



TOXIC INEQUITIES

How an Outdated Standard Leads to Toxics
in Low-Cost Children's Car Seats



ECOLOGYCENTER
HEALTHY STUFF LAB

Researching toxic chemicals in the everyday world

AUTHORS AND
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The Ecology Center is a Michigan-based nonprofit environmental health organization that works for a safe and healthy environment where people live, work, and play. The Healthy Stuff Lab is a program of the Ecology Center that researches hazardous chemicals in everyday products and in our environment.

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EXECUTIVE SUMMARY

Note: Child car seats are required by law and are essential for crash safety. Please, always properly install and use a car seat for a child, regardless of any chemical concerns.

Car seat companies have made significant achievements in reducing children's exposure to toxic chemicals. In the last five years several have done exactly what the Ecology Center has advocated for, including screening their products for hazardous chemicals to hold suppliers accountable and adjusting their designs to make fire retardant-free seats.

Despite these successes, more than half of U.S. children's car seats still contain hazardous chemicals such as flame retardants (FRs) or per- and polyfluoroalkyl substances (PFAS). A number of FRs are known endocrine disruptors, while some PFAS are likely carcinogens and immune disruptors. The potential hazards of many FRs and PFAS in use remain unknown. FRs typically are not bound to the foams and fabrics to which they are applied, and PFAS can also come off fabrics, so these chemicals migrate out and build up in dust. Children and adults are exposed through breathing and ingesting dust, as well as skin contact.

The Ecology Center's Healthy Stuff Lab tested over 600 components of 25 car seats, including three seats from the European Union and 22 from the United States. For the first time, we also tested four strollers that came bundled with matching car seats. Infant and convertible seats from 11 different brands were tested for FRs and PFAS using three different analysis techniques.

Additionally, we compiled information about the status of FR-free and PFAS-free seats in the marketplace via company websites and conversations with company representatives.

REPORT HIGHLIGHTS

The number of seats without flame retardant chemicals has grown.

We found over 40 car seat models--from 8 companies--marketed as FR-free. This is up from 8 seats from 4 companies in 2018. Two companies, Britax and Maxi-Cosi, offer FR- and PFAS-free seats for \$200, a lower price than had been available for an FR-free car seat in the past. Additionally, Maxi-Cosi recently released an FR- and PFAS-free convertible car seat for \$130.

FR-free is still cost prohibitive.

There are currently no FR- and PFAS-free infant or convertible car seats sold in the U.S. for under \$100 and just one model for \$130. Because of this, families looking for the most affordable children's products largely bear the brunt of toxic chemical exposure.

An outdated U.S. federal flammability standard is unnecessarily exposing lower income children to toxic chemicals.

In the United States car seat companies must meet a federal flammability rule written for vehicle interiors by the National Highway and Traffic Safety Administration. Because it's cheaper to add FRs to a product than use expensive fabrics to meet the standard, the most affordable car seats in the U.S. still contain FRs. As a result, children from lower income households are likely to bear a greater impact of toxic chemicals than children from families who can afford expensive car seats.



Many car seats sold in the U.S. still contain FRs, although the types of FRs have changed.

Testing revealed that while car seat companies have eliminated a number of well-known toxic FRs, they are often switching to phosphorus-based FRs whose toxicity profiles are mostly unknown. Overall, 55% (12 of 22) of tested U.S. seats contained flame retardant chemicals in major components. All 12 of these seats contained phosphorus-based FRs in the upholstery. Two of these seats additionally contained elevated bromine in the upholstery and seven also contained elevated bromine in rigid foam under the upholstery, consistent with brominated flame retardants. In total, 32% (7 of 22) of the seats had major components with high levels of bromine. Brominated FRs are bioaccumulative and are linked to developmental toxicity. Aside from the major components, many of the seats contained phosphorus-based FRs or high levels of bromine in minor components such as labels and interfacing.

European Union child car seats have fewer FRs than U.S. seats due to a different flammability standard.

Car seats purchased in the E.U. did not contain phosphorus-based FRs even when similar U.S. seats of the same brand did. This is likely due to the nations' different flammability standards. The E.U. recently implemented a standard called EN 71-2 to replace the 50-year-old standard still used in the U.S. However, some of the E.U. seats had elevated bromine, suggesting FRs in certain components.

Strollers contained no FRs even when the identical fabrics on their matching car seats contained FRs.

None of the four strollers we tested contained bromine or phosphorus-based FRs even when the matching car seat in the set contained those chemicals. These findings indicate that companies add FR chemicals only to meet the U.S. federal flammability standard for car interiors and do not add these chemicals to other children's products.

Some car seats and strollers use PFAS for water and stain resistance.

21% of tested car seats (4 of 19) had water- and stain-resistant fabrics likely containing PFAS, based on testing for total organic fluorine. Of the four strollers, two had likely PFAS, as did their matching car seats. In private conversations, some companies have confirmed they use PFAS treatments on certain models. We urge car seat companies to stop using PFAS and instead make car seat and stroller covers easy to remove and wash.

Three major companies have yet to release an FR-free seat and still contain PFAS.

Graco, Evenflo, and Baby Trend sell some of the most affordable and popular children's car seats. They also had the lowest ranked seats in the study due to FRs and PFAS in their seats. Graco, Evenflo, and Baby Trend do not offer any FR-free seats.

INTRODUCTION

Child car seats are necessary safety devices that should be affordable and toxic-free. The National Highway Traffic Safety Administration (NHTSA) estimates that in 2017 car seats saved the lives of over 320 children aged four and younger.¹ Ironically, while car seats play a significant role in child safety, many seats unnecessarily expose children—especially from low-income families—to dangerous chemicals that are harmful to children’s health.

The Ecology Center has been periodically testing children’s car seats for hazardous chemicals for 15 years. In our 2021/22 study, we tested for flame retardant chemicals and performed a fluorine analysis that reveals fabrics likely containing per- and polyfluorinated alkyl substances (PFAS).

In the 2021/22 testing, the Ecology Center’s Healthy Stuff Lab tested 25 car seats from 11 car seat brands, including three purchased in Denmark. The brands tested were Baby Trend, Britax, Chicco, Clek, Costco, Evenflo, Graco, Maxi-Cosi, Nuna, Safety 1st, and UPPAbaby. The Denmark seats were made to European Union flammability standards by global brands Graco, Britax, and Safety 1st, allowing comparison with similar seats made to U.S. standards. Four of the U.S. car seats were purchased as “travel systems” (a matching set of a car seat and a stroller sold together). The matching strollers were subject to the same testing as the car seats.

Children’s car seats are required by law and are essential for crash safety. Please, always properly install and use a car seat for a child, regardless of any chemical concerns.



