

Laser Pointers as a Threat to Aviation Safety: The Problem, Current Policies, and Proposed Solutions

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INTRODUCTION

Laser pointers, while useful when highlighting information in a PowerPoint presentation or drawing the viewers' attention to a particular spot on a chalkboard, can be dangerous—especially when aimed at an aircraft. The act of aiming a laser pointer at an in-flight aircraft is called “lasering.” Unauthorized lasering is illegal, but it is difficult to locate and apprehend perpetrators. There has been a sharp increase in reported lasering incidents over the last few years.¹

More specifically, reports of lasers illuminating airplane cockpits increased at an alarming rate.² In response, Congress and the Federal Aviation Administration (FAA) passed laws and regulations that criminalizes such conduct.³ These prohibitions have not, however, managed to decrease the activity.⁴

Pilots of laser-illuminated aircraft report sobering reactions to lasering ranging from distractions while flying, to eye pain, and temporary loss of vision.⁵ Even subtle distractions, or minor loss of vision while a pilot is operating an aircraft, especially during take-off and landing, could be catastrophic.⁶ To date, there have been no crashes linked to lasering, but the potential for an accident is conceivable when pilots are hindered from performing their

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¹ Patrick Murphy & Captain Daniel Hewett, *FDA's Proposed Change to the Regulation of Laser Pointers*, INT'L LASER DISPLAY ASS'N, fig. 2, <http://www.laserpointersafety.com/resources/FDA-CDRH-TEPRSSC/2017-ILSC-FDA-Proposed-Change-Laser-Pointers-v07.pdf> [<http://perma.cc/HA4V-5FTQ>].

² *Id.*

³ FAA Modernization and Reform Act of 2012, H.R. 658, 112th Cong., SEC. 311, § 39A (2012).

⁴ Murphy & Hewett, *supra* note 1.

⁵ FED. AVIATION ADMIN., No. 17-2021, LASER HAZARDS IN NAVIGABLE AIRSPACE, FAA, https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/laser_hazards.pdf [hereinafter FAA, NAVIGABLE AIRSPACE] [<http://perma.cc/WLS3-K4L8>].

⁶ See FED. AVIATION ADMIN., ADVISORY CIRCULAR No. 70-2A, REPORTING OF LASER ILLUMINATION OF AIRCRAFT 1 (2013), [hereinafter FAA, LASER ILLUMINATION] https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_70-2A.pdf [<https://perma.cc/FU4X-GEKZ>].

duties.⁷ Notwithstanding an absence of fatalities, lasering is responsible for forcing pilots to abort landings, thereby creating delays that are unwelcome in the aviation industry.⁸

In addition, when an airplane is illuminated by a laser, it is standard procedure for pilots to alert Air Traffic Control (ATC) and for ATC to then broadcast warnings to other pilots in the area.⁹ This takes up valuable communications bandwidth, burdening the system, and potentially leading to miscommunications or airplane mishaps.¹⁰ As such, this Article analyzes the ever-growing issue of lasering and offers a solution that relies on technology and FAA requirements working in unison with current legislation. The system—from ATC communications to pilot reporting procedures—is stressed every time a cockpit is illuminated by a laser. Further, pilots report many different adverse reactions to lasering.

Even if there are not yet any accidents linked to lasering, the increased cost of time and money spent dealing with lasering incidents to prevent potentially devastating accidents outweighs the social utility of allowing a few knuckleheads a bit of entertainment. Unfortunately, it appears that existing legislation has done little to solve the lasering epidemic because reporting incidents of lasering are on the rise. However, there are at least two pieces of technology that would protect pilots from lasering: the first is protective eye-wear, the second (and more appropriate option) is a protective film that can be placed on cockpit windows; both options serve to filter out harmful laser light.¹¹

I. BACKGROUND

Albert Einstein developed the initial concept of the laser, though the first person to use the word “laser” was Gordon Gould

⁷ See FAA, NAVIGABLE AIRSPACE, *supra* note 5.

⁸ *Id.*

⁹ FAA, LASER ILLUMINATION, *supra* note 6, at 2–3.

¹⁰ *Id.* at 3.

¹¹ See *Laser Reflection Glasses*, IRIDIAN, [hereinafter *Laser Reflection Glasses*] <https://www.iridian.ca/specialty-filters/laser-reflection-glasses/> [http://perma.cc/WD2P-2JMG]; see also *Our Engineers Develop Novel Technology to Protect Pilots from Laser Attacks*, BAE SYS. (Sept. 12, 2017) [hereinafter *Novel Technology*], <https://www.baesystems.com/en/article/bae-systems-engineers-develop-novel-technology-to-protect-pilots-from-the-dangers-of-laser-attacks> [http://perma.cc/B5FV-8CJV].

in 1977.¹² The term “laser” is an acronym for “light amplification by stimulated emission of radiation.”¹³ Lasers used as demonstrative aids are referred to as “demonstration laser products,” which are statutorily defined as “any laser product manufactured, designed, intended, or promoted for purposes of demonstration, entertainment, advertising display, or artistic composition.”¹⁴ Additionally, lasers have many other uses, including medical lasers used to assist with surgery, lasers used for entertainment in laser light shows and concerts, lasers used to cut and form metal, and lasers used to read and write information onto CDs and DVDs.¹⁵

A. *The Classification of Lasers*

Laser pointers are statutorily defined as “any device designed or used to amplify electromagnetic radiation by stimulated emission that emits a beam designed to be used by the operator as a *pointer* or highlighter to indicate, mark, or identify a specific position, place, item, or object.”¹⁶ The International Electrotechnical Commission (IEC) categorizes all lasers, including laser pointers, into the following applicable classes: 1, 2, 3A, 3B, and 4.¹⁷

The IEC has different labeling requirements for the different classes of lasers.¹⁸ Class 1 lasers require only a small radiation warning and an order to not view the laser directly “with optical instruments,” while Class 4 lasers require a much sterner

¹² Scott Schwertly, *The History of the Laser Pointer*, ETHOS3 (May 7, 2014), <https://www.ethos3.com/2014/05/the-history-of-the-laser-pointer/> [http://perma.cc/392S-9TPM].

¹³ *Health Risks From the Use of Laser Pointers, Fact Sheet No. 202*, WORLD HEALTH ORG. (July 1998), <https://www.who.int/uv/resources/fact/fs202laserpointers.pdf> [http://perma.cc/PK3G-FS5U]; INT’L CIVIL AVIATION ASSOC. [ICAO] & REG’L AVIATION SAFETY GRP. – MIDDLE E., No. RASG-MID/MIDRAST/RGS/SEI/06, LASER ATTACKS SAFETY GUIDELINES, at 5 (2017) [hereinafter RASG-MID], <https://www.icao.int/MID/Documents/2017/RASG-MID6/WP%2011%20-%20Runway%20Safety.pdf> [http://perma.cc/NVS3-ZL5H].

¹⁴ 21 C.F.R. § 1040.10(b)(13).

¹⁵ Harry Stine, *Uses of Lasers*, http://ffden2.phys.uaf.edu/212_fall2003.web.dir/James_Becwar/uses/ [http://perma.cc/4PM6-9Y4N].

¹⁶ 18 U.S.C.A. § 39A(b) (West 2012) (emphasis added).

¹⁷ See INT’L ELECTROTECHNICAL COMM’N [IEC], *International Standard 28-29*, 60825-1 (August 2001); see also WORLD HEALTH ORG., *supra* note 13, at 2.

¹⁸ See INT’L ELECTROTECHNICAL COMM’N, *supra* note 17, at 27–28.

warning: “Class 4 laser radiation[,] when open avoid eye or skin exposure to direct or scattered radiation.”¹⁹ These labeling requirements are merely that—labeling requirements. Classes 1 through 4 are available to anyone with internet access and the means to purchase them.²⁰ To make matters worse, manufacturers have been known to misclassify the lasers they produce, many times categorizing Class 3B lasers under Class 2.²¹ The World Health Organization (“WHO”) considers the use of the lower classes of lasers as demonstrative aids “justified,” while the use of Class 3B lasers is “justified” only in “the workplace where the user has received adequate training.”²² That is merely a preference of the WHO, and no other administrative agency or legislative body in the United States has actually prohibited or even restricted the abundant availability of any class of laser in a meaningful way.²³

B. The Dangerous Uses of Lasers

While the acquisition of laser pointers is largely unregulated, certain uses of laser pointers are prohibited. For example, in Maine it is a criminal offense to point a laser at a person while the laser pointer is engaged if the laser beam causes bodily injury or even mere annoyance.²⁴ Similarly, in Utah it is a criminal offense to aim a laser pointer at a moving motor vehicle or any occupant of the motor vehicle.²⁵ For a final example, in

¹⁹ *Id.* at 25–26.

²⁰ *See, e.g., Laser Products & Instruments*, FOOD & DRUG ADMIN. (Aug. 16, 2017), <https://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/LaserProductsandInstruments/default.htm> [<https://perma.cc/52VR-TV83>] (listing Class 1 lasers as those used in CD and DVD players and Class 2 lasers as those used in bar code scanners, both readily available online); *Class 3R Laser Pointers*, BURNINGLASERPOINTER, <https://burninglaserpointer.com/class-3r-lasers> [<https://perma.cc/3GXQ-ZHV3>] (advertising multiple Class 3R lasers for less than \$30.00, most for less than \$10.00); BEAMQ, <http://www.beamq.com/class-iiib-green-laser-pointer-p-78.html> (advertising Class 3B lasers for less than \$100.00) [<https://perma.cc/4K4T-J6P5>]; *Class IV Laser Pointer Brief Introduction*, EVERYONETOBUY, <http://www.everyonetobuy.com/high-quality-class-4-laser-pointer>. [<https://perma.cc/4RCB-4ZKC>] (advertising multiple Class 4 lasers, most for less than \$200.00); *see also*, Murphy & Hewett, *supra* note 1, (prohibiting Class 3B lasers from being advertised as “laser pointers,” however, they still function as laser pointers).

