

BEFORE THE ADMINISTRATOR
FEDERAL AVIATION ADMINISTRATION

Billy Nolen
Acting Administrator
Federal Aviation Administration
800 Independence Ave., SW
Washington, DC 20591

Rulemaking Petition: The Case of the Incredible Shrinking Airline Seat

Submitted by:
FlyersRights.org

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Pursuant to § 553(e) of the Administrative Procedure Act¹, 49 U.S.C. § 106², and to fulfill the requirements of Sec. 577 of Public Law 115-254³, and Sec. 337 of Public Law 115-254⁴, FlyersRights.org petitions the Federal Aviation Administration (FAA) to promulgate a regulation mandating minimum seat size standards for commercial airlines, including minimum seat width and seat pitch. The FAA should establish minimum seat standards that fit 90-92%⁵ of people, allow for a safe evacuation of an aircraft during an emergency, reduce the incidence of deep vein thrombosis and pulmonary embolism (DVT and PE), and allow for passengers to assume the brace position. Until a minimum seat standard is promulgated and until the emergency evacuation standards are updated to address changed circumstances identified in the Department of Transportation Inspector General (OIG) report, the FAA should establish a moratorium on further seat size shrinkage.

More than just seat pitch and seat width are of concern. Other seat dimension standards must be established for the safety of passengers in emergency evacuations to allow for rapid egress and adoption of the brace position, as well as for passenger health issues, including deep

¹ 5 U.S.C § 553.

² 49 U.S.C. § 106.

³ 49 U.S.C. § 42301 note prec.

⁴ 49 U.S.C. § 44903 note.

⁵ This standard requires dimensions that fit the 5th percentile female up to the 95th percentile male. Due to the different measurements, this will actually fully accommodate approximately 90-92% of people.

vein thrombosis and pain. These dimensions include shoulder to shoulder width, elbow to elbow width, Dimension B⁶, Dimension C⁷, foot envelope clearance⁸, and aisle width.

Need for Rulemaking

Four years ago, Congress ordered the FAA to promulgate minimum seat size standards to correct for the FAA's failure to consider changed circumstances, including changes in passenger size, demographics, plane configurations, human behavior, carry-on baggage, and on-board items. This failure, combined with the FAA's reliance on outdated demonstrations and analyses, its use of older demonstrations over newer ones, and its use of analysis⁹ over demonstrations, all require a comprehensive overhaul of emergency evacuation criteria, assumptions, and practices in addition to minimum seat standards. Failing to act will continue to jeopardize passenger health and safety. Since FlyersRights.org's rulemaking petition in 2015,¹⁰ seats have only continued to shrink, load factors have increased, and passengers have continued to grow in size.

While the FAA has refused to establish seat standards on the sole justification that seat size has no effect on emergency evacuations, at some point, seat pitch will be too small to safely evacuate an aircraft in an emergency. This point should not be up for debate. At some point, seat pitch, seat width, and other seat dimensions will be too small that it will harm passenger health and safety. Refusing to set minimum standards to protect passenger safety and health would be ignoring reality and is no longer acceptable. The United Kingdom Civil Aviation Authority promulgated minimum seat dimensions in 1988.¹¹ These minimums are no longer enforced and would need to be updated to reflect the increase in passenger size over the past 30 years.

In the field of ergonomics, scholars aim for the accommodation of the 5th percentile of female passengers on the low end up to the 95th percentile of male passengers on the high end.¹² This means that a dimension fits all except the smallest 5% of women, up to all but the largest 5% of men. This accommodates approximately 90%-92% of the population.¹³ The minimum seat

⁶ Dimension B, as defined by the United Kingdom Civil Aviation Authority Airworthiness Notice 64 (AN64) (!988) is measured as the minimum distance between a seat and the seat or other fixed structure in front.

⁷ Dimension C, as defined by AN64, is measured as the minimum vertically projected distance between seat rows or between a seat and any fixed structure forward of the seat.

⁸ Foot envelope clearance is the space needed "to avoid obstruction from seat structures when accessing/egressing the seat and to enable a healthy sitting posture and change in posture." Quigley v.

⁹ In 1998, the FAA changed its policy to allow more usage of analysis. Previously, the use of analysis was permitted only for passenger seating capacity increases of 5% or less.

¹⁰ See *infra* note 29.

¹¹ AN 64 has three minimum seat size measurements: Dimension A, B, and C.

¹² Claire Quigley et. al., *Anthropometric Study to Update Minimum Aircraft Seating Standards*, at ii. (July 2001).

¹³ J.F.M. Molenbroek et. al., *Thirty years of anthropometric changes relevant to the width and depth of transportation seating spaces, present and future*, (2017).

dimensions promulgated in AN64 by the United Kingdom used this measurement in order to aid egress.¹⁴

When safety issues are involved, scholars argue that standards should fit the 1st percentile of female passengers up to the 99th percentile of male passengers.¹⁵ This higher standard both addresses the seriousness of safety issues and also allows for further increases in passenger size.¹⁶ Space should be sufficient to allow not just a seated passenger but also movement, clothing, ingress, and egress.¹⁷

Most commercial aviation accidents are survivable.¹⁸ An analysis of sixty NTSB reports shows that 78% of fatalities occurred after impact.¹⁹ Of those, 95.4% were attributed to smoke inhalation.²⁰ Rapid evacuation can increase survivability by 98%, and to Gobbin et al., “[t]his shows that rapid and successful evacuation of the passenger cabin has a significant impact on occupant safety and survival.”²¹

At present, the average seat width only accommodates, at most, 50% of passengers.²² Using anthropometric data on military personnel from the 1980s, a 2019 study found “[t]he combined effects of decreased seat size and increased load factor have had a dramatic impact. In a worst-case assessment, accommodation on a fully-loaded plane is around 60%” In this study, accommodation measures the percentage of passengers who fit within the dimensions of their own seat without any encroachment by neighboring passengers.²³

More recent and granular data sampling men and women from Italy, Japan, Kenya, South Korea, Thailand, the Netherlands, and the United States shows that the average seat width of 17.5 inches accommodates the elbow width of 9.2% of Dutch males, 13% of Italian males,

¹⁴ United Kingdom Civil Aviation Authority Airworthiness Notice 64 (1998), i.

¹⁵ Quigley, iii.

¹⁶ Elizabeth L. Miller, Samuel M. Lapp, & Matthew B. Parkinson, *The effects of seat width, load factor, and passenger demographics on airline passenger accommodation* (2019); Quigley (2001); Jung (1998).

¹⁷ Quigley.

¹⁸ The European Transport Safety Council (ETSC) categorizes 90% of commercial transport airplane accidents as survivable or technically survivable. ETSC, *Increasing the Survival Rate in Aircraft Accidents: Impact Protection, Fire survivability and evacuation* (December 1996).

¹⁹ Andreas Gobbin, Raman Khosravi & Andreas Bardenhagen, *Emergency evacuation simulation of commercial aircraft* (2021).

²⁰ *Id.*

²¹ *Id.*

²² Kayla Diagle et. al., *Aircraft Accommodation for People Living with Obesity: A Call for a Review of Existing Seating, Safety and Emergency Regulations*, (2020).

²³ Load factors affect accommodation percentage because an empty seat means that a passenger who fits within the dimensions of their seat will not be encroached upon by another passenger and also a person who otherwise would not fit within the width dimensions of a single seat would fit using the unoccupied seat.

26.9% of South Korean males, up to 71.9% of Japanese males.²⁴ The average seat width accommodates the shoulder width of 12.8% of American males, 20% of Dutch males, 23% of Korean males, up to 52.1% of Thai males.²⁵ For hip breadth, the average seat width accommodates 75.8% of American females, 77.2% of Dutch females, and up to 100% of Japanese, Korean, and Thai females.²⁶

In addition to the effect of seat size on emergency evacuations, seat size also affects how adequately passengers can assume the brace position²⁷ as well as what risks passengers have of developing DVT/PE.²⁸

History of Petitioner’s Efforts for Safe Seats

On August 26, 2015, FlyersRights.org submitted a rulemaking petition to the FAA to establish minimum seat standards, convene an advisory committee, and to place a moratorium on further seat size shrinkage until a rule was finalized.²⁹ The trends cited in that petition have continued along the same trajectory. Each day of FAA inaction continues to increase the risk to passenger safety, passenger health, and aviation safety.

