IN THE SUPREME COURT OF TEXAS

NO. 12-0987

GHARDA USA, INC. AND GHARDA CHEMICALS, LTD., PETITIONERS,

v.

CONTROL SOLUTIONS, INC., UNITED PHOSPHORUS, INC., AND MARK BOYD, RESPONDENTS

ON PETITION FOR REVIEW FROM THE
COURT OF APPEALS FOR THE FIRST DISTRICT OF TEXAS

Argued December 10, 2014

JUSTICE GREEN delivered the opinion of the Court.

In complex litigation, parties often support their respective positions with expert testimony. Such expert testimony must be both relevant and based on a reliable foundation. *Helena Chem. Co. v. Wilkins*, 47 S.W.3d 486, 499 (Tex. 2001). This case presents the question of whether interdependent opinion testimony from a series of four experts was reliable. The court of appeals held that each expert's individual testimony was reliable, and therefore the experts' collective testimony was reliable. 394 S.W.3d 127, 159, 164 (Tex. App.—Houston [1st Dist.] 2012). We hold that the testimony of all four experts is unreliable because the individual opinion testimony of at least two experts was unreliable and the remaining two experts based their opinions on the first two

experts' unreliable opinions. Because all of the plaintiffs' expert testimony was unreliable, there was no evidence of an essential element of the plaintiffs' claims. Accordingly, we reverse the court of appeals' judgment and reinstate the trial court's judgment that the plaintiffs take nothing.

I. Factual and Procedural Background

This dispute arose out of a warehouse fire in Pasadena, Texas. At the time of the fire, Mark Boyd owned the warehouse and leased it to Control Solutions, Inc. Another company, United Phosphorus, Inc., stored materials in the warehouse. Control Solutions operated a blending facility that formulated insecticides and pesticides in the warehouse. One of the chemicals Control Solutions used in its formulations was chlorpyrifos technical (chlorpyrifos). Before Control Solutions could blend chlorpyrifos with other materials, it had to melt the chlorpyrifos using an industrial oven called a "hot box." Control Solutions's hot box was located in the southwest quadrant of the warehouse. The melting process Control Solutions employed took twenty-four hours when the hot box was set at 180 degrees Fahrenheit. All told, numerous chemicals, including flammable solvents, were stored in the warehouse.

Gharda Chemicals, Ltd. and Gharda USA, Inc. (collectively, the Gharda defendants) supplied the chlorpyrifos that Control Solutions used at its blending facility. Gharda Chemicals manufactured the chlorpyrifos in India using a batch process—as opposed to a continual process—and utilized, among other "inert ingredients," ethylene dichloride (EDC).[1] While EDC was initially present in

[1] The Environmental Protection Agency defines an "inert ingredient" in a pesticide as any ingredient that is not an "active ingredient." 40 C.F.R. § 152.3. An "active ingredient" is "any substance (or group of structurally similar substances if specified by the [Environmental Protection] Agency) that will prevent, destroy, repel or mitigate any pest." *Id*.

high quantities during the manufacturing process, Gharda Chemicals distilled each batch to remove nearly all of the EDC. When making a batch of chlorpyrifos, Gharda Chemicals tested each batch for contaminants and also retained samples of each batch so that it could test for impurities later. Ultimately, the manufacturing process was designed to produce a product that contained 99.3% chlorpyrifos and 0.7% inert ingredients. When the desired purity was reached, Gharda Chemicals packaged the chlorpyrifos into sealed fifty-five gallon drums. Gharda USA then imported the drums of chlorpyrifos and sold them to American companies.

A. The Fire

At about 1:00 p.m. on March 8, 2004, Control Solutions employees placed thirty-two drums of the Gharda defendants' chlorpyrifos in the hot box to be melted overnight. The drums remained in the hot box after the Control Solutions employees went home for the day. The last person to leave the warehouse was Howard Stoddard, vice president of operations for Control Solutions. Before he left at approximately 10:00 p.m., Stoddard conducted a walk-through examination of the warehouse to ensure that the facility was running normally, and concluded that it was. The next morning, Robert Blair, distribution manager for Control Solutions, was the first person to enter the facility. Blair was working in a building adjacent to the warehouse that contained the hot box when, at approximately 5:15 a.m., he heard a boom. Blair went to the warehouse to investigate but could not determine the boom's origination. The fire alarm sounded thirty or forty-five seconds after Blair heard the boom.

The fire department arrived shortly thereafter. The first responders entered through a door in the northwest quadrant of the warehouse. During interviews with fire origin investigators, the fire

fighters reported that they saw flames to their right, near the southwest quadrant of the warehouse. Television news helicopters arrived and took video of the fire. The news helicopters recorded the fire fighters entering the warehouse, damage to a ridge vent on the roof in the area of the warehouse above the hot box, and the overall progression of the fire. The fire fighters decided to let the fire burn, and it spread to other portions of the warehouse. The northwest quadrant burned with such intensity that the steel beams supporting that quadrant failed, resulting in a partial collapse of the warehouse roof.