²¹ *See* WORLD HEALTH ORG., *supra* note 13, at 3.

²² *Id.*

²³ *Id.*

²⁴ ME. STAT. TIT. 17-A, § 1002-A(1)(A), (C) (2019).

²⁵ UTAH CODE ANN. § 76-10-2501(2)(a) (LexisNexis 2018).

Arizona it is a criminal offense to point a laser at a peace officer.²⁶ Even though those certain uses of laser pointers are prohibited, it is possible that there will not be any restrictions on the procuring of lasers by those in the United States any time soon—even Class 4 lasers.²⁷ As such, those fearful of falling victim to the potentially blinding blast of a laser pointer may have to seek protection elsewhere.

One class of individual is particularly vulnerable to the intrusive beam of the laser pointer: pilots. Laser pointers “shot” into the sky—which might not appear to “shoot” very far to potential users—can travel far distances because of the atmospheric makeup of our planet.²⁸ Lasers require reflective materials in order to be seen (dust, smoke, etc.).²⁹ Above an imaginary line known as the Planetary Boundary Layer, these reflective materials clear out and leave cleaner, thinner air incapable of reflecting the beam of a laser.³⁰ This creates an optical illusion where the laser beam appears to end at the Planetary Boundary Layer, but in actuality, the beam of the laser extends far beyond this point.³¹ Because of this illusion, people who point lasers into the sky thinking the beam from their laser pointer could not reach the cockpit of an in-flight airplane are quite mistaken.³² In fact, an experiment conducted using a Class 1 laser pointer revealed that the beam of light emitted from it was visible with the naked eye more than twelve miles away.³³ If low-power laser pointers can transmit light over such vast distances, it is little surprise that laser pointers can and do reach the cockpits of airplanes during take-off and landing—the most critical stages of

²⁶ ARIZ. REV. STAT. ANN. § 13-1213(A) (2018).

²⁷ *But see US: UPDATED - FDA Wants to Allow Only Red Laser Pointers, Calling All Other Colors 'Defective'*, LASERPOINTERSAFETY.COM (Oct. 26, 2016) [hereinafter *US: UPDATED*], http://www.laserpointersafety.com/news/news/other-news_files/c3463b49a6a9232c8dab8615df027ba2-514.php#on [<https://perma.cc/F97W-GSP2>] (discussing an FDA proposal which may give the FDA more control over lasers that do not emit red light).

²⁸ *See Why Laser Beams Outdoors Seem to End*, LASERPOINTERSAFETY.COM, <http://www.laserpointersafety.com/aviationfacts/whybeamsseemtoend.html> [<https://perma.cc/FSL4-FBL2>].

²⁹ *Id.*

³⁰ *Id.*

³¹ *See id.*

³² *See id.*

³³ Toshi Nakamura, *One Man's Quest to Prove How Far Laser Pointers Reach*, KOTAKU (Nov. 14, 2013) <https://kotaku.com/one-mans-quest-to-prove-how-far-laser-pointers-reach-1464275649> [<https://perma.cc/T8WE-YYE9>].

a flight according to Robert Hamilton, an airline captain and victim of five laser attacks himself.³⁴ Recognizing the increasing trend, the International Civil Aviation Organization declared in early 2017 that lasering incidents “ha[ve] become a *serious* factor in aviation safety. . . .”³⁵

While the actual type of laser pointer used in most reported lasering incidents remains unknown, models that the Food and Drug Administration (FDA) defines as “toys” are considered likely responsible for at least a portion of those incidents.³⁶ The FDA defines “toy” laser pointers as manufactured, designed, and intended for use by those under fourteen years of age.³⁷ In 2011, a fourteen-year old boy was arrested for “allegedly shining a powerful laser pen in the direction of a number of aircraft near . . . Los Angeles International Airport.”³⁸ Police located the source when the boy shined the powerful green laser directly at a police helicopter.³⁹

In 2004, the FAA received forty-six reports of lasers illuminating the cockpits of in-flight airplanes.⁴⁰ Just five years later, the FAA received reports of lasering activity that numbered well into the hundreds, with 1,527 incidents of lasering reported in 2009.⁴¹ By 2012, the number of reported lasering incidents more than doubled to 3,482, and in 2016 the number of reported lasering incidents continued to grow exponentially to nearly 7,500.⁴² The

³⁴ See *Laser Strikes Hit Record High*, CBS NEWS (Sep. 14, 2015), <https://www.cbsnews.com/news/spikes-in-laser-strikes-against-air-planes-hit-record-high> [hereinafter *Laser Strikes Hit Record High*] [<https://perma.cc/QZ7D-D729>].

³⁵ RASG-MID, *supra* note 13, at 5 (emphasis added).

³⁶ See *US: FDA Proposes Amending Federal Laser Manufacturer Regulations*, LASERPOINTERSAFETY.COM (July 29, 2013), http://www.laserpointersafety.com/news/news/other-news_files/9af3c2d1f520977b70a880073ccd4579-331.php#on [hereinafter *FDA Proposes Amending*] [<https://perma.cc/2KK6-K6CD>]. *But See* FDA, BACKGROUND MATERIALS PREPARED FOR THE OCTOBER 25–26 2016 TECHNICAL ELECTRONIC PRODUCT RADIATION SAFETY STANDARDS COMMITTEE, at 21 (2016) [hereinafter FDA, BACKGROUND MATERIALS] (proposing a new definition for “children’s toy laser products,” however, the new definition still includes laser pointers that have the capability to reach the cockpit of some in-flight airplanes).

³⁷ See *FDA Proposes Amending*, *supra* note 36, at 21.

³⁸ *Boy Arrested for Pointing Laser Pen at Aircraft on Flightpath for Los Angeles International Airport*, DAILY MAIL (UK) (last updated Feb. 10, 2011), <http://www.dailymail.co.uk/news/article-1355518/Boy-arrested-pointing-laser-pen-aircraft-flightpath-Los-Angeles-International-airport.html> [<https://perma.cc/M3B9-7X3Z>].

³⁹ *Id.*

⁴⁰ Murphy & Hewett, *supra* note 1, fig. 2.

⁴¹ *Id.*

⁴² *Id.*

number of incidents is particularly troubling considering that the FAA tracks lasering only in the United States.⁴³ From 2008-2015 there were more than 2,500 reports of lasering in Canada, and from 2007-2015, more than 3,700 lasering incidents were reported in Australia.⁴⁴ Of the lasering incidents in the United States, most occur near airports and in clusters, which are “multiple strikes on one or several aircraft that appear to originate from a specific location.” These cluster attacks may occur in short spurts, or be spread out over multiple days.⁴⁵ For example, according to the Air Line Pilots Association, International (the Pilot’s Union), in 2015, eleven flights heading for Newark Liberty International Airport were targeted by laser pointers in a ninety-minute span.⁴⁶ These attacks resulted in temporary blindness for one of the pilots.⁴⁷

While all lasering is capable of grave impact,⁴⁸ the degree of danger depends on the color of laser emitted by the pointer.⁴⁹ This spectrum is representative of both the rather confusing relationship between the emitted light’s wavelength and its frequency.⁵⁰ For example, more than twenty years ago red laser pointers, an authorized color, was the most used color reported;⁵¹ since then, green and blue lights—both prohibited by the FDA—are associated with ninety-five percent of the reported lasering incidents.⁵² This shift in color exacerbates the lasering problem

⁴³ Tony Reed, President, ST Laserstrike, Laser Attacks Against Aircrafts: Trends and Solutions, Presentation to the Flight Safety Foundation Business Aviation Safety Summit (May 4–5, 2017), <https://flightsafety.org/wp-content/uploads/2017/05/Reed.pdf> [<https://perma.cc/GUQ9-9MWW>].

⁴⁴ *Id.* at 4.

⁴⁵ See FAA, NAVIGABLE AIRSPACE, *supra* note 5.

⁴⁶ Press Release, Air Line Pilots Ass’n Int’l, Stopping Laser Attacks on Aircraft: No Shot in the Dark (Nov. 1, 2015), <http://www.alpa.org/news-and-events/news-room/112015-stopping-laser-attacks> [hereinafter Stopping Laser Attacks] [<https://perma.cc/Z6BF-LBVC>].

⁴⁷ *Id.*

⁴⁸ FED. BUREAU OF INVESTIGATION, PROTECTING AIRCRAFT FROM LASERS (Feb. 11, 2014), <https://www.fbi.gov/news/stories/protecting-aircraft-from-lasers> [<https://perma.cc/7XVE-FQCC>] [hereinafter PROTECTING AIRCRAFT] (statement of the assistant director of the FBI’s Criminal Investigative Division, Ron Hosko) (“[lasering] is a criminal act with potentially deadly repercussions”).

⁴⁹ See *US: UPDATED*, *supra* note 27 (Violet, Indigo, Blue, G, Yellow, Orange, & Red).

⁵⁰ See Ted Montgomery, *Is the Color of Light Determined by its Frequency or its Wavelength?*, TEDMONTGOMERY.COM, <http://www.tedmontgomery.com/bblov-rvw/emails/lightfrequency.html> [<https://perma.cc/PKD5-RS7X>].

⁵¹ See *US: UPDATED*, *supra* note 27.