The FAA denied that rulemaking petition on February 1, 2016 and cited the adequacy of the emergency evacuation standards and the alleged existence of secret tests done at seat pitches as low as 28 and 29 inches performed under those standards.³⁰ With respect to deep vein thrombosis, the FAA offered advice for passengers to “periodically move around on a long flight.”³¹ In a supplementary response on March 14, 2016, the FAA declared that seat size does not affect emergency evacuation times.³²

FlyersRights.org appealed the FAA’s denial to the U.S. Court of Appeals for the District of Columbia Circuit. On July 28, 2017, the appeals court agreed with FlyersRights.org, ruling that secret data and studies cannot be a basis to refuse to engage in rulemaking. Specifically, the appeals court held “information critically relied upon by the agency that no one can see does not count.”³³ The three judge panel, naming the lawsuit “The Case of the Incredible Shrinking

²⁴ Molenbroek.

²⁵ *Id.*

²⁶ *Id.*

²⁷ See section on brace position.

²⁸ See section on DVT/PE.

²⁹ FAA-2015-4011-0001, <https://www.regulations.gov/document/FAA-2015-4011-0001>.

³⁰ FAA-2015-4011-0140.

³¹ *Id.*

³² FAA-2015-4011-0147.

³³ *Flyers Rights v. FAA*, 864 F.3d 738, 747 (D.C. Cir. 2017).

Airline Seat”,³⁴ remanded the rulemaking petition back to the FAA, allowing the FAA to provide evidentiary support to its denial or to reconsider its denial.

Almost one year later, on July 3, 2018, the FAA provided its second denial of the rulemaking petition in a response consisting of four videos of live evacuation demonstrations by Boeing, Airbus, and Embraer and a declaration by Jeffrey Gardlin, the FAA’s Policy and Innovation Division Senior Technical Specialist for Aircraft Cabin Security and Survivability. The FAA declared that seat size, at least at the seat sizes the FAA studied, does not adversely affect evacuation times.³⁵ Note, the OIG later concluded that the FAA provided false information as the basis for its response.³⁶

Unsatisfied with the FAA’s inaction and rationale, Congress passed two important provisions in the 2018 FAA Reauthorization Act, signed into law on October 5, 2018. First, Congress ordered the FAA to establish minimum seat standards. Section 577 provides:

Not later than 1 year after the date of enactment of this Act, and after providing notice and an opportunity for comment, the Administrator of the Federal Aviation Administration shall issue regulations that establish minimum dimensions for passenger seats on aircraft operated by air carriers in interstate air transportation or intrastate air transportation, including minimums for seat pitch, width, and length, and that are necessary for the safety of passengers.³⁷

Second, Congress instructed the FAA to review its emergency evacuation certification process and to improve the process by incorporating new assumptions and data. Section 337 provides:

The Administrator of the Federal Aviation Administration shall review--(1) evacuation certification of transport-category aircraft used in air transportation, with regard to--(A) emergency conditions, including impacts into water; (B) crew procedures used for evacuations under actual emergency conditions; (C) any

³⁴ *Id.* at 740.

³⁵ The Department of Transportation Office of Inspector General concluded that the basis for the FAA’s denial was inaccurate information. At most, only one of the four videos actually portrayed an evacuation at 28 inch seat pitch. And of the five demonstrations that Gardlin claimed to have personally witnessed or had Canadian colleagues witness at 28 inch seat pitch, only one was conducted at 28 inch seat pitch. Over one third of the evacuation demonstrations that the FAA has based its analysis on even reported a seat size.

³⁶ “Lack of comprehensive information on the pitches of seats used in evacuation demonstrations hinders FAA’s ability to respond to public concerns about seat pitch. It also affected the accuracy of the Agency’s response to the 2015 passenger petition.” DOT OIG FAA’s Process for Updating Its Aircraft Evacuation Standards Lacks Data Collection and Analysis on Current Evacuation Risks, 12. September 16, 2020.

³⁷ 49 U.S.C § 42301 note prec.

relevant changes to passenger demographics and legal requirements, including the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.), that affect emergency evacuations; and (D) any relevant changes to passenger seating configurations, including changes to seat width, padding, reclining, size, pitch, leg room, and aisle width; and (2) recent accidents and incidents in which passengers evacuated such aircraft.³⁸

Section 337 required the FAA to report to Congress by October 5, 2019:

Not later than 1 year after the date of enactment of this Act, the Administrator shall submit to the appropriate committees of Congress a report on the results of the review under subsection (a) and related recommendations, if any, including recommendations for revisions to the assumptions and methods used for assessing evacuation certification of transport-category aircraft.³⁹

Congress required the FAA to establish minimum seat size standards and to submit its emergency evacuation report to Congress by October 5, 2019. More than two and a half years later, the FAA has not even begun the rulemaking process.⁴⁰ It has also failed to present any excuse justifying its long delay and failure to comply with the 2018 law.

The lack of minimum seat standards, and the resulting effect on emergency evacuations, deep vein thrombosis, and other issues raised in this position affect every passenger. Most acutely, it affects passengers over the age of 60, passengers who have had DVT or are clinically susceptible, passengers over 73 inches in height,⁴¹ passengers with a BMI greater than 25,⁴² women taking oral contraceptives,⁴³ and smokers.⁴⁴ DVT is also more prevalent in people with recent surgery, recent leg trauma, cancer, estrogen-progestin treatment, congestive heart failure, and pregnancy.⁴⁵ DVT also affects young and healthy people.⁴⁶

³⁸ 49 U.S.C. § 44903 note.

³⁹ *Id.*

⁴⁰ FAA has only solicited comments on one narrow issue of the seat dimension topic: the effect of small seats on emergency evacuation.

⁴¹ Sasakia Kuipers et. al, *The Absolute Risk of Venous Thrombosis after Air Travel: A Cohort Study of 8,755 Employees of International Organisations*, (2007); Susan R. Khan et. al., *Prevention of VTE in nonsurgical patients: Antithrombotic Therapy and Prevention of Thrombosis*, (2012).

⁴² *Id.*

⁴³ *Id.*

⁴⁴ Cynthia A. Kos, *Air Travel and Deep Vein Thrombosis*, National Blood Clot Alliance, https://www.stoptheclot.org/learn_more/air_travel_and_thrombosis/.

⁴⁵ Kuipers; *Air Travel Advice*, World Health Organization, Apr. 27, 2020, <https://www.who.int/news-room/questions-and-answers/item/air-travel-advice>.

⁴⁶ See section on DVT/PE.

Paul Hudson, President of FlyersRights.org, is a frequent traveler for over 35 years, is 75 years old, 6 feet tall, and approximately 190 pounds. He takes blood pressure and high cholesterol medications. Andrew Appelbaum, Counsel of FlyersRights.org, developed DVT on a 12 hour long-haul flight in economy seating at the age of 29 while in good health, requiring hospital attention.

The World Health Organization (WHO) found that the risk of developing DVT is two to three times more likely for 4 hour flights or longer.⁴⁷ The risk is highest for the two weeks after the flight but remains elevated for eight weeks.⁴⁸ Some evidence suggests the incidence of DVT increases for flights longer than 8 hours for passengers with certain other risk factors.⁴⁹ Others have found a heightened risk of DVT within two weeks of a long haul flight and a 12% increase if a long haul flight was taken in the previous year.⁵⁰ Hypoxia, from the lower-oxygen cabin environment, can increase the risk of DVT.⁵¹

There is disagreement⁵² on exactly what roles air travel-specific conditions⁵³ have on DVT risk, but there is an agreement on the role that long-distance travel can have on DVT regardless of mode.⁵⁴ There is more of an agreement that air travel increases the risk of DVT for those who already have a risk factor.⁵⁵

⁴⁷ *Air travel advice*, World Health Organization,

<https://www.who.int/news-room/questions-and-answers/item/air-travel-advice>.

⁴⁸ Michèle Cazaubon, *Deep vein thrombosis and air travel: risk management in 2015*,

<https://www.phlebology.org/deep-vein-thrombosis-and-air-travel-risk-management-in-2015/>.

⁴⁹ Yaser Adi et. al., *The association between air travel and deep vein thrombosis: Systematic review & meta-analysis*, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC434500/>.

⁵⁰ C W Kelman et. al., *Deep vein thrombosis and air travel: record linkage study*,

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC261739/>.