The fire consumed nearly everything inside the warehouse. However, either two or four unburned drums of the Gharda defendants' chlorpyrifos were found in the warehouse and were, for the most part, in "pristine condition."

B. The Plaintiffs' Experts and Their Investigations and Testimony

At the time of the fire, Harold "Buddy" Rice was the lead investigator in the Harris County Fire Marshal's Office. Rice was the first fire origin investigator on the scene when he arrived at the warehouse about two hours after the fire began. The fire was still active at that time, so Rice's initial investigation was limited to photographing the warehouse's exterior and conducting interviews with fire fighters and Control Solutions personnel. When Rice first entered the warehouse to investigate the next day, he only investigated the interior of the warehouse twice in forty-five minute intervals. He spent half of the first interval and ten to fifteen minutes of the second interval investigating the hot box. Rice spent the remaining time investigating other portions of the warehouse, but he did not investigate the heavily burned northwest quadrant because it had collapsed. During his investigation, Rice observed burn patterns that led away from the hot box, bending of the hot box's hinges,

distension of the hot box, and differential burning of several of the drums of chlorpyrifos within the hot box.[2] Based on this investigation, Rice concluded that "there was a buildup of some sort of flammable vapors or something within—within that hot box that caused the explosion and fire." However, Rice admitted that he did not know what the vapor could have been, how much vapor there was, or what source ignited the vapor. Rice also testified that he did not investigate any of these aspects of his theory.

Soon after the fire, Control Solutions began its own investigation into the cause. It retained Salvador "Sammy" Russo as a fire origin investigator. Russo first visited the burned warehouse six days after the fire. On this first visit, Russo interviewed Control Solutions personnel, determined the pre-fire contents of the warehouse, and inspected the exterior of the building. Russo had also previously reviewed the news video of the fire. On a subsequent visit, Russo investigated the entire interior of the warehouse and observed that the hot box's hinges appeared to have been pushed open, the latching mechanism on the hot box doors was bent, the roof above the hot box was distorted, there were fire patterns leading away from the hot box, and the drums within the hot box exhibited differential burning. Russo also observed the condition of the warehouse's and hot box's electrical systems.[3]

Part of Russo's duties as a fire origin inspector required him to conduct a chemical forensic analysis of the burned drums of chlorpyrifos. The analytical protocol Russo employed called for

---

[2] Differential burning refers to a fire pattern that demonstrates hotter burning at a focal point surrounded by areas of cooler burning.

[3] Roger Owen, an electrical engineer retained by the plaintiffs, testified that he ruled out the electrical system as a source of the fire. The Gharda defendants do not challenge Owen's testimony on appeal to this Court.

taking samples of both the solids and the volatile gases that remained within the burned drums of chlorpyrifos. To analyze the volatile gases, Russo numbered each drum, placed each drum into an overpack, placed an absorbent charcoal badge within the overpack, and sealed the overpack. After the charcoal badges and vapor content of the drums spent seventeen days in the overpacks, Russo removed them and sent them to be analyzed using gas chromatography mass spectrometry (GC-MS). This protocol was designed to determine only whether a specific volatile gas was present in the burned drums of chlorpyrifos, but not to provide a quantitative measurement of the volatile gases detected. Russo began this sampling protocol of the volatile gases thirteen days after the fire. Despite taking samples of the solids, Russo never had those samples tested.

Based on his investigation, Russo concluded that the fire originated within the hot box, and, conversely, that the fire did not start outside of the hot box and spread into it. Specifically, Russo testified that an ignitable vapor within the hot box exploded and the ensuing fire spread throughout the warehouse. Like Rice, however, Russo could not testify as to what the alleged vapor was, the source of the vapor, the extent of the vapor, whether any vapor that existed was sufficient to reach the lower flammability limit of the vapor, or an ignition source. Russo explained that he would "defer to the chemist" to fill in these portions of his theory.

Dr. Andrew Armstrong was one of the chemists to whom Russo deferred. Control Solutions retained Armstrong to help develop the sampling protocol Russo employed, perform GC-MS testing of the charcoal badges, and develop an ignition theory. The GC-MS testing Armstrong conducted demonstrated that several volatile gases were present in the burned drums. Armstrong noted that toluene and EDC, both flammable substances, were present in the test results. However, the test

results revealed that only eight of the thirty-two drums contained EDC, and none of those eight drums had shown signs of differential burning.

