UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Prime Time Toys LLC, Prime Time Toys Ltd.
and Easebon Services Ltd.
Petitioners

v.

Spin Master, Inc.
Patent Owner

U.S. PATENT NOS. 8,371,282, 8,640,683, AND 8,596,255

Case No. IPR2023-01348 (‘282 Patent)
Case No. IPR2023-01339 (‘683 Patent)
Case No. IPR2023-01461 (‘255 Patent)

REBUTTAL DECLARATION OF DR. AMY COURTNEY, Ph.D., CAISS

PETITIONERS' EXHIBIT 1037
Prime Time Toys et al. v. Spin Master, Inc.
IPR2023-01348

4938-8821-7374v.1

CONTENTS

I. INTRODUCTION 1

II. BACKGROUND AND QUALIFICATIONS 2

III. COMPENSATION 5

IV. SUMMARY OF OPINIONS 5

V. THE CHALLENGED PATENTS 6

VI. SPITBALLS 8

VII. PERSON OF ORDINARY SKILL IN THE ART (POSITA) 10

VIII. MY RESPONSE TO DR. KUDROWITZ'S OPINIONS REGARDING KINETIC ENERGY 11

A. Dr. Kudrowitz Fails To Fully Consider Mr. Delman's Position 12

B. Basic Principles Of Physics Relating To Impacts 15

C. The Characteristics of Transfer of Pre-impact Kinetic Energy Of Spitballs and Paintballs To A Target Are Disparate 23

D. The Properties Of Spitballs Make Them More Likely To Reduce The Likelihood of Injury As Compared To Airsoft Ammunition 29

IX. MY RESPONSE TO DR. KUDROWITZ'S OPINIONS REGARDING AIRSOFT INJURIES 30

X. CONCLUSION 33

I, Dr. Amy Courtney, do hereby declare as follows:

I. INTRODUCTION

1. I have been retained as an expert witness on behalf of Prime Time Toys LLC, Prime Time Toys Ltd., and Easebon Services Ltd. ("Petitioners") for the above-captioned *Inter Partes* Review proceedings ("IPR") concerning U.S. Patent Nos. 8,371,282 ("the '282 Patent"), 8,640,683 ("the '683 Patent"), and 8,596,255 ("the '255 Patent"). I refer to the '282, '683, and '255 Patents collectively as "the Challenged Patents."

2. I have been asked to provide my opinions relating to issues raised in the "Declaration Of Dr. Barry Matthew Kudrowitz Regarding U.S. Patent Nos. 8,371,282, 8,640,683, And 8,596,255" (Ex. 2015). I submit this Declaration in rebuttal to Dr. Kudrowitz's Declaration.

3. I understand that the earliest alleged invention date claimed by Patent Owner in a related ITC case with Investigation No. 337-TA-1325 ("the ITC Case") involving the '282 and '683 Patents is February 21, 2010. In rendering my opinions in this Declaration, I have assumed an invention date of February 21, 2010 for the Challenged Patents.

4. In preparing this Declaration, I reviewed the Challenged Patents, scientific literature, and certain prior art.

5. In forming the opinions expressed in this Declaration, I relied upon my education, training, knowledge, and experience. I have also considered the materials specifically referenced herein. I also relied upon the expertise of Dr. Maureen Reitman regarding the chemistry and properties of super-absorbent polymers (SAPs).

II. BACKGROUND AND QUALIFICATIONS

6. I am a Senior Manager in the Biomechanics Practice at Exponent, Inc. ("Exponent"). Founded in 1967, Exponent is a multi-disciplinary engineering and scientific consulting firm that brings together more than 90 different disciplines to solve engineering, science, regulatory, and business issues facing our clients.

7. I hold a Ph.D. in Medical Engineering and Medical Physics from a joint program between Harvard University, Harvard Medical School, and the Massachusetts Institute of Technology (MIT), a M.S. in Engineering Sciences from Harvard University and a B.S. in Engineering Mechanics from Michigan State University. I am a Certified Abbreviated Injury Scale Specialist (CAISS), a Certified Pistol Instructor, I hold a High Master Classification, High Power Rifle Competition, and hold an International Defensive Pistol Association (IDPA) Safety Officer Certification. I have additional education and training in forensic shooting incident reconstruction and blood detection, documentation & collection techniques.

I regularly participate in pistol shooting competitions. I have published research pertaining to rifles and pistols as well as a variety of projectile launchers in the scientific literature.

8. At Exponent, I provide our clients with technical expertise in areas of injury biomechanics, including orthopedic, spine, and traumatic brain injury, blast injury, and ballistics. I address issues related to traumatic events, motor vehicle safety, and product safety. My ballistics expertise includes the safe operation of small arms and the internal physics, trajectories, and terminal behavior of ammunition. I have been active in research on the material and structural properties of musculoskeletal tissues in normal, aging, and disease conditions for more than 35 years and active in research in ballistics for more than 20 years.

9. In addition to my engineering training and expertise, my doctoral studies in the Harvard/MIT Division of Health Sciences and Technology included medical coursework and clinical training at Harvard Medical School. I am a certified Abbreviated Injury Scale (AIS) specialist, which is a certification related to the categorization of traumatic injury severity. My research is documented in more than 75 publications in the medical and scientific literature.

10. Prior to joining Exponent, I was a researcher in the Department of Biomedical Engineering at The Cleveland Clinic Foundation and the Orthopedic

Biomechanics Laboratory of Beth Israel Hospital and Harvard Medical School. I also held an appointment as Assistant Professor teaching physics at the United States Military Academy at West Point.

11. I have designed and conducted laboratory-based and field-based experiments, human subject testing, and testing with Anthropomorphic Test Devices (ATDs, or crash test dummies) for basic scientific purposes as well as to investigate specific situations. I have provided scientific consultation in the areas of injury mechanisms and injury tolerance, experimental design, techniques for data collection and analysis, and prototype evaluation. My work includes novel experiments and mathematical modeling of internal, external, and terminal ballistics of small arms and a variety of projectile launchers. I have collaborated in the invention and characterization of novel experimental tools and techniques for laboratory-based blast experiments.

12. I have attached a copy of my *curriculum vitae* as Appendix A. My *curriculum vitae* lists the publications that I authored in the previous 10 years and lists other cases in which, during the previous 4 years, I testified as an expert at trial or by deposition.

III. COMPENSATION

13. While I am a salaried employee of Exponent, Exponent is being compensated for my work on this matter at my customary hourly rate of $425 per hour in 2025. My compensation does not depend in any way on the contents of my Declaration or the outcome of this matter. I have no interest, financial or otherwise, in the outcome of this these IPR proceedings. I have no financial interest in, or affiliation with, any of the parties in these IPR proceedings.

IV. SUMMARY OF OPINIONS

14. As discussed herein, it is my opinion that Dr. Kudrowitz's opinion that a person of ordinary skill in the art ("POSITA") would not have been motivated to make airsoft safer by creating softer ammunition (Ex. 2015, p. 46) is not supported by and is contrary to basic principles of physics.

15. Specifically, Dr. Kudrowitz did not consider the deformation, fragmentation, and scattering of fragments of SAP projectiles. These properties play a crucial role in determining the amount of pre-impact kinetic energy that contributes to the projectile's ability to cause injury.

16. Because Spitballs "[w]ill bounce and/or explode into mushy parts on impact (depending on the force you throw them)" (Ex. 1002, p. 15), it is my opinion that prior to 2010, a POSITA would have known that SAP ammunition (Spitballs)

was a safer ammunition than hard plastic airsoft ammunition and was less likely to cause injury.

17. It is also my opinion that injuries caused by airsoft ammunition to teenagers and young adults were a problem known to the POSITA prior to 2010, as demonstrated by the literature discussed herein.

V. THE CHALLENGED PATENTS

18. The specification of the Challenged Patents defines the term "soft-projectiles" as being any projectile formed from SAP:

> The present patent document discloses and teaches projectile launching devices, such as toys, amateur guns and weaponry that ***use projectiles formed from*** a super absorbent polymer ***(SAP)***. ***As a result, the projectiles*** launched by the devices of the present patent document ***are soft-projectiles***.