⁵¹ AJM Schreijer, *Explanations for coagulation activation after air travel*,

https://www.researchgate.net/publication/41531329_Explanations_for_coagulation_activation_after_air_travel

⁵² Disagreement originates from concerns of the large sample size needed to confirm a relationship between air travel and DVT. See Adi. The extended time period between flight and the manifestation of DVT symptoms has also challenged researchers. See Kos. However, Schreijer's study on thrombin levels suggests something other than immobility plays a large factor. See *id.*

⁵³ High altitude, low oxygen, low humidity, low barometric pressure, dehydration, alcohol consumption.

⁵⁴ Adi.; Frequent flyers were found to have a 3.65 times higher rate of DVT than passengers who flew once. *Id.*

⁵⁵ Arya R, Barnes et. al., *Long-haul flights and deep vein thrombosis: A significant risk only when additional factors are also present* (2002).

The primary advice given to passengers by medical authorities, as well as the FAA,⁵⁶ is to exercise⁵⁷ and stretch frequently, up to every half hour, stay hydrated, and take doctor-prescribed medicine. Many passengers with DVT are asymptomatic or undiagnosed.⁵⁸

There are insufficient studies to dismiss the idea that seat size does not exacerbate the incidence of DVT, particularly at current seat sizes and factoring in current passenger sizes. In this absence, the FAA should study the effect of decreased seat size on DVT in the airplane environment.

Duty to Protect Passenger Health

The FAA's refusal to regulate seat size on the basis of passenger health also ignores the FAA's statutory duty to protect airline passenger health.⁵⁹ The FAA's Civil Aerospace Medical Institute, in its own words, "is the medical certification, research, education, and occupational health wing of the FAA's Office of Aerospace Medicine."⁶⁰ CAMI's goal "is to enhance aviation safety."⁶¹ It has conducted research on "health and safety effects of the airline cabin environment on passengers and crewmembers" and "emerging technologies with the potential to eliminate bleed air contaminants and purify aircraft air supplies."⁶²

The courts have confirmed that the FAA's statutory duty to "promote safe flight of civil aircraft in air commerce"⁶³ includes the duty to safeguard passenger health.⁶⁴ As an example, The FAA requires the placement of first aid medical kits on airplanes to protect passenger health.⁶⁵

Deep vein thrombosis and pulmonary embolism, although more likely to occur in older passengers on longer flights, can happen to any passenger on any flight.⁶⁶ The FAA must also

⁵⁶ In its 2016 denial of FlyersRights.org's rulemaking petition, the FAA counseled, "[I]t is medically advisable to periodically move around on a long flight." Docket FAA-2015-4011-1040.

⁵⁷ However, Quigley found "the effects of exercise are only short-lived with the changes in flow existing only during the exercise period. Exercising every hour during enforced sitting for five hours does not appear to decrease abnormal haemodynamic responses." *Quigley*, at 83.

⁵⁸ JH Scurr et. al., *Frequency and prevention of symptomless deep-vein thrombosis in long-haul flights: a randomised trial*, at 1485–89, (2001).

⁵⁹ See *Flyers Rights v. FAA*, 864 F.3d 738, 748 (D.C. Cir. 2017).

⁶⁰ *Office of Aerospace Medicine*, Federal Aviation Administration, https://www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/cami.

⁶¹ *Id.*

⁶² *Id.*; See also *Airliner Cabin Environment Research*, Federal Aviation Administration, https://www.faa.gov/data_research/research/med_humanfacs/cer.

⁶³ 49 U.S.C. § 44701.

⁶⁴ *Flyers Rights*, at 748 (citing *Bargmann v. Helms*, 715 F.2d at 642 (D.C. Cir. 1983)).

⁶⁵ 14 C.F.R. § 125.207.

⁶⁶ See *infra* notes 162-166.

ensure that passengers have enough space to reach the brace position in an emergency.⁶⁷ The FAA must update its seat standards to reflect growing passenger size.

The FAA incredibly and unconvincingly has denied it has a duty to safeguard passenger health.⁶⁸ But passenger health is obviously a safety issue. Indeed, the FAA has a unit dealing with safety and medical health issues in air travel. The FAA CAMI facility has approximately 100 professionals dealing with aviation medical issues.⁶⁹

The CDC estimates that 900,000 Americans are affected by DVT each year, and 60,000 to 100,000 die from DVT each year.⁷⁰ The American Heart Association suggests as many as 2 million Americans will develop DVT per year.⁷¹ Scurr estimates that one million Americans are diagnosed with DVT each year, and an additional 800,000 with symptoms have DVT but are misdiagnosed or not diagnosed.⁷² Scurr also estimates that 28.2 million Americans have DVT each year but are asymptomatic.⁷³ One third to one half of affected people will suffer long term health consequences. One quarter of people with a pulmonary embolism will suffer sudden death. One third will have a recurrence in the following 10 years. Up to 8% of the population has genetic risk factors that elevate their risk of DVT. Accordingly, the FAA must take DVT seriously and must make airline seat space safer for at least 90%-92% of the population.

The FAA may continue to argue that a 2012 American College of Chest Physicians panel determined that it could not find a higher incidence of DVT in economy class compared to first class.⁷⁴ The chair of the panel, Dr. Gordon Guyatt, advised passengers who do not fall within any higher risk factors and are worried about DVT, “the most important message is to forget about it.”⁷⁵ The study noted “[e]specially tall or short passengers may have an increased risk [of DVT].”⁷⁶

⁶⁷ CAMI has concluded that the standard brace position is more effective than a modified brace position that is necessitated by lack of space.

⁶⁸ *Flyers Rights v. FAA*, Respondent’s Brief 9.

⁶⁹ See *supra* note 60.

⁷⁰ *Venous Thromboembolism (Blood Clots)*, Centers for Disease Control and Prevention, <https://www.cdc.gov/ncbddd/dvt/data.html>.

⁷¹ Jack Hirsch and John Hoak, *Management of Deep Vein Thrombosis and Pulmonary Embolism*, <https://www.ahajournals.org/doi/full/10.1161/01.cir.93.12.2212> (1996).

⁷² Scurr, at 1485-89.

⁷³ *Id.*

⁷⁴ Susan R. Khan et. al, *Prevention of VTE in Nonsurgical Patients*, [https://journal.chestnet.org/article/S0012-3692\(12\)60124-X/fulltext](https://journal.chestnet.org/article/S0012-3692(12)60124-X/fulltext)

⁷⁵ <https://healthland.time.com/2012/02/07/no-clots-in-coach-debunking-economy-class-syndrome/>

⁷⁶ Khan, citing SC Cannegiester et. al., *Travel-related venous thrombosis: results from a large population-based case control study* (2006).

Airline Seat Size History

In 1958, Congress created the Federal Aviation Agency, now the Federal Aviation Administration, to promote aviation safety. Safety functions were previously vested in the Department of Commerce, the Civil Aeronautics Authority, and the Civil Aeronautics Board.

The FAA has promulgated numerous regulations to promote aviation safety, including regulations on safety belts,⁷⁷ headrests,⁷⁸ fire retardation,⁷⁹ aisle width, the maximum number of seats abreast in an airliner,⁸⁰ and first aid medical kits.⁸¹

According to the 1984 seat regulation, seats must be designed for a human of at least 170 pounds.⁸² In 1984, a 170 pound man was 50th percentile.⁸³ Today, a 170 pound man is just above the 25th percentile.⁸⁴ A 50th percentile man today weighs 192.6 pounds.⁸⁵

Airlines have reduced average seat pitch from 35 inches to 31 inches, often going as low as 28 inches.⁸⁶ Meanwhile, low-cost carriers typically have 29 or 30 inch seat pitch. When the emergency evacuation standards were first promulgated in 1967, seat width was typically 17 or 18 inches.⁸⁷ Seat width for all of today's Big 4 carriers was between 19 and 21 inches at that time.⁸⁸ Seat width has decreased to as low as 16 to 17 inches from an average of 18.5 inches 40

⁷⁷ 14 C.F.R. § 25.785.

⁷⁸ *Id.*

⁷⁹ 14 C.F.R. § 25, App. F.

⁸⁰ 14 C.F.R. § 25.817.

⁸¹ 14 C.F.R. § 125.206.

⁸² 14 C.F.R. § 25.785.

⁸³ *Weight in pounds for males 18-74 years of age - number examined, mean, standard deviation, and selected percentiles, by race and age: United States, 1976-1980*, National Center for Health Statistics, Table 4, https://www.cdc.gov/nchs/data/series/sr_11/sr11_238.pdf (1987).