Armstrong began his search for an ignition theory with the assumption that Rice's and Russo's origin theories correctly placed the fire's origin in the hot box. His initial ignition theory was that the chlorpyrifos was contaminated with toluene, toluene gas collected in the hot box, and the toluene gas spontaneously combusted. Armstrong maintained that theory for two years until he learned that Gharda Chemicals did not use toluene at any point during its manufacturing process. Armstrong then changed course and opined that EDC contamination caused the chlorpyrifos to melt at a faster pace, resulting in exothermic decomposition of the remaining chlorpyrifos. Under Armstrong's new theory, this exothermic decomposition created toluene and EDC gases that collected in the hot box and ultimately either spontaneously combusted or were ignited by static electricity.[4] However, Armstrong neither tested nor testified to the amount of EDC contamination that is required to cause exothermic decomposition, the actual amount of EDC contamination in the drums, the concentration of vapors that must have been present under his ignition theory, the temperature at which spontaneous combustion would occur, or how a static charge could develop in the hot box. During the *Robinson* hearing, *see E.I. du Pont de Nemours & Co., v. Robinson*, 923 S.W.2d 549 (Tex. 1995), when asked if he tested or should have tested his theory, Armstrong said that "running a couple of experiments just to say, 'I ran an experiment,' I don't believe is necessary, fruitful or beneficial. Science must rely on independent evaluation of the phenomenon that we are

[4] Although Gharda Chemicals did not use toluene in its manufacturing process, toluene is a byproduct of the exothermic decomposition of chlorpyrifos.

discussing. And it's simply very, very straightforward." Armstrong also did not test the unburned drums of chlorpyrifos in the warehouse or the samples retained by the Gharda defendants.[5] Armstrong explained this failure to test was because the retained samples were past their expiration date, unsatisfactorily documented, sampled in an unscientific manner, and stored in containers that absorbed EDC. When asked whether he tested samples taken from the unburned drums of chlorpyrifos, he explained that testing samples would be futile—he would "need a lot of material to test the self-heating portion" of his theory.

Another chemist to whom Russo deferred was Dr. Nicolas Cheremisinoff. Control Solutions retained Cheremisinoff to testify about whether Gharda Chemicals manufactured defective chlorpyrifos and the viability of ignition theories.[6] To determine whether the Gharda defendants manufactured and sold defective chlorpyrifos, he examined Gharda Chemicals's manufacturing process and relied on the evidence of the drums' differential burning and the uneven distribution of EDC in the burned drums of chlorpyrifos. Ultimately, Cheremisinoff testified that it was "possible" that flaws in Gharda Chemicals's manufacturing process resulted in EDC contamination.[7] This possibility arose from Gharda Chemicals's reliance on its chemical technicians' experience and judgment—as opposed to reliance on a computer-operated system—to properly distill each batch of chlorpyrifos. Introducing the possibility of human error, Cheremisinoff speculated, could have

[5] The Gharda defendants' experts testified that the retained samples showed no EDC contamination.

[6] To a lesser extent, Cheremisinoff also refuted the testimony of the Gharda defendants' experts.

[7] Cheremisinoff used the words "possible" and "probable" when describing whether Gharda Chemicals manufactured defective EDC. However, Cheremisinoff unequivocally clarified that he had been using the word "possible" with regard to Gharda Chemicals's manufacturing process.

resulted in contaminated chlorpyrifos. Cheremisinoff bolstered his opinion by noting the presence of EDC in some, but not all, of the charcoal badge tests. During direct examination, Cheremisinoff testified that he would not expect EDC to be present in any of the drums because it is not a decomposition product of chlorpyrifos, the elevated temperatures within the hot box would have boiled the EDC, and the resulting EDC gas would have burned. However, Cheremisinoff contradicted himself on cross-examination, stating that he would expect to see EDC in the samples that underwent GC-MS testing even if the chlorpyrifos had been made according to specifications. Further, Cheremisinoff conceded that the presence of EDC in the samples, alone, did not mean that a drum was contaminated with EDC. Cheremisinoff also conceded that he was unable to determine the level of any contaminants in the drums of chlorpyrifos. Cheremisinoff acknowledged that just because Gharda Chemicals could have manufactured a contaminated drum of chlorpyrifos did not mean that it actually did so. Finally, when asked about tests performed on the retained samples, Cheremisinoff testified that the retained samples were sampled in an unscientific manner, implying that any testing on those samples would also be unscientific.

Cheremisinoff also testified that drums of chlorpyrifos contaminated with EDC could have exploded. Ultimately, Cheremisinoff concluded that an explosion could have occurred if a vapor cloud consisting of 6% EDC gas, an amount equal to EDC gas's lower flammability limit, formed within the hot box. Cheremisinoff reasoned that, to form a 6% EDC vapor cloud in the hot box, the aggregate amount of EDC must have been 1.2% to 1.4% of the material within the drums. Once this concentration of EDC gas had accumulated within the hot box, Cheremisinoff believed that static electricity generated by ionized dust particles ignited the EDC gas. However, Cheremisinoff based

his theory on the assumption that the drums of chlorpyrifos were sufficiently contaminated. He admitted there was no evidence of the amount of any actual contamination of the drums within the hot box.

