow the definition below," while noting that "[o]ur system forms an intumescent char" and "works by forming a thermal insulation barrier." (Doc. 373-10 at 2.) PFG cross examined Wildeman regarding both the contents of the letter and his knowledge of the coating at the time of Tietex's alleged infringement. (Tr. at 1027-34.)

During the course of its cross examination of Wildeman, PFG's counsel repeatedly elicited otherwise inadmissible testimony for the purpose of establishing literal infringement. Indeed, one of

the challenged statements identified by PFG was elicited during PFG's own cross examination of the witness, and PFG failed to move to strike the testimony. (Doc. 380 at 7 (citing Tr. at 1020).) Acting on its own initiative, the court not once but twice sustained objections to the testimony proffered during PFG's cross examination of Wildeman to ensure that the jury was instructed that the evidence was limited to the issue of willfulness. (Tr. at 1021-22.)³⁵ Outside the presence of the jury, the court later noted:

I allowed [Wildeman] to continue to testify because there was no objection to some of his answers. But some of the answers, in my view, went solely to the issue of willfulness, particularly his testing and what he claims

³⁵ The relevant portion of the transcript is as follows:

Q: Is it true that the only testing that Tietex has done, Tietex itself has done of the SV-X41 is on the fabric substrate?

A: That's correct. However, we also have had Dr. Horrocks since that time conduct testing on the coating alone. And the results of that testing in my opinion are extremely convincing.

THE COURT: Sustained. Please move on.

[. . .]

Q: Did you take any measurements of the coated fabric to assess intumescent swelling?

A: No, I didn't. I did look under a microscope and I saw no visible swelling of the coating. But no, I didn't take any measurements because, quite frankly, I didn't see any swelling to measure.

THE COURT: Ladies and gentlemen, I said sustained. This testimony is directed to the issue of willfulness in the case as with my other instruction to you. All right.

(Tr. at 1021-22 (emphasis added).)

he did by way of testing.

[. . .]

In my view, those answers go solely to the issue of willfulness. I have a fine line between controlling the evidence in the case in light of my motions in limine, in which case I will act on my own. And I did on some instances involving the non-infringing alternative because I've ruled on that. But I'm not going to jump in and decide what evidence is proper or improper if there's no objection.

So I just caution both sides about that because we're going to keep moving forward. And there's been a dispute about who ought to be able to say what in this case. And don't assume I'm going to be sitting here deciding what's proper and improper sua sponte. It's not necessarily my role. My role is to try to make sure there's no error in the case. Sometimes that's invited by the parties. So I just caution you about that because I don't intend to – let me put it this way, if you're expecting me to rule on things when there's no objection, it's unlikely to happen.

(Id. at 1032-33 (emphasis added).)

Tietex next called Holland as a witness. The court limited his lay testimony to his opinions based on his perceptions, and PFG did not dispute his ability to testify as a lay witness. (Id. at 1044-46); see Fed. R. Evid. 701. However, the court held that PFG had opened the door to permitting him to testify regarding the contents of the email. (Tr. at 1046, 1056.) Over PFG's objection, the court permitted Holland to testify regarding the four-component definition listed in the email. (Id. at 1052-53.) During a side bar, the court acknowledged the risk of confusing the jury regarding the court's claim construction as a result of

PFG's introduction of the email and counselled the parties as follows:

My understanding is the plaintiffs put this document into evidence because it was some evidence of willfulness. That was the plaintiff's decision. When they did that, the door's open. I agree. And you can examine him and that's why you examined him on the document. However, it needs to be clear whether he's giving his opinion about whether his product meets his definition that he gave there or whether he meets some other definition. And it needs to be clear that he's not telling the jury something inconsistent with the Court's instruction as to what an intumescent is. I leave it to you all as to how far he can go with all these opinions. And I'll take it question by question. But my concern is confusing the jury between the Court's instruction and some other testing, even if it's an email. It wasn't clear from the question what test he was applying.

(Id. at 1056-57.) Despite having introduced the email into evidence, PFG now challenges several statements from Holland regarding the contents of that email. (Id. at 1051, 1052, 1054.) However, the court sustained PFG's objections to other testimony, including one of the challenged statements, which suggested Holland was offering testimony as to the ultimate issue of infringement. (Id. at 1040 ("[T]here's four requirements for an intumescent coating." (Holland)); "Can you tell us what is meant by the term intumescent coatings?" (Tietex's counsel)).) These statements cannot serve as a proper basis for granting a new trial where the proffered testimony was admissible for purposes of establishing willful infringement and PFG, not Tietex, bore the primary responsibility for its admission. See Verizon, 602 F.3d

at 1335.