⁸⁴ *Weight in pounds for adult males aged 20 and over and number of examined persons, mean, standard error of the mean, and selected percentiles, by race and Hispanic origin and age: United States, 2015-2018*, National Center for Health Statistics, Table 6, https://www.cdc.gov/nchs/data/series/sr_03/sr03-046-508.pdf (2021).

⁸⁵ *Id.*

⁸⁶ Daisy Carrington, *Feeling cramped? How to battle the shrinking airline seat*, CNN, Nov. 11, 2013, <https://www.cnn.com/travel/article/feeling-cramped-battle-airline-seat/index.html>.

⁸⁷ Stephanie Rosenbloom, *Fighting the Incredible Shrinking Airline Seat*, New York Times, Feb. 29, 2016, <https://www.nytimes.com/2016/02/29/travel/shrinking-airline-seats.html>.

⁸⁸ *Id.*

years ago.⁸⁹ In 1967, the average man was an inch shorter and 32 pounds lighter than the modern average, while the average woman was 2.5 inches shorter and 28 pounds lighter.

Airbus called for an industry standard minimum seat width of 18 inches in 2013. Boeing strongly opposed this standard. Kevin Keniston, Head of Passenger Comfort at Airbus, explained, “If the aviation industry doesn’t take a stand right now, then we risk jeopardizing passenger comfort into 2045 and beyond – especially if you take into account aircraft delivery timetables combined with expected years in service – which means another generation of passengers will be consigned to seats which are based on outdated standards.”⁹⁰ This remark highlights the need to complete a long overdue update to passenger safety and health standards.

Keniston revealed the disconnect between the decision makers who shrink seats, or allow seats to be shrunk, and those who sit in them. Keniston revealed, “Airbus has offered many opportunities to let airline senior management experience firsthand what it feels like to sit in a 17” economy seat versus an 18” seat. During these tests it became very clear that not all of them were aware of what they were selling in the back of the aircraft.”⁹¹

Similarly, subjects in the 2019 CAMI evacuation studies, when exposed to a 26 inch pitch seat, answered overwhelmingly that it was difficult to get out of the seat⁹² and that it would be dangerous on a short flight, but especially on a two hour flight.⁹³ Note, test subjects who were

⁸⁹ Stephanie Sarkis, *Airlines’ Seat Pitch Gets Shorter And Passengers Reach Their Limits*, Forbes, Feb. 24, 2020, <https://www.forbes.com/sites/stephaniesarkis/2020/02/24/airlines-seat-pitch-gets-shorter-and-passengers-r-each-their-limits/?sh=dd9f26441a74>; Jon Ostrower, *The Incredible Shrinking Plane Seat*, WSJ, Oct. 23, 2013, <https://www.wsj.com/articles/SB10001424052702304384104579141941949066648>.

⁹⁰ *Airbus calls for wider seats for better passenger sleep*, Yahoo News, Oct. 28, 2013, <https://www.yahoo.com/news/2013-10-28-airbus-appeal-wider-seats-for-better-passenger-sleep-quality.html>.

⁹¹ Kevin Keniston, *Why Economy Seats Don’t Have To Be A Pain*, Forbes, Jul. 17, 2014, <https://www.forbes.com/sites/airbus/2014/07/17/why-economy-seats-dont-have-to-be-a-pain/?sh=4d50962f7d97>.

⁹² 61.9% of passengers who were not dismissed from the CAMI test answered that it would be “difficult” or “very difficult” to get into the 26 inch seat. 60% responded that it would be “difficult” or “very difficult” to get out of the 26 inch seat. This number increased to 69.9% when the passengers were asked how difficult it would be to get out of the seat “quickly.” *Effects of Airplane Cabin Interiors on Egress I: Assessment of Anthropometrics, Seat Pitch, and Seat Width on Egress*, Civil Aerospace Medical Institute, https://www.faa.gov/sites/faa.gov/files/2022-04/Effects_of_Airplane_Cabin_Interiors_on_Egress_I.pdf, 34.

⁹³ 76.9% of passengers who were not dismissed from the CAMI test answered that it would be “dangerous” or “very dangerous” to use a 26 inch seat on a 2+ hour flight, compared to 57.9% on a 30-120 minute flight *Id.* at 36.

unable to fit in the 26 inch seat pitch or the 28 inch pitch were dismissed from the study and the questionnaires.⁹⁴ Those answering the questions were able to fit in the 28 inch seat pitch.

While Airline Seats Shrink, Other Seats Are Growing

While airline seat sizes shrink, other types of seating used by the general public have grown in size to reflect the taller and larger population.⁹⁵ Movie theaters, sports stadiums, and office chairs have all grown in size.

Movie theater/auditorium seats have increased from 24 inches in the late 19th century, to 33 inches in 1990, to 38 inches in 2010.⁹⁶ Similarly, seat width has increased from 18 inches in the late 19th century, to 20 inches in 1990, to 23 inches in 2010.⁹⁷ Sports stadium seats have increased from 19 inches in 2008 to 20 inches wide in 2013.⁹⁸ Wembley Stadium increased its seat width in 2007 from 15.7 inches to 19.7 inches.⁹⁹ The University of Nebraska is expanding its seat widths.¹⁰⁰ Amtrak seat widths have increased from 21 inches for its premium Acela service in 2013 to 23 inches in 2018 for its standard coach seat.¹⁰¹

⁹⁴ “Individuals too large to safely participate in the study were debriefed separately, paid for their time, thanked for their participation, and returned to the MMAC Visitor Center for release.” *Id.* at 24; “Excluding the six participants who were unable to sit in the 28-inch (71.12-cm) seat pitch and the one participant who was unable to read the survey questions, 56 participants (7.2%) self-reported that they were unable to sit in the 26-inch (66.04-cm) seat pitch experimental seat mock-up. Responses from these 56 participants were also excluded from further analysis of the experimental seating post-test questionnaire. Tables 17 to 22 present the Likert Scale responses of the remaining 712 participants to questions about their opinions related to the ease of getting into and out of a 26-inch (66.04-cm) seat pitch and seat comfort.” *Id.* at 34.

⁹⁵ *Airbus calls for airlines to offer minimum 18-inch seat width in long-haul economy*, Future Travel Experience, Oct. 2013, <https://www.futuretravelexperience.com/2013/10/airbus-calls-airlines-offer-minimum-18-inch-seat-width-long-haul-economy/>.

⁹⁶ *Size Matters*, Theatre Project Consultants, <https://studylib.net/doc/18503198/size-matters---theatre-projects-consultants>, 8 (2010).

⁹⁷ *Id.*

⁹⁸ *Seating an Important Component of a Sports Venue Renovation*, Athletic Business, Jul. 10, 2013, <https://www.athleticbusiness.com/facilities/stadium-arena/article/15142808/seating-an-important-component-of-a-sports-venue-renovation>.

⁹⁹ *See supra* note 96.

¹⁰⁰ Brian Christopherson, *Driving for 6: Memorial Stadium’s wider seats; why the number 91,585 may live in Husker history, comparing Rileys*, Lincoln Journal Star, Jun. 7, 2017, https://journalstar.com/sports/huskers/life-in-the-red/driving-for-6-memorial-stadiums-wider-seats-why-the-number-91-585-may-live-in/article_17397f26-4bad-11e7-b646-a77c53383885.html.

¹⁰¹ Scott McCartney, *Why Airlines Are Passing Up Wider Coach Seats*, WSJ, Dec. 11, 2013, <https://www.wsj.com/articles/SB10001424052702303293604579252240559417428>; Bill McGee, *Is Amtrak becoming like the airlines?*, USA Today, Oct. 24, 2018, <https://www.usatoday.com/story/travel/columnist/mcgee/2018/10/24/amtrak-service-fees/1740462002/>

While other seats have been increasing in size, manufacturers of airline seats, at the behest of their airline customers, constantly explore new seating options that would be considerably below 28 inches and could harm passenger safety, including saddle-style seats, bar stools, and multi-level seating.¹⁰² Without minimum standards, the airlines will chase these seats in the future just like they have made decision after decision to prioritize shareholder profit over safety, health, security, employees, and passengers.¹⁰³ Meanwhile, movie theater, stadium, and office seats will likely continue to grow.