FLAME RETARDANT CHEMICALS IN CHILDREN'S CAR SEATS

THE PROBLEM WITH THE U.S. FEDERAL FLAMMABILITY STANDARD

Flame retardants pose exposure and health risks

Chemical flame retardants are added to children's car seats as an inexpensive way to meet federal flammability standards. A number of flame retardants (FRs) are known endocrine disruptors; some are linked to cancer and many persist and travel in the environment.² Other FRs are lacking in toxicity information. Most flame retardant chemicals used in products like car seats are not strongly bound to the fabric or foam to which they are added, so they easily migrate out and build up in air and dust. Human exposure can occur by breathing, through the skin, or by ingesting dust, such as through hand-to-mouth contact.



Some FRs are called "halogenated" because they contain chlorine or bromine, which are in a group known as halogens in the periodic table. Halogenated FRs can be toxic in the human body and in the environment and can transform to additional toxic byproducts when incinerated. These chemicals do not break down easily and can persist in the environment for long periods of time, travel long distances, and bioaccumulate in animals.³

Phosphorus-based FRs, made without halogens, have increased in usage as concerns about halogenated FRs have grown. Their use in everyday products has led to their widespread presence in the earth's fresh water.⁴ One such FR we found in some car seats, resorcinol diphenyl phosphate, shows moderate developmental and endocrine toxicity.⁵ Another, called PMMMPs, is used despite the absence of information about potential human and environmental hazards.⁶ A third, ammonium polyphosphate, is considered a low hazard to humans but is highly persistent in the environment.⁶

Are flame retardant chemicals in children's car seats necessary?

The National Highway and Traffic Safety Association (NHTSA) requires children's car seats to meet federal flammability standards created for car interiors. Regulation FMVSS 302: Flammability of Interior Materials intends to protect vehicle occupants from fires, particularly fires caused by cigarettes. NHTSA, the agency responsible for traffic safety, wrote the rule in 1969, yet has never evaluated the effectiveness of the standard as it applies to car seats due to lack of relevant data.^{1,7}

FMVSS 302 does not require the use of chemical flame retardants, but flame retardants have been marketed by the chemical industry as an easy, low-cost way for manufacturers to comply with

FMVSS 302. As a result, automakers began adding chemical flame retardants to interior vehicle parts, such as seat cushions, seat belts, floor coverings, and padding. In 1981, children's car seats were required to comply with FMVSS 302. Thus, children's car seat manufacturers also began to treat the foams and fabrics of car seats. Car seats are unique among children's products in that their use is mandated by law and they must comply with a fire safety standard designed for vehicle interiors rather than children's products.

The U.S. flammability standard for car seats exposes low income families to chemical hazards

While FMVSS 302 was intended to reduce deaths and injuries from vehicle fires (particularly from cigarettes, which constitute an ever-diminishing share of vehicle fire sources), it has never been proven to have a safety benefit for children in car seats. NHTSA has admitted it does not have any records or evidence to show a benefit to children.^{8,9} Yet FMVSS 302 has resulted in car seat makers adding thousands of pounds of chemical flame retardants to products that infants and children are in close contact with every day. Additionally, in case a fire does occur, halogenated FRs cause the smoke to be more toxic and potentially lead to more health problems in the future.¹⁰

Car seat companies have difficulty producing child car seats under \$100 without added FRs. It's cheaper to meet the flammability standard by adding chemical FRs to a product than to use more expensive fabrics. Consequently, the standard sets up a discriminatory policy benefitting families that can afford non-toxic car seats while imposing greater chemical exposure on lower-income families.

The Ecology Center advocates for families of all incomes to have access to non-toxic, affordable car seats, especially lower income families that may face higher cumulative chemical exposures in their lifetimes. With no evidence in over 50 years that meeting FMVSS 302 actually saves lives in the event of a vehicle fire, many car seat companies are creating a hazardous exposure problem to follow a broken regulation.



The standard sets up a discriminatory policy benefitting families that can afford non-toxic car seats while imposing greater chemical exposure on lower-income families.



PFAS IN CHILDREN'S CAR SEATS

PFAS Pose Exposure and Health Risks

Per- and poly-fluorinated alkyl substances (PFAS) are added to materials to make them repellent to water and stains. Some children's car seats contain PFAS. The Healthy Stuff Lab first tested for PFAS in children's car seats in 2018. We partnered with Indiana University researchers to publish a 2021 article, "Side-chain fluorotelomer-based polymers in children car seats," in the journal *Environmental Pollution*.¹¹

PFAS used for fabric waterproofing are called side-chain polymers. A polymer "backbone" adheres to fibers in the fabric while PFAS "side chains" along the backbone repel water and oil. The PFAS side chains tend to break off over time. Once free, they pose an exposure hazard to people using the product and additionally can transform in the environment to more stable forms of PFAS that pose known toxic hazards—the notorious "forever chemicals."^{11,12,13}

A study by the North American Commission for Environmental Cooperation in 2017 detected PFAS in all waterproof baby mats, pads, and blankets tested and nearly half of bibs tested.¹² The researchers used artificial saliva and mouthing simulations as well as artificial sweat simulations to test the migration of PFAS. They found nearly one half of PFAS present in these children's items transferred in the saliva simulation, and one-fifth transferred in the sweat simulation.

Little is known about potential health impacts of the PFAS chemicals coming from treated fabrics. The chemicals they can transform into, however, include the better-studied perfluoroalkyl acids, some of which build up in the liver and kidneys and may contribute to elevated cholesterol, suppression of immune response, thyroid disease, kidney cancer and testicular cancer.¹⁴



In addition to potential hazards for the user, the manufacture of PFAS chemicals causes severe pollution of our water, soil, and even air.¹⁵ Disposing of PFAS-treated fabrics poses another problem: recycling would produce a contaminated product, incinerating may release fluorinated byproducts of unknown toxicity, and landfilling may eventually allow leakage of PFAS into fresh water.¹⁶

The solution is to eliminate PFAS from children's products. The Ecology Center recommends companies make seat covers removable and washable to avoid the need for stain repellents.

STATE EFFORTS TO ADDRESS TOXIC FLAME RETARDANTS AND PFAS

Some U.S. states have passed legislation to protect children from toxic FRs and PFAS by passing limits or bans. In particular, recent laws in Massachusetts and California have banned FRs and PFAS, respectively, from being manufactured, sold, or distributed in those states. The Ecology Center supports this state-by-state approach to push change federally and send a message to car seat retailers and manufacturers. Ultimately, we call for a comprehensive federal solution that protects all children, no matter in which state they live.

State Laws

Massachusetts, S.2988: In January, 2021, Massachusetts passed the Children and Firefighters Protection Act, banning 11 toxic flame retardant chemicals in children's products. All children's car seats manufactured after January 1, 2022 and sold in Massachusetts must comply. As of this report release, car seats manufactured before January 1st are still on store shelves.

California, AB 652: In October, 2021, California approved a bill that prohibits juvenile products (including children's car seats) containing PFAS from being manufactured or sold in California. The law goes into effect in July, 2023.