⁵² Murphy & Hewett, *supra* note 1.

because green colored laser pointers emit light at the wavelength most sensitive to the human eye.⁵³ Unsurprisingly, green-colored laser pointers have become increasingly more common because they have a brighter emittance without the need for additional power, unlike red laser pointers.⁵⁴ Of the ninety-five percent of lasering incidents involving green-colored or blue-colored lasers, more than ninety percent of these incidents involved green-colored lasers.⁵⁵ Additionally, the FAA notes that green-colored lasers are “close to the eye’s peak sensitivity” when the human eye is “dark-adapted.”⁵⁶ Dark-adapted eyes are a common occurrence for pilots flying at night in darkened cockpits, prompting the FAA to recommend that pilots illuminate airplane cockpits at night to lessen the damage caused by lasering.⁵⁷

Pilots who have suffered lasering attacks reported a wide range of serious symptoms, prompting Air Traffic Control (ATC) to regard lasering incidents as in-flight emergencies.⁵⁸ Symptoms include flash blindness, after-imaging, and continued retinal burning,⁵⁹ as well as abnormal ocular discomfort or pain.⁶⁰ Perhaps the most unsettling symptom experienced by pilots who have been lasered is the distraction it causes—rendering them unable to give their full attention to flying the aircraft.⁶¹ In 2013, the FAA documented thirty-five instances of pilots needing medical assistance after falling victim to a laser strike.⁶² Beyond the physical strain on the pilot is the commercial (and private) strain on the aviation system caused by lasering: reports indicate that more than three percent of lasering incidents include operational issues, such as aborted landings and the shutting down of runways when repeated lasering incidents occur over short periods of time.⁶³

⁵³ JAMELLIE GALANG, ET AL., NAT’L INST. OF STANDARDS & TECH., U.S. DEP’T OF COMMERCE, NIST TECH. NOTE 1668: A GREEN LASER POINTER HAZARD 3 (August 2, 2010) [hereinafter GREEN LASER POINTER HAZARD].

⁵⁴ *Id.* (“[green-colored laser pointers] are superior to red [colored] laser pointers for demonstration purposes.”).

⁵⁵ *See* FAA, NAVIGABLE AIRSPACE, *supra* note 5 (noting that today, only 6.3 percent of lasering incidents involve red colored lasers).

⁵⁶ *Id.*

⁵⁷ *Id.*

⁵⁸ *See* FAA, LASER ILLUMINATION, *supra* note 6, at 1.

⁵⁹ *See* Stopping Laser Attacks, *supra* note 46, at 2.

⁶⁰ *See* FAA, NAVIGABLE AIRSPACE, *supra* note 5.

⁶¹ Murphy & Hewett, *supra* note 1.

⁶² *See* FBI, *Protecting Aircraft*, *supra* note 48, at 3.

⁶³ *See* FAA, NAVIGABLE AIRSPACE, *supra* note 5, at 3.

III. THE SEARCH FOR A SOLUTION

Lasering is most dangerous when attacks occur during take-off and landing.⁶⁴ In response to the ever-increasing number of lasering incidents, the FAA published a revised order requiring legitimate laser operations (laser light shows, for example) to adhere to certain restrictions.⁶⁵ The revision also establishes three “Flight Hazard Zones” to negate the effects caused by the sanctioned laser operations.⁶⁶ The flight zones are categorized by elevation: the lowest zone ranges from zero to 2,000 feet, the second zone ranges from 2,000 to 8,000 feet, and the third zone is anything above 8,000 feet.⁶⁷ The different zones have varying restrictions on the laser activity allowed within them.⁶⁸ Most notably, the lowest zone has been aptly titled the “Laser Free Zone,” where any and all unauthorized laser activity is prohibited.⁶⁹ The FAA order has effectively eliminated lasering incidents due to legitimate laser operations, however, “such guidelines cannot prevent misuse due to ignorance or maliciousness.”⁷⁰ In fact, more than sixteen percent of all lasering incidents occur in the Laser Free Zone.⁷¹ Alarming, thirty-one percent of reported effects on pilots’ vision, forty-two percent of reported physical pain or injuries, and forty-two percent of reported operational problems are attributed to the more than sixteen percent of low-altitude lasering incidents.⁷² Accordingly, the FAA has concluded that low-altitude lasering incidents, like those that occur during take-off and landing, are a greater risk to aviation safety than those occurring at higher altitudes.⁷³

The FAA issued precautionary suggestions that pilots can incorporate in their routine to mitigate the effects of a laser

⁶⁴ See generally, *Laser Strikes hit Record High*, *supra* note 34.

⁶⁵ See FAA, NAVIGABLE AIRSPACE, *supra* note 5.

⁶⁶ See FED. AVIATION ADMIN., Order JO 7400.2L, PROCEDURES FOR HANDLING AIRSPACE MATTERS, at 29-1-2 (2017), https://www.faa.gov/documentLibrary/media/Order/JO_7400.2L_Chg1_dtd_10-12-17.pdf [<https://perma.cc/S5RV-7P3U>].

⁶⁷ *Id.* at 29-1-6.

⁶⁸ *Id.* at 29-1-5.

⁶⁹ *Id.* at 29-1-4.

⁷⁰ FAA, NAVIGABLE AIRSPACE, *supra* note 5.

⁷¹ *Id.*

⁷² *Id.*

⁷³ *Id.*

attack.⁷⁴ For example, the FAA recommends pilots illuminate the airplane's cockpit at night to keep the pilot's eyes from becoming too dark-adapted.⁷⁵ The FAA also advises pilots afflicted by a laser to the eye to not rub the eye or aggravate the injury in any way so as to avoid further harm.⁷⁶ Another FAA recommendation is for pilots to use the fuselage of the aircraft to "block the laser beam."⁷⁷ The dangers involved in such maneuvering are exacerbated during take-off and landing, which is when pilots are most vulnerable to laser attacks.⁷⁸

In addition to safety recommendations, the FAA devised sophisticated procedures for reporting and dealing with laser strikes.⁷⁹ In a five-page document titled the, "Laser Beam Exposure Questionnaire," the FAA collects detailed information about the lasering event, such as the time of day of the incident, the approximate altitude of the aircraft when it was lasered, whether the laser attack disrupted the flight, the color of the laser, the effect the laser had on the pilot, and a litany of other relevant questions.⁸⁰ In addition to the pilot questionnaire, which is filled out after the flight, the FAA established procedures and protocol to respond with immediately following strike.⁸¹ Pilots are to radio the appropriate ATC facility as soon as they experience a laser attack.⁸² ATC is to then broadcast the phrase, "UNAUTHORIZED LASER ILLUMINATION EVENT" with the location and altitude of the event every five minutes for twenty minutes, clogging the frequency.⁸³ The FAA's ATC facilities then report the incident to the Domestic Events Network (DEN), which, with other

⁷⁴ *Id.*

⁷⁵ *Id.*

⁷⁶ *Id.*

⁷⁷ *Id.*

⁷⁸ *Id.*

⁷⁹ *See generally*, FED. AVIATION ADMIN., RAC – R8, LASER BEAM EXPOSURE QUESTIONNAIRE, (2012) [hereinafter FAA QUESTIONNAIRE], https://www.faa.gov/aircraft/safety/report/laserinfo/media/FAA_Laser_Beam_Exposure_Questionnaire.pdf [<https://perma.cc/XCE7-6ZZQ>] (showing the actual questionnaire utilized by the FAA to acquire data on laser beam exposure).

⁸⁰ *Id.*

⁸¹ *See* FAA, LASER ILLUMINATION, *supra* note 6, at 2–3.

⁸² FAA, LASER ILLUMINATION, *supra* note 6, at 3; *see also* FAA QUESTIONNAIRE, *supra* note 79 (highlighting the similarities between the exposure questionnaire and the ATC reports required information).

⁸³ FAA, LASER ILLUMINATION, *supra* note 6, at 2.

governmental agencies including law enforcement, takes action to catch those responsible for the lasering incident.⁸⁴

Others have proffered solutions to help curb the problem. Because most lasering incidents happen during landing, Dr. Tom Reynolds, “a laser strike detection researcher” at the Massachusetts Institute of Technology, developed a geolocation network of sensors that is placed strategically along runways and can be used to detect those responsible for pointing lasers at aircraft.⁸⁵ In addition, Iridian Spectral Technologies has developed eyewear for pilots that claim to reflect up to ninety-nine percent of the harmful light emitted from laser pointers, including the light emitted from green laser pointers.⁸⁶ The Pilot’s Union is also committed to eradicating lasering issues and plans to work with private and governmental actors to mitigate lasering.⁸⁷ Perhaps the most promising development in the anti-lasering space comes from a United Kingdom-based firm, BAE Systems, which has developed an inexpensive film that is installed over the windows of a cockpit and blocks harmful light emitted from laser pointers.⁸⁸

Lasers are relatively easy to obtain and are also inexpensive.⁸⁹ In addition, easily obtainable lasers are often misclassified, leaving the purchaser with a much more powerful laser than they realize.⁹⁰ The increasing popularity, accessibility, and power of lasers has led to an enormous increase in the number of reported lasering incidents each year.⁹¹ When coupled with the increased use of green laser pointers, these changes in the market are a recipe for disaster.⁹² The increase in lasering incidents is occurring amidst the FAA’s enforcement of the Laser Free Zone, and pilots are still suffering injuries despite the FAA prompting them to use the body of the plane as a shield from the harmful laser

⁸⁴ *Id.*

⁸⁵ Erin Lee, *Developing Sensors to Defend Aircraft Against Lasers*, MIT NEWS (Sept. 8, 2017), <http://news.mit.edu/2017/mit-lincoln-laboratory-lassos-sensors-defend-aircraft-against-laser-strikes-0928> [https://perma.cc/5BQU-BY3G].

⁸⁶ *Laser Reflection Glasses*, *supra* note 11.

⁸⁷ AIRLINE PILOT’S ASS’N INT’L, STRATEGIC PLAN PROGRESS REPORT 18-19 (2016), http://fdx.alpa.org/portals/26/docs/091616_BODSP.pdf [https://perma.cc/XM64-JP62].

⁸⁸ *Novel Technology*, *supra* note 11.

⁸⁹ *Laser Pointers Fact Sheet*, AUGUSTA UNIV., <https://www.augusta.edu/services/ehs/lasersafetyoff/documents/laser.pointer.fact.sheet.pdf> [https://perma.cc/JTU2-W6D4].

⁹⁰ WORLD HEALTH ORG., *supra* note 13, at 3.

⁹¹ Murphy & Hewett, *supra* note 1.