In summary, Rice and Russo testified that they believed the fire started in the hot box, but they relied on other experts to prove how the fire could have started there. Armstrong and Cheremisinoff assumed that the fire started in the hot box and testified that EDC contamination could have caused the fire. Armstrong assumed that there was sufficient EDC contamination to cause exothermic decomposition, but did no calculations, research, or tests to determine what a sufficient amount of contamination would be. Cheremisinoff similarly assumed that there was sufficient EDC contamination to cause an explosion, but he admitted there was no such evidence supporting his assumption. Finally, Cheremisinoff testified that Gharda Chemicals's manufacturing process possibly resulted in a sufficient amount of EDC contamination, but he was unable to testify to the actual amount of EDC in the drums within the hot box.

C. The Trial and Appeal

Control Solutions, Boyd, and United Phosphorus (collectively, the plaintiffs) sued the Gharda defendants for manufacturing defect, marketing defect, breach of express and implied warranties, breach of contract, negligence, and gross negligence. The case was tried to a jury, and, over the Gharda defendants' objections, the plaintiffs introduced all of the experts' testimony as described above. The jury found that the chlorpyrifos was defective, the Gharda defendants were negligent, and the Gharda defendants breached the parties' contract. However, the jury found that only the Gharda defendants' negligence and manufacturing defect caused the fire. The jury apportioned 90%

of the fault to Gharda Chemicals, 10% to Gharda USA, and assessed the total amount of damages at $8,370,000.

The Gharda defendants moved for judgment notwithstanding the verdict. In their motions, the Gharda defendants argued that there was no evidence of negligence, defect, or causation because the plaintiffs' expert testimony was unreliable. The trial court denied the motions and entered judgment for the plaintiffs. After the trial court entered judgment, the Gharda defendants again moved for judgment notwithstanding the verdict. This time, the trial court agreed that the plaintiffs' expert testimony was unreliable and constituted no evidence of negligence, manufacturing defect, and causation. It therefore disregarded the jury's answers to the negligence and defect questions and rendered a take-nothing judgment in favor of the Gharda defendants.

The plaintiffs appealed. The court of appeals reversed in a split decision, holding that the plaintiffs' expert testimony was reliable and that there was sufficient evidence of negligence, manufacturing defect, and causation. 394 S.W.3d at 134, 164. The Gharda defendants petitioned this Court for review. We granted the petition. 58 TEX. SUP. CT. J. 3 (Oct. 6, 2014).

II. Standard of Review

We review a trial court's grant of a judgment notwithstanding the verdict under a no-evidence standard, examining whether any evidence supports the jury's findings. *Mancorp, Inc. v. Culpepper*, 802 S.W.2d 226, 227 (Tex. 1990). No evidence exists when there is:

> (a) a complete absence of evidence of a vital fact; (b) the court is barred by rules of law or of evidence from giving weight to the only evidence offered to prove a vital fact; (c) the evidence offered to prove a vital fact is no more than a mere scintilla; (d) the evidence establishes conclusively the opposite of the vital fact.

City of Keller v. Wilson, 168 S.W.3d 802, 810 (Tex. 2005) (citing Robert W. Calvert, *"No Evidence" and "Insufficient Evidence" Points of Error*, 38 TEX. L. REV. 361, 362–63 (1960)). More than a scintilla of evidence exists when the evidence supporting the finding "rises to a level that would enable reasonable and fair-minded people to differ in their conclusions." *Burroughs Wellcome Co. v. Crye*, 907 S.W.2d 497, 499 (Tex. 1995) (citation omitted). When determining whether any evidence supports a judgment, we are "limited to reviewing only the evidence tending to support the jury's verdict and must disregard all evidence to the contrary." *Mancorp, Inc.*, 802 S.W.2d at 227. We view the evidence and possible inferences in the light most favorable to the verdict. *Id.* at 228. If more than a scintilla of evidence supports the verdict, it must be upheld. *Garcia v. Ins. Co. of State of Pa.*, 751 S.W.2d 857, 858 (Tex. 1988) (per curiam).

We review a trial court's rulings on the admissibility of evidence for an abuse of discretion, including rulings on the reliability of expert testimony. *Whirlpool Corp. v. Camacho*, 298 S.W.3d 631, 638 (Tex. 2009); *Gammill v. Jack Williams Chevrolet, Inc.*, 972 S.W.2d 713, 727 (Tex. 1998). "Admission of expert testimony that does not meet the reliability requirement is an abuse of discretion." *Cooper Tire & Rubber Co. v. Mendez*, 204 S.W.3d 797, 800 (Tex. 2006) (citation omitted). If a litigant has properly preserved a no-evidence challenge, "we independently consider whether the evidence at trial would enable reasonable and fair-minded jurors to reach the verdict." *Whirlpool Corp.*, 298 S.W.3d at 638. This review "encompasses the entire record, including contrary evidence tending to show the expert opinion is incompetent or unreliable." *Id.*; *see also City of Keller*, 168 S.W.3d at 810 (stating that no evidence exists if "the court is barred by rules of law or of evidence from giving weight to the only evidence offered to prove a vital fact").