(Ex. 1001 of the '683 Patent IPR, Col. 3:54-58); (Ex. 1001 of the '282 Patent IPR, Col. 3:45-49); (Ex. 1001 of the '255 Patent IPR, Col. 4:62-66).

19. The specification of the Challenged Patents explains that an advantage of SAP projectiles over paintballs is that the SAP projectiles break down under excessive pressure such that the force at impact is spread over a much wider surface area, thereby reducing the likelihood of injury:

> Further, once hydrated, the unique properties that SAP's exhibit give the ***soft-projectiles several advantages over*** current projectile materials such as ***paint balls***, plastics, and foams. For example, hydrated SAP projectiles can maintain their shape under modest pressure. The ability of SAP projectiles to maintain their shape allows them to be projected with a reasonable force and velocity without breaking apart. However, under excessive pressure, hydrated SAP projectiles will break down and lose their shape. Because SAP projectiles break down under excessive pressure, ***the force at impact is spread over a much wider surface area, thus reducing the likelihood of injury***.

(Ex. 1001 of the '683 Patent IPR, Col. 3:58-Col. 4:3); (Ex. 1001 of the '282 Patent IPR, Col. 3:49-61); (Ex. 1001 of the '255 Patent IPR, Col. 4:66-Col. 5:11).

20. The specification of the Challenged Patents explains that when hydrated, the soft-projectiles can be made to be any size, ranging from about 3 mm to 30 mm in diameter:

> ***Soft-projectiles*** made from a SAP ***can be any size***. Preferably, however, the soft-projectiles made from a SAP are between about ***3 millimeters*** (mm) and about ***15 mm in diameter when hydrated*** and more preferably between about 5 mm and 8 mm in diameter when

> hydrated. Typically, the soft-projectiles are about 1 mm or less when the SAP forming the projectile is dehydrated.
>
> Larger soft-projectiles made from a SAP are possible. For example, rounds having a diameter of ***30 mm*** have been created.

(Ex. 1001 of the '683 Patent IPR, Col. 3:58-Col. 4:3); (Ex. 1001 of the '282 Patent IPR, Col. 4:24-33); (Ex. 1001 of the '255 Patent IPR, Col. 5:41-50).

VI. SPITBALLS

21. I understand from Dr. Reitman that Spitballs are SAP projectiles. Ex. 1017, ¶56.

22. The description of Spitballs in Ex. 1002 (reproduced below) states that Spitballs are "slimy and squishy." Ex. 1002 at 15, 21. "If you throw them gently, they will bounce." *Id.* "If you throw them hard enough, they will explode into mushy pieces." *Id.* Spitballs "[w]ill bounce and/or explode into mushy parts on impact (depending on the force you throw them)." *Id.*

Spitballs start off as small hard little spheres. Soak them in water for about 4 hours (or overnight for best results) and they will absorb water and grow up to 200 times their original size. *Spitballs* are now ready for war. They are slimy and

CLICK HERE! CLICK HERE!

squishy. If you throw them gently, they will bounce. If you throw them hard enough, they will explode into mushy pieces. And here's the best part about *Spitballs*: when the war is over, collect all the whole ones and let them dry out. They will shrink back to their original state and can be reused at a later date. *Spitballs* - grow 'em and throw 'em.

Spitballs

- Will bounce and/or explode into mushy parts on impact (depending on the force you throw them).

23. The Spitballs packaging states that they "Slip, Slide, Bounce & Explode!" (See Ex. 1002, p. 18.)

VII. PERSON OF ORDINARY SKILL IN THE ART (POSITA)

24. In the ITC Case, I understand that Petitioners and Mr. Delman proposed that a POSITA at the time of the alleged invention of the ’282 and ‘683 Patents would be “(i) an individual with a Bachelor’s degree in Industrial Design or Mechanical Engineering or (ii) a toy designer with at least five years’ experience designing toys (including launchers), with both of (i) and (ii) having access to a chemist knowledgeable regarding super absorbent polymers.”

25. In the ITC Case, I also understand that Patent Owner proposed that a POSITA would have had “a bachelor’s degree in mechanical engineering, industrial design, or equivalent, with at least one year of relevant experience designing projectile launching systems but would also be a member of a team, which would include a person with a bachelor’s in materials science, chemistry, or equivalent (e.g., chemical engineering), or has at least one year experience working with materials for use in consumer products.”

26. In arriving at my opinions in this Declaration, I have considered the issues from the perspective of the hypothetical POSITA as of the February 21, 2010, alleged invention date of the Challenged Patents. My opinions do not change under either proposed definition of the POSITA.

27. In my opinion, the education and degree of a POSITA (under both parties' definitions) would have provided the POSITA with the knowledge and understanding of basic principles of physics and mechanics. The physics principles of kinetic energy, conservation of energy, the relationship between force and change in kinetic energy, momentum, and the relationship between impact force and change in momentum (an application of Newton's Second Law of Motion) are introduced in high school physics courses. In college, the physical principles and mathematical tools to consider the injury potential of small, low-velocity projectiles are taught in the first semester of college physics and in the first mechanics of materials course for engineers (e.g., Ex. 1039, Sections 5.3, 5.5, Ex.1040, section 11.7). Considering any of these basic principles - conservation of energy, Newton's Second Law of Motion, or the principles of impact mechanics - a POSITA would have been motivated to replace plastic airsoft ammunition with softer SAP (Spitballs) projectiles in airsoft guns.

VIII. MY RESPONSE TO DR. KUDROWITZ'S OPINIONS REGARDING KINETIC ENERGY

28. In opining that a POSITA would not have been motivated to replace plastic airsoft ammunition with softer SAP (Spitballs) projectiles in airsoft guns, Dr. Kudrowitz provides a lengthy discussion of (a) the kinetic energy of paintballs and Spitballs, and (b) how a POSITA would have expected that Spitballs would not

decrease the likelihood of injury, based on the pre-impact kinetic energy. (*See* Ex. 2015, ¶¶42-62.)

29. I disagree with Dr. Kudrowitz's opinions. As explained below, he did not consider key physical properties of SAP projectiles (Spitballs) that reduce the amount of pre-impact kinetic energy transferred to the impacted target in total and per unit area of contact. When these properties are properly considered, it is my opinion that a POSITA would have expected that such properties would reduce the likelihood of injury from a SAP projectile launched from an airsoft gun as compared to the more rigid plastic airsoft ammunition.

A. Dr. Kudrowitz Fails To Fully Consider Mr. Delman's Position

30. In his Declaration, Dr. Kudrowitz criticizes Mr. Delman's position as being "overly reductive softer-means-safer logic." *See* Ex. 2015, ¶¶42, 43 (reproduced below).

> 42. Mr. Delman has taken the position that "[p]rior to 2010, Spitballs were softer projectiles…that could be used in place of the hard spherical plastic ammunition [of Peev] to address the injury problem" with airsoft guns. EX1016(01348) ¶77; EX1016(01339) ¶84; EX1016(01461) ¶75. According to Mr. Delman, using Spitballs as the ammunition for the kind of airsoft gun Peev teaches would make airsoft "safer." EX1016(01348) ¶82; EX1016(01339) ¶90; EX1016(01461) ¶81. I disagree that a POSITA would have jumped to Mr. Delman's conclusion.
>
> 43. A POSITA would have understood that just because one kind of ammunition is softer than another does not mean the softer ammunition is safer. Thinking from a POSITA's perspective, it is not difficult to provide examples that disprove Mr. Delman's overly reductive softer-means-safer logic.