⁹² GREEN LASER POINTER HAZARD, *supra* note 53, at 6.

light.⁹³ As of 2013, when the latest numbers were available, there have not been any accidents attributed to lasering.⁹⁴ However, the potential for an accident does exist. One pilot, Chris Potter, claims permanent eye damage from a laser strike.⁹⁵ In describing the incident, Potter claims he “couldn’t see anything out of [his eye]. He explained:

I saw stars. It literally felt like I got punched in my eye and there was a piece of debris, like a piece of glass in my eye. It began watering to the point where it was watering down my cheek.”⁹⁶

The stress lasering imposes upon pilots and the aviation industry are serious,⁹⁷ prompting one aviation news source to decree lasering as “the greatest threat to aviation.”⁹⁸ Surrounding a culmination of distressing facts, Congress passed the FAA Modernization and Reform Act of 2012, which, inter alia, punishes those who point a laser at an in-flight aircraft.⁹⁹

A. Legal Developments

The FAA Modernization and Reform Act of 2012 makes it a criminal offense for someone to “knowingly aim the beam of a laser pointer at an aircraft in the special aircraft jurisdiction of the

⁹³ FAA, NAVIGABLE AIRSPACE, *supra* note 5.

⁹⁴ *Id.*

⁹⁵ Emilie Eaton, *New State Law Addresses Danger of Laser Pointers to Aircraft*, CRONKITE NEWS (Sept. 22, 2014), <http://cronkitenewsonline.com/2014/09/new-state-law-addresses-danger-of-laser-pointers-to-aircraft/index.html> [<https://perma.cc/ZQ6Y-6WM4>].

⁹⁶ *Id.*

⁹⁷ *See e.g.* Stopping Laser Attacks, *supra* note 46; Murphy & Hewett, *supra* note 1; FAA, NAVIGABLE AIRSPACE, *supra* note 5; Jake Rossen, *What Pilots See When You Shine a Laser Pointer at Aircraft*, MENTAL FLOSS (June 23, 2015), <http://mentalfloss.com/article/65424/what-pilots-see-when-you-shine-laser-pointer-aircraft> [<https://perma.cc/MRT3-DXSM>] (stating that the Plexiglas windows of the cockpit magnify the lasers effect, engulfing the cockpit). *But cf.*, Thom Patterson, *Laser Pointers Can’t Permanently Damage Pilots’ Eyes, Study Says*, CNN (Apr. 19, 2016), <http://www.cnn.com/2016/04/19/health/laser-pointer-airplane-pilot-vision-study/index.html> [<https://perma.cc/PF6W-AN2E>] (citing a study saying that lasering does not permanently damage a pilot’s eyes).

⁹⁸ Jeffrey Madison, *The Greatest Threat to Aviation*, GENERAL AVIATION NEWS (May 25, 2015), <https://generalaviationnews.com/2015/05/25/the-greatest-threat-to-aviation/> [<https://perma.cc/DVA6-RMDA>].

⁹⁹ FAA Modernization and Reform Act of 2012, 18 U.S.C. § 39A (2012).

United States, or at the flight path of such an aircraft.”¹⁰⁰ Under the statute, an individual who aims a laser pointer at an in-flight aircraft is subject to a fine, or up to a five-year prison sentence, or both.¹⁰¹

The passage of this law, while a great achievement, was long overdue. In 2005 a Congressional Research Service (CRS) report for Congress outlined some of the dangers of lasering.¹⁰² The report noted that light emissions from laser pointers pose a hazard to flight operations, cause vision problems (such as retinal injury) for pilots, and distract pilots.¹⁰³ The CRS report provided some options to mitigate risks posed by lasering, such as regulating laser pointers by requiring different standards for power output based on the color or the laser (in response to the increased dangers of green colored laser pointers), as well as restricting sales of Class 3a lasers.¹⁰⁴

Even earlier, in 1997, the National Transportation Safety Board (NTSB) issued a safety recommendation detailing two harrowing instances of lasering.¹⁰⁵ In the first laser attack mentioned by the NTSB, a pilot who was lasered while approaching Los Angeles International Airport sustained an eye injury and was rendered incapacitated.¹⁰⁶ The pilot reported that as the flight continued “it became increasingly difficult [to see] from the eye [that was hit by the laser beam] because of a burning sensation and tearing.”¹⁰⁷ By the time the plane made its final approach, the pilot, who was the captain on board, had to turn the controls over to his co-pilot to finish landing the aircraft.¹⁰⁸

The second incident mentioned in the report details yet another instance of a pilot sustaining an eye injury and

¹⁰⁰ *Id.*

¹⁰¹ 18 U.S.C.A. § 39A(a) (2012).

¹⁰² Bart Elias, Cong. Research Serv., RS22033, *Lasers Aimed at Aircraft Cockpits: Background and Possible Options to Address the Threat to Aviation Safety and Security* (2005).

¹⁰³ *Id.* at 1

¹⁰⁴ *Id.* at 5 (advocating for the expansion and enforcement of the FAA’s Laser Free Zones, though the ineffectiveness of the Laser Free Zones has since come to light).

¹⁰⁵ Nat’l Transp. Safety Bd., No. 6802, Safety Recommendation Letter on Laser Beams Affecting the Aviation Community to FAA Acting Adm’r Barry L Valentine 1 (Feb. 27, 1997).

¹⁰⁶ *Id.*

¹⁰⁷ *Id.*

¹⁰⁸ *Id.*

incapacitation due to a laser attack.¹⁰⁹ This second laser attack took place during take-off from McCarran International Airport in Las Vegas, while the plane was at around 7,000 feet above main sea level (msl).¹¹⁰ Unlike the pilot in the first attack, the pilot in the second attack reported that “he *immediately* experienced pain and was completely blinded in his right eye.”¹¹¹ The pilot stated that he was completely blinded for about thirty seconds, could not focus his eye enough to interpret his flight instruments for an additional two minutes, was completely disoriented, and had to turn control of the aircraft over to his co-pilot.¹¹² In 1997, the NTSB recommended that the FAA determine the maximum safe power level of lasers and regulate accordingly, update the Aeronautical Information Manual to include information to aid pilots in avoiding lasering incidents, and identify the location of laser activity in the event that avoidance was not possible.¹¹³

In 1993, the National Aeronautics and Space Administration (NASA) received a report of a lasering attack on an airplane departing McCarran International.¹¹⁴ The NASA report notes that the evening flight was hit by a laser during take-off some 500 feet above the ground.¹¹⁵ The doctor who examined the afflicted pilot noted that the laser beam had “burned the outer coating of the white area of his eye, also breaking blood vessels.”¹¹⁶ The pilot stated that if the laser beam had also struck his co-pilot, the lives of the crew and all passengers aboard the flight would have been in danger.¹¹⁷

These are far from the only reported incidents of lasering before the passage of the FAA Modernization and Reform Act of

¹⁰⁹ *Id.*

¹¹⁰ *Id.* at 1–2.

¹¹¹ *Id.* at 2 (emphasis added).

¹¹² *Id.* (discussing the fact that lasering incidents mentioned in the safety recommendation occurred on Southwest Airlines flights; while employing not one but two of the pilots involved in some of the first reported laser attacks is quite a feat, Southwest Airlines does not seem to be touting this fact).

¹¹³ *Id.* at 4.

¹¹⁴ NATIONAL AERONAUTICS & SPACE ADMINISTRATION (“NASA”), AVIATION SAFETY REPORTING SYSTEM (“ASRS”), No. 285091; NASA, AVIATION SAFETY REPORTING SYSTEM, No. 290036.

¹¹⁵ NASA, No. 290036, *supra* note 114; NASA, No. 285091, *supra* note 114.

¹¹⁶ NASA, No. 285091, *supra* note 114; NASA, No. 290036, *supra* note 114

¹¹⁷ NASA, No. 290036, *supra* note 114; NASA, No. 285091, *supra* note 114.

2012.¹¹⁸ While the purpose of this Article is not to deliver a scathing review of the inefficiencies and the sloth-like nature of the federal government, a brief historical review of the depth and breadth of the problem of lasering before the FAA Modernization and Reform Act of 2012 illuminates the inadequacy of the Act as a quintessential solution to the problem of lasering.

i. Enforcement of the FAA Modernization and Reform Act of 2012

In 2005, the Federal Bureau of Investigation (FBI) began tracking lasering incidents occurring in the United States.¹¹⁹ In addition to jail time, the FBI fines individuals who interfere with the operation of an aircraft—including lasering—up to \$250,000.¹²⁰ Lasering has become such a problem that twelve FBI field offices, in an effort to crack down on perpetrators, enacted programs offering rewards of up to \$10,000 for information leading to the arrest of anyone who pointed a laser at an airplane.¹²¹ The potential fine and the risk of five years of jail time¹²² impose steep penalties and could serve as a major deterrence. However, from 2005 to 2013, there were only 134 arrests for violating the anti-lasering law.¹²³ Of the paltry 134 arrests made over this eight-year period, only eighty resulted in convictions.¹²⁴ To put that in

¹¹⁸ See, e.g. NASA, ASRS, No. 322991; VAN B. NAKAGAWARA & RONALD W. MONTGOMERY, FED. AVIATION ADMIN., NO. DOT/FAA/AM-01/7, LASER POINTERS: THEIR POTENTIAL AFFECTS ON VISION AND AVIATION SAFETY, at 6, (2001) (making numerous mentions of reported incidents involving lasering of aircraft, including more than 150 incidents of lasering from January, 1996, to July, 1999); Murphy & Hewett, *supra* note 1 (showing that from 2004 through 2011 there were 10,235 reported incidents of “[l]aser pointer illuminations of aircraft”).

¹¹⁹ See *Protecting Aircraft*, *supra* note 48.

¹²⁰ FBI, *Making a Point About Lasers* (Sept. 26, 2011), <https://www.fbi.gov/news/stories/illegal-use-of-laser-pointers-a-serious-crime> [<https://perma.cc/3JRS-VEY7>] [hereinafter *Making a Point*]. But See Press Release, FAA, FAA Steps Up Enforcement of Laser Penalties (May 26, 2012), https://www.faa.gov/news/press_releases/news_story.cfm?newsId=13555 [<https://perma.cc/SEB5-Q5C7>] (stating that “[t]he maximum penalty for one laser strike is \$11,000,” and the largest proposed fine for multiple offenses is \$30,800).