III. Expert Opinion Testimony

"Expert testimony is required when an issue involves matters beyond jurors' common understanding." *Mack Trucks, Inc. v. Tamez*, 206 S.W.3d 572, 583 (Tex. 2006) (citation omitted). Proof other than expert testimony will support a jury finding only when the jurors' common understanding and experience will allow them to make that finding with reasonable probability. *Id.* We have consistently required expert testimony and objective proof to support a jury finding that a product defect caused the plaintiff's condition. *See, e.g.*, *id.* at 582–83 (requiring expert testimony when the plaintiffs' causation theory was based on allegations that a tractor's fuel system was "defectively designed and manufactured so as to be unreasonably prone to fail and release flammable fluids in an environment conducive to ignition and fire; that such defects caused the release of diesel fuel; and that a defectively designed and placed ignition source then caused ignition of the released diesel"); *Nissan Motor Co. v. Armstrong*, 145 S.W.3d 131, 137–38 (Tex. 2004) (requiring expert testimony to demonstrate that a product defect caused a motor vehicle to accelerate unintentionally). The plaintiffs' causation theory in this case is complex, just as the causation theories were in *Mack Trucks, Inc.* and *Nissan Motor Co*. Here, the plaintiffs sought to prove that the Gharda defendants manufactured and sold drums of chlorpyrifos that were contaminated with EDC, EDC contamination caused an exothermic reaction that released flammable gases into the hot box, spontaneous combustion or static electricity ignited the vapors and caused an explosion, and the ensuing fire spread throughout the warehouse. This causation theory "involves matters beyond jurors' common understanding." *See Mack Trucks, Inc.*, 206 S.W.3d at 583. We therefore hold that the plaintiffs

must have supported their causation theory with expert testimony and objective proof. *See id.*; *Nissan Motor Co.*, 145 S.W.3d at 137–38.

Qualified experts may offer opinion testimony if that testimony is both relevant and based on a reliable foundation. *Helena Chem. Co.*, 47 S.W.3d at 499. Expert opinion testimony is relevant when it is "sufficiently tied to the facts of the case [so] that it will aid the jury in resolving a factual dispute." *Robinson*, 923 S.W.2d at 556 (citation omitted). Courts generally determine the reliability of an expert's chosen methodology by applying the *Robinson* factors. *Helena Chem. Co.*, 47 S.W.3d at 499. While we outlined in *Robinson* six factors trial courts may consider in determining whether an expert's methodology is reliable, we noted that the factors "will differ with each particular case."[8] *Robinson*, 923 S.W.2d at 557. "[E]ach material part of an expert's theory must be reliable." *Whirlpool Corp.*, 298 S.W.3d at 637.

Whether an expert's testimony is reliable is based on more than whether the expert's methodology satisfies the *Robinson* factors. *See id.* at 637–38; *Mack Trucks, Inc.*, 206 S.W.3d at

---

[8] These factors include, but are not limited to:

(1) the extent to which the theory has been or can be tested;

(2) the extent to which the technique relies upon the subjective interpretation of the expert;

(3) whether the theory has been subjected to peer review and/or publication;

(4) the technique's potential rate of error;

(5) whether the underlying theory or technique has been generally accepted as valid by the relevant scientific community; and

(6) the non-judicial uses which have been made of the theory or technique.

Robinson, 923 S.W.2d at 557.

580; *Volkswagen of Am., Inc. v. Ramirez*, 159 S.W.3d 897, 904–05 (Tex. 2004). Reliable expert testimony must be based on a probability standard, rather than on mere possibility. *See Gen. Motors Corp. v. Iracheta*, 161 S.W.3d 462, 471–72 (Tex. 2005); *Burroughs Wellcome Co.*, 907 S.W.2d at 500. Expert testimony is unreliable "if there is too great an analytical gap between the data on which the expert relies and the opinion offered." *Volkswagen of Am., Inc.*, 159 S.W.3d at 904–05 (citation omitted). Whether an analytical gap exists is largely determined by comparing the facts the expert relied on, the facts in the record, and the expert's ultimate opinion. *See id.* at 904–06 (analyzing the data on which the expert relied and the opinion offered); *Burroughs Wellcome Co.*, 907 S.W.2d at 499–500. Analytical gaps may include circumstances in which the expert unreliably applies otherwise sound principles and methodologies, *see Exxon Pipeline Co. v. Zwahr*, 88 S.W.3d 623, 629 (Tex. 2002), the expert's opinion is based on assumed facts that vary materially from the facts in the record, *Burroughs Wellcome Co.*, 907 S.W.2d at 499, or the expert's opinion is based on tests or data that do not support the conclusions reached, *City of San Antonio v. Pollock*, 284 S.W.3d 809, 818–19 (Tex. 2009). "[A] claim will not stand or fall on the mere *ipse dixit* of a credentialed witness." *Burrow v. Arce*, 997 S.W.2d 229, 235 (Tex. 1999) (citation omitted). Regardless of the manner in which we determine reliability, we do not decide whether the expert's opinions are correct; rather, we determine whether the analysis used to form those opinions is reliable. *Exxon Pipeline Co.*, 88 S.W.3d at 629.