31. However, Dr. Kudrowitz omits and fails to consider critical language in Mr. Delman's Declaration. Specifically, Dr. Kudrowitz omits (via the ellipsis highlighted above) from Paragraph 42 (and his discussion that follows) the language highlighted in yellow below. (Ex. 1016 of the '683 Patent IPR, ¶ 85; Ex. 1016 of the '282 Patent IPR, ¶ 77; Ex. 1016 of the '252 Patent IPR, ¶ 76.)[1]

[1] For the quoted language in Paragraph 42 of his Declaration, Dr. Kudrowitz cites Paragraph 84 of Mr. Delman's Declaration for the '683 Patent and Paragraph 76 of Mr. Delman's Declaration for the '255 Patent. This is a mistake. I understand that

> 85. Prior to 2010, Spitballs were softer projectiles ("Will bounce and/or explode into mushy parts on impact." Ex. 1002, 21) that could be used in place of the hard spherical plastic ammunition to address the injury problem.

32. Dr. Kudrowitz never discusses the fact that Spitballs "[w]ill bounce and/or explode into mushy parts on impact." (*See* Ex. 2015, ¶¶ 42-62.) Further, he does not discuss the implications of this language on the issue of how much kinetic energy from a SAP projectile will be absorbed by the projectile either deforming during a "bounce" or "explod[ing] into mushy parts." *Id.* This omission is surprising, since the Challenged Patents acknowledge that "[b]ecause SAP projectiles break down under excessive pressure, the force at impact is spread over a much wider surface area, thus reducing the likelihood of injury." (Ex. 1001 of the '683 Patent IPR, Col. 3:58-Col. 4:3); (Ex. 1001 of the '282 Patent IPR, Col. 3:58-61); (Ex. 1001 of the '255 Patent IPR, Col. 5:8-11). As discussed below, the ability of SAP projectiles to deform such that the force of impact is spread over a much

---

during his deposition, Dr. Kudrowitz explained that he meant to cite Paragraph 85 and Paragraph 77 of Mr. Delman's Declarations for the '683 and '255 Patents, respectively.

wider area was well-known prior to the alleged invention date of the Challenged Patents. *See* Par. 51 *et seq.* below.

B. Basic Principles Of Physics Relating To Impacts

33. The principles for analyzing the impact between two objects predate the alleged invention date of the Challenged Patents and are not specific to the Challenged Patents. Factors that affect the damage potential of a projectile impacting a surface include its mass, velocity, size, contact area, and deformability. The overall concept of damage potential from a launched projectile is related to the way its kinetic energy is managed upon impact and to the time over which its momentum is transferred upon impact. In addition to the mechanical properties of the projectile itself, the contact or target surface has mechanical properties that will also affect how and how much of a projectile's kinetic energy and momentum are transferred during the impact interaction, and whether the energy transfer and peak force result in damage.

34. In the case of biological tissue, such as the skin or the eye, damage is called injury. Like damage in general, injury has a range of severities. Injury caused by an impact is categorized as blunt traumatic injury. Milder forms of blunt traumatic injury include abrasion, contusion, and laceration. Injury considerations for small projectiles also include risk of penetrating injuries. Increased "safety" in the realm

of projectile injuries includes reducing the severity of likely injuries as well as reducing overall injury risk. Ex. 1041 and Ex. 1042.

35. Prior to 2010, it was known to a POSITA that the damage/injury potential of a launched projectile is related to its kinetic energy. The mass and velocity of a small projectile are relevant to injury potential because the kinetic energy (KE) of a launched projectile is computed as one half its mass, m, times the square of the velocity, v ($KE = 0.5mv^2$).

36. Energy is a physical quantity that is conserved – it is neither created nor destroyed. In an impact from a projectile onto a surface, its pre-impact kinetic energy may be transferred to the target, absorbed by the projectile, or converted into another form of energy, such as heat. Energy can be absorbed by deformation (elastic or permanent) and by the creation of fracture surfaces (damage – such as tearing, cracking, fragmenting) in the projectile and/or the target. These are basic physical properties that were well known to a POSITA prior to the alleged date of invention of the Challenged Patents.

37. Prior to 2010, it was known to a POSITA that the damage/injury potential of a launched projectile is also related to its momentum. The mass and velocity of a small projectile are relevant to injury potential because the momentum (p) of a launched projectile is computed as its mass, m, times the velocity, v ($p = mv$).

38. Momentum is another physical quantity that is conserved. When a moving object impacts a surface, it slows or comes to a stop over a short period of time. Based on Newton's Second Law of Motion, the change in momentum over time is equal to the force applied ($F_{net} = \Delta p/\Delta t$). This is a vector (three-dimensional) equation; however, for an in-line collision prior to any fragmentation, it can be treated as a one-dimensional equation. This equation makes it clear that increasing the time over which a projectile's momentum is transferred to the target decreases the peak force. A softer impact increases the time over which momentum is transferred and decreases the peak force. Ex. 1039, Section 6.2.

39. Dr. Kudrowitz is critical of Mr. Delman's so-called "overly reductive softer-means-safer logic." However, when all other variables are held constant, softer is safer, meaning injury potential is reduced. Dr. Kudrowitz himself presents what may be termed a reductive "heavier means less safe" logic. *See, e.g.*, Ex. 2015, ¶62. Again, when all other variables are held constant, heavier is less safe, meaning injury potential is increased. But the projectiles being considered in these IPR proceedings vary in more ways than one.

40. When seeking to reduce the injury potential of a launched projectile, basic principles of physics require that factors affecting the transfer of energy to the

skin or eye be considered, and that factors affecting the time over which an impact occurs also be considered.

41. The contact area of a small projectile is also important to injury risk. It has been demonstrated that the tolerance of biological tissues to impacts from projectiles that are much stiffer than tissue (such as plastic or metal) is well characterized by the kinetic energy transferred per unit area of contact. Ex. 1041 and Ex. 1042. In the toy projectile launcher industry, this quantity is referred to as Kinetic Energy Density. Ex. 1043, p. 30.

42. Deformability and frangibility (how easily something breaks apart) are also factors that affect the management of a projectile's pre-impact kinetic energy upon impact and the rate of transfer of pre-impact momentum (peak force). In his Declaration, Dr. Kudrowitz does not consider the influence of relative deformability of the SAP projectiles compared to the impact surface on injury risk. As discussed above, Dr. Kudrowitz omits the critical language in Mr. Delman's Declaration that Spitballs "[w]ill bounce and/or explode into mushy parts on impact." *See* Ex. 2015, ¶42.

43. Other variables held constant, the softer or more frangible the projectile material is compared to the target material, the more energy the projectile itself will absorb on impact, whether through deformation, elastic (e.g., bounce) or permanent,

and/or fracture (e.g., explode into mushy parts). There are two ways this behavior will reduce injury potential based on conservation of energy, other factors being held constant. One way is that some of the kinetic energy at impact is absorbed by the projectile itself through deformation and/or fragmentation, so that less of the pre-impact kinetic energy is transferred to the target. A second way a softer projectile will reduce injury potential is by increasing the contact area with the target surface as it deforms, thereby reducing the kinetic energy transferred per unit area. These are basic physical principles that Dr. Kudrowitz does not discuss in his Declaration.

44. Quantitative measurements demonstrating that a deformable tip on a launched toy projectile reduced the peak force and transfer of kinetic energy to the target surface were published in the scientific literature at least as early as 1979 (though the physics principles involved go back to the time of Isaac Newton). Ex. 1044. In this early research assessing the eye injury potential of propelled objects, Berger observed further that a "completely flexible missile" would bend on impact, and the energy expended in bending was no longer available to be applied to the target, thus reducing the maximum force compared to a similar but rigid projectile. *Id.*, p. 17.

45. The reduction of injury potential by using a softer, deformable projectile tip was contemplated in Dr. Kudrowitz's own master's thesis work co-authored and published in 2006, in which he designed new launcher toy concepts for Hasbro (Ex. 1043). Dr. Kudrowitz's thesis discusses "non-rigid (i.e., including resilient tipped) projectiles" but his declaration in these IPRs fails to discuss the fact that Spitballs are resilient ("Will bounce").