BOX 1

CAR SEATS RECYCLABILITY

Around 12 million children's car seats are landfilled or incinerated in the U.S. each year.²³ Car seats are commonly a complicated combination of plastic, fabric, foam, and metal, making recycling difficult, but not impossible. Recycling a car seat requires manual labor to separate the different materials from each other. Parts like plastic warning labels permanently adhered to seat fabric (per government guidelines) can stymie recyclers.

In efforts to curb unnecessary waste some manufacturers, such as Clek and Century (a new car seat company launched by Newell, Graco's parent company) offer recycling options. Additionally, retailers Target and Walmart have worked with recyclers to offer car seat take-back programs at certain times of the year. Target estimates they have reclaimed 1.4 million car seats and 22.2 million pounds of plastic since 2016.²⁴ Walmart estimates they collected over a million car seats in 2019, their inaugural year of car seat recycling. Before considering recycling, car seat owners can use Consumer Reports' interactive tool, "Can I Reuse or Donate My Car Seat," to figure out if their seat can be safely donated and reused.

We encourage car seat manufacturers to create car seats with the end of life in mind. Making car seats easy to disassemble and with recyclable materials would make a difference in the amount of car seats being thrown away each year. Ideally, easy-to-recycle seats should be made with FR-free upholstery, so the recycled product doesn't pass on related chemical hazards. We also encourage car seat makers to be responsible for taking back their seats and the process of recycling them. And, as safety allows, to include recycled materials in their new seats.

TABLE 1 Car Seats Tested

Brand Name	Model	Fashion	Type	Retail Location	~Retail Price	Source	Manufacture Date
Baby Trend	Ally 35	Crochet	Infant	U.S.	\$85	Target	12/31/2020
Baby Trend	Envy	Bobbleheads	Infant seat + Stroller	U.S.	\$150	Baby Trend	5/4/2020
Britax	Allegiance 3-Stage	Azul	Convertible	U.S.	\$160	Buy Buy Baby	3/1/2021
Britax	B Safe Gen 2	SafeWash (Eclipse)	Infant	U.S.	\$200	company donation	1/8/2021
Britax	Emblem	SafeWash (Slate)	Convertible	U.S.	\$200	company donation	1/7/2021
Britax (EU)	Römer Evolva 123	Cosmos Black	Convertible	E.U.	\$110	Denmark	N/A
Chicco	KeyFit 30	Lilla	Infant	U.S.	\$200	Target	7/1/2020
Chicco	KeyFit 35	ClearTex (Shadow)	Infant	U.S.	\$270	Target	4/1/2021
Clek	Liing	C-Zero Plus (Marshmallow)	Infant	U.S.	\$460	company donation	N/A
Clek	Liing	Mammoth	Infant	U.S.	\$490	company donation	N/A
Clek	Liing	Railroad	Infant	U.S.	\$400	company donation	N/A
Cosco	Scenera Next	Candy Apple	Convertible	U.S.	\$50	Walmart	5/13/2020
Cosco	Lift & Stroll DX	Featherly	Infant seat + Stroller	U.S.	\$140	Walmart	11/12/2020
Evenflo	Nurture	Grace Pink	Infant	U.S.	\$60	Walmart	2/12/2021
Evenflo	Tribute LX	Neptune	Convertible	U.S.	\$70	Walmart	1/9/2021
Graco (EU)	Extend	Black	Convertible	E.U.	\$90	Denmark	N/A
Graco	Extend2Fit	Spire	Convertible	U.S.	\$200	Buy Buy Baby	7/27/2020
Graco	Verb Click Connect	Merrick	Infant seat + Stroller	U.S.	\$160	Amazon	11/18/2020
Maxi-Cosi	Mico 30	PureCosi (Midnight Black)	Infant	U.S.	\$220	company donation	12/7/2020
Maxi-Cosi	Pria Max All-in-One	PureCosi (Tetra Graphite)	Convertible	U.S.	\$350	company donation	6/7/2021
Maxi-Cosi	Romi	PureCosi (Essential Black)	Convertible	U.S.	\$130	company donation	1/31/2022
Nuna	Pipa	Granite	Infant	U.S.	\$320	company donation	7/31/2020
Safety 1st (EU)	Ever Fix	Pixel	Convertible	E.U.	\$155	Denmark	N/A
Safety 1st	Smooth Ride	Sangria	Infant seat + Stroller	U.S.	\$175	Target	6/11/2020
UPPAbaby	KNOX	Jordan	Convertible	U.S.	\$400	company donation	5/6/2021

METHODS

As listed in Table 1, car seats were purchased at retail prices from popular retailers or donated by the manufacturer for this study. Only infant and infant-to-toddler convertible seats were selected.

To test the car seats and strollers, we used a combination of techniques:

1. On every component: X-ray fluorescence was used to measure potential flame retardant indicators: phosphorus, bromine, and chlorine.
2. On select components: Infrared spectroscopy was used to identify material types, intentionally added phosphorus-based flame retardants, and certain other additives. Not all flame retardants are fully identified by this method.
3. On outer fabric samples from most seats: Combustion with ion-selective electrode for measurement of total organic fluorine was used as a proxy for PFAS.

We isolated the components of each seat as shown in Figure 1, for a total of over 600 components from 25 seats (and 4 strollers). Seat covers and strap covers frequently consisted of several layers of fabric, foam, and interfacing, each of which we tested separately.

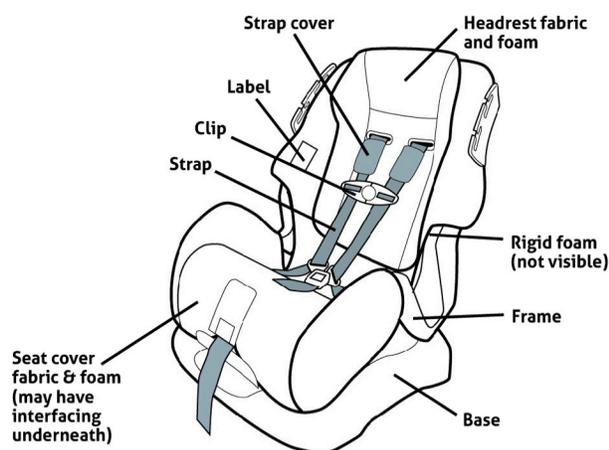


FIGURE 1 Components of a typical child car seat

TABLE 2 Definitions of Major and Minor Components for this Study

	Major components	Minor components
Upholstery	Seat cover fabric, headrest fabric, seat cover foam, headrest foam	Interfacing fabric, labels and tags
Shell	Frame, base, shade fabric and frame, rigid foam	Clip, strap, strap cover, hook-and-loop fastener

Testing with other methods in the future may find FRs or other chemicals that we didn't detect due to inherent method limitations.

X-RAY FLUORESCENCE (XRF)

XRF spectroscopy measures element levels. Our HD Mobile instrument from XOS is a high-definition XRF that uses monochromatic excitation energies of 7, 17, and 33 keV. The spot size is one millimeter. Elements heavier than aluminum are measurable. Detection limits are in the low parts-per-million (ppm) range for all elements of interest except chlorine and phosphorus, which have limits in the hundreds of ppm.