¹²¹ *Making a Point*, *supra* note 120.

¹²² 18 U.S.C.A. § 39A(a) (West 2012).

¹²³ *US: 134 Laser Arrests, 80 Convictions, Out of 17,725 Incidents*, LASERPOINTERSAFETY.COM (May 21, 2014) http://www.laserpointersafety.com/news/news/other-news_files/category-statistics.php#on [<https://perma.cc/AU7S-J5TW>].

¹²⁴ *Id.*

perspective, of the 17,725 reported lasering incidents between 2005 and 2013, less than one percent of the offenders were arrested.¹²⁵ These are reported incidents; there very well may be many lasering incidents that go unreported.¹²⁶ Despite the FAA's sophisticated reporting system¹²⁷ and the Domestic Event Network's (DEN) ability to muster multiple governmental agencies to catch offenders, a minuscule number of reported lasering incidents result in the perpetrator being apprehended, because "[i]t is difficult for pilots to see where a laser beam is coming from, and even more difficult for police officers to pinpoint the perpetrator's location based on the pilot's report."¹²⁸ More so, if police officers are to locate the area where the lasering incident originated from, even with the FAA's sophisticated reporting procedures, it seems unlikely that the offender would remain on the scene by the time law enforcement arrives.

Nevertheless, a number of people have found themselves behind the laser pointer and subject to some rather intense sentencing. In 2012, on an August evening in Fresno, California, Sergio Rodriguez decided to "see how far his laser would go at night."¹²⁹ The green laser Rodriguez shone into the night sky struck the cockpit of a helicopter about 1,000 feet in the air.¹³⁰ The pilot recounted the distraction caused by the laser stating, "[there was a] bright green flash inside the cabin," causing "everything in the cabin [to] light up."¹³¹ After the initial laser attack, Rodriguez hit the helicopter with the green laser again, making it hard for the pilot to see.¹³² The pilot attempted to locate the position the laser originated from and contacted ATC, which alerted the Fresno Police Department regarding the lasering.¹³³ A police chopper in the area began orbiting the location where the laser strike

¹²⁵ *Id.*

¹²⁶ *Laser Attacks Pose 'Real Threat' to Aviation Safety: British Pilots' Association*, INSURANCE J. (Feb. 28, 2017), <https://www.insurancejournal.com/news/international/2017/02/28/443020.htm> [<https://perma.cc/AB8W-AU25>].

¹²⁷ See FAA, LASER ILLUMINATION, *supra* note 6, at 2.

¹²⁸ Lee, *supra* note 85.

¹²⁹ *United States v. Rodriguez*, 790 F.3d 951, 953 (9th Cir. 2015) (noting that § 39A was "designed for *knuckleheads* like [Rodriguez]" who do not intend to interfere with flight operations) (emphasis added).

¹³⁰ *Id.* at 954.

¹³¹ *Id.*

¹³² *Id.*

¹³³ *Id.*

originated from, and while at an altitude of 500 feet, the police helicopter was struck by the green colored laser, causing a “big flare” as it “[lit] up the entire cockpit.”¹³⁴ The pilot of the police helicopter, Tactical Flight Officer George Valdez, noted that the laser was more intense than a camera flash and “brighter than the high beams of a car light by far.”¹³⁵ Finally, Valdez directed ground crews to Rodríguez’s location, which was in front of his apartment.¹³⁶ Rodríguez was initially sentenced to the maximum of five years in prison for the lasering incidents, however, the maximum sentence was enhanced on the grounds that Rodríguez intentionally and recklessly tried to interfere with flight operations and endanger the pilots¹³⁷—an element not found on Rodríguez’s first appeal.¹³⁸ After the dust settled, Rodríguez was again sentenced in 2016 to the full five-year maximum, primarily because he was on probation at the time of the offense.¹³⁹

In a case decided prior to *Rodríguez*, another California “knucklehead”¹⁴⁰ was arrested for pointing a green colored laser at a seven passenger Cessna jet and a police helicopter.¹⁴¹ The perpetrator, high-school student Adam Gardenhire, intentionally tried to hit the aircraft with the laser.¹⁴² However, on appeal, the court determined that Gardenhire did not know the risks created by his actions, thus falling short of the “reckless” behavior required for enhanced sentencing.¹⁴³ Like Rodríguez, Gardenhire’s initial sentence was vacated and his case remanded for resentencing.¹⁴⁴ However, unlike Rodríguez, it is unknown how much time Adam Gardenhire will spend in jail for his crime.¹⁴⁵

A more recently decided case, arising from Florida, involved the lasering of a commercial airplane pilot.¹⁴⁶ Like Rodríguez and Gardenhire, perpetrator Shannan Winemiller also lasered the

¹³⁴ *Rodríguez*, 790 F.3d at 954.

¹³⁵ *Id.* Valdez further stated that the laser strike impeded his ability to see the instruments in his cockpit, as well as potential hazards outside the cockpit.

¹³⁶ *Id.*

¹³⁷ *Id.* at 953.

¹³⁸ *Id.* at 960–61.

¹³⁹ United States v. Rodríguez, 664 Fed. Appx. 607, 609–10 (9th Cir. 2016).

¹⁴⁰ *Rodríguez*, 790 F.3d at 953.

¹⁴¹ United States v. Gardenhire, 784 F.3d 1277, 1278 (9th Cir. 2015).

¹⁴² *Id.* at 1279.

¹⁴³ *Id.*

¹⁴⁴ *Id.* at 1286; *Rodríguez*, 790 F.3d at 961.

¹⁴⁵ *Gardenhire*, 784 F.3d at 1285; *Rodríguez*, 790 F.3d at 961.

¹⁴⁶ United States v. Winemiller, 679 Fed. Appx. 759, 760 (11th Cir. 2017).

police helicopter that came searching for him,¹⁴⁷ but increased the risk to the pilots by using a green laser.¹⁴⁸ Much like *Gardenhire* and *Rodriguez*, the officer piloting the police chopper alerted ground crews to the location where the laser appeared to originate from (possibly using the DEN), and the offender was apprehended.¹⁴⁹ *Winemiller* was sentenced to a year of probation and twenty-five hours of community service for his offense.¹⁵⁰

Finally, Californian Barry Bowser was convicted of pointing a laser at an aircraft in 2015.¹⁵¹ Bowser wasted no time lasering civilian aircraft—his only target was the law enforcement helicopter he lasered while “play[ing] with his dog.”¹⁵² The police helicopter immediately spotlighted Bowser after it was lasered and he was detained until ground forces could make an arrest.¹⁵³ Unlike *Gardenhire* and *Gonzalez*, the color of Bowser’s laser is unknown because the laser pointer was destroyed.¹⁵⁴ There were, however, multiple green laser strikes on the police chopper at the same time and in the same location as the lasering incident in question, so it is probable that Bowser’s laser pointer emitted green light.¹⁵⁵ For the act of lasering an aircraft, Bowser received a twenty-one-month prison sentence, thirty-six months of supervised release, and a \$100 penalty.¹⁵⁶

These illustrate the varied range in sentences—and the sometimes-lengthy process of delivering them—perpetrators receive for lasering aircraft.¹⁵⁷ The dangers associated with lasering, the widespread availability of lasers, and the increased

¹⁴⁷ *Winemiller*, 679 Fed. Appx. at 760; *Rodriguez*, 790 F.3d at 954; *Gardenhire*, 784 F.3d at 1278.

¹⁴⁸ Brief for Petitioner-Appellant at 7, *United States v. Winemiller*, 679 Fed. Appx. 759 (11th Cir. 2017) (No. 16-10505-H).

¹⁴⁹ *Winemiller*, 679 Fed. Appx. at 760; *Rodriguez*, 790 F.3d at 954; *Gardenhire*, 784 F.3d at 1278.

¹⁵⁰ See Brief for Petitioner-Appellant, *supra* note 148, at 6.

¹⁵¹ *United States v. Bowser*, No. 1:15-cr-00088 LJO SKO, 2015 WL 13055918, at *1 (E.D. Cal. Sept. 24, 2015).

¹⁵² Brief for Petitioner-Appellant at 4, *United States v. Bowser*, 667 Fed. Appx. 188 (9th Cir. 2016) (No. 15-10486).

¹⁵³ *Id.* at 5.

¹⁵⁴ *United States v. Bowser*, 667 Fed. Appx. 188, 198 (9th Cir. 2016).

¹⁵⁵ See Brief for Petitioner-Appellant, *supra* note 152, at 5-6.

¹⁵⁶ *Id.* at 4.

¹⁵⁷ See, e.g., *Rodriguez*, 790 F.3d 951; *Winemiller*, 679 Fed. Appx. 759; *Bowser*, 667 Fed. Appx. 188; and *Gardenhire*, 784 F.3d 1277.

frequency of lasering incidents despite federal regulations indicate that legislation alone may not be enough.

IV. ANALYSIS OF POSSIBLE SOLUTIONS

There are at least three viable options available to supplement the statutory prohibition on shining laser pointers at aircraft. First, the FDA has proposed to reclassify all non-red lasers as defective.¹⁵⁸ Doing this would allow the FDA to more easily confiscate certain laser pointers, reducing the availability of more dangerous colored lasers.¹⁵⁹ The reclassification would also prevent the criminalization of the sale or possession of such lasers.¹⁶⁰ Second, certain classes of lasers could be completely prohibited with exceptions made for uses by trained professionals—an approach that has already been adopted in Australia, New Zealand, and has been considered in the United Kingdom.¹⁶¹ A prohibition would reduce the accessibility and ease of purchase of the banned lasers, but this approach may actually make the problem it seeks to solve worse.¹⁶² Finally, the FAA could issue a mandate requiring all pilots to wear laser-filtering eyewear during the most crucial stages of flight.¹⁶³ Alternatively, the FAA could require aircraft manufacturers and airlines to install laser-filtering film on all new and existing cockpit windows.¹⁶⁴

A. The FDA Could Deem Certain Colors of Laser Pointers Defective

Lasers pointers are electronic products subject to FDA regulation.¹⁶⁵ Because a laser pointer is an electromagnetic-radiating device, the FDA can declare one defective if it emits

¹⁵⁸ See FDA, BACKGROUND MATERIALS, *supra* note 36, at 30–31.