PFG correctly notes that Tietex did make arguments and pursue lines of questioning that called the court's claim construction into question. See, e.g., (Tr. at 1083 ("An intumescent is a material which swells and chars to form a thermal barrier once it's been exposed to heat or flame."), 1136 ("Would one of ordinary skill in the art have seen any scientifically significant swelling in those results?").) Furthermore, Tietex's counsel also made statements and posed questions that were less than clear as to the line between literal infringement and infringement under the doctrine of equivalents. See, e.g., (Tr. at 127 ("Ladies and gentlemen, as I just mentioned, this case comes down to whether the coating Tietex uses on its fabric swells or not. The evidence will show that the coating does not swell. And if the coating does not swell, there is no infringement. It's that simple."), 639 ("And can we agree, Dr. Bhat, that if Dr. Horrocks is right and there's no swelling, then there is no infringement? Can we agree on that?").)³⁶

Despite its contentions that Tietex frequently "stepped over

³⁶ Prior to trial, the court rejected Tietex's theory that SV-X41 must swell in order to infringe under the doctrine of equivalents, precluding Tietex from offering evidence in support of this argument. (Doc. 318 at 49.) Notably, PFG did not object or otherwise seek a limiting instruction to address the statement by Tietex's counsel in his opening argument that "if the coating does not swell, there is no infringement." (Tr. at 127.)

[the] line" with respect to the court's claim construction, (Doc. 373 at 25), PFG failed to object or otherwise seek a curative instruction at trial to the majority of the challenged statements it identified. (Tr. at 135, 1020, 1051, 1054, 1118, 1154, 1158, 1383, 1387, 1392.) For the statements to which PFG did object, the court sustained all but two objections. (Tr. at 1000, 1040, 1052, 1083, 1136, 1205.)³⁷ Furthermore, the court went to great lengths to ensure the jury was informed of the proper claim construction. In response to Dr. Horrocks's statement that "[a]n intumescent is a material which swells and chars to form a thermal barrier once it's been exposed to heat or flame," the court not only sustained PFG's objection, but provided the following limiting instruction to the jury: "Ladies and gentlemen, I'll remind you that [for] purposes of this lawsuit, the Court's defined the term intumescent as I've previously instructed you as a substance that swells and chars upon exposure to heat or flame." (Id. at 1083-84.) During its closing charge, the court repeatedly informed the jury regarding the proper definition of intumescent (id. at 1414, 1415, 1417, 1420-1421), and twice instructed the jury that it must apply the court's definition of an intumescent rather than any other definition (id. at 1415, 1420). The court specifically instructed

³⁷ While not addressed within the parties' briefing, the court also sustained PFG's objections to statements or testimony which suggested that a coating must swell in order to infringe under the doctrine of equivalents. See, e.g., (Tr. at 647, 655-60.)

the jury that it was not to consider the four-component chemistry definition of an intumescent for purposes of determining infringement. (Id. at 1440 (“You may have heard evidence concerning Tietex's reliance on a four-component chemistry definition of intumescent during this case that the Court rejected. That evidence is not to be considered by you in determining infringement, but is only to be considered with regard to whether Tietex reasonably believed it did not infringe the PFG patents.”).)

Under these circumstances, the court finds that PFG has failed to demonstrate a reasonable probability that any potential misconduct arising from Tietex's representations regarding the court's claim construction improperly influenced the jury. See Nichols v. Ashland Hosp. Corp., 251 F.3d 496, 501 (4th Cir. 2001) (“‘[W]hile it may not always be simple for the members of a jury to obey’ a curative instruction, there is an ‘almost invariable assumption of the law that jurors follow their instructions.’” (quoting Richardson v. Marsh, 481 U.S. 200, 206-07 (1987))); cf. Waddington, 2011 WL 3444150, at *5.

3. Testimony Regarding Alleged Non-Infringing Alternatives

PFG contends that a new trial is warranted because Tietex attempted to introduce evidence that it developed a silica rayon fabric, a potential non-infringing alternative, even though the court had ordered such evidence excluded as a result of PFG's

pretrial motion in limine. (Doc. 373 at 26.) The court precluded evidence of the silica rayon fabric as a non-infringing alternative, which could have reduced potential damages, on the ground that Tietex failed to timely disclose it. (Doc. 318 at 23-24.) However, the court permitted Tietex to present evidence regarding the fabric as it related to the limited issue of willfulness. (Tr. at 551-56.)