For most seats, component samples were cut with isopropanol-cleaned scissors. Seat fabric and interfacing (nonwoven fabric placed behind upholstery fabric or foam) pieces were folded several times and clamped to create a thicker and denser layer before XRF testing. This may allow a slightly more accurate measurement because the XRF penetration depth for elements of interest in most polymers is substantial, exceeding several millimeters. Thin foam layers were treated the same way.

While most seats were cut apart to obtain samples, four seats (Maxi-Cosi Romi, UPPAbaby KNOX, Clek Liing Mammoth and Clek Liing Railroad) were tested non-destructively in order to preserve the product for later donation and use. Fabrics and foams were tested by XRF directly on the seat rather than cutting and removing pieces. Soft and rigid foams were accessed underneath the seat upholstery. Our testing has shown this approach can slightly alter the levels of bromine, chlorine, and phosphorus reported by the software, but not enough to affect findings of FR presence or absence.

After collecting XRF data, we flagged bromine levels above 1000 ppm and phosphorus levels above 500 ppm as possible flame retardants. We also flagged chlorine above 1000 ppm as possibly arising from a chemical of concern such as a chlorinated flame retardant. These thresholds are consistent with those used by companies in the industry that do their own testing, and, based on our experience testing car seats, are likely to capture cases of intentional use. We tested components with those flags using FTIR spectroscopy as described in the next section.

We used a built-in XRF optimization mode for chlorine and phosphorus to improve their measurement. This optimization, however, causes the software to not report antimony, an element of concern found as a catalyst residual in some polyester fabrics. Although antimony is not a focus of this study, we collected an additional XRF scan in the default mode on all the major fabrics in order to collect antimony data.

More information on using XRF bromine, chlorine, and phosphorus as proxy indicators of FRs can be found in the references.^{6,17,18,19}

FOURIER TRANSFORM INFRARED SPECTROSCOPY (FTIR)

A Nicolet iS5 FTIR spectrometer with a single-bounce attenuated total reflection (ATR) accessory was used to identify polymer type or fiber type as well as additives. Components with elevated bromine, chlorine, or phosphorus according to XRF were analyzed by ATR-FTIR before and after solvent extraction. We used a combination of FTIR spectral libraries from Thermo Scientific and reference standards in our own lab to match spectra and identify materials and extracted chemicals. Between the purchased libraries and our own standards we can identify many commonly used FR chemicals, but not all possible ones.

Depending on the chemical, additives typically need to be present at levels of at least 0.1-1% in order to be detected by this method. Phosphorus-based FRs and melamine,⁶ also used as a FR, were identifiable by this method, while bromine-based FRs were only occasionally identifiable by this method due to poor extraction efficiency. Chlorinated organophosphate FRs are identifiable but were not found in this study. Other identifiable additives include but are not limited to plasticizers, slip agents, fillers such as talc and calcium carbonate, and some antioxidants.

To rank car seat chemical hazards, we considered the presence of phosphorus-based FRs identified by FTIR and elevated bromine measured by XRF. Samples with elevated phosphorus but without a positive flame retardant identification by FTIR were *not* marked as containing a chemical of concern because in some cases the source was an antioxidant containing phosphorus. Samples with elevated bromine were all marked as containing a chemical of concern because brominated chemicals, such as flame retardants and dyes, present a variety of hazards and are not necessary in children's products.

TOTAL FLUORINE (F) TESTING

Techniques that measure total organic fluorine provide a useful indicator for the presence of PFAS without the expense of targeted PFAS testing.^{11,20,21}

From each seat and stroller tested for fluorine we cut two pieces of fabric from the main seat upholstery and the shade, if present. The fabric samples were shipped to Galbraith Labs in Tennessee. One set of the samples was subjected to oxygen flask combustion followed by ion-selective electrode measurement of fluorine. This test gives the total level of fluorine in the sample. The other set was subjected to ion-selective electrode measurement without combustion. This test gives concentration of inorganic fluorine (fluoride ion, F⁻). Subtracting inorganic F from total F gave total organic F.

Six seats were obtained after the samples were shipped to Galbraith Labs and did not go through the total F test. To determine whether those seats likely contained PFAS, we used a water drop test, described in the section "How can I tell whether a seat has PFAS?" and communication with the companies about the fabrics used on their products.

FINDINGS

A table containing test results for the components of each car seat tested can be found at www.ecocenter.org/healthy-stuff.

Unlike the European Union standard, the U.S. flammability standard for child car seats needlessly exposes low income families to chemical hazards.

- Car seats purchased in the U.S. and the E.U. differed notably (Table 3). Affordably priced E.U. seats did not contain phosphorus-based flame retardants that were found in similar U.S. seats of the same brand. This is likely due to the implementation of the EN 71 flammability standard in the E.U.
- In other respects, U.S. and E.U. seats were similar: 2 of 3 of the E.U. seats contained bromine in the rigid foam at levels suggesting brominated FRs, and one of the E.U. seats contained elevated bromine in the upholstery fabric. More research is needed to determine the source of bromine in seat fabrics.

Most FRs detected in car seat upholstery are based on phosphorus.

- Phosphorus-based FRs were found in the seat pads (fabric or foam) of 55% of tested U.S. seats (12 of 22). The most frequent were PMMMPs, the cyclic phosphonate ester FR we reported for the first time in North American products in 2018.¹⁷ PMMMPs were found in 41% of U.S. seat fabrics. Several additional seats had PMMMPs in minor components like warning labels.

- Other phosphorus-based FRs were found. 9% of tested U.S. seats (2 of 22) contained resorcinol diphenyl phosphate and 14% (3 of 22) contained ammonium polyphosphate.
- Two U.S. seats also contained melamine, a persistent chemical with moderate carcinogenicity and endocrine activity that can be used as a flame retardant, in the upholstery.
- Brominated chemicals at levels suggesting intentional use were found in the upholstery fabrics of 9% of U.S. car seats tested (2 of 22) and in one shade fabric. Elevated bromine was also found in many minor components such as labels and interfacing fabric. We were unable to determine their molecular identities. They could be brominated flame retardants, dyes, or an unknown source.

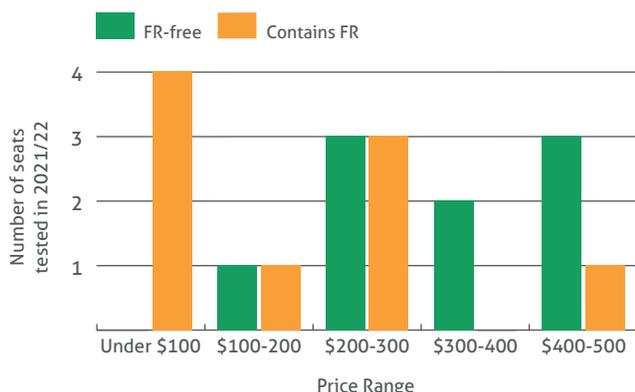
FR-free options are plentiful, IF you can afford them.