Load Factors

Load factor, the average percentage of seats filled in an aircraft, continues to increase. In 2019, load factors reached a high of 89.2%.¹⁰⁴ Seven of the twelve months of 2019 saw load factors above 85.5%.¹⁰⁵ Load factors of this level are historical aberrations but appear to be the new normal. As air travel rebounds after the sharp decline in 2020, the most recent data shows a domestic load factor of 89.96% for June 2022.¹⁰⁶ With higher load factors come more luggage and more “passenger debris” that must be accounted for in emergency evacuation demonstrations. In contrast, load factors in the 1980’s were around 57% to 63%.¹⁰⁷

¹⁰² James Hetherington, *Saddle Seat Economy Flights Could Have You Standing from L.A. to New York*, Newsweek, Apr. 17, 2018,

<https://www.newsweek.com/saddle-seat-economy-flights-could-have-you-standing-la-new-york-888943>;

Mark Wilson, *More leg room, less space to breathe: Meet the double-decker plane seat*, Fast Company, Jun. 17, 2022,

<https://www.fastcompany.com/90761861/more-leg-room-less-space-to-breathe-meet-the-double-decker-plane-seat>.

¹⁰³ Kendall Creighton, *Standing Room Only*, FlyersRights.org, Apr. 12, 2018,

<https://flyersrights.us/seat-space/standing-room-only/>.

¹⁰⁴ *Load Factors*, Bureau of Transportation Statistics,

https://www.transtats.bts.gov/Data_Elements.aspx?Data=1

¹⁰⁵ *Id.*

¹⁰⁶ *Id.*

¹⁰⁷ James. D. Dana, Jr. and Eugene Orlov, *Internet Penetration and Capacity Utilization in the US Airline Industry*, American Economic Journal: Microeconomics, <https://www.jstor.org/stable/43189690>, (2014).

Year	1980s ¹⁰⁸	1993 ¹⁰⁹	1995 ¹¹⁰	1999 ¹¹¹	2003 ¹¹²	2007 ¹¹³	2011 ¹¹⁴	2015 ¹¹⁵	2019 ¹¹⁶
Load Factor ¹¹⁷ (%) (dom.)	57-63	62	66	70	72.68	79.87	82.87	84.98	85.11

Space Standards for Animals

The federal government has minimum space standards regulations for the transport of cats and dogs: “Primary enclosures used to transport live dogs and cats must be large enough to ensure that each animal contained in the primary enclosure has enough space to turn about normally while standing, to stand and sit erect, and to lie in a natural position.”¹¹⁸

Passenger Demographics

While airline seat sizes have shrunk, passenger size has significantly increased. The average man in 1960-1962 would fit in the current 35-40th percentile for height and the 25th-30th percentile for weight. The average man in 1960-1962 was 5’8.2” tall and 168 pounds, but the average man in 2015-2018 was 5’9” tall and 199.8 pounds. 15% of men are over 6 feet tall and 15% of men are over 224.6 pounds.

¹⁰⁸ *Id.*

¹⁰⁹ *Id.*

¹¹⁰ *Load Factors,*

<https://web.mit.edu/airlinedata/www/2019%202012%20Month%20Documents/Traffic%20and%20Capacity/Domestic/Domestic%20Load%20Factor%20.htm>.

¹¹¹ *Id.*

¹¹² *Load Factors,* Bureau of Transportation Statistics

¹¹³ *Id.*

¹¹⁴ *Id.*

¹¹⁵ *Id.*

¹¹⁶ *Id.*

¹¹⁷ Percentage of seats occupied on domestic flights.

¹¹⁸ 9 C.F.R. § 3.15.

Year	1960-1962 ¹¹⁹	1976-1980 ¹²⁰	1999-2002 ¹²¹	2015-2018 ¹²²
Men's Average Height (inches)	68.2	69.1	69.3	69
Men's Average Weight (pounds)	168	172.2	190.4	199.8
Women's Average Height (inches)	61	63.7	63.8	63.5
Women's Average Weight (pounds)	142	144.2	163.3	170.8

Passengers have also gotten older. From 1980 to 2020, the median age of Americans increased from 30 years to 38.6 years.¹²³

Minimum seat standards must acknowledge that elderly passengers will have greater difficulty getting in and out of seats at lower pitches due to “lack of maneuverability and difficulty in supporting their own body weight when in the unbalanced position required to access many seating configurations.”¹²⁴

Inspector General Report on Emergency Evacuations

Since FlyersRights.org’s first rulemaking petition in 2015 and the 2018 Congressional mandate, more information, with respect to emergency evacuations, confirming the need for a rule has been made public. To protect passenger safety, FAA regulation requires aircraft

¹¹⁹ *Skin Folds, Body Girths, Biacromial Diameter, and Selected Anthropometric Indices of Adults: United States, 1960-1962*, U.S. Department of Health, Education, and Welfare, https://www.cdc.gov/nchs/data/series/sr_11/sr11_035acc.pdf, Table J, (1970).

¹²⁰ *Anthropometric Reference Data and Prevalence of Overweight: United States, 1976-80*, U.S. Department of Health and Human Services, https://www.cdc.gov/nchs/data/series/sr_11/sr11_238.pdf, Tables 4, 5, 13, 14 (1987).

¹²¹ *Anthropometric Reference Data for Children and Adults: U.S. Population, 1999-2002*, U.S. Department of Health and Human Services, <https://www.cdc.gov/nchs/data/ad/ad361.pdf>, Tables 17, 19, 30, 32 (2005).

¹²² *Anthropometric Reference Data for Children and Adults: United States, 2015-2018*, U.S. Department of Health and Human Services, https://www.cdc.gov/nchs/data/series/sr_03/sr03-046-508.pdf, Tables, 4, 6, 10, 12 (2021).

¹²³ Erin Duffin, *Median age of the U.S. population 1960-2020*, <https://www.statista.com/statistics/241494/median-age-of-the-us-population/> (2022).

¹²⁴ Quigley, viii.

manufacturers to demonstrate that all passengers can be safely evacuated from each aircraft type within 90 seconds¹²⁵ under prescribed conditions.¹²⁶

In 2020, the Department of Transportation Office of the Inspector General (OIG) most significantly determined that the FAA made false statements to FlyersRights.org in its 2017 response denying the rulemaking petition.¹²⁷ The FAA rejected any link between seat size and evacuation times by providing 3 videos and conclusions from evacuations it claimed were conducted at 28 inches. They were in fact, not.

The FAA claimed that the videos it provided depicted an evacuation demonstration on a Boeing 767 and an Airbus 350 at 28 inch seat pitch.¹²⁸ The FAA also claimed that the Boeing 737-300 and the Airbus 320 were tested at 28 inches.¹²⁹ However, the OIG revealed that those evacuation demonstrations actually occurred above 28 inches.¹³⁰ In fact, out of 43 manufacturer emergency evacuation demonstrations, only one was performed at 28 inches. Only 30 of the 43 demonstrations that the FAA relied on even reported the seat pitch, which sometimes ranged as high as 38 inches.¹³¹ OIG concluded, “Lack of comprehensive information on the pitches of seats used in evacuation demonstrations hinders FAA’s ability to respond to public concerns about seat pitch. It also affected the accuracy of the Agency’s response to the 2015 passenger petition.”¹³²

The FAA’s conclusion that seat size does not harm evacuation times was insufficient for four reasons. First, the FAA, in not setting a minimum seat standard, cannot possibly conclude that seat size will never have an effect on emergency evacuation times. At some point, seat pitch or seat width must affect emergency evacuation times.¹³³ Emergency evacuation has been tested at 28 inches only once, and never below 28 inches. Thirty percent of its demonstrations do not even include seat dimensions.

¹²⁵ 14 C.F.R. § 25.803.

¹²⁶ 14 C.F.R Appendix J to Part 25.

¹²⁷ *FAA’s Process for Updating Its Aircraft Evacuation Standards Lacks Data Collection and Analysis on Current Evacuation Risks* (“OIG Report”), Office of the Inspector General for the Department of Transportation, September 16, 2020, <https://www.oig.dot.gov/sites/default/files/FAA%20Oversight%20of%20Aircraft%20Evacuations%20Final%20Report%20-%202009-16-20.pdf>.

¹²⁸ “The information provided by these manufacturers demonstrates that passengers continue to be able to exit their seats promptly, including from 16 and 16.5-inch wide seats installed at 28-inch pitch (the configuration for the A350 and B767 tests, respectively)...” Gardlin Decl. at 18, FAA-2015-4011-0159.