PFG argues that Tietex violated the court's order in limine as to evidence of the silica rayon fabric during Wildeman's testimony. (Doc. 373 at 26 (citing Tr. at 1007-09).) However, as Tietex correctly points out, the record contains no contemporaneous objection during that portion of the testimony, only a subsequent request for an instruction that such testimony was limited to the issue of willfulness which, as noted below, the court subsequently gave. (Doc. 377 at 20-21 (citing Tr. at 1008).) In response to further questioning from Tietex regarding this topic, the court intervened *sua sponte*, even though PFG's counsel did not object. (Tr. at 1013-14.) Thereafter, the court instructed the jury that this evidence was being allowed for the limited purpose of PFG's claim of willfulness. (Id. at 1016 ("Ladies and gentlemen, before we go any further, let me instruct you that I'm allowing this testimony as to Tietex and the silica rayon product for the limited question of your determination of the plaintiff's claim that any alleged infringement was willful.

And it is not to be considered by you in any manner as to the merits of the underlying infringement claim or as to any damage issue. All right?").) In its closing charge, the court similarly instructed the jury that Tietex did not have a non-infringing alternative for purposes of calculating damages. (Id. at 1428.)

Therefore, PFG fails to demonstrate that any prejudice it claims to have suffered from the disclosure of evidence of Tietex's silica rayon fabric warrants a new trial. See Nichols, 251 F.3d at 501; cf. Waddington, 2011 WL 3444150, at *5.

4. Reliance on Inadmissible Evidence

PFG also argues that a new trial is warranted because Tietex offered irrelevant evidence concerning PFG's motivations to bring this lawsuit. (Doc. 373 at 27.) PFG contends that evidence of its motive for bringing suit was irrelevant to the issue of infringement and that Tietex's repeated efforts to introduce such evidence were prejudicial and rendered the trial unfair. (Doc. 380 at 8-11.)

Tietex contends that such evidence was relevant, as it demonstrated PFG's motive to bring the instant lawsuit and that PFG lacked a good-faith belief that Tietex was infringing its patents. (Doc. 377 at 22-23.) While acknowledging that the court disagreed with its arguments at trial, Tietex notes that federal courts have recognized that a party's motive can be relevant in determining credibility and further claims that motive is relevant

to the determination of attorneys' fees to the prevailing party under 35 U.S.C. § 285. (Id.). Nevertheless, Tietex notes that the court largely sustained PFG's objections to the introduction of such evidence at trial and maintains that this evidence was not in fact presented to the jury. (Id. at 24.)

Within the context of a patent infringement action, "a plaintiff's motive for bringing suit is irrelevant, except in the face of certain equitable defenses, bad faith, or questions of witness bias." Samsung Elecs. Co., Ltd. v. NVIDIA Corp., No. 3:14CV757, 2016 WL 754547, at *2 (E.D. Va. Feb. 24, 2016). Contrary to Tietex's assertion, evidence of PFG's motive for bringing an infringement action is irrelevant to the liability issue in the case - whether Tietex infringed PFG's patents. Id.³⁸ To the extent that such evidence may be relevant to the issue of witness credibility, the probative value of such evidence is substantially outweighed by the risk of prejudice to PFG. See Fed. R. Evid. 403. As one district court noted,

[A]s in non-patent law, motive for bringing suit is irrelevant to the trial of a patent infringement suit, absent circumstances not present here. Moreover, as is true generally, motive evidence can be quite a complicated topic. Therefore, admitting motive evidence would of necessity open the door to countervailing evidence that would necessarily detract from the real issues, that would cause delay and waste of time, and that would confuse the jury. All of that would be

³⁸ While Tietex did file counterclaims against PFG alleging abuse of process and unfair and deceptive trade practices, it withdrew those claims prior to the court's ruling on PFG's motion for summary judgment. (Doc. 147.)

unfairly prejudicial and would substantially outweigh any marginal relevance of the motive evidence offered here.

Samsung, 2016 WL 754547, at *4 (citations omitted). Evidence of PFG's motive may be relevant to the issue of whether to award Tietex attorneys' fees as the prevailing party. See 35 U.S.C. § 285 (providing that the court may award reasonable attorney fees to the prevailing party in "exceptional cases"); Octane Fitness, LLC v. ICON Health & Fitness, Inc., 572 U.S. 545, 554 n.6 (2014) (suggesting that a court may consider several factors in determining whether a case is "exceptional" including "frivolousness, motivation, objective unreasonableness (both in the factual and legal components of the case) and the need in particular circumstances to advance considerations of compensation and deterrence."); Lumen View Tech., LLC v. Findthebest.com, Inc., 24 F. Supp. 3d 329, 336 (S.D.N.Y. 2014) (noting that the plaintiff's motivations in the litigation weigh in favor of a finding of an "exceptional case"), aff'd, 811 F.3d 479 (Fed. Cir. 2016). However, this determination is left to the discretion of the district court and is not a matter for the jury to decide. See 35 U.S.C. § 285 (providing that the court may award of reasonable attorney's fees to the prevailing party in "exceptional cases"). As PFG notes, none of the cases relied on by Tietex supports the proposition that such evidence is relevant at trial to the issue of infringement. See (Doc. 380 at 10-11.) To the

extent that such evidence may be relevant within this context, the probative value of such evidence is substantially outweighed by the risk of unfair prejudice to PFG. See Fed. R. Evid. 403.