Chapter 1

Introduction

1.1 Objective

The goal of this research was to apply the product design process to develop new projectile toy technologies. The developed products were required to fit within one of Hasbro®'s current lines of projectile toys; Nerf® and Super Soaker®. Nerf® is a product line which incorporates foam plastic and Super Soaker® is a product line which involves high performance pressurized water guns. The products were required to meet all safety specifications and regulations provided by the sponsor company Hasbro® Incorporated. An emphasis was placed on the development of a technology that was capable of being applied to a variety of toys.

2.3 Standards and Safety

In designing projectile toys, standards are needed to minimize any potential for injury (especially eye injury), while maintaining the traditional (or expected) play value of the toy. The sponsor provided a detailed listing of all safety specifications for projectiles in a document entitled, "Corporate Quality Assurance, Safety and Reliability Specification, SRS-045, Projectiles" [1]. This document addresses the various structural characteristics and kinetic parameters of projectiles used on Hasbro® products. Only applicable clauses of this document will be referred to in this Standards and Safety section. The full Safety and Reliability Specifications can be found in Appendix A.

Kinetic Energy and Kinetic Energy Density

Projectiles fired from a toy with a kinetic energy exceeding .08 *Joules* must have an impact surface (tip) of a resilient material. Resilient tips have a Shore A durometer rating that is under 55. The Kinetic Energy Density (KED) must be determined for all projectiles exceeding a kinetic energy of .08 *Joules*. The Kinetic Energy Density (expressed in *Joules/area*) is the kinetic energy of the projectile divided by its contact area. The Kinetic Energy Density of a projectile must not exceed 1600 J/m^2.

SRS-045
PAGE 9 OF 12
REVISION G

5.8 Projectile Kinetic Energy Density

The projectile kinetic energy density must be determined on all projectiles with a kinetic energy greater than .08joule. The Projectile Kinetic Energy Density is the kinetic energy of the projectile divided by its contact area. On non-rigid (i.e. including resilient tipped) projectiles the contact area is measured by applying a suitable staining agent (e.g. Prussian Blue) to the projectile, firing it at a suitable surface 1 foot away and measuring the area of the residual impression. Area is determined by the following:

Radius in meters: Area = $\prod r^2$
Radius in inches: Area = $.0006452 \prod r^2$

The kinetic energy density is expressed as joules/area.

Id., pages 19, 29, 30, and 148 as numbered in original.

46. Many examples of fragmentation reducing damage potential are known. Consider bullets fired from a pistol. There is a class of bullets referred to as frangible bullets. While these bullets, launched from the same firearms at similar velocities as typical bullets, will penetrate biological tissue, they are designed to break apart into small pieces (and absorb energy by creation of fracture surfaces) upon striking a hard target. Ex. 1045. Frangible bullets are intended to reduce the damage potential to hard targets and/or to reduce the ricochet or secondary penetration potential of the projectile. Situations where this reduction in damage potential is desirable include shooting steel targets at close range during training, police or military actions in close quarters or urban areas to avoid collateral injury,

aboard aircraft or watercraft, or in environments where hazardous material could be exposed by damage to a container.

47. The concept of decreasing the applied force, and thus the injury risk, by increasing the interaction time between a launched projectile and an impact surface is basic, predates the alleged invention date of the Challenged Patents, and was known to a POSITA. Ex. 1039, Section 6.2. Because a softer projectile deforms during impact, it comes to a stop over a longer period of time than a similar hard projectile. Based on Newton's Second Law of Motion, with other variables held constant, a softer projectile will apply a lower force to the target.

48. Many examples of a softer impact reducing injury potential are known. In reverse, this is a principle utilized by padding in protective sports equipment, soft body armor, and airbags in automobiles, as well as the recommendation to wear loose, thick clothing when participating in paintball competitions. It is also the concept behind moving one's hands with the ball when catching a fast-moving ball to reduce injury potential compared to catching it stiff-armed. Increasing the time over which an object's momentum is transferred on contact reduces the peak applied force. Ex. 1039, Section 6.2.

49. A reduction in applied force can similarly be achieved by increasing the softness of the projectile itself. Consider a person jumping from a height of 1 m onto

a concrete floor. In this example, the human body is the projectile being accelerated by gravity. The peak force upon landing is higher if the person jumps stiff-legged compared to landing with the hip, knee, and ankle joints flexed, in part because the time over which the body slows down is shorter in the stiff-legged position. Landing with these joints flexed permits further flexion during the impact, increasing the landing time and decreasing the peak force. (In addition, landing with the joints of the lower extremities flexed allows the soft tissues of the body to contribute to energy absorption through deformation, as discussed above.) Ex. 1039, Section 6.2.

50. When considering other launched projectiles, basic physical concepts teach that a softer, more frangible projectile will reduce damage/injury potential upon impact because 1) less of the projectile's initial kinetic energy is transferred to the target per unit area compared to an otherwise similar but harder and/or intact projectile, and 2) the increased stopping time for a softer projectile reduces the peak impact force. These concepts predate the alleged invention date of the Challenged Patents and were known to a POSITA.

C. The Characteristics of Transfer of Pre-impact Kinetic Energy Of Spitballs and Paintballs To A Target Are Disparate

51. Super absorbent polymer (SAP) beads have been studied for a variety of applications in physics and engineering. The mechanical properties of SAPs can be altered by changes in polymer chemistry. The softness/deformability as well as

the strength/frangibility are readily manipulated. In general, SAPs deform on impact with stiffer surfaces. In fact, nominally spherical, hydrated SAPs can deform to a nearly pancake shape on contact, increasing the contact diameter to approximately twice the nominal sphere diameter (*e.g.*, Ex. 1046, Figure 1).

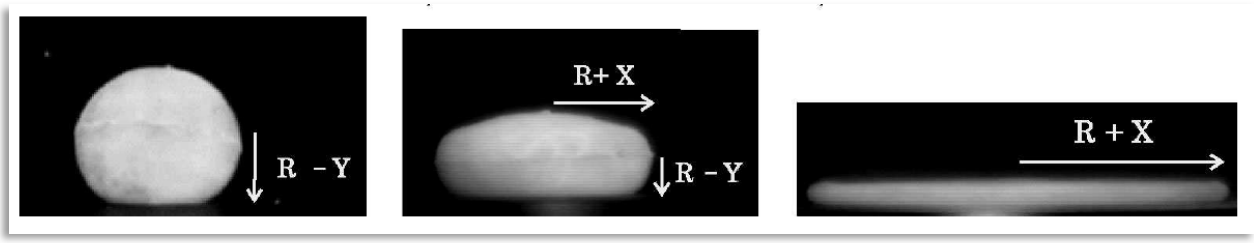

Figure 1. Deformation of a hydrogel (SAP) sphere on a hard surface (Tanaka 2003). R = nominal radius of undeformed hydrogel (SAP) sphere.

52. The deformation of a SAP on contact with human skin or the eye will reduce the amount of its kinetic energy per unit area that is transferred to the tissue, thus reducing injury potential compared to a similar, nondeforming projectile. In addition, SAPs used in launchers are frangible (e.g., explode into mushy parts); when they fragment on contact, additional kinetic energy is dissipated, further reducing injury potential. A third consideration is what happens to the fragments. The fragments (e.g., mushy parts) scatter with some velocity, dissipating even more of the initial kinetic energy. Each of these mechanisms of energy dissipation is grounded in basic principles of physics that were known to the POSITA prior to the alleged invention date of the Challenged Patents.

53. Among the small projectiles described in Dr. Kudrowitz's Declaration (see Ex. 2015, ¶¶47-50), paintballs have some unique features that warrant further discussion. While paintballs of smaller diameter can be purchased, typical paintballs are 14 mm in diameter and comprise a gelatin shell filled with polyethylene glycol fluid (the "paint"). A typical mass for this size paintball is about 3 grams. Participants in paintball games/sports typically utilize eye/face protection and wear loose clothing with thick fabric and/or padding to help absorb the impact energy and increase the stopping time of the projectile.