Here, the plaintiffs introduced the testimony of four experts to establish the Gharda defendants' liability for negligence and manufacturing defect. In logical progression, Cheremisinoff testified that it was possible Gharda Chemicals manufactured drums of chlorpyrifos that were

contaminated with EDC. Armstrong and Cheremisinoff testified that EDC contamination could have caused an explosion within the hot box. Finally, Rice and Russo testified that the fire originated within the hot box when an ignitable vapor exploded, and that the ensuing fire spread throughout the warehouse, but deferred to the chemists with respect to what the vapor was and a possible ignition source. The Gharda defendants contend that this testimony is unreliable and therefore no evidence of negligence, manufacturing defect, or causation.

At the outset, we note that the Gharda defendants do not challenge any of the experts' qualifications on appeal to this Court. Accordingly, we assume that Rice, Russo, Armstrong, and Cheremisinoff are qualified to testify in the fields in which they offered their opinions.

Our reliability determinations begin with Cheremisinoff's opinion that Gharda Chemicals possibly manufactured drums of chlorpyrifos that were contaminated with EDC. Cheremisinoff formed this opinion by reviewing Gharda Chemicals's manufacturing process and the GC-MS test results of the charcoal badges. Cheremisinoff ultimately opined "that it was possible that product could be shipped with excess amounts of [EDC] in it." This opinion is suspect for several reasons.

First, we require expert testimony to be based on reasonable probability, and Cheremisinoff's testimony was based only on a mere possibility. *See Gen. Motors Corp.*, 161 S.W.3d at 471–72; *Burroughs Wellcome Co.*, 907 S.W.2d at 500. While it is true that Cheremisinoff used the words "possible" and "probable" when describing whether Gharda Chemicals manufactured defective EDC, he unequivocally clarified that he had been using the word "possible" with regard to Gharda Chemicals's manufacturing process. Furthermore, Cheremisinoff's basis for his opinion was that Gharda Chemicals relied on its chemical technicians' experience and judgment in distilling

chlorpyrifos, thus introducing the possibility of human error that could have resulted in contaminated chlorpyrifos. Because the basis for his opinion was the byproduct of possibilities, we believe the most accurate characterization of Cheremisinoff's testimony is that it was based in mere possibility. *See Burroughs Wellcome Co.*, 907 S.W.2d at 500 ("Reasonable probability is determined by the substance and context of the opinion, and does not turn on semantics or on the use of a particular term or phrase.").

Second, Cheremisinoff's opinion that Gharda Chemicals's manufacturing process "could" have resulted in contaminated product does not establish that it did in this case. *See Mack Trucks, Inc.*, 206 S.W.3d at 581; *Gen. Motors Corp.*, 161 S.W.3d at 471–72. Cheremisinoff's review of Gharda Chemicals's manufacturing process "did no more than set out 'factors' and 'facts' which were consistent with his opinion[]." *See Mack Trucks, Inc.*, 206 S.W.3d at 581. This type of expert testimony is based on mere speculation, and is therefore unreliable. *See id.* at 581, 583.

Third, Cheremisinoff based his opinion on the presence of EDC in some, but not all, of the charcoal badge tests. However, Cheremisinoff's reliance on this fact is internally contradictory. Notably, he testified that he expected to find EDC in conforming drums of chlorpyrifos, but also reasoned that the elevated temperature in the hot box would have boiled all of the EDC out of the drums. Cheremisinoff performed no testing or experiments to explain this inconsistency. Rather, he merely testified that "all I know is, from the analysis I did and looking at the process, that you had a product that was not in every drum, but you had two drums, possibly a few more drums, that had an abnormally higher level of EDC. That's all I can tell you." This inconsistency, coupled with the

lack of any explanation, cannot provide a reliable foundation for Cheremisinoff's opinion. *See Gen. Motors Corp.*, 161 S.W.3d at 472.