¹²⁹ “Successful full-scale evacuation tests on models with all seats installed at a pitch of 28 inches in the test include Boeing models B737-300, and B767, the Airbus A320, and the Bombardier C-series. I personally observed all of these tests except for the C-series...” *Id.* at 15.

¹³⁰ OIG Report, 12.

¹³¹ *Id.*

¹³² *Id.*

¹³³ The FAA increased the exit row cross-aisle width from 6 inches to 20 inches in 1992 after CAMI trials demonstrated that exit times at 20 inches were faster than exit times at 6 inches.

Second, the FAA's emergency evacuation demonstration standards and assumptions are outdated and flawed. The last time the FAA revised its emergency evacuations was in 2004 in response to a 1991 crash.¹³⁴ The FAA has only updated the standards five times, including the 2004 revision.¹³⁵ Each revision has been a response to an accident rather than a proactive adjustment. The FAA has not once updated the standards due to a proactive assessment of changed circumstances, such as passenger size and age, seat and aisle size, passenger load factors, passenger behavior, or number of carry-on bags.¹³⁶ The FAA has also not conducted sufficient research on passenger behavior, carry on bags, support animals, and seat size.¹³⁷

Third, the FAA allows manufacturers, for their analyses in lieu of full scale demonstrations, to select older data over newer data, as well to pick analysis-based results over tangible demonstration test results, even when the real data is newer than the analysis.¹³⁸ The FAA allows manufacturers to use older data that is more advantageous to the manufacturers rather than less favorable, recent data.

Not only does the FAA allow manufacturers to use older, more advantageous data when more recent data is available, the FAA also permits manufacturers to use data from analyses when data from demonstrations is available and differs. Small changes in the assumptions of a simulation model can dramatically affect the results.¹³⁹ An evacuation model must make many assumptions, including acceleration speed, slide speed, comfort distance, prioritization, conflict scenarios, and collision response time.¹⁴⁰ Gobbin et al. concluded that body dimensions have a significant influence on total evacuation time, and “[d]ue to demographic change...it can be assumed that increasing acceleration times are plausible and must be taken into account in future simulations.”¹⁴¹ Liu et. al determined that waist size is the main influencing parameter on overall evacuation time for a given evacuation.¹⁴²

¹³⁴ OIG Report, 7.

¹³⁵ *Id.*

¹³⁶ *Id.* at 3.

¹³⁷ *Id.* at 13.

¹³⁸ *Id.* at 16.

¹³⁹ “Based on our analysis, use of recent data can yield results that differ from the results based on old data. For example, a manufacturer used data that were about 12 years old to calculate the evacuation time for an aircraft model, despite the fact that data approximately 3 years old were available. The test with the 12-year-old data indicated that participants evacuated through an exit door in under 90 seconds. However, we found that use of the 3-year-old data indicated participants could not evacuate through the same door in 90 seconds.” OIG Report at 18; Increasing the baseline acceleration time by a quarter of a second increases overall evacuation time by 13.3 seconds. Gobbin Fig. 7.

¹⁴⁰ Gobbin (*See supra* note 18).

¹⁴¹ *Id.*

¹⁴² Liu Y Liu et. al, *A new simulation model for assessing aircraft emergency evacuation considering passenger physical characteristics*, <https://www.sciencedirect.com/science/article/abs/pii/S0951832013002585?via%3Dihub>, 191 (2014).

The FAA allows manufacturers to rely more and more on analyses over live full and partial demonstrations even as the underlying data in the analysis is becoming older. These more favorable conclusions from analysis become baked in as assumptions in subsequent analysis after subsequent analysis.

Fourth, as the Inspector General uncovered, the FAA has retained inadequate information and data surrounding emergency evacuations. In the FAA's second denial to FlyersRights.org, it revealed that it keeps only the most basic information on emergency evacuations, such as the plane model, the number of passengers, and the evacuation time.¹⁴³ As a result, the FAA must make a request of the airplane manufacturer if the FAA wants more detailed information, including video evidence. The FAA relies on the manufacturers to retain and accurately record evacuation results and details. It is impossible for the FAA to conclude that seat size does not affect emergency evacuations and passenger safety when the FAA's process has so many deficiencies.

The OIG found the FAA is in violation of FAA SMS requirements and GAO Standards for Internal Control in the Federal Government.¹⁴⁴ The FAA does not collect or preserve comprehensive evacuation data from manufacturer demonstration and analyses that could help inform the FAA on the changes that need to be made.¹⁴⁵

Lastly, the DOT OIG report concluded that the FAA's lack of data—both due to lack of data retention and the lack of conducting new research—inhibits its ability to meet the 2018 Congressional deadline. As of the time of the report, the FAA had no plans to conduct research on carry-on bags, emotional support animals, and updated passenger demographics. The FAA convened the Emergency Evacuation Standards Aviation Rulemaking Committee, but its May 2020 report submitted to the FAA was only submitted to Congress at the end of March 2022 and the public as a result of FlyersRights.org's mandamus litigation.

Actual Evacuation Times Exceed 90 Seconds

Any discussion of the adequacy of the FAA's emergency evacuation standards, assumptions, methodology, and procedures would not be complete without real-world evacuation data—data the FAA never mentions. While not all evacuations will finish within 90 seconds, the

¹⁴³ “The FAA does not generally retain all the records created by an applicant (airplane manufacturer) relating to passenger evacuation or seat testing. Most data is retained by the applicant. The FAA typically retains records relating to the high-level outcomes of such testing, including the date of the test, the number of passengers, and the overall evacuation time.” Gardlin Decl. at 17, FAA-2015-4011-0159.

¹⁴⁴ OIG Report, 14.

¹⁴⁵ *Id.* at 16.

disconnect between demonstration times and real world times signals that the FAA's assumptions and analysis methodology are missing the mark.

More Flaws In FAA's Testing

In November-December 2019, the FAA invited FlyersRights.org President Paul Hudson and other members of the Emergency Evacuation Standards Aviation Rulemaking Committee to the headquarters of Civil Aerospace Medical Institute (CAMI) to observe parts of the FAA's emergency evacuation testing. Paul Hudson observed a partial demonstration containing approximately 20 rows with one ground-level exit. There were no test subjects over 250 pounds, under 18 years old, or over 60 years old. Despite this, Hudson observed a significantly slower evacuation time when narrower seat configurations were used. Studies have shown that anthropometric variation in passengers greatly affects evacuation time.¹⁴⁶ The FAA is not capturing a realistic or representative sample of the population and needs to update the standards¹⁴⁷ for its sampling.

During emergency evacuation demonstrations conducted by plane manufacturers, test subjects are given multiple attempts¹⁴⁸ to achieve a sub-90 second evacuation time despite the regulatory prohibition on practicing, rehearsing, or describing the demonstration, or participation in a test in the previous six months.¹⁴⁹ Additionally, the regulation requires approximately one half of all carry-on bags, blankets, pillows, and other similar items to be placed in the aisles and emergency exits as obstacles.¹⁵⁰ The FAA does not compile statistics on the number of carry-on bags on a typical airplane. The number of carry-on bags has increased with higher load factors and also as a response to higher and more prevalent checked bag fees.

The regulations prohibit the use of airline or aircraft manufacturer employees as passengers in addition to passengers who have been primed or have recently participated in a test. However, manufacturers are given as many as nine attempts to achieve a successful demonstration. The FAA, by its own admission, does not keep records of how many attempts were made before a successful attempt.¹⁵¹ Reviewing the results of the most recent CAMI tests, a passenger's time to evacuate during a fourth trial could decrease by as much as 19.8%.¹⁵²

¹⁴⁶ *Liu*.

¹⁴⁷ 14 C.F.R. Appendix J to Part 25.

¹⁴⁸ Some demonstrations failed nine times but succeeded on the tenth time.

¹⁴⁹ 14 C.F.R. Appendix J to Part 25 (m).

¹⁵⁰ 14 C.F.R. Appendix J to Part 25 (k).

¹⁵¹ "The FAA does not generally retain all the records created by an applicant (airplane manufacturer) relating to passenger evacuation or seat testing. Most data is retained by the applicant. The FAA typically retains records relating to the high-level outcomes of such testing, including the date of the test, the number of passengers, and the overall evacuation time." Gardlin Decl. at 17.

¹⁵² CAMI Report, 37.