54. Paintballs typically have much higher kinetic energy than the other projectiles described in Dr. Kudrowitz's declaration (see Ex. 2015, ¶¶47-50) because they are heavier. Ex. 1047, Table 3. Even though they have larger cross-sectional areas, the kinetic energy per unit area is still larger for paintballs than for airsoft pellets at typical launch velocities. Paintballs are designed to rupture on impact to reduce the risk of a penetrating bodily injury. Nevertheless, the force of the impact can cause significant bruising and laceration to the skin and serious damage to the eye. Ex. 2118, Ex. 1047. This is acknowledged by Dr. Kudrowitz in his declaration. See Ex. 2015, ¶¶50-57. While the shell of the paintball ruptures or splits open on impact, the bolus of liquid acts like a unit and still delivers much of the kinetic energy to the target surface.

55. In contrast to paintballs, hydrated SAPs (e.g., Spitballs) do not behave like a bolus of liquid. I understand from Dr. Reitman that in a SAP, water is co-located with the polymer (the polymer and the water form a gel). When a SAP is cut in two, each piece is still a SAP. When a SAP ball shatters upon impact, water molecules remain co-located within the polymer fragments (i.e., the shattered SAP remains a gel). When a SAP ball shatters upon impact, water molecules remain co-located within the polymer fragments (i.e., the shattered SAP remains a gel). As such, a POSITA would not have considered hydrated SAP balls (Spitballs) to be "liquid-filled" projectiles. I understand from Dr. Reitman that this would have been known to the chemist that the POSITA had access to.

56. As described above, some of the kinetic energy of a SAP (e.g., Spitballs) is used to deform (e.g., bounce) the SAP, some of the kinetic energy is used in the fragmentation of the SAP (e.g., into mushy pieces), and therefore less kinetic energy is transmitted to the impacted surface. Further, when a SAP strikes a surface, the fragments do not stop on the surface like paint in a paintball. Rather, the SAP fragments scatter, dissipating additional kinetic energy. Kinetic energy that is mitigated in these ways – deformation, fragmentation, and scattering of fragments – is not transmitted to the skin or eye, thus reducing the injury potential compared to projectiles with similar kinetic energy but that do not deform, fragment, or scatter.

Further, because the SAP deforms during the impact, the impact time is increased, decreasing the applied force compared to a similar harder projectile. These are basic physical principles that were known to a POSITA prior to the alleged invention date of the Challenged Patents.

57. Dr. Kudrowitz's analysis does not discuss how the transfer of kinetic energy or of momentum of SAP projectiles is mitigated by deformation, fragmentation, and scattering of fragments. Dr. Kudrowitz's analysis also does not discuss how deformation, fragmentation, and scattering of fragments of SAP projectiles reduce the injury potential compared to projectiles with similar kinetic energy but that do not deform, fragment, or scatter. Further, Dr. Kudrowitz's kinetic energy calculations do not account for the deformation, fragmentation, and scattering of fragments of SAP projectiles.

58. The contact surfaces of the small, hard projectiles (hard plastic airsoft balls) discussed by Dr. Kudrowitz are much stiffer than the eye or the skin, so that these projectiles do not significantly deform or fracture on contact. Therefore, differences among these small, hard projectiles in the transfer of energy to the eye or skin, and the corresponding injury potential, result from differences in contact area, mass, and/or velocity.

59. However, in the case where the deformability and frangibility of the projectile (e.g., Spitballs) are comparable to or more than the deformability and frangibility of the eye (or skin, or other biological tissue), some of the kinetic energy at impact will be absorbed by the projectile through deformation (elastic or permanent) and/or fragmentation. In addition, deformation of the projectile increases the contact surface area, thus decreasing the kinetic energy per unit contact area and thus further reducing injury potential. Dr. Kudrowitz's analysis does not account for these energy dissipation mechanisms.

60. Further, deformation of a softer projectile increases the time over which its momentum is transferred to the contact surface, decreasing the peak applied force. Dr. Kudrowitz's analysis does not account for this force reduction mechanism.

61. Dr. Kudrowitz does not consider the deformation, fragmentation, and scattering of fragments of SAP projectiles. He merely calculates the kinetic energy of hydrated 15.24 mm diameter Spitballs (Ex. 2015, ¶¶59, 62) and then compares his kinetic energy calculations to those of paintballs. Based on this comparison, he concludes incorrectly that a POSITA would assume that Spitballs are not a safer form of ammunition than hard plastic airsoft ammunition (*id.*, ¶¶42-62).

62. Because Dr. Kudrowitz does not consider the deformation, fragmentation, and scattering of fragments of SAP projectiles, it is my opinion that

his opinion suffers from lack of consideration of the most basic principles of physics and is not the product of reliable scientific principles and methods.

63. Because Spitballs bounce and explode into mushy parts on impact, it is my opinion that a POSITA would have readily concluded that SAP ammunition (Spitballs) was a safer ammunition than hard plastic airsoft ammunition.

D. The Properties Of Spitballs Make Them More Likely To Reduce The Likelihood of Injury As Compared To Airsoft Ammunition

64. Airsoft ammunition is made of rigid plastic spheres and does not shatter, fragment or break apart when it strikes a target. Further, because of its rigid plastic surface, there is no significant deformation of the airsoft ammunition when it strikes biological tissue such as skin or the eye. Ex. 1048. As a result, in contrast to Spitballs, most of the kinetic energy of the airsoft ammunition is transmitted to the target that it strikes, and relationships developed through research between pre-impact kinetic energy, cross-sectional area, and injury risk apply. Ex. 1042.

65. Although Dr. Kudrowitz does not discuss any of these properties of rigid plastic airsoft ammunition, Patent Owner in these IPR proceedings does acknowledge that "it was known that airsoft guns could cause injuries." (Paper 19 at p. 13.) Dr. Kudrowitz explains that airsoft ammunition can cause a "non-trivial amount of pain" that is even "felt through clothing/gear." (Ex. 2015, ¶83.) Dr.

Kudrowitz further explains that it is important for the airsoft ammunition to "mimic[]—to a lesser degree—the impact of an ammunition round." (*Id.*, ¶82.)

66. The fact that rigid plastic airsoft ammunition causes injury at typical launch velocities is not surprising. This is in contrast to Spitballs, which was less likely to cause injury because of the deformation, fragmentation, and scattering of fragments of SAP projectiles on impact.

IX. My Response To Dr. Kudrowitz's Opinions Regarding Airsoft Injuries

67. Although Dr. Kudrowitz agrees that hard projectiles from airsoft guns cause injuries, he contends that these injuries were not a problem that needed solving. However, as discussed below, Dr. Kudrowitz's opinions are contrary to the literature.

68. ***First,*** Dr. Kudrowitz seeks to disregard the injuries caused by airsoft ammunition because in his view, such injuries are "trivial" and "minor" and are not "significant" enough "to result in hospitalization." (Ex. 2015, ¶¶ 45, 50, 78, 84, 85). As discussed below, the literature shows that the POSITA knew prior to 2010 that injuries (both significant and less significant) caused by airsoft ammunition were a problem.

69. ***Second,*** Dr. Kudrowitz discusses a 2005 report from the California Senate Office of Research stating that "paintball guns . . . have sent a rising number

of targeted victims to hospital emergency rooms." (Ex. 2015, ¶51, *citing* Ex. 1019.) Dr. Kudrowitz goes on to say that the "report does not make the same claim about airsoft, nor does it mention airsoft injuries of any kind." *Id*. (underline in original). However, Dr. Kudrowitz then cites to another report that indicates that airsoft gun injuries resulted in 7.0% of hospital admissions for "Nonpowder Firearm Injuries". (Ex. 2015, ¶50, *citing* Ex. 2118.) Other literature (discussed below) demonstrates that the POSITA knew prior to 2010 about the injury problem being caused by airsoft ammunition.