¹⁵⁹ *Id.*

¹⁶⁰ *Id.*

¹⁶¹ See FOOD AND DRUG ADMIN., TECHNICAL ELECTRONIC PRODUCT RADIATION SAFETY STANDARDS COMMITTEE OCT. 25, 2016, TRANSCRIPT, at 146 (2016) [hereinafter FDA, TRANSCRIPT] <https://www.fda.gov/downloads/AdvisoryCommittees/CommitteesMeetingMaterials/Radiation-EmittingProducts/TechnicalElectronicProductRadiationSafetyStandardsCommittee/UCM528629.pdf> [perma.cc/D39X-5ZYL].

¹⁶² See *infra* note 180.

¹⁶³ See IRIDIAN, *supra* note 11.

¹⁶⁴ See BAE SYS., *supra* note 11.

¹⁶⁵ 21 C.F.R. §1000.3(j)(1)–(k)(1).

radiation that is unnecessary to the accomplishment of its primary purpose and which creates a risk of injury to any person.¹⁶⁶ If the FDA used this regulation to designate certain colors of lasers defective, it could go so far as requiring manufacturers to refund purchases of all lasers so-designated, effectively ending commercial sales of those colors of lasers in the United States.¹⁶⁷

At a 2016 presentation to the Technical Electronic Product Radiation Safety Standards Committee, the FDA proposed to designate all non-red lasers as defective.¹⁶⁸ The FDA noted that it “received numerous letters from Congress requesting action on laser pointer illuminations of aircraft” and sought to designate all blue and green laser pointers defective under 21 C.F.R. 1003.2(b)(2).¹⁶⁹ The FDA made clear it intended to amend performance standards so that any laser pointer emitting light in a range of wavelengths from 400 to 609 nanometers (that is, visible light ranging from deep violet to orange-red) would be considered defective.¹⁷⁰

In its presentation to the Safety Standards Committee, the FDA pulled no punches, noting that green laser pointers are “[twenty-eight] times brighter than equivalently-powered red laser pointers,” that there had been an “[eighty]-fold increase [over ten years] in reported incidents of aircraft illuminations from laser pointers,” and that green laser pointers are abundantly available.¹⁷¹ The FDA explained that the hazards associated with flash blinding are reduced when red lasers are involved.¹⁷² In fact, the FDA went so far as to claim that “[t]he hazard from laser aircraft illuminations would be effectively eliminated if green and blue laser pointers were not available.”¹⁷³

However, the Safety Standards Committee members held differing opinions on the efficacy of the FDA’s proposal. One supporter of the proposal, stated that the slight advantage a green or blue laser may aid a presenter in delivering a presentation was far outweighed by the safety hazard that green and blue laser

¹⁶⁶ 21 C.F.R. §1003.2(b)(2).

¹⁶⁷ *US: UPDATED*, *supra* note 27.

¹⁶⁸ *FDA Proposes Amending*, *supra* note 36, at 30.

¹⁶⁹ *Id.* at 29–30.

¹⁷⁰ *Id.* at 31.

¹⁷¹ FDA TRANSCRIPT, *supra* note 161, at 104–05.

¹⁷² *Id.* at 106, 113.

¹⁷³ *Id.* at 106.

pointers present.¹⁷⁴ Another member was more skeptical of the proposal, saying that because green- and blue-colored laser pointers are so widespread and prevalent, re-characterizing them as defective would do little to mitigate the problem of aircraft lasering.¹⁷⁵ As Dr. Lambeth aptly put it, “the cat is out of the bag, they’re everywhere, and they will be continued to use [sic] even if we make a regulation . . .”.¹⁷⁶

The marginal benefit offered to most legitimate laser pointer users is far outweighed by the potentially devastating effect green- and blue-colored lasers could have.¹⁷⁷ However, green- and blue-colored lasers are widely possessed and regulation at the manufacturing level will do little—especially in the foreseeable future—to curb the problem.¹⁷⁸ FDA restrictions on green- and blue-colored laser pointers are certainly not a step in the wrong direction. Prohibitions like these are, however, quite possibly too small a step in the right direction.

B. A Prohibition on Laser Pointers

An outright ban could be effective if the sale and possession or use of laser pointers was criminalized. If the United States took such action, it would not be the first country to do so.¹⁷⁹ The widespread use of laser pointers and the difficulties surrounding the actual capture of lasering perpetrators point to the possible futility of prohibitions. The section that follows provides policy examples from three countries that have attempted to deal with the lasering problem.

¹⁷⁴ *Id.* at 189.

¹⁷⁵ *See id.* at 192.

¹⁷⁶ *Id.* at 192.

¹⁷⁷ *Id.* at 188–89.

¹⁷⁸ *See Id.* at 192.

¹⁷⁹ *See Prohibited Goods*, AUSTRALIAN BORDER FORCE <https://www.abf.gov.au/importing-exporting-and-manufacturing/prohibited-goods/categories/weapons> [<https://perma.cc/W9NK-73XQ>] (last updated Nov. 12, 2018) [hereinafter *Prohibited Goods*]; *see also* Ben Richmond, *Australia’s Laser Pointer Ban Isn’t Working Very Well*, MOTHERBOARD (June 26, 2014, 5:24 PM), https://motherboard.vice.com/en_us/article/wnj4y/australias-laser-pointer-ban-isnt-working-very-well [<https://perma.cc/XM4X-6TN2>].

i. Australia

Australia's individual states are responsible for regulating the use and possession of lasers, while its federal government is primarily concerned with regulating imports and exports.¹⁸⁰ In Australia, laser pointers that have a strength greater than 1 milliwatt (mW) are not allowed in Australia without a permit.¹⁸¹ Penalties for violating this prohibition include the forfeiture of the laser pointer, fines, and prosecution.¹⁸² While not all Australian states prohibit the use or possession of laser pointers, the State of Victoria does.¹⁸³ Victoria currently deems laser pointers to be "hand-held battery-operated article[s]" that are "designed or adapted to emit a laser beam with an accessible emission limit of greater than 1 mW" as "prohibited weapons."¹⁸⁴ Federal restrictions on the importation of laser pointers, and state prohibitions on the use and possession of laser pointers, has earned Australia the honor of having the strictest laser pointer laws in the world.¹⁸⁵

Statistics show that in the four years following bans on sales and possession of laser pointers (mid-2008 to 2012), reported that lasering incidents in Australia increased nearly six-fold.¹⁸⁶ Ironically, during the same period, the increase of reported lasering incidents in the United States, without any federal

¹⁸⁰ Trevor A. Wheatley, *Laser Pointer Prohibition: Improving Safety or Driving Misclassification*, Proceedings of the Int'l Laser & Safety Conf. 48-54 (2013).

¹⁸¹ *Prohibited Goods*, *supra* note 179.

¹⁸² *Id.*; see also Ally Foster, *Australian Border Force Issues Stern Warning to Schoolies in Bali*, NEWS.COM.AU (November 14, 2018 3:29 PM), <https://www.news.com.au/travel/travel-advice/health-safety/australian-border-force-issues-stern-warning-to-schoolies-in-bali/news-story/3d4d969aae36b6f2f309a3b14c3c705d> [https://perma.cc/YN6Q-EKG3].

¹⁸³ See AUSTL. CUSTOMS AND BORDER PROT. SERV., POST IMPLEMENTATION REVIEW: RESTRICTION ON THE IMPORTATION OF HANDHELD LASER POINTERS 21–22 (2012).

¹⁸⁴ *Id.* at 21.

¹⁸⁵ *The Worrying Failure of Australia's Ban on High-Power Laser Pointers*, MIT TECHN. REV. (June 23, 2014) [hereinafter MIT TECHN. REV.], <https://www.technologyreview.com/s/528566/the-worrying-failure-of-australias-ban-on-high-power-laser-pointers/> [https://perma.cc/HD23-NUFW].

¹⁸⁶ *Australia: Laser Incidents Rose 2007-2012; Fell From 2013-2015*, LASERPOINTERSAFETY.COM (Mar. 1, 2016) [hereinafter *Australia: Laser Incidents*] https://www.laserpointersafety.com/news/news/other-news_files/2659c33c505a234af556fb281e6a6f96-485.php#on [https://perma.cc/495F-9G9T].

prohibitions on the sale or possession of laser pointers,¹⁸⁷ roughly tracked Australia's numbers.¹⁸⁸ However, in the subsequent three years, (2013-2015) reports of lasering in Australia did decline, though the number of reported incidents in 2015 was still nearly four-times larger than the number of reported incidents in mid-2008.¹⁸⁹

The increase in lasering activity in Australia is not the only problem. According to Trevor Wheatley, an electrical engineer and professor at the University of New South Wales at the Australian Defence Force Academy School of Engineering and Information Technology, laser pointer suppliers "have learnt[sic] how to bypass the prohibition [on laser pointers]."¹⁹⁰ According to Wheatley, manufacturers are mislabeling lasers.¹⁹¹ For example, lasers advertised at 1 mW were found to substantially exceed 1 mW. Laser pointers from international suppliers producing 5 mW lasers were found to advertise the same lasers as 1 mW lasers in the Australian market.¹⁹² In fact, in a study performed by Wheatley, out of the forty laser pointers advertised as 1 mW, forty percent were actually labeled as greater than or equal to 1 mW (a fact learned upon receipt).¹⁹³ Some of the lasers Wheatley received were even labeled as greater than or equal to 5 mW laser pointers, and one laser was labeled as greater than 10 mW.¹⁹⁴ Even more astounding, when tested, nearly all of the forty-one lasers exceeded 1 mW. Most lasers exceeded 15 mW and one even exceeded 100 mW.¹⁹⁵ In all, Wheatley ordered forty-four lasers for his test and only received forty-one due to confiscation at customs, meaning that even though almost every laser contained a label stating that it exceeded the 1 mW limit, Australian customs only intercepted three of the lasers.¹⁹⁶

¹⁸⁷ *Schumer Takes Aim at High-Powered Laser Pointers*, CBS N.Y. (March 15, 2015, 1:54 PM), <https://newyork.cbslocal.com/2015/03/15/schumer-takes-aim-at-high-powered-laser-pointers/> [<https://perma.cc/9YHB-KV8P>].