Carry-On Bags

As checked baggage fees increased among many airlines, passengers decided to bring more carry-on bags that did not require an additional fee.¹⁵³ As a result, airlines have seen more carry-on bags than ever before. There is rarely a flight where the airline does not have to gate-check an economy passenger's carry-on bags due to lack of overhead compartment space. A key component of the emergency evacuation standards is the requirement that approximately one half of the average number of carry-on bags, blankets, pillows, and other debris be placed throughout the aisles and in the exit areas as minor obstacles.¹⁵⁴ The DOT does not tabulate or store this data even though carry-on bags directly pertain to safety and the FAA's emergency evacuation standards.

Passenger behavior must also be thoroughly studied due to the multiple occurrences of passengers grabbing overhead luggage and personal items during actual emergency evacuations. Action must be taken to prevent this behavior, and to the extent it remains a problem, must be a factor in any update to emergency evacuation standards. The Emergency Evacuation ARC report highlights these issues regarding passenger behavior.¹⁵⁵

Families Sitting Together

Airlines currently are able to charge passengers an additional seat fee to ensure that parents sit with their minor children. Congress directed the DOT to establish a family seating rule, "if appropriate" to guarantee any family member under the age of 14 to sit with a family member over the age of 14 for no additional fee. The DOT declined to implement the Family Seating Rule. Parents traveling against the flow of passengers to assist their separated, minor children will pose a real danger to emergency evacuations. No demonstration or analysis has considered this recent problem.

¹⁵³ American Airlines, Delta Air Lines, and United Airlines began charging a checked bag fee of \$15 in 2008. Now, they charge \$30-35 for the first checked bag. Micheline Maynard, *American Airlines to begin charging for checked luggage*, New York Times, May 21, 2008, <https://www.nytimes.com/2008/05/21/business/worldbusiness/21iht-amr.4.13100744.html>; *Delta to start charging fee for checked luggage*, Boston.com, Nov. 6, 2008, http://archive.boston.com/business/articles/2008/11/06/delta_to_start_charging_fee_for_checked_luggage/; *United to charge for checked luggage*, CNN, Jun. 12, 2008, https://money.cnn.com/2008/06/12/news/companies/united_bags/.

¹⁵⁴ 14 C.F.R. Part 25 Appendix J.

¹⁵⁵ *Emergency Evacuation Standards Aviation Rulemaking Committee Final Report*, [https://www.faa.gov/regulations_policies/rulemaking/committees/documents/media/Emergency%20Evac%20Standards%20ARC%20final%20report%20final%20\(5-26-2020\).pdf](https://www.faa.gov/regulations_policies/rulemaking/committees/documents/media/Emergency%20Evac%20Standards%20ARC%20final%20report%20final%20(5-26-2020).pdf) (2020).

FAA has not released actual data

The purported results and conclusions of the 2021 CAMI report run counter to the observations of Paul Hudson. CAMI allowed Paul Hudson to observe some of the partial emergency evacuation demonstrations. He observed that the passengers, who were volunteers from local colleges and churches, were young, tended to be more athletic, and in athletic clothing and shoes. Hudson observed that actual evacuation times were affected by seat dimensions and passenger size. FlyersRights.org has submitted a Freedom of Information Act request for this data.

Passenger Health and Deep Vein Thrombosis

In the FAA's February 2016 denial¹⁵⁶ of FlyersRights.org's rulemaking petition, the FAA cited a report that it claimed had concluded that deep vein thrombosis is not more common in economy class than in business class.¹⁵⁷ None of the sources FAA cited actually supported its claims. In fact, studies suggest that the benefits of exercise as an attempt to avoid DVT only last for the duration of the exercise.¹⁵⁸

Even if the results were to be trusted, the FAA should study whether the demographics of business class travelers may have affected the results. Business class travelers are older on average and more likely to be men.¹⁵⁹ Men are almost 50% more likely to develop DVT, and older passengers are at a higher risk than younger passengers. With these differences, the fact that DVT is equally likely in business class as it is in coach without adjusting for passenger demographics may actually prove the opposite conclusion. Again, it appears the FAA is searching for data to support further inaction rather than seeking and compiling data to proactively evaluate whether revisions to old standards and assumptions are needed.

DVT can affect any passenger, including passengers with anemia, arthritis, congestive heart failure, hypertension, lymphoma, obesity, weight loss, and other conditions. Having two or more of these conditions led to a 180%-450% increased likelihood of experiencing DVT.¹⁶⁰ Of a large sample of millions of hospitalizations, 64.4% of patients with DVT had one of the preexisting comorbid conditions, and 35.6% had at least two conditions.

¹⁵⁶ <https://www.regulations.gov/document/FAA-2015-4011-0140>;
<https://www.regulations.gov/document/FAA-2015-4011-0147>

¹⁵⁷ James Tsai et. al., *Determinants of Venous Thromboembolism among Hospitalizations of US Adults: A Multilevel Analysis*, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4399914/pdf/pone.0123842.pdf> (2015).

¹⁵⁸ See *supra* note 58.

¹⁵⁹ *U.S. Business Travel*, Bureau of Transportation Statistics, https://www.bts.gov/archive/publications/america_on_the_go/us_business_travel/entire (2011). (Finding that 77% of business travelers across all modes of transportation were men.)

¹⁶⁰ Tsai.

Deep vein thrombosis can lead to sudden death or hospitalization if the blood clot travels up the body to the heart or to the lungs. Pulmonary embolism occurs when the blood clot travels to the lung and blocks a pulmonary artery.¹⁶¹

Deep vein thrombosis has afflicted frequent traveler athletes, including tennis star Serena Williams,¹⁶² NBA player Chris Bosh,¹⁶³ NBA player Jerome Kersey¹⁶⁴ who have all had DVT and PE. Jerome Kersey died from a pulmonary embolism in 2015.¹⁶⁵ Chris Bosh retired from the NBA in 2016 at the age of 31 due to DVT and pulmonary embolism.¹⁶⁶

Brace Position

Passengers are instructed to assume the brace position during an airplane crash. Passengers are advised to put the crown of their head up against the seat or wall in front of them, with their hands either on the top of the seatback or at their lower legs.¹⁶⁷

The brace position is designed to minimize the force of and the injuries sustained in the secondary impact.¹⁶⁸ Secondary impact is the impact of the body against the interior of the airplane, while primary impact is between the airplane and the ground.¹⁶⁹ Injuries to the head and legs are considered the most important injuries to minimize in order to aid survival and emergency evacuation.¹⁷⁰

¹⁶¹ *Pulmonary embolism*, Mayo Clinic, [https://www.mayoclinic.org/diseases-conditions/pulmonary-embolism/symptoms-causes/syc-20354647#:~:text=Pulmonary%20embolism%20\(PE\)%20occurs%20when,deep%20vein%20thrombosis%20\(DVT\).](https://www.mayoclinic.org/diseases-conditions/pulmonary-embolism/symptoms-causes/syc-20354647#:~:text=Pulmonary%20embolism%20(PE)%20occurs%20when,deep%20vein%20thrombosis%20(DVT).)

¹⁶² Alex Portée, *Serena Williams on her near-death experience after giving birth: 'No one was really listening'*, Today, Apr. 6, 2022, <https://www.today.com/health/womens-health/serena-williamss-essay-black-pregnancy-rcna23328>.

¹⁶³ A.J. Perez, *Expert: Chris Bosh, like many, at risk of blood clot recurrence*, USA Today, Feb. 17, 2016, <https://www.usatoday.com/story/sports/nba/heat/2016/02/16/chris-bosh-risk-blood-clot-recurrence/80453318/>.

¹⁶⁴ *Jerome Kersey's death linked to blood clot that traveled to lung*, USA Today, Feb. 19, 2015, <https://www.usatoday.com/story/sports/nba/2015/02/19/kerseys-death-linked-to-blood-clot-that-traveled-to-lung/23686793/>.

¹⁶⁵ *Id.*

¹⁶⁶ *Chris Bosh: 'Friends told me to buy a Ferrari, I just wanted a car I could fit in'*, The Guardian, Sep. 13, 2021, <https://www.theguardian.com/sport/2021/sep/13/chris-bosh-interview-hall-of-fame-miami-heat-nba>.

¹⁶⁷ Amanda Taylor et. al., *Effect of Passenger Position on Crash Injury Risk in Transport-Category Aircraft*, Civil Aerospace Medical Institute, https://www.faa.gov/data_research/research/med_humanfacs/oamtechreports/2010s/media/201517.pdf, i. (2015).