Finally, Cheremisinoff was unable to testify to the amount of actual EDC contamination in any of the drums, but reasoned that there must have been a sufficient amount of contamination because there was an explosion.[9] This reasoning is, at best, merely consistent with his overall theory. *See Mack Trucks, Inc.*, 206 S.W.3d 581 (rejecting expert testimony that "did no more than set out 'factors' and 'facts' which were consistent with [the expert's] opinions"). It also assumes a fact that Cheremisinoff testified he was unable to determine. *See Burroughs Wellcome Co.*, 907 S.W.2d at 499.

Each of these shortcomings on its own would be sufficient to support a conclusion that Cheremisinoff lacked a reliable foundation to testify that Gharda Chemicals manufactured drums of chlorpyrifos that were contaminated with EDC. Considered together, it is even more apparent that Cheremisinoff's testimony suffers from analytical gaps and "is connected to existing data only by the *ipse dixit* of the expert." *See Gammill*, 972 S.W.2d at 727 (citation omitted). This type of connection is unreliable, and is therefore not evidence. *See Mack Trucks, Inc.*, 206 S.W.3d at 581. The trial court therefore did not abuse its discretion by disregarding Cheremisinoff's testimony that Gharda Chemicals manufactured drums of chlorpyrifos that were contaminated with EDC.

[9] When asked by the Court during oral argument whether there was evidence in the record that would allow for a determination of the amount of any EDC contamination, the plaintiffs' counsel stated, "There is no proof in the evidence of the amount of the EDC that was in the drums." Counsel was then asked to confirm that there is no proof anywhere in the record, and she replied, "Anywhere, your Honor."

Cheremisinoff also testified that drums of chlorpyrifos contaminated with EDC could have exploded. This opinion was based on his calculations that drums of chlorpyrifos could have exploded if the aggregate amount of EDC was 1.2% to 1.4% of the material within the thirty-two drums placed in the hot box. However, Cheremisinoff could not testify to the amount of EDC in the drums, and we have already concluded that his general opinion that Gharda Chemicals manufactured drums of chlorpyrifos that were contaminated with EDC is unreliable. Here, too, Cheremisinoff assumed a fact that he was unable to determine. *See Burroughs Wellcome Co.*, 907 S.W.2d at 499. This aspect of Cheremisinoff's testimony likewise suffers from an analytical gap and "is connected to existing data only by the *ipse dixit* of the expert," and is therefore unreliable. *See Gammill*, 972 S.W.2d at 727. The trial court therefore did not abuse its discretion by disregarding Cheremisinoff's testimony that drums of chlorpyrifos contaminated with EDC could have exploded.

We next address the reliability of Armstrong's testimony that EDC contamination caused exothermic decomposition of the chlorpyrifos, which then created a toluene and EDC gas cloud in the hot box that either spontaneously combusted or was ignited by static electricity. We conclude that Armstrong's testimony suffers from the same deficiencies as Cheremisinoff's testimony. Armstrong, like Cheremisinoff, was never able to quantify the amount of contamination in the drums. Armstrong tried to explain this failure by testifying that "what is left in the drum after a fire has little or no bearing as to what was in the drum . . . prior to the fire." The only factual basis Armstrong relied upon was the GC-MS testing demonstrating that EDC gas was present in eight of the thirty-two burned drums and that several of the drums showed signs of differential burning. However, none of those eight drums that contained EDC gas also showed signs of differential

burning, which undermines Armstrong's theory that the drums indicating differential burning were contaminated with EDC. Moreover, Armstrong neither tested nor testified to the amount of EDC contamination that would be required to cause exothermic decomposition, the actual amount of EDC contamination in the drums, the concentration of vapors that would need to be present under his ignition theory, at what temperature spontaneous combustion would occur, or whether a static charge could develop in the hot box. Without this information, Armstrong has not even identified facts or factors consistent with his theory. *See Mack Trucks, Inc.*, 206 S.W.3d at 581. As such, Armstrong's testimony is a bare opinion that is "connected to existing data only by the *ipse dixit* of the expert." *See Gammill*, 972 S.W.2d at 727. The trial court therefore did not abuse its discretion by disregarding Armstrong's testimony that EDC contamination caused exothermic decomposition of the chlorpyrifos, which then created a toluene and EDC gas cloud in the hot box that either spontaneously combusted or was ignited by static electricity.