70. ***Third,*** Dr. Kudrowitz asserts that there were only two uses of airsoft guns, namely, military/police training and military-simulation airsoft games. (Ex. 2015, ¶30.) According to Dr. Kudrowitz, the injuries caused in these airsoft activities were "necessary" and therefore were not a problem. However, as discussed below, Dr. Kudrowitz ignores another population who used airsoft guns, namely, teens and young adults. The literature discussed below demonstrates that the POSITA knew prior to 2010 that teens and young adults were being injured by airsoft ammunition and that this was a problem.

71. Contrary to Dr. Kudrowitz's opinions, prior to 2010, there was a problem that airsoft ammunition was causing injuries (both significant and less significant) in teenagers. An article published in 1999, entitled "Ocular Injuries

Caused by Airsoft Guns," summarized eye injuries from airsoft projectiles in nine boys, age 11 to 17 years old. Ex. 1048. The authors were motivated to write the article due to treating "an escalating number of ocular injuries caused by 'airsoft' or 'softgun' toy weapons." *Id.*, p. 1437.

72. As discussed in an article entitled "Ball Bearing (BB) Gun Injuries", "Although most BB guns fire ***low-velocity*** missiles, some can still shoot to ***penetrate the abdomen, thorax, facial sinuses and even the cranium***. A ***pellet*** with a velocity of ***45 m/s*** [i.e., 148 fps] can penetrate human skin and a velocity reaching ***60 m/s*** [i.e., 197 fps] can fracture bone."). Ex. 1033 at p. 490, citing articles from 1986, 1995, 1996 and 2004. This article explains that (1) airsoft guns are a "new type of BB gun" (p.489) and (2) "[m]ost BB pellets are made of plastic" (p.490).

73. Contrary to Dr. Kudrowitz's assertion that some may consider some airsoft guns to be toys, the toy nomenclature is not determinative when it comes to possible injury. "Although considered toys by most, these [airsoft] weapons have been associated with serious injuries." Ex.1034 at p. 402. Further, the characterization of airsoft guns as toys is not universal. "BB and pellet [airsoft] guns are more than toys." Ex. 1033 at p. 491. "You can't give a kid an airsoft for Christmas and tell him to go out and play with it. It's not a toy." Ex. 1032, p. 2.

X. CONCLUSION

74. Dr. Kudrowitz's opinion that a POSITA would not have been motivated to make airsoft safer by creating softer ammunition (Ex. 2015, see heading on p. 46) is not supported by and is contrary to basic principles of physics.

75. Dr. Kudrowitz does not consider the deformation, fragmentation, and scattering of fragments of SAP projectiles. These properties play a crucial role in determining the amount of kinetic energy that contributes to the projectile's ability to cause injury.

76. Because Spitballs "[w]ill bounce and/or explode into mushy parts on impact (depending on the force you throw them)" (Ex. 1002, p. 15), it is my opinion that prior to 2010, a POSITA would have known that SAP ammunition (Spitballs) was a safer ammunition than hard plastic airsoft ammunition and was less likely to cause injury.

77. It is also my opinion that injuries caused by airsoft ammunition to teenagers and young adults were a problem known to the POSITA prior to 2010, as demonstrated by the literature discussed herein.

78. I hereby declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct, and that all statements made of my own knowledge are true and that all statements made on information and belief

are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: February 26, 2025

Amy Courtney, Ph.D., CAISS

APPENDIX A

Exponent®
Engineering & Scientific Consulting

Amy Courtney, Ph.D., CAISS

Senior Manager | Biomechanics
Tampa
+1-678-412-4811 | acourtney@exponent.com

Professional Profile

Dr. Courtney provides technical expertise in the area of injury biomechanics, including orthopaedic, spine, and traumatic brain injury, blast injury, and ballistics. She addresses issues related to traumatic events, motor vehicle safety, and product safety. Dr. Courtney's ballistics expertise includes the safe operation of small arms and the internal physics, trajectories, and terminal behavior of ammunition. She has been active in research on the material and structural properties of musculoskeletal tissues in normal, aging, and disease conditions for more than 35 years.

In addition to her engineering training and expertise, her doctoral studies in the Harvard/MIT Division of Health Sciences and Technology included medical coursework and clinical training at Harvard Medical School. She is also a certified Abbreviated Injury Scale (AIS) specialist. Her research is documented in more than 75 publications in the medical and scientific literature.

Prior to joining Exponent, Dr. Courtney was a researcher in the Department of Biomedical Engineering at The Cleveland Clinic Foundation and the Orthopedic Biomechanics Laboratory of Beth Israel Hospital and Harvard Medical School. She also held an appointment as Assistant Professor teaching physics at the United States Military Academy at West Point.

Dr. Courtney has designed and conducted laboratory-based and field-based experiments, human subject testing, and testing with Anthropomorphic Test Devices (ATDs, or crash test dummies) for basic scientific purposes as well as to investigate specific situations. She has provided scientific consultation in the areas of injury mechanisms and injury tolerance, experimental design, techniques for data collection and analysis, and prototype evaluation. Her work includes novel experiments and mathematical modeling of internal, external, and terminal ballistics of small arms. She collaborated in the invention and characterization of novel experimental tools and techniques for laboratory-based blast experiments.

Academic Credentials & Professional Honors

Ph.D., Engineering Sciences, Harvard University, 1994

M.S., Engineering Sciences, Harvard University, 1991

B.S., Engineering Mechanics, Michigan State University, 1989

Department of the Army, Commander's Award for Public Service

International Society of Biomechanics Promising Scientist Award

National Science Foundation Graduate Fellow

© 2024 Exponent, Inc. All Rights Reserved

MSU Alumni Distinguished Scholar

Licenses and Certifications

Certified Abbreviated Injury Scale Specialist (CAISS)

Certified Pistol Instructor

High Master Classification, High Power Rifle Competition

IDPA Safety Officer Certification

Professional Affiliations

American Society for Bone and Mineral Research

Association for the Advancement of Automotive Medicine (AAAM), Scientific Program Committee

International Ballistics Society, Senior Member

Publications

Biomechanics and Injury Mechanisms

Courtney A, Crosby C, Miller B, Osterhout A, Walker J, Gondek J. Effects of anthropometry and passive restraint deployment timing on occupant metrics in moderate-severity offset frontal collisions. SAE Technical Paper 2024-01-2749.

Sharpe S, Grijalva S, Allin L, Courtney A, et al. Evaluation of occupant kinematics and kinetics during moderate severity simulated frontal impacts with and without frontal airbag deployment. SAE Technical Paper 2023-01-0559.

Parenteau C, Courtney A, Campbell I, and Lau E. An update on front-seat occupant injury rates in frontal crashes: focus on modern vehicles. IRCOBI, September 8-10, 2021; Paper No. IRC-21-50.

Kirschman J, Pokutta-Paskaleva A, Courtney A, Courtney M. Blast pressures and waveforms of consumer firecrackers. Shock Waves 2021; 31:301-306.

Parenteau C, Lau E, Campbell I, Courtney A. "Prevalence of spine degeneration diagnosis by type, age, gender, and obesity using Medicare data" Nature: Scientific Reports 2021; DOI 10.1038/s41598-021-84724-6.

Pasquesi SA, Bruno A, Courtney A, Imler SM et al. Risk of concussion in low- to moderate-speed frontal and rear end motor vehicle collisions evaluated using head acceleration-based metrics. SAE Technical Paper 2019-01-1218, 2019.

Courtney A, Campbell IC, Courtney E, and Pasquesi SA. Risk of concussion due to head acceleration in rear impact sled tests of passenger automobile seats. Traffic Injury Prevention 2018; 19(S2):S133-S135

Courtney A, Courtney M. The complexity of biomechanics causing primary blast-induced traumatic brain injury: a review of potential mechanisms. Frontiers in Neurology 2015; 6:221, -.

Courtney A, Corrigan C, Steffey D. Letter to the Editor regarding Bajaj D, et al., The resistance of cortical bone tissue to failure under cyclic loading is reduced with alendronate. Bone 2014; 64:57-64.