- The number of seats marketed as FR-free continues to expand (over 40 seat models from 8 companies; we tested only a subset of these).
- The price distribution of car seats tested by the Healthy Stuff Lab (Figure 2) shows that all four seats under \$100 contain FRs, while most seats in the \$300+ range are FR-free. (Seats bundled with strollers and seats purchased in Denmark are excluded from Figure 2.)

TABLE 3 European vs. U.S. child car seats

Brand	Origin	Car Seat	Phosphorus FR	Bromine in Rigid Foam	Price
Britax	United States	Allegiance 3 Stage (Azul)	present	0	\$160
	Denmark	Romer Evolva 123 (Cosmos Black)	0	present	\$112
Graco	United States	Extend2Fit (Spire)	present	present	\$200
	Denmark	Extend (Black)	0	present	\$90
Safety 1st	United States	Smooth Ride (Sangria)	present	0	\$160
	Denmark	Ever Fix (Pixel)	0	0	\$155

FIGURE 2 Price distribution of U.S. car seats tested in 2021/22



Strollers don’t have FRs, yet identical fabrics in matching car seats do.

- Car seats and strollers sold together as part of “travel systems” differed in chemical composition. None of the four strollers had phosphorus-based FRs even when the matching car seat in the set contained those FRs (Table 4). Also, strollers did not have elevated bromine in any components. These findings indicate that car seat makers add FR chemicals only to meet the vehicle flammability standard and do not add such chemicals to strollers, even when the same fabrics are used.
- Three strollers, however, contained high levels of chlorine--ranging from about 4% to 10%--in the foam covering the handle bar. Two of those were found to contain chlorinated paraffins, a hazardous chemical sometimes used as a flame retardant. Chlorinated chemicals and polymers represent an unnecessary hazard the manufacturers should eliminate.

TABLE 4 Flame retardant chemicals detected in upholstery of car seats vs strollers

Brand & Model	Car Seat	Stroller
Baby Trend Envy (Bobbleheads)	Ammonium polyphosphate	none
Cosco Lift & Stroll (Featherly)	PMMMPs	none
Graco Verb Click Connect (Merrick)	Ammonium polyphosphate	none
Safety 1st Smooth Ride (Sangria)	PMMMPs	none



Strollers don’t have FRs, yet identical fabrics in matching car seats do.



Some car seats and strollers use PFAS for water and stain resistance.

- 19 car seats were tested for fluorine. 21% (4 of 19) had total organic fluorine at levels suggesting use of a PFAS-based fabric treatment. Car seat companies confirmed in private communications that PFAS-treated fabrics are still used on some products.
- None of the three E.U. seats had likely PFAS.
- Of the 4 stroller-car seat combos (travel systems) tested, two had elevated fluorine in both the car seat and stroller fabrics. Two did not have elevated fluorine in either.
- Car seat fabrics were also subjected to a water drop test. On fabrics with elevated organic fluorine, indicating likely PFAS treatment, water drops beaded up, rolled around, and left no residue. On fabrics without elevated organic fluorine, water drops soaked in, showing the lack of a water-resistant treatment. See our water drop test video at www.ecocenter.org/healthy-stuff.
- Some companies have found other ways to achieve water resistance. Wool fabric, like that used by UPPAbaby’s Henry and Jordan fabrics and Clek’s Mammoth fabric, naturally repels water. Alternatively, Clek utilizes a PFAS-free coating in their C-Zero fabric line.



FIGURE 3 Example of a bundled car seat and stroller “travel system”

While several known toxic hazards have been eliminated, the industry can further reduce children’s FR exposure.

- Phosphorus-based FRs were in 50% of U.S. seats (11 of 22). No chlorinated FRs or polybrominated diphenyl ethers were detected in the 2021/22 seats, a finding that has remained consistent for more than five years.
- We support the elimination of halogenated chemicals but continue to caution that phosphorus-based FRs should be eliminated too.
- 32% of tested U.S. seats (9 of 22, from 5 of 11 companies) had elevated bromine in polystyrene rigid foam. Rigid foam is used for impact absorption, but is not required. A small number of car seats do not use rigid foam at all, while several use alternative polymers that do not require added FRs.
- We have been tracking four specific seat models for over five years (Table 5). The results illustrate the difficulty companies face making lower cost FR-free seats. Three models -- Chicco KeyFit 30, Cosco Scenera Next, and Evenflo Nurture -- still contain added FRs, particularly in the seat covers. Just one model, Nuna Pipa, has cleaned up significantly, but its retail price is much higher. Nuna has changed its entire line of seats to be FR- and PFAS-free.

FINDINGS SUMMARY

Since our 2018 car seat report, we have seen further progress toward healthier infant and child car seats with increasing FR-free and PFAS-free options. We learned that companies run into difficulty making the most affordable seats FR-free because more expensive fabrics are required to meet the flame standard without adding FRs. Two companies, Britax and Maxi-Cosi, offer the most affordable FR-free seats (priced at \$200 and

\$130). But, we still need sub-\$100 infant and toddler seats that are FR-free to meet the needs of many families. We urge car seat makers to keep working toward this goal through innovative design.

At the same time, another path to FR-free car seats is for NHTSA to exempt child restraints from the flammability standard used for vehicles. Along with industry and trade groups, we advocate for that exemption given the lack of evidence that the standard provides meaningful protection from vehicle fires. Additionally, it has led to companies using toxic chemicals as an inexpensive way to meet the standard, thereby exposing generations of children unnecessarily. The vehicle flammability standard is 50 years old and the agency has yet to demonstrate that its application to child restraints has saved lives or prevented injury.



TABLE 5 Changes in FR content of four child car seat models over time

Car seat model tested over 5 years	2016		2018		2021	
	PFR	Br	PFR	Br	PFR	Br
Chicco Keyfit 30 (\$200)	X	X	X		X	
Cosco Scenera Next (\$50)	X		X		X	
Evenflo Nurture (\$60)	X	X	X	X	X	X
Nuna Pipa (\$320)	X	X	X	X		

PFR=phosphorus-based FR in fabrics; Br=bromine; X=present.

CAR SEAT RANKINGS

Table 6 ranks the 2021 and 2022 tested car seats based on chemical content. **This list is not representative of the market as a whole.** It is skewed toward “low concern” seats because we purposely obtained several seats marketed as FR-free.

The ranking is based on test results from the upholstery (seat cover fabric and foam) and shell components (rigid foam underneath upholstery and, if present, shade).

More detailed test results can be found at www.ecocenter.org/healthy-stuff



TABLE 6 Hazard ranking of 2021-22 tested car seats. SEE TABLE 2 FOR MAJOR AND MINOR COMPONENTS.