¹⁶⁸ Secondary impact is the impact of the passenger against the interior of the airplane. *Id.* at 1.

¹⁶⁹ *Id.*

¹⁷⁰ *Id.*

CAMI's 2015 study is the most recent study exploring the most effective brace positions. Notably, CAMI conducted the tests at a 30.5 inch seat pitch, "one of the narrowest pitches currently used by major US air carriers," because 30.5 inches is a "near worst case for evaluating brace effectiveness, since at close pitch, a braced occupant would initially be more upright than at a longer pitch."¹⁷¹ This small seat pitch "[results] in higher injury risk" because (1) the more upright position of the torso allows greater space to generate differential velocity between the head and seat and (2) the chance of leg interaction with the seat is much higher. CAMI deemed 30.5 inches to be "worst case for leg impact."¹⁷² Airplane seat certification standards were developed in the 1980s.¹⁷³ According to CAMI, these standards "did not specifically address all potential neck and leg injury mechanisms."¹⁷⁴ Seat sizes are now beyond the "worst case" scenario.

Personal Privacy

Decreased seat width and pitch means less personal privacy for passengers. While screen blockers can combat unwanted eyes on one's phone or laptop, cramped seats means that passengers feel the stresses of crowding and encroachment. Studies have concluded that women are more likely to feel discomfort from lateral encroachment, while men are more likely to feel discomfort from face-to-face encroachment.¹⁷⁵

Cramped seating has also led to increased air rage. The President of the Association of Flight Attendants-CWA, Sara Nelson, stated, "Anecdotally, this leads to air rage incidents... We find that people have shorter fuses, are more just generally agitated when the space around them is much smaller, when people are closer to them... When people are squeezed, literally tensions rise and we have to manage those tensions and de-escalate."¹⁷⁶ DOT data reveals that unruly passenger incidents increased in 2021 even when removing incidents related to protective facemasks.

¹⁷¹ *Id.* at 5.

¹⁷² The CAMI report found femur compression values to be below the regulatory limit and reasoned that the seat belt restrained the pelvis, preventing or minimizing knee strikes. However, other research suggests that greater amounts of body fat around the waist limit the effectiveness of a restraint belt in cars. *Id.* at 11.

¹⁷³ *Id.* at 15.

¹⁷⁴ *Id.*

¹⁷⁵ J.D. Fisher and D. Byrne, *Too close for comfort: sex differences in response to invasions of personal space*, *Journal of Personality and Social Psychology*, vol. 32, no. 1, pp. 15-21, 1975.

¹⁷⁶ Kelly Yamanouchi, *Airplane seat squeeze sparks debate over safety concerns in evacuation*, *Atlanta Journal-Constitution*, Aug. 3, 2018, <https://www.ajc.com/business/airplane-seat-squeeze-sparks-debate-over-safety-concerns-evacuation/EIcC12yaC0ruc9mQntvbdN/>.

The FBI believes that cramped seating and higher load factors will lead to more sexual assault. According to the FBI's press release at the end of Sexual Assault Awareness Month in April 2022, "While sexual assaults were reported during 2020 and 2021, passengers were separated on many flights and less people were flying. As COVID restrictions have eased; however, more people are flying and all airplane seats are made available on most airlines. For these reasons, agents expect to see an increase in reported sexual assaults."¹⁷⁷ The FBI warns passengers that "offenders will often test their victims, sometimes pretending to brush against them to see how they react or if they wake up." As seat width and personal space decreases, these offenders will be more able to make the contact about which the FBI is warning. Sexual assault on airplanes is underreported and has not received as much attention from authorities as it deserves. The FAA must investigate the effect of seat size on personal space and sexual assault.

Proposed Rule

FlyersRights.org proposes seat standards that accommodate the 5th percentile woman to the 95th percentile man, in line with the recommendations of academics.

1. Seat Pitch: 32.1 inches¹⁷⁸
2. Seat Width (between armrests): 20.1 inches¹⁷⁹
3. Dimension B: 10 inches at armrest level; 8.3 inches at cushion level¹⁸⁰
4. Dimension C: 7.5 inches¹⁸¹
5. Shoulder Width: 21.7 inches
6. Elbow width: 22.5 inches
7. Foot clearance: 13.8-14.2 inches¹⁸²
8. Vertical free foot space: 8.3 inches¹⁸³
9. Foot clearance envelope: 45.9 inches¹⁸⁴
10. Collapsible footrest¹⁸⁵

¹⁷⁷ Laura Eimiller, *During Sexual Assault and Prevention Month—and National Crime Victims Week—the FBI Reminds the Flying Public About Sex Assaults on Airplanes*, FBI, Apr. 29, 2022, <https://www.fbi.gov/contact-us/field-offices/losangeles/news/press-releases/during-sexual-assault-and-prevention-month-and-national-crime-victims-week-the-fbi-reminds-the-flying-public-about-sex-assaults-on-airplanes>.

¹⁷⁸ Molenbroek, 125.

¹⁷⁹ Minimum width between armrests is needed to facilitate access and egress from the seat. 20.12 inches recommended by Daigle (2020); 19.7 inches recommended by Molenbroek (2016); 19.6 inches recommended by Quigley, although 23 inches is ideal (2001).

¹⁸⁰ 8.3 inches recommended by Quigley at cushion level, iv (2001).

¹⁸¹ Quigley notes Dimension C must be increased from 3 inches to 12 inches to allow the 95th percentile man to stand upright, but recognizes it to be impractical and would require a seat pitch of 37 inches. *Id.*

¹⁸² *Id.* at v.

¹⁸³ *Id.*

¹⁸⁴ *Id.*

¹⁸⁵ Seat base heights may be too small for smaller passengers, causing back problems and DVT. *Id.* at vi.

Implementation

There should be no significant delay for the implementation of seat pitch, Dimension B, Dimension C, and foot envelope clearance standards. Boeing and Airbus fuselage interior widths are fixed for current models. As a result, minimum seat width regulations would either need to have an implementation delay so that manufacturers can design a plane that could contain safe seats, or would require airplanes to move from six seats across to five seats across.¹⁸⁶ While passenger safety should be the FAA's primary focus, the detractors of the minimum seat standard rule may criticize such rule as unfeasible. Passenger safety is clearly the FAA's primary focus. A reasonable and proper phase-in of the rule would make it both economically practical and much safer for passengers.

Minimum seat and passenger space dimensions other than seat width and aisle width should apply to all aircraft certificated more than one year from the present date, all aircraft delivered more than five years from the present date, and existing aircraft when the interior is reconfigured for any reason. The seat width and aisle width standard can and should apply to all aircraft not yet certificated within 5 years of the present date, and all aircraft delivered more than 10 years from the present date.

The fact that less than 50% of the public can reasonably fit in current seats is no doubt a factor that inhibits and reduces air travel by large segments of the population. Setting safe seat standards should increase air travel and the number of passengers, thereby increasing airline revenues and employment. Similarly, a slight reduction in the maximum number of seats in an aircraft should increase the number of planes ordered and produced. Boeing has kept the same fuselage width on the 737 for fifty-five years, since 1967.

¹⁸⁶ Note, many U.S. airlines just recently moved up from 9 seats across a twin aisle aircraft to 10 seats in 2013 and 2017. *See supra* note 90; Hugo Martin, *United Airlines becomes latest carrier to put economy passengers in rows of 10 seats*, LA Times, Oct. 21, 2017, <http://www.latimes.com/business/la-fi-travel-briefcase-united-boeing-20171021-story.html>.

About FlyersRights.org

FlyersRights.org is the largest airline passenger advocacy organization. FlyersRights.org advocates for passengers and aviation safety. It published "The Boeing 737 MAX Debacle" in November 2019. FlyersRights.org operates a hotline at 1-866-FLYERS-6 to assist passengers.

Conclusion

The FAA should promulgate regulations by July 1, 2023 after an appropriate public comment period of sixty to ninety days.

Respectfully submitted,



Paul Hudson
President
FlyersRights.org
4411 Bee Ridge Rd #274
Sarasota, FL 34233
800-662-1859 ext. 0
240-391-1923 (fax)
paul@flyersrights.org



Andrew Appelbaum
Counsel
1030 15th St NW #292
Washington, DC 20005
800-662-1859 ext. 1
andrew@flyersrights.org