We end our reliability determinations by considering whether Rice's and Russo's testimony that the fire originated in the hot box is reliable. No rule prohibits experts from using other experts' opinions to formulate new opinions based on their own expertise. In fact, Texas Rule of Evidence 703 and our prior cases contemplate exactly such an arrangement. *See* TEX. R. EVID. 703 ("An expert may base an opinion on facts or data in the case that the expert has been made aware of, reviewed, or personally observed."); *see also, e.g.*, *City of San Antonio*, 284 S.W.3d at 819 (discussing a testifying oncologist's reliance on data derived from a landfill management engineer's expert testimony). However, interrelated expert testimony cannot be used to "form a hybrid for which no [single] expert can offer support." *Gen. Motors Corp.*, 161 S.W.3d 472. "It is incumbent

on an expert to connect the data relied on and his or her opinion and to show how that data is valid support for the opinion reached." *Whirlpool Corp.*, 298 S.W.3d at 642. Here, both Rice and Russo relied on other experts to provide a complete factual foundation for their origin theories. But the investigators' factual foundation never materialized because neither chemist provided reliable expert opinion testimony. *See Ford Motor Co. v. Ledesma*, 242 S.W.3d 32, 38–39 (Tex. 2007) ("Expert testimony is unreliable if it is based on unreliable data . . . ."); *Helena Chem. Co.*, 47 S.W.3d at 499. Because Armstrong's and Cheremisinoff's testimony was unreliable, the trial court therefore did not abuse its discretion by disregarding Rice's and Russo's testimony that the fire originated in the hot box.[10]

IV. No-Evidence Challenge

We next consider whether any evidence supports the jury's findings on negligence, manufacturing defect, and causation. *See Mancorp, Inc.*, 802 S.W.2d at 227. "The elements of a negligence cause of action are the existence of a legal duty, a breach of that duty, and damages proximately caused by the breach." *IHS Cedars Treatment Ctr. of DeSoto, Tex., Inc. v. Mason*, 143 S.W.3d 794, 798 (Tex. 2004) (citation omitted). "A manufacturing defect exists when a product deviates, in its construction or quality, from the specifications or planned output in a manner that renders it unreasonably dangerous." *Ford Motor Co. v. Ridgway*, 135 S.W.3d 598, 600 (Tex. 2004) (citation omitted). "A plaintiff must prove that the product was defective when it left the hands of the manufacturer and that the defect was a producing cause of the plaintiff's injuries." *Id.* (citation

[10] Because Rice's and Russo's testimony is unreliable on these grounds, we do not address the Gharda defendants' contentions that their testimony is unreliable based upon a failure to reliably apply their stated methodology.

omitted). To be successful on a manufacturing defect claim, the plaintiff must identify a specific defect by competent evidence and rule out other possible causes of the damage. *Nissan Motor Co.*, 145 S.W.3d at 137. "Causation-in-fact is common to both proximate and producing cause, including the requirement that the defendant's conduct or product be a substantial factor in bringing about the injuries in question." *Mack Trucks, Inc.*, 206 S.W.3d at 582.

In this case, the trial court did not abuse its discretion by disregarding the plaintiffs' unreliable expert testimony that the alleged defect or negligence caused the damage to the warehouse. The only remaining evidence from which the jury might infer causation consists of Rice's and Russo's observations that several of the drums exhibited signs of differential burning, fire patterns led away from the hot box, eight of the thirty-two burned drums contained some level of EDC gas, and other similar circumstantial evidence. However, our holding that the plaintiffs must have supported their causation theory with expert testimony prohibits the jury from inferring causation based on this circumstantial evidence. Because the rules of evidence bar us from considering the plaintiffs' expert testimony and a rule of law prohibited the jury from inferring causation based on circumstantial evidence alone, there is no evidence of an essential element of the plaintiffs' negligence and manufacturing defect claims. *See City of Keller*, 168 S.W.3d at 810 (stating that no evidence exists if "the court is barred by rules of law or of evidence from giving weight to the only evidence offered to prove a vital fact"); *IHS Cedars Treatment Ctr. of DeSoto, Tex., Inc.*, 143 S.W.3d at 798 (outlining the essential elements of a negligence claim); *Ridgeway*, 135 S.W.3d at 600 (outlining the essential elements of a manufacturing defect claim). The result is the same even when viewing the evidence and possible inferences in the light most favorable to the

verdict. *See Mancorp, Inc.*, 802 S.W.2d at 228. Therefore, the trial court did not err when it granted the Gharda defendants' motion for judgment notwithstanding the verdict and entered judgment that the plaintiffs take nothing.[11]

V. Conclusion

Expert testimony must be both relevant and reliable. In this case, the plaintiffs' expert testimony was unreliable and therefore could not be considered by the jury. Without expert testimony, there is no evidence of an essential element of the plaintiffs' negligence and manufacturing defect claims. We therefore reverse the court of appeals' judgment and reinstate the trial court's judgment that the plaintiffs take nothing.

_____

Paul W. Green
Justice

OPINION DELIVERED: May 8, 2015

[11] Because we conclude that no evidence supports the jury's finding on causation, we do not address whether expert testimony was required to establish the Gharda defendants' alleged negligence or the alleged manufacturing defect. We similarly do not address whether any evidence supported the jury's findings on negligence or defect.