Toxic Chemicals in Car Seats: 2021-2022 Hazard Ranking

 **Low Concern** = FR-free upholstery, rigid foam, & shade
No PFAS

	RETAIL PRICE
 Britax , SafeWash B Safe Gen 2 Infant	\$200
Britax , SafeWash Emblem Convertible	\$200
 Chicco , ClearTex KeyFit 35 Infant	\$270
 Clek , Mammoth Liing Infant	\$490
 Clek , Railroad Liing Infant	\$400
Maxi-Cosi , PureCosi Romi Convertible	\$130
Maxi-Cosi , PureCosi Mico 30 Infant	\$220
Maxi-Cosi , PureCosi Pria Max All-in-One Convertible	\$350
 Nuna , Pipa Infant	\$320
 UPPAbaby , Jordan KNOX Convertible	\$400

 **Moderate Concern** = FR or Br present in upholstery
No PFAS

Baby Trend , Ally 35 Infant	\$85
Britax , Allegiance 3-Stage Convertible	\$160
Clek , C-Zero Plus Liing Infant	\$460
Cosco , Scenera Next Convertible	\$50
Cosco , Lift & Stroll DX Infant Seat + Stroller	\$140
Evenflo , Tribute LX Convertible	\$70
Graco , Extend2Fit Convertible	\$200
Safety 1st (Sold in EU) , Ever Fix Convertible	sold in EU
Safety 1st , Smooth Ride Infant Seat + Stroller	\$175

Low-Moderate Concern = FR-free upholstery, No PFAS
FR or Br present in rigid foam or shade

Britax (Sold in EU) , Römer Evolva 123 Convertible	sold in EU
Graco (Sold in EU) , Extend Convertible	sold in EU

 **High Concern** = FR or Br present in upholstery
Likely PFAS

Baby Trend , Envy Infant Seat + Stroller	\$150
Chicco , KeyFit 30 Infant	\$200
Evenflo , Nurture Infant	\$60
Graco , Verb Click Connect Infant Seat + Stroller	\$160

FR-free means no detected flame retardants or bromine >1000 ppm.
 In addition to upholstery, rigid foam & shade, the seat's minor components (e.g. labels, interfacing) were free of FR & bromine.

Read the report at ecocenter.org/healthy-stuff

COMPANIES INNOVATING FR-FREE AND PFAS-FREE SEATS

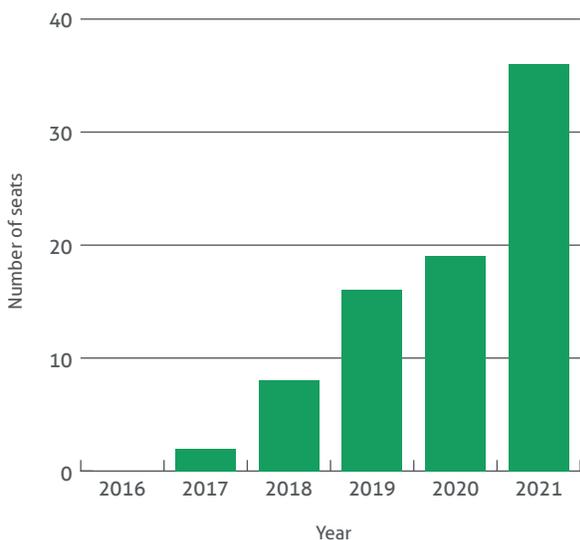
The Ecology Center compiled information from brand websites and direct conversations with company representatives to create a snapshot view of the FR-free and PFAS-free seats on the market (Table 7). Some of the seats included in Table 7 have been tested by the Ecology Center; others have not. This is noted in the table.

FR-FREE CAR SEATS

Families looking for FR-free car seats have many more options in 2022 as compared to five years ago when the first two FR-free car seat models were introduced by UPPAbaby and Nuna (Figure 4). In 2017, both FR-free seats on the market were infant seats and both sold for \$350. Since then six more companies have innovated seats without added FRs that still meet flammability standards. FR-free seats are now available for every age. Additionally, we have seen some companies rise to the challenge of making FR-free seats more affordable.



FIGURE 4 Number of children’s car seat models marketed as FR-free



At the release of this report, 42 models sold by eight companies are marketed to have no added FRs, with more expected to be released later this year. (See Box 2: New Developments in FR-free Seats.) The Ecology Center has tested seats from six of the eight companies. We have not tested Peg Perego or Orbit Baby seats at the time of this report release.

We expect the trend of more FR-free models from a broader range of companies to continue, as well as the continued trend toward affordability. In this vein, we hope more companies will follow the lead of Nuna, the only company that has converted its entire line of seats to FR-free.

With these innovations, the brands without an FR-free seat stand out as lagging behind. We continue to look to Baby Trend, Cosco, Evenflo, Graco, and Safety 1st to release their first FR-free seat.

TABLE 7 Flame retardant-free children's car seats available in 2022

Flame retardant-free INFANT Car Seats			
BRAND	FR-FREE FABRIC LINE	MODEL	PRICE
Britax	SafeWash	B-Safe Gen2 ^^	\$200
		B-Safe Gen2 FlexFit ^	\$250
		B-Safe Gen2 FlexFit+ ^	\$310
Chicco	ClearTex	KeyFit 30 ^	\$220
		KeyFit 35 ^^	\$250
		KeyFit 35 Zip ^	\$250
Clek	Railroad (available in May)	Liingo ^	\$240
		Liing ^^	\$400
	Mammoth	Liing ^^	\$490
Maxi-Cosi	PureCosi	Mico 30 ^^	\$200
		MicoXP Max ^	\$300
		Coral XP. ^	\$400
Nuna	All Nuna fabrics	Pipa ^^	\$320
		Pipa Lite ^^	\$350
		Pipa RX ^	\$380
		Pipa Lite R ^	\$400
		Pipa Lite LX ^	\$400
		Pipa Lite RX ^	\$450
Orbit Baby	All Orbit Baby fabric	G5 *	\$500
Peg Perego	Merino Wool	Primo Viaggio 4-35 Nido *	\$450
UPPAbaby	Henry & Jordan	MESA ^^	\$350
Flame retardant-free CONVERTIBLE Car Seats			
BRAND	FR-FREE FABRIC LINE	MODEL	PRICE
Britax	SafeWash	Emblem 3 Stage ^^	\$200
		Marathon ClickTight ^	\$310
		Boulevard ClickTight ^	\$335
		Advocate ClickTight ^	\$360
		One4Life All-in-one ^	\$400
Chicco	ClearTex	OneFit All-in-One ^	\$300
		NextFit Max ^	\$280
Clek	Mammoth	Flo ^^	\$470
		Foonf ^^	\$600
	Railroad (available in May)	Flo ^	\$400
		Foonf ^	\$530
Maxi-Cosi	PureCosi	Romi ^^	\$130
		Pria All-in-One ^	\$300
		Pria Max All-in-One ^^	\$340
Nuna	All Nuna fabrics	Rava ^	\$480
		Exec ^	\$700
Peg Perego	Merino Wool	Primo Viaggio Kinetic *	\$480
UPPAbaby	Jordan	KNOX ^^	\$400

TABLE 7 Flame retardant-free children's car seats available in 2022 CONTINUED

Flame retardant-free BOOSTER Seats			
BRAND	FR-FREE FABRIC LINE	MODEL	PRICE
Britax	Safewash	Grow with You ClickTight ^	\$310
		Grow With You ClickTight Plus ^	\$350
Chicco	ClearTex	KidFit PLUS ^	\$110
Clek	Mammoth	Oobr ^	\$400
	Railroad (available in May)	Oobr ^	\$330
Maxi-Cosi	PureCosi	RodiFix ^	\$200
Nuna	All Nuna fabrics	Aace ^	\$250

Key

^HS Tested Cover: Healthy Stuff tested the upholstery cover only or tested a different model with the same fabric.