¹⁸⁸ *Australia: Laser Incidents*, *supra* note 186.

¹⁸⁹ *Id.*

¹⁹⁰ WHEATLEY, *supra* note 180.

¹⁹¹ *Id.*

¹⁹² *Id.*

¹⁹³ *Id.*

¹⁹⁴ *Id.*

¹⁹⁵ *Id.*; *accord.* MIT TECHN. REV., *supra* note 185 (suggesting that one reporter's interpretation of the data, all but *two* of the lasers exceeded the 1 mW threshold).

¹⁹⁶ WHEATLEY, *supra* note 180.

Australia's ban on laser pointers acts as a test case.¹⁹⁷ The sharp increase in reported lasering incidents after the prohibition of laser pointers does not bolster confidence that the ban has been successful. Of course, there may have been more reported incidents in Australia had laser pointers not been banned, but since the increase of reported incidents tracks closely with the increase in reported incidents in the United States—where the possession of laser pointers is not prohibited—this may not be the case. In addition, the inability of Australian authorities to intercept laser pointers that are clearly labeled to exceed the legal limit raises more doubt about the viability of prohibiting laser pointers as a solution to the lasering problem.¹⁹⁸

ii. New Zealand

The New Zealand laser-pointer ban is similar to Australia's. The New Zealand law prohibits the possession of “high-powered laser pointers” in “any public place, without reasonable excuse.”¹⁹⁹ The law fails to define a “reasonable excuse,” and further, the New Zealand Ministry of Transport advises that if someone found in possession of a laser pointer does not provide an excuse the police deem reasonable, “the police will be provided with a degree of certainty that the person intended to misuse the device.”²⁰⁰ This interpretation of the law affords the New Zealand government great discretion in not only determining “reasonable excuses” but also the intent of the individual in possession.

While the New Zealand law does leave some questions unanswered, it provides a clear definition of “high-powered laser pointer” quite similar to the Australian law. In New Zealand, a high-powered laser pointer is “a device that, in the Director-General of Health's opinion, is of the kind commonly known as a laser pointer,” is battery operated, “designed or intended to be operated while held in the hand,” and, most importantly, produces more than 1 mW of power.²⁰¹ Persons caught in New Zealand

¹⁹⁷ *Id.*

¹⁹⁸ *Id.*

¹⁹⁹ Summary Offences Act 1981, s 13B(1) (N.Z.).

²⁰⁰ MINISTRY OF TRANSPORT, SUMMARY OFFENCES (POSSESSION OF HAND-HELD LASERS) AMENDMENT BILL 4 (2014) [hereinafter MINISTRY OF TRANSPORT] (stating that two States in the United States do regulate the sale and possession of laser pointers) (N.Z.).

²⁰¹ Summary Offences Act, s 13B(3) (N.Z.).

possessing a laser pointer—without a reasonable excuse—face possible jail time up to three months, a maximum fine of \$2,000, and forfeiture of the laser pointer.²⁰²

Despite New Zealand officials' wide latitude in dealing with people possessing laser pointers and the fairly tough penalties offenders are subject to, much like in Australia, the number of reported lasering incidents continues to rise.²⁰³ New Zealand saw more lasering incidents in the first eleven months of 2017 than the entirety of 2016, and 2016 yielded nearly thirty-three percent more reported incidents than 2015—the first full calendar year after the passage of the law.²⁰⁴ This prompted the New Zealand Pilot's Union to call for tougher penalties for laser attacks, equating laser attacks to hijacking and bomb threats.²⁰⁵ However, the post-prohibition increase in lasering incidents in Australia and New Zealand may indicate that tougher penalties are not the answer.

iii. United Kingdom

In evaluating solutions to its lasering problem, the United Kingdom addressed the issue in a January 2018 “government response” by discussing lasering in incidents in Australia and New Zealand.²⁰⁶ According to this report, lasering incidents in Australia increased sharply after the country implemented its ban.²⁰⁷ Further, in New Zealand, lasering incidents reached an all-time high shortly after the its ban was implemented. The failure of the Australian and New Zealand bans led the United Kingdom to call

²⁰² *Id.* at 13B(1)–(2).

²⁰³ See *Laser Strike Incidents on the Rise: It Could Cause an Accident*, RADIO NZ (Dec. 28, 2017, 8:43 AM), <https://www.radionz.co.nz/news/national/347089/laser-strike-incidents-on-the-rise-it-could-cause-an-accident> [<https://perma.cc/ZLP4-CV45>].

²⁰⁴ *Id.*; *New Zealand: Laser Pointer/Aircraft Incidents Increase About 11% in 2017*, LASERPOINTERSAFETY.COM (Dec. 29, 2017), https://www.laserpointersafety.com/news/news/other-news_files/eb43c58a11990ea53d2c76035054bb17-558.php#on [<https://perma.cc/A3VJ-DRPH>] (“If the trend continued through December 2017, it would mark an 11% increase in reported incidents from 2016.”).

²⁰⁵ Press Release, “We’ve had Enough” NZ Pilots Call for the Complete Prohibition on Possession of Laser Devices, New Zealand Air Line Pilots Association, (Apr. 18, 2018) <https://www.nzalpa.org.nz/Media-Centre/News/ArticleId/91/weve-had-enough-nz-pilots-call-for-the-complete-prohibition-on-possession-of-laser-devices> [<https://perma.cc/JRW5-E4VR>] (stating that a laser attack is “one of the most terrifying things [pilots have] ever gone through.”).

²⁰⁶ DEP’T FOR BUS., ENERGY & INDUSTRIAL STRATEGY, CALL FOR EVIDENCE: LASER POINTERS, GOVERNMENT RESPONSE 11 (2018) [hereinafter CALL FOR EVIDENCE].

²⁰⁷ *Id.*

for no legislative ban on laser pointers—noting that in Australia, the ban may have even had a detrimental effect because high-powered lasers were mislabeled as low-powered laser pointers.²⁰⁸

The British government, however, does not wish to overlook lasering because, as most countries are experiencing, it has become a substantial issue in the United Kingdom. In 2016, there were 151 lasering incidents at Heathrow Airport in London alone.²⁰⁹ In 2016, an international passenger flight departing from Heathrow airport was struck by a laser at around 8,000 feet, causing one of the pilots on board the plane to fall ill and requiring the plane to turn back to Heathrow Airport.²¹⁰ Heathrow Airport is not the only “hot-spot” for lasering activity in the United Kingdom though—Glasgow Airport saw a near doubling of laser attacks in 2016.²¹¹ During 2016, the United Kingdom saw a total of 1,258 lasering attacks.²¹²

The United Kingdom House of Lords recently passed a bill making it a criminal offense to shine a laser pointer at a vehicle—including an aircraft—making the legislation quite similar to the United States’ criminal prohibition, but this seems to be as far as the United Kingdom is willing to go legally.²¹³ The country appears to be focused on other options to deal with the lasering problem, and while the effectiveness of those options is unknown, they do not at first glance instill confidence.

²⁰⁸ *Id.*

²⁰⁹ Patrick Grafton-Green, *Heathrow Airport Tops Country for ‘Incredibly Dangerous’ Laser Attacks on Aircraft*, EVENING STANDARD (Feb. 27, 2017, 4:32 PM), <https://www.standard.co.uk/news/london/heathrow-airport-tops-country-for-incredibly-dangerous-laser-attacks-on-aircraft-a3477191.html> [<https://perma.cc/GGM4-47S5>].

²¹⁰ Adam Aspinall, *Pilots Call for Laser Ban After Flight Forced to Turn Back to London*, MIRROR (Feb. 16, 2016, 11:13 AM), <https://www.mirror.co.uk/news/uk-news/pilots-call-laser-ban-after-7377077> [<https://perma.cc/EVS5-CFCT>].

²¹¹ Grafton-Green, *supra* note 209.

²¹² *Id.* (noting, however, total incidents of lasering in 2016 were down from 1,439 the year before).

²¹³ Laser Misuse (Vehicles) Bill 2017, HL Bill [75], cl. 1(1), (6) (Gr. Brit.), <https://publications.parliament.uk/pa/bills/lbill/2017-2019/0075/18075.pdf> [<https://perma.cc/F7KB-MUP6>]. *See also UK: New UK Law Provides Stronger Penalties, Easier Prosecution for Aiming a Laser at a Vehicle*, LASERPOINTERSAFETY.COM (Dec. 21, 2017), http://www.laserpointersafety.com/news/news/other-news_files/bb745ab1533d399cf2def8680c45498a-555.php#on [<https://perma.cc/83QL-8SBE>]; CALL FOR EVIDENCE *supra* note 206, at 11 (stating the Government Response pointed out the ineffectiveness of other Nation’s prohibitions on laser pointers and seemed to conclude that a legislative prohibition was not the answer).

The United Kingdom's 2018 government response outlines a few strategies taken by its government to address the lasering problem.²¹⁴ For example, the government began cracking down on the import of certain types of laser pointers, though the paltry £100,000 the government is willing to allocate to aid in this effort must either be a typo or a serious miscalculation.²¹⁵ Another option is to “encourage more effective voluntary labelling of laser pointers.”²¹⁶ The intentional mislabeling and false advertising of laser pointers running rampant through Australia is an all-too-real possibility for the United Kingdom as well.²¹⁷ Furthermore, the government considered banning all advertising of laser pointers, but realized that laser pointers are not advertised domestically and online vendors fall out of the purview of United Kingdom legislation.²¹⁸ Perhaps the United Kingdom's best plan of attack is to pursue a public awareness campaign that alerts the public to hazards associated with laser pointers.²¹⁹ However, the ignorant, mischievous, and unreached masses wielding laser pointers will still pose a risk to aviation.