Courtney A, Berg A, Michalke G, Courtney M. A history of blast exposure may affect the transmission properties of cranial bone. Experimental Mechanics 2013; 53(2):319-325.

Courtney M, Courtney A. History and evidence regarding hydrostatic shock. Neurosurgery 2011; 68(2):E596-E597.

Courtney M, Courtney A. Working toward exposure thresholds for blast-induced traumatic brain injury: Thoracic and acceleration mechanisms. NeuroImage 2011; 54:S55-S61.

Courtney A, Courtney M. Physical mechanisms of soft tissue injury from penetrating ballistic impact. Defense Technology Information Center 2012; ADA570804.

Courtney A, Courtney M. A thoracic mechanism of mild traumatic brain injury due to blast pressure waves. Medical Hypotheses 2009; 72(1):76-83.

Courtney A, Courtney M. Links between traumatic brain injury and ballistic pressure waves originating in the thoracic cavity and extremities. Brain Injury 2007; 21:657-662.

Courtney M, Courtney A. Apparent measurement errors in "Development of biomechanical response corridors in the thorax to blunt ballistic impacts." Journal of Biomechanics 2007; 41:486-487.

Perusek G, Davis B, Courtney A, D'Andrea S. An extensometer for global measurement of bone strain suitable for use in vivo in humans. Journal of Biomechanics 2001; 34:385-391.

Courtney A, Davis B, Manning T, Kambic H. Effects of age, density and geometry on the bending strength of human metatarsals. Foot & Ankle International 1997; 18(4):216-221.

Hayes W, Myers E, Robinovtich S, Van Den Kroonenberg A, Courtney A, McMahon T. Etiology and prevention of age-related hip fractures. Bone 1996; 18(1) Supplement.

Courtney A, Hayes W, Gibson L. Age related differences in post-yield damage in human cortical bone—Experiment and model. Journal of Biomechanics 1996; 29(11):1463-1471.

Courtney A, Wachtel E, Myers E, Hayes W. Age-related reductions in the strength of the femur tested in a fall-loading configuration. Journal of Bone and Joint Surgery 1995; 77-A(3):387-396.

Bouxsein M, Courtney A, Hayes W. Ultrasound and densitometry of the calcaneus correlate with the failure loads of cadaveric femurs. Calcified Tissue International 1995; 56(2):99-103.

Courtney A, Wachtel E, Myers E, Hayes W. Effects of loading rate on strength of the proximal femur. Calcified Tissue International 1994; 55:53-58.

Courtney A, Myers E, Wachtel E, Hayes W. Multiple angle and anteroposterior dual energy x-ray absorptiometry predict femoral strength in vitro. J Bone Miner Res 1996; 8(Supp 1):S350.

Haut RC, [Courtney] Powlison AC. The effects of test environment and cyclic stretching on the failure properties of human patellar tendons. Journal of Orthopaedic Research 1990; 8(4), 532-540.

Haut, RC, [Courtney] Powlison AC, Rutherford, GW, Kateley JR. Order of irradiation and lyophilization on the strength of patellar tendon allografts. Trans Orthop Res Soc 1989; 14(514):.

[Courtney] Powlison, AC, Haut, RC. Effects of testing environment and cyclic loading on mechanical properties of human patellar tendon. 13th Annual Mtg. Amer. Soc. Biomech. August 23-25, 1989.

Haut RC, [Courtney] Powlison AC, Rutherford OW, Kateley JR. Some effects of donor age and sex on the

mechanical properties of patellar tendon graft tissues. ASME Adv Bioeng 1988;, 8:75-78.

Ballistics and Blast

Courtney E, Andrusiv L, Courtney A, Courtney M. Quantifying handgun recoil with high-speed video. Proceedings of the 32nd International Symposium on Ballistics, pp. 670-678, May 2022

Courtney E, Courtney A, Courtney M. Comparing lead-based (CCI 41) and lead-free (Ruag SINTOX) primer performance in 5.56 mm NATO. Proceedings of the 32nd International Symposium on Ballistics, pp. 441-445, May 2022

Courtney J, Courtney A, and Courtney M. Laboratory simulation of underwater blast waves by high speed water entry. Proceedings of the 32nd International Symposium on Ballistics, pp. 63-68, May 2022

Courtney E, Courtney A Andrusiv L, Courtney M. Clear Ballistics Gel ®: Retarding force analysis of paraffin-based alternative to gelatin-based lead-free bullet testing. Proceedings of the 30th International Symposium on Ballistics, September 2017.

Courtney ER, Courtney A, Courtney M. External ballistics and accuracy of lead free bullets in 5.56 x 45 mm NATO. Proceedings of the 30th International Symposium on Ballistics, September 2017.

Courtney ER, Courtney A, Couvillion R, Courtney M. Effects of sound suppressors on muzzle velocity, bullet yaw, and drag. Proceedings of the 30th International Symposium on Ballistics, September 2017.

Courtney E, Courtney A, Andrusiv L, Courtney M. Experimental studies of terminal performance of lead-free pistol bullets in ballistic gelatin using high speed video. Investigative Sciences Journal 2017; 9(1):1-18.

Courtney E, Courtney AC, Andrusiv LP, Courtney MW. Experimental test of the acoustic impedance model for underwater blast wave transmission through plate materials. J Engineering Mechanics 2017; 143(4):06017001.

Courtney E, Courtney A, Courtney M. Device for underwater laboratory simulation of unconfined blast waves. Review of Scientific Instruments 2015; 86:066103.

Kabu S, Jaffer H, Petro M, Dudzinski D, Stewart D, Courtney A, Courtney M, Labhasetwar V. Blast-associated shock waves result in increased brain vascular leakage and elevated ROS levels in a rat model of traumatic brain injury. PLoS ONE 2015; 10(5):e0127971.

Courtney E, Courtney A, Courtney M. Shock tube design for high intensity blast waves for laboratory testing of armor and combat materiel. Defence Technology 2014; 10(2):245-250.

Courtney M, Courtney ER, Courtney A, Summer PD. Performance testing of lead free primers: Blast waves, velocity variations, and environmental testing. Paper #160, 28th International Symposium on Ballistics, Atlanta, GA, September 22-26, 2014.

Courtney M, Courtney ER, Courtney A. Experimental tests of the proportionality of aerodynamic drag to air density for supersonic projectiles. Paper #159, 28th International Symposium on Ballistics, Atlanta, GA, September 22-26, 2014.

Courtney AC, Andrusiv LP, Courtney MW. A test of the acoustic impedance model of blast wave transmission. Journal of Battlefield Technology 2013; 16(3):1-4.

Gaylord S, Blair R, Courtney M, Courtney A. Bullet retarding forces in ballistic gelatin by analysis of high

speed video. Cornell University Library, Medical Physics, 2013.

Sherrill M, Powers R, Courtney A, Courtney M. Relative armor penetration of jacketed lead, solid copper, solid brass and steel core bullets. Defense Technology Information Center 2012; ADA567525.

Courtney M, Courtney A. Ballistics of the 30-06 rifle cartridge. Defense Technology Information Center 2012; ADA570469.

Courtney ER, Courtney A, Courtney W. Detecting pitch and yaw and in-flight damping with optical chronographs. Defense Technology Information Center 2012; ADA570911.

Her H, Courtney A, Courtney M. Quantifying momentum transfer due to blast waves from oxy-acetylene driven shock tubes. Defense Technology Information Center 2012; ADA564113.

Courtney EDS, Courtney A, Courtney M. Blast wave transmission through transparent armour materials. Journal of Battlefield Technology 2012; 15(2):19-22.

Courtney A, Andrusiv L, Courtney M. Oxy-acetylene driven laboratory scale shock tubes for studying blast wave effects. Review of Scientific Instruments 2012; 83:045111.

Courtney M, Courtney A. Using sound of target impact for acoustic reconstructions of shooting events. Medicine, Science, and the Law 2012; 52(2):89-92.