^^HS Tested Whole Seat: Healthy Stuff tested components of the entire seat.

*Manufacturer Claim: Healthy Stuff did not test this seat. "FR-free" status is based on information from the company.

The lowest priced seats in each category are highlighted in blue.

Note: HS Tested seats that are FR-free also tested as PFAS-free. Companies, as of yet, have not made claims regarding PFAS.

PFAS-FREE CAR SEATS**Choosing a PFAS-Free Car Seat**

In addition to testing select seats for likely PFAS, we scoured car seat brand websites and had private discussions with companies to determine which brands, among those we tested for this study, offer car seats with and without added PFAS. These survey results are summarized in Table 8. We also noted which brands have seats with removable covers, which allows for easy washing, mitigating the need for water-repellency and stain-repellency.

The specific seats found to contain likely PFAS in this study were Baby Trend Envy (Bobbleheads), Chicco Key Fit 30 (Lilla), Evenflo Nurture (Grace Pink), and Graco Verb Click Connect (Merrick).

Avoiding PFAS through Design and Washable Covers

As a result of California's law prohibiting PFAS in all juvenile products, all car seats manufactured or sold in California will be required to be PFAS-free by 2023. This law has pushed laggard companies to seek safer alternatives for stain- and water-proofing. All car seat companies included in this report offer at least some models with washable and removable covers, a design option that prevents the need for stain treatments. All companies included in this report offer at least one PFAS-free car seat model. Most companies, however,

don't advertise seats as PFAS-free, making it difficult to identify which are and which are not.

We urge companies to publicly state when their product lines are PFAS-free, and use a third-party assessment like GreenScreen from Clean Production Action to prove any alternative chemical stain-repellant is a safer substitute. Companies can also certify their products with GreenScreen Certified, which restricts PFAS.²²

What else should companies do?

Companies should create PFAS-free policies and practices that can be replicated by other companies. It is possible to change car seat designs and materials to eliminate added PFAS, and some companies are already proving that safer alternatives exist. We believe car seats at all price points can be made without added PFAS. We challenge companies to achieve this goal so that healthier seats are more affordable.

Can I tell whether a car seat has PFAS?

Seats advertising stain- and water repellency may have PFAS-treated fabric. But PFAS-free seats can be hard to identify. A **water drop test** (see our video!) is a simple way to determine if a fabric has waterproof properties. It cannot tell you what chemicals are used, but *may* indicate the presence of PFAS.

PFAS treatments cause the fabric to strongly repel water. If you drop a water droplet onto a PFAS-treated fabric, it will bead up, roll around, and typically leaves no residue. In contrast, a droplet dropped onto an untreated fabric will soak in.

A “positive” water drop result does not definitely indicate PFAS. Non-PFAS alternatives do exist. For example, the Clek Liing C-zero seat we tested showed a “positive” result with the droplet beading up and rolling because the C-zero fabric has a proprietary non-PFAS treatment. Another alternative is wool and wool-blend fabrics, which are naturally water-repellent to varying degrees. UPPAbaby’s seat in this report is an example of that. The water droplet on the UPPAbaby seat beaded up.

If you get a “positive” water drop test result on a child car seat, we suggest asking the manufacturer whether they use PFAS fabric treatments of any kind.

TABLE 8 PFAS usage overview of brands included in this study (some or all models)

Brand	PFAS-Free Seats	Removable Seat Covers
Baby Trend	Some	Some
Britax	Some	Some
Chicco	Some	All
Clek	All	Some
Cosco	All	All
Evenflo	Some	Some
Graco	Some	Some
Maxi-Cosi	All	All
Nuna	All	All
Safety 1st	All	All
UPPAbaby	All	All

**BOX 2
NEW DEVELOPMENTS IN FR-FREE SEATS**

Car seat companies continue to innovate to meet flammability standards without FR chemicals and continue to expand their offerings. Recent and upcoming developments include:

Maxi-Cosi answered our call to develop an FR-free seat for less than \$200 and released the travel convertible PureCosi Romi seat shortly before this report release. The seat sells for \$130 and was tested for this report. Maxi-Cosi’s FR-free PureCosi line now includes infant, convertible, and booster seats.

Britax plans to release new FR-free fashions in their SafeWash line of covers (available on multiple car seat models) throughout the spring and summer 2022. Ecology Center’s Healthy Stuff Lab has tested samples of the new fabric and found no evidence of FR chemicals. In 2021 Britax introduced SafeWash B-Safe Gen 2, one of two of the most affordable infant seats on the market, retailing at \$200. (Maxi-Cosi PureCosi’s Mico 30 also sells for \$200).

Three companies within the past year have released their first FR-free seat for the U.S. market: **Chicco, Orbit Baby, Peg Perego**. We congratulate these

companies and applaud their innovation. Of these, only Chicco’s FR-free ClearTex KeyFit 35 was tested for this report.

Chicco entered the FR-free market with six models in their ClearTex line, available in infant, convertible, and booster. Chicco’s ClearTex fashions sell at the same price points as their other fabrics. Chicco’s booster, KidFit ClearTex PLUS, is the most affordable FR-free booster currently on the market, retailing for \$110.

Clek made their least expensive fabric option FR-free. Their new “Railroad” FR-free fabric option will be available on all seats in May 2022. A Railroad Liing seat was tested for this report. Clek now offers two FR-free fabrics: Mammoth and Railroad.

UPPAbaby introduced their first convertible car seat, KNOX, this past year, which has an FR-free fabric option. UPPAbaby’s Jordan KNOX was tested for this report.

All of the FR-free seats listed here are also PFAS-free.

CALL TO ACTION: RECOMMENDATIONS FOR REGULATORS

Parents need car seats to keep babies and children safe while driving. In fact, the law requires them. However, as a result of an outdated federal flammability regulation from the National Highway Traffic Safety Administration (NHTSA) the majority of children's car seats are treated with chemical flame retardants.

NHTSA hasn't updated their fire safety regulations since 1969 and has no evidence that the flame retardant chemicals used to meet the standard provide a fire safety benefit to children. Exposure to flame retardant chemicals is associated with disruption of the hormone system, developmental delays, obesity, and cancer.