In support of its motion, PFG notes that Tietex: (1) attempted to introduce evidence that PFG had previously sued Tietex in 2012; (2) offered evidence and argument that "PFG filed this lawsuit within hours of having the patent issued"; (3) forecasted evidence in its opening statement that PFG did not test Tietex's coating for swelling before filing the lawsuit; (4) offered testimony that PFG's chief executive officer, Walt Jones, had promised Tietex's CEO that he would not sue without first attempting to personally resolve the dispute and allegedly broke that promise by filing this lawsuit; and (5) attempted to elicit testimony regarding tests conducted on the accused fabrics at the direction of PFG prior to bringing this lawsuit. (Doc. 373 at 27.) While Tietex's repeated efforts to introduce evidence of PFG's motive at trial are concerning, the court sustained the vast majority of PFG's objections to the admission of evidence that properly should have been excluded. See, e.g., (Tr. at 214, 410, 1329.)

PFG did not object to the statement offered during Tietex's opening argument forecasting evidence that PFG did not test Tietex's coating prior to filing suit. (Id. at 127.) Nor did PFG object to Wildeman's testimony regarding the promise PFG's CEO allegedly made to him that Jones would not sue without first

attempting to personally resolve the dispute. (Id. at 985-986.) Any prejudice resulting from the admission of that testimony is further limited given that PFG subsequently put on testimony from Jones in its rebuttal case disputing Wildeman's testimony. (Id. at 1322.) While the testimony that "PFG filed this lawsuit within hours of having the patent issued" was admitted over PFG's objection, (id. at 213-14), the court does not find that this evidence created a reasonable probability that the jury was improperly influenced, where the majority of such evidence was admitted as a result of PFG's own failure to object and PFG introduced evidence at trial to mitigate any prejudicial effects.

5. Consideration of Cumulative Effect of Evidence

Finally, PFG further argues that even if the individual acts of misconduct do not warrant a new trial, Tietex's conduct, when viewed in the aggregate, was prejudicial to PFG and rendered the trial unfair. (Doc. 373 at 27-32.) To be sure, the tactics of Tietex at trial were aggressive and, on occasion, may have resulted in the admission of evidence that was objectionable. But in these hotly-contested lawsuits, the court repeatedly warned the parties that it was their duty to object and invoke the court's remedies. The court also repeatedly took steps to enforce its prior rulings and ensure the jury was properly instructed as to literal infringement and infringement under the doctrine of equivalents. See, e.g., (Tr. at 1083-84, 1414, 1415, 1417, 1420-1421, 1440);

see Nichols, 251 F.3d at 501.

On balance and considering the complete record, the court concludes that PFG has failed to meet its burden of demonstrating a “reasonable probability[]” that improper arguments effectively subverted “the jury’s reason or [] its commitment to decide the issues on the evidence received and the law as given it by the trial court.” Verizon, 602 F.3d at 1335 (quoting Arnold, 681 F.2d at 197).³⁹

IV. CONCLUSION

For the reasons stated above, therefore,

IT IS ORDERED that PFG’s motion for judgment as a matter of law (Doc. 372) and its alternative motion for new trial (Doc. 372) are DENIED.

A Judgment in accordance with these rulings will be entered separately.

/s/ Thomas D. Schroeder
United States District Judge

March 8, 2019

³⁹ While the court does not condone these tactics, they do not rise to the level of having rendered the trial unfair. Cf. Waddington, 2011 WL 3444150, at *3 (granting motion for new trial by plaintiffs in patent infringement action, where defendant’s counsel and witnesses “repeatedly disregarded the orders and rulings set forth above, brought in improper evidence, made numerous arguments that were contrary to the law, denigrated the presumption of validity, and substituted leading questions for the testimony of [defendant’s] witnesses.”); Lucent Techs., Inc. v. Extreme Networks, Inc., 231 F.R.D. 453, 454 (D. Del. 2005) (denying defendant’s motion to reconsider court’s order granting new trial in favor of plaintiff in patent case, where defendant’s counsel repeatedly violated district court’s orders despite being forewarned that the failure to adhere to such orders could result in a new trial).