Courtney M, Courtney A. Comparing blast pressure variations of lead styphnate based and diazodinitrophenol based primers. Weapons Systems Technology Information Analysis Center (WSTIAC) Journal 2011; 11(2):3-5.

Courtney M, Courtney A. A table-top blast driven shock tube. Review of Scientific Instruments 2010; 81(12):126103.

Courtney M, Courtney A. Comments on "Ballistics: A Primer for the Surgeon." Injury 2008; 39(8):9654-9655.

Courtney M, Courtney A. A method for testing bullets at reduced velocity. Cornell University Library, Medical Physics, 2008.

Quantitative Fisheries Science

Courtney J, Courtney A, Courtney M. Nutrient loading increases red snapper population in the western Gulf of Mexico. Hypotheses in the Life Sciences 2013; 1:7-14.

Courtney J, Courtney A, Courtney M. Do rainbow trout and their hybrids outcompete cutthroat trout in a lentic ecosystem? Fisheries and Aquaculture Journal 2013; FAJ-78.

Courtney J, Courtney A, Courtney M. Estimating interaction strengths with correlations in annual relative weight: interspecific competition and predation in fishes, Pueblo Reservoir, Colorado. Cornell University Library, Populations and Evolution, 2013.

Courtney J, Klinkmann T, Courtney A, Torano J, Courtney M. Relative condition factors of fish as bioindicators one year after the Deepwater Horizon oil spill. Defense Technology and Information Center 2012; ADA564207.

STEM (Science, Technology, Engineering and Mathematics) Education

Courtney A, Courtney M. Illuminating Fourier series with audacity. Cornell University Library, Physics Education, 2012.

Courtney M, Courtney A. Science and math education: Who is the customer? Cornell University Library, Physics Education, 2012.

Courtney M, Slusher T, Courtney A. EI Videos. Mathematica Militaris, April 2012.

Courtney M, Courtney A. Measuring thrust and predicting trajectory in model rocketry. Cornell University Library, Popular Physics, 2009.

Courtney M, Courtney A. Comments regarding "On the Nature of Science." Physics in Canada 2008; 64:3.

Courtney M, Courtney A. Acoustic measurement of potato cannon velocity. The Physics Teacher 2007; 45:496-497.

Courtney M, Althausen N, Courtney A. Five frequently fatal freshman physics fantasies. Physics Education 2007; 42:116.

Additional Education & Training

Forensic Shooting Incident Reconstruction Course

Certified IDPA Safety Officer

Blood Detection, Documentation & Collection Techniques

Peer Reviews

Journal of Biomechanics

Journal of Neurotrauma

Advances in Life Sciences and Medicine

NeuroImage

Journal of Neuroscience Research

Defence Technology

International Journal of Energetic Materials and Chemical Propulsion

Shock Waves

Journal of Visual Experiments (JoVE)

Traffic Injury Prevention

SAE International Journal of Transportation Safety

Accident Analysis and Prevention

4-year Testimony List for Amy Courtney, Ph.D. 2021-2025

Case	Testimony	Jurisdiction	Date
Melanie Thrash v. KLLM Transport Services, LLC	Trial	Alabama United States District Court Northern District of Alabama, Northeastern Division	February 11, 2025
Adele Dominge Ortego... v Hunter Johnson, Pebbles Johnson, et al.	Deposition	Louisiana Orleans Parish Civil District Court	January 10, 2025
Teka Day vs. Howard Harris ...Double H Transport, LLC...	Deposition	Mississippi Hinds County Circuit Court, First Judicial District	July 1, 2024
Eureka Cole vs. Carnival Corporation	Trial	Florida United States District Court Southern District of Florida	May 31, 2024
Eureka Cole vs. Carnival Corporation	Deposition	Florida United States District Court Southern District of Florida	February 12, 2024
Michelle Bonner ... v. Georgia Waste Systems, LLC, Ace American Insurance Company et al.	Deposition	Georgia Bibb County State Court of Bibb County	January 12, 2024
Rebekah Puroll vs. ABF Freight System, Inc. and Philip Razey	Deposition	Florida Volusia County Circuit Court of the Seventh Judicial Circuit	August 4, 2023
Madison and June Goss v. Mitsubishi Polycrystalline Silicon America Corporation, et al.	Deposition	Alabama Mobile County Circuit Court of Mobile County	July 27, 2023
Hunter Bice, Shannon Bice, and Brandy Bice v. Pamela Spain...Toyota Motor Corporation et al.	Deposition	Alabama Bibb County Circuit Court of Bibb County	July 25, 2023
Vincent Kluge and Kimberlee Kluge vs. American Honda Motor Co., Inc., and Christopher P. Hauck	Trial	Missouri St. Louis County Circuit Court of the County of St. Louis	June 22, 2023

Exponent treats all consulting assignments as confidential, and is under an obligation not to disclose the names of our clients, or the nature of the engagement, unless such engagement has been made public through deposition, trial, or other public disclosure.

Melissa Barry and Matt Barry vs. Chops & Hops, LLC	Trial	Georgia Oconee County Superior Court of Oconee County	May 25, 2023
David Gauld and Julie Gauld v. Caterpillar Inc.	Deposition	Michigan United States District Court Eastern District of Michigan, Northern Division	April 26, 2023
Bushra Gordon v. Brian Rowley and … U.S. Bank	Trial	Georgia United States District Court Columbus Division	March 15, 2023
Mae Sellers v Volkswagen of America, Inc., and Volkswagen of America Chattanooga Operations, LLC	Deposition	Mississippi United States District Court Southern District of Mississippi, Eastern Division	February 22, 2023
Kimberly Turner v. Luis Felipe Abbud Romero and Lyft, Inc. dba Lyft Florida, Inc.	Deposition	Florida Miami-Dade County Circuit Court in and for Miami-Dade County	January 19, 2023
Vincent Kluge and Kimberlee Kluge vs. American Honda Motor Co., Inc., and Christopher P. Hauck	Deposition	Missouri St. Louis County Circuit Court of the County of St. Louis	January 5, 2023
Lindel Wiltshire v. Mid-America Apartments, L.P., et al.	Deposition	Georgia Gwinnett County State Court of Gwinnett County	November 1, 2022
Ruth Washington v. ABM-Lanier-Hunt, Granite State Insurance Company, and Winsome Hemmings	Deposition	Georgia Clayton County State Court of Clayton County	October 10, 2022
Jennifer Pell v. Royal Caribbean Cruises LTD.	Deposition	Florida United States District Court Miami Division	May 31, 2022
Linda P. Crawley v Xylem Water Solutions, et al.	Deposition	Georgia Gwinnett County State Court of Gwinnett County	April 28, 2022 June 14, 2022
Lydia Meadows ... Estate of Victoria Dawn McIntosh et al. vs. Ford Motor Company, et al.	Deposition	Alabama Russell County Circuit Court for Russell County	April 14, 2022 April 20, 2022
Gaoly N. Lee ... v. Toyota Motor Corporation, et al.	Deposition	Georgia Gwinnett County State Court of Gwinnett County	April 12, 2022

Exponent treats all consulting assignments as confidential, and is under an obligation not to disclose the names of our clients, or the nature of the engagement, unless such engagement has been made public through deposition, trial, or other public disclosure.

Stacey O'Key, Lawryn Sweet, and Don Lewis v USA	Trial	Louisiana United States District Court Lake Charles Division	February 24, 2022
Stacey O'Key, Lawryn Sweet, and Don Lewis v USA	Deposition	Louisiana United States District Court Lake Charles Division	August 5, 2021
Jackson Ralph Hall vs. Jayve Molina Navarro, J&J Towing, Inc. and USAA General Indemnity Company	Deposition	Florida Broward County 17th Judicial Circuit	May 26, 2021

Exponent treats all consulting assignments as confidential, and is under an obligation not to disclose the names of our clients, or the nature of the engagement, unless such engagement has been made public through deposition, trial, or other public disclosure.