From outright prohibition to public awareness campaigns, government solutions to the lasering issue have either proven ineffective or questionable. Due to the possible exclusion of prohibition,²²⁰ government responses such as the implementation of a public awareness campaign, the FDA's reclassification of “defective” laser pointers, and the criminalization of pointing a laser at an aircraft will arguably have a positive effect. However, a mere positive effect is insufficient when reports of lasering incidents are skyrocketing across the globe. Perhaps the best possible answer to the lasering problem lies in technological advances working in unison with legislative action.

²¹⁴ See CALL FOR EVIDENCE *supra* note 206, at 9.

²¹⁵ *Id.*

²¹⁶ *Id.*

²¹⁷ *Id.*

²¹⁸ *Id.* at 12.

²¹⁹ CALL FOR EVIDENCE *supra* note 206, at 10.

²²⁰ See *id.* at 9–11.

B. The Technological Solutions

There are two excellent technological solutions to lasering: protective eyewear²²¹ and protective cockpit window lining or film.²²² Anti-laser eyewear provides pilots with adequate protection from harmful laser strikes, but requires pilots to remember to wear them during the critical stages of flight (take-off and landing). Anti-laser film can be installed on cockpit windows to shield pilots from harmful laser light and does not require pilots to remember to take action to gain this protection. While either option is superior to the absence of both, anti-laser film is presumably the best option.

i. Protective eyewear

Iridian Spectral Technologies seized the opportunity to develop protective eyewear when the company engineered eyeglasses to reflect harmful laser pointer light, called *LaseReflect*®.²²³ A close run-in with a laser pointer is an intense experience for the person wearing *LaseReflect*® glasses, however, the glasses will reduce the intensity of a laser beam.²²⁴ Most importantly, *LaseReflect*® glasses can reflect more than ninety-nine percent of the more harmful green colored laser light.²²⁵ In addition to green laser light, *LaseReflect*® can filter out more than ninety-nine percent of harmful violet, blue, red, and orange laser light.²²⁶ A new pair of *LaseReflect*® glasses sells for \$219.00, which is a relatively low cost for the protection they provide and the potential disasters they can prevent.²²⁷

In 2016, the Pilot's Union recommended pilots use Iridian *LaseReflect*® glasses to protect their eyesight from lasering

²²¹ *Laser Reflection Glasses*, *supra* note 11.

²²² *Novel Technology*, *supra* note 11.

²²³ *Id.*

²²⁴ *See id.*

²²⁵ *New Lower Price for LaseReflect*®, IRIDIAN, [hereinafter *Lower Price for LaseReflect*®] <https://www.iridian.ca/news/new-lower-price-for-lasereflect/> [https://perma.cc/E9CR-BKVM].

²²⁶ *Laser Reflection Glasses*, *supra* note 11.

²²⁷ *Lower Price for LaseReflect*®, *supra* note 225.

attacks.²²⁸ The Pilot's Union is not the only organization interested in anti-laser eyewear; the United States Air Force awarded a more than \$20 million contract to Teledyne Technologies, Inc. for the purpose of developing, testing, and deploying more than 8,000 pairs of anti-laser glasses.²²⁹ However, unlike the Iridian *LaseReflect*® glasses, which cost \$219.00 a pair, the United States Air Force paid \$2,400 per pair of Teledyne glasses.²³⁰

ii. Protective film

Protective film is a solution that could solve the lasering problem without requiring pilots to take any additional steps to protect themselves because it is placed directly onto the plane. BAE Systems has developed a “low cost, lightweight, flexible system that can block dangerous laser light, protecting pilots and flight crew from hostile attacks.”²³¹ BAE Systems’ protective film filters out certain wavelengths of dangerous laser light without compromising natural light’s ability to illuminate the cockpit. Most importantly, it does not affect a pilot’s ability to see hazards outside the aircraft.²³² BAE Systems is still in the testing phase, but the results so far are promising.²³³ The film is completely “passive,” meaning it requires no power and has no response time, so it is “always ‘on.’”²³⁴ In addition, the film is programmable and upgradable, enabling the BAE Systems film to be used against unforeseeable threats.²³⁵

²²⁸ See *Protecting Yourself from Cockpit Laser Attacks*, AIR LINE PILOTS ASS’N, INT’L (Aug. 22, 2016), <http://www.alpa.org/news-and-events/news-room/2016-08-22-air-safety-forum-lasers> [<https://perma.cc/UM4D-ZRNU>].

²²⁹ Jim Moore, *Laser Defense for Pilots*, AIRCRAFT OWNERS & PILOT ASS’N (Nov. 12, 2014), <https://www.aopa.org/news-and-media/all-news/2014/november/12/laser-defense-for-pilots> [<https://perma.cc/SX8K-XSPE>].

²³⁰ *Id.* (calculating 8,000 pairs of glasses divided by the twenty-one million dollars paid for the glasses).

²³¹ *Novel Technology*, *supra* note 11.

²³² *Id.*

²³³ *Id.*

²³⁴ UK: Updated – BAE Systems Developed Laser-Reducing Film for Pilots; Lab Tests Successful, LASERPOINTERSAFETY.COM (Sept. 12, 2017), http://www.laserpointersafety.com/news/news/other-news_files/4e93b2dc3fa75694d9797db2347828f3-551.php#on [<https://perma.cc/ZW34-7AV2>].

²³⁵ *Id.*

BAE Systems is not the only player developing protective film.²³⁶ In 2014, a company called Metamaterial Technologies Inc. (MTI) entered into an agreement with aeronautics company Airbus to test its laser-reflective filter, metaAIR™.²³⁷ As of early 2017, MTI and Airbus entered into another agreement to commercialize and use metaAIR™.²³⁸ This non-metallic filter is installed on the inside of a window and protects against harmful light from lasers, while also filtering out approximately ninety-nine percent of harmful ultraviolet rays.²³⁹ Much like BAE Systems' protective film, metaAIR™ can be installed onto existing cockpit windows, while still allowing natural light to penetrate the cockpit without compromising the pilot's visibility of external hazards or instrumental hazards within the cockpit.²⁴⁰ Further, metaAIR™ is customizable and can be adjusted to block a myriad of laser colors, including green, blue, and red.²⁴¹

Laser reflective technology could make laser issues in aviation a thing of the past. Although many laser "incidents" have been reported, there have been no accidents attributable to laser use. Therefore, wide adoption of this technology may not be a reality in the near future.²⁴² Airlines may determine that the extra expense to outfit airplane cockpits with protective film or protective glasses is not justified. Instead of waiting on insurance companies to offer incentives to airlines to provide pilots with protection from laser strikes, the FAA should step in and require that all airplanes—or at least commercial airplanes—be outfitted

²³⁶ See generally, *infra* note 239 (discussing Metamaterial Technologies Inc.'s protective film, metaAIR™).

²³⁷ *Premium Laser Protection*, METAMATERIAL TECHN. INC. <http://www.metamaterial.com/lamda-guard/metaair/> [<https://perma.cc/K8BC-88UA>].

²³⁸ *Metamaterial Technologies Inc. Partners with Airbus to Co-Develop and Commercialize metaAIR™, a Laser Protection Solution*, METAMATERIAL TECHN. INC. (Feb. 21, 2017), <http://www.metamaterial.com/news-and-events/press-releases/press-release/metamaterial-technologies-inc-partners-with-airbus-to-co-develop-and-commercialize-metaair-a-laser-protection-solution/> [<https://perma.cc/3GLM-UPJ3>].

²³⁹ METAIR™ LASER PROTECTION GUIDE, METAMATERIAL TECHN. INC., https://cdn2.hubspot.net/hubfs/1871983/Offers/2017-08-17%20metaAIR%20CTA.pdf?__hssc=84920774.1.1555284213919&__hstc=84920774.f7cb48850ddbc3d5a25cbcf4960c6371.1555180142791.1555180142791.1555284213919.2&__hsfp=1440270773&hsCtaTracking=205e9a2a-5e9a-4cd4-9e6a-f4f4b5146b3e%7C5f6be8f8-14eb-44ec-adaa-7e08ab079ddf [<https://perma.cc/JLG9-RVV7>].

²⁴⁰ See *id.*

²⁴¹ See *id.*

²⁴² See FAA, NAVIGABLE AIRSPACE, *supra* note 5.

with protective film. At a minimum, the FAA should require that pilots wear protective eyewear in airplane cockpits.

CONCLUSION

Lasering is a problem, but the severity of the issue is debatable. Regardless, the potential for catastrophe exists and if one airplane crashes because a laser pointer incapacitates a pilot, the debate will be over and the issue will gain the attention it deserves.

Legal responses to lasering, such as criminalization, public awareness campaigns, classifying certain colors of laser pointers “defective,” and outright prohibitions on laser pointer possession likely will have some positive effect,²⁴³ but regulation and education are not enough. These responses are necessary to tell potential offenders that lasering is dangerous, socially unacceptable, and intolerable. While the legal response compliments changes within the aviation industry, more must be done to end lasering. Companies are currently seeking solutions to this problem through the use of new technology. Protective eyewear and protective film are two viable solutions that would seriously mitigate, if not eliminate, the lasering problem.

Of the two technological solutions, protective film is the superior option because it does not require pilots to remember to wear protective glasses during take-off and landing—the most critical stages of a flight. But without prompting from the FAA, the transition to fully protected cockpits will most certainly be a slow one. Ideally, the FAA will require any aircraft registered in the United States to be outfitted with protective, laser-proof film. Lasering is a complex problem, but the solution does not have to be.

²⁴³ While reports of lasering increased after the criminalization of lasering and prohibitions on the possession of laser pointers, it is possible that the increase in activity is simply a correlation rather than a response to legislation.