Ecology Center advocates changing these standards that expose young children to toxic chemicals when they are at their most vulnerable stages of development. We've created a petition on change.org calling on NHTSA to update their flammability standards (bit.ly/carseatdetox). We are not alone in this effort. A national coalition of car seat manufacturers, child safety advocates, and public health groups together demand changes to these car seat regulations that would allow manufacturers to produce safe, affordable car seats without the use of added flame retardants. Affordable car seats should come without chemical costs to kids. We need NHTSA to update their standards!

RECOMMENDATIONS FOR FAMILIES

While we cannot test every car seat for every chemical of concern, our general advice is: buy the safest car seat you can afford and try to use it only for travel, support companies that publicly prioritize healthier, non-toxic products and, most importantly, enjoy your journey through parenthood! More tips:

Sign the petition to NHTSA: bit.ly/carseatdetox

Always use an appropriate car seat for children when traveling.

Limit time in the car seat when not traveling in a vehicle if you are uncertain about the chemical safety of the car seat. **Don't use it as a place to sit or nap.**

Limit direct sunlight on the car seat **and high temperatures** in your car. Flame retardants and other hazardous chemicals may be released at a higher rate

when your car becomes hot. When possible, park in the shade or in covered parking. Window coverings in a car also substantially lower the interior temperature on a warm day.

Vacuum the car interior and the nooks and crannies of car seats. Chemicals that migrate out, including flame retardants, can cling to dust particles.

Open the car windows when possible.

Look for companies that have comprehensive chemical policies or a system to prioritize reduction and elimination of toxic chemicals in their products if you're looking to purchase a car seat. Ask if you can't find the information easily. Companies that sell children's products should publicly disclose these policies.

RECOMMENDATIONS FOR COMPANIES

We urge companies to:

Prioritize the manufacturing of safer, healthier products by following Clean Production Action's Five Essential Practices for Retailers, Brand Owners and Suppliers:

- Establish a goal of seeking safer chemicals,
- Disclose all chemical ingredients,
- Identify chemicals of concern,
- Actively seek safer alternatives,
- Continue to improve and report.

Keep working toward the goal of sub-\$100 infant and toddler seats that are FR-free to meet the needs of many families.

Make all seats offered FR-free; not just a subset of seats.

Stop using PFAS for water and stain repellents and instead **make car seat and stroller covers easy to remove and wash.**

Create PFAS-free policies and practices that can be replicated by other companies. It is possible to change car seat designs and materials to eliminate added PFAS. Some companies are already proving that safer alternatives exist. Car seats at all price points should be made without added PFAS.

Publicly state when product lines are PFAS-free.

Use a third-party assessment like GreenScreen from Clean Production Action to prove any alternative chemical stain-repellant is a safer substitute. Companies can also certify their products with GreenScreen Certified, which restricts PFAS.

Create car seats with the end of life in mind. Make car seats easy to disassemble and with recyclable materials. Easy-to-recycle seats should be made with FR-free upholstery, so the recycled product doesn't pass on related chemical hazards.

Take back car seats and be responsible for recycling them. And, as safety allows, include recycled materials in new seats.

Avoid halogenated chemicals in general, including halogenated polymers. Halogens pose distinct hazards related to manufacturing and disposal, as well as in some cases during use.

Investigate the sources of elevated bromine, chlorine, and phosphorus in products and work to eliminate chemical hazards.

BOX 3

CAR SEAT MAKERS SHOULD IDENTIFY MYSTERY CHEMICALS AND CLEAN UP THE “MINOR” COMPONENTS

Car seats categorized as “FR-free” aren’t necessarily completely free of chemicals of concern. Some seats we tested had indicators of chemicals that we couldn’t fully identify. And while we focused on the major components--primarily the upholstered seat pads--of each seat, many seats had minor components such as labels and interior fabrics that contained flame retardants or elevated bromine. This section describes these findings in more detail.

Some seat components had elevated phosphorus or bromine according to XRF, but FTIR analysis wasn’t able to identify the specific chemical(s) responsible. The reasons were twofold: 1) In some cases we lacked an appropriate reference spectrum in our FTIR libraries. An example is the black seat cover of the Cosco Scenera Next seat, which contained approximately 0.5% phosphorus that, after solvent extraction, produced a spectrum that was consistent with a phosphonate but was not a good match for any library spectra. 2) In other cases, particularly when brominated chemicals were present, the chemicals were not sufficiently extracted by our method. An example is the pink fabric on the Evenflo Nurture seat, which had a backcoating containing a high level of bromine, approximately 10,800 ppm (1.8%). FTIR after extraction showed the fabric contained ammonium polyphosphate, but no brominated chemicals were extracted.

FTIR determined that a few samples contained phosphorus-based antioxidants, which were not flagged as hazardous in this report, pending further research.

“Mystery” XRF bromine above the threshold was found in both major and minor car seat components (Table 2), while unexplained phosphorus was primarily found in minor components. Minor and major component results are included in the downloadable table at www.ecocenter.org/healthy-stuff.

Although we excluded minor components from the ranking in Table 6, companies should investigate the sources of chemicals of concern in these components and work with suppliers to eliminate them.

“Mystery” XRF bromine or phosphorus could represent flame retardants that are either polymeric or reactive. Polymeric and reactive FRs are explained in more detail in our factsheet. “Polymeric, Additive, and Reactive Flame Retardant Chemicals” factsheet. (Available online: bit.ly/polymeric_factsheet) Polymeric FRs are especially large molecules and as such are claimed by industry to be unlikely to migrate out of the product and unlikely to enter the human body. Unfortunately, these claims have not been sufficiently tested. One study found a polymeric FR, called PolyFR, may break down into smaller molecules, potentially creating a hazard.²⁵

Reactive FRs, on the other hand, modify materials such as polyester fabric with chemically bound flame retardants, in contrast to unbound FRs such as PMMMPs and other FRs in some car seats. The finished material contains a built-in FR that cannot easily migrate out.

Another possible source of “mystery” bromine is brominated dyes. Textiles (fabrics) can contain a wide variety of dyes, and recent research has found concerning levels of brominated dye chemicals in household dust.²⁶

High levels of chlorine were found in a few components of various seats and should be investigated by manufacturers. In three strollers (Safety 1st Smooth Ride, Cosco Lift and Stroll, and Graco Verb Click Connect), foam surrounding the handle was found to have chlorine levels ranging from around 20,000 ppm (2%) to over 100,000 ppm (10%). In two of these strollers, FTIR revealed chlorinated paraffins, a hazardous group of chemicals that are highly toxic to aquatic life.^{27,28} We did not find other chlorinated flame retardants that were historically used in car seats.

We strongly urge companies to avoid halogenated chemicals in general, including halogenated polymers. (Halogenated refers to chemicals containing chlorine, bromine, or fluorine.) Halogens pose distinct hazards related to manufacturing and disposal, as well as in some cases during use.

Companies should investigate the sources of elevated bromine, chlorine, and phosphorus in their products and work to eliminate chemical hazards.

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