



# ***Identifying Flame Retardant Chemicals in Consumer Products Insights into Human Exposure Pathways***

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**NIEHS**  
National Institute of  
Environmental Health Sciences



Superfund  
Research Program



# ***Flame Retardants (FRs) Used to Meet California's TB 117***

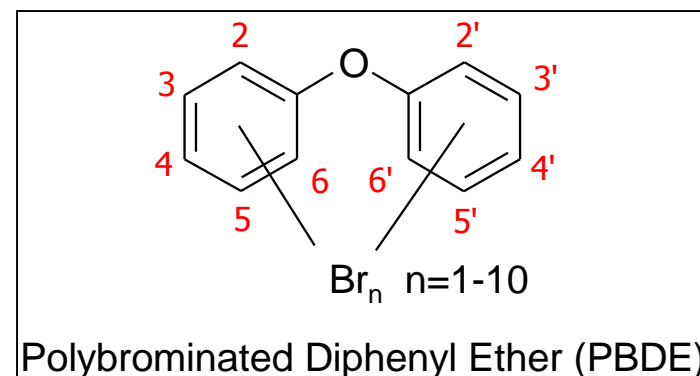
- Promulgated by California Bureau of Home Furnishing and Thermal Insulation, within the Department of Consumer Affairs
- Requires 12-second open flame testing for polyurethane inside furniture





# ***PentaBDE Flame Retardant Mixture***

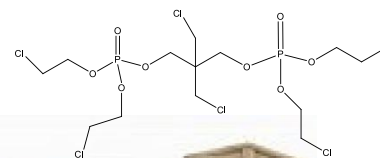
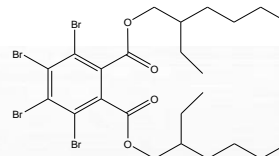
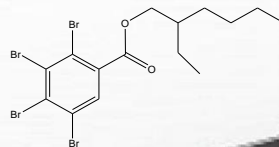
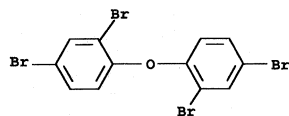
- 98% of World Market Demand for PentaBDE was in North America, primarily to meet TB 117
- Concern about persistence, bioaccumulation and potential toxicity led to voluntary phase-out in US in 2005; (banned in Europe in 2002)
- However, there are very limited data available on the flame retardants used as replacements for PentaBDE





# *The Chemical Conveyor Belt*

**When one flame retardant is banned, another chemical moves in to take its place, and less is known about the replacement chemical...**



# EPA's PentaBDE Alternatives Assessment

Table 4-1 Screening Level Toxicology and Exposure Summary

L = Low hazard concern  
 M<sup>†</sup> = Moderate hazard concern  
 H = High hazard concern  
 L, M<sup>†</sup>, or H = Endpoint assigned using estimated values and professional judgment (Structure Activity Relationships)

N = No  
 Y = Yes  
 P = Yes for pure chemical

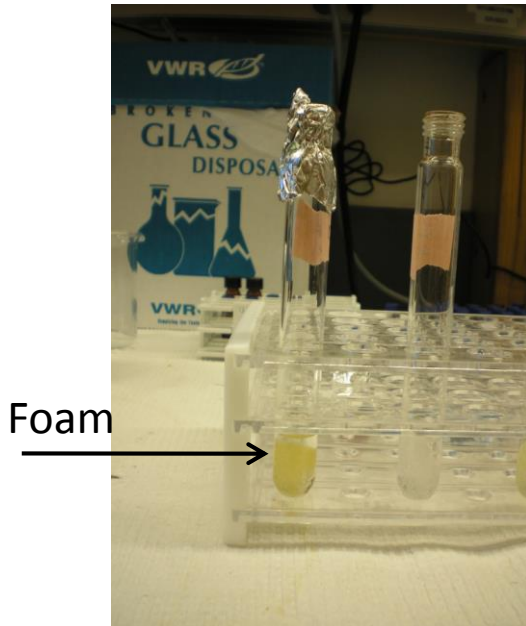
\*Ongoing studies may result in a change in this endpoint  
 †Persistent degradation products expected<sup>5</sup>

Company	Chemical	% in Formulation <sup>6</sup>	Human Health Effects							Ecotoxicity		Environmental		Potential Routes of Exposure							Reactive or Additive?				
			Cancer Hazard	Skin Sensitizer	Reproductive	Developmental	Neurological	Systemic	Genotoxicity	Acute	Chronic	Persistence	Bioaccumulation	Worker			General Population			Aquatic					
														Inhalation	Dermal	Ingestion	Inhalation	Dermal	Ingestion						
Albemarle	SAYTEX RZ-243																								
	Proprietary E Tetrabromophthalate diol diester		L	L	L*	L*	L	M*	L	L	H	L <sup>†</sup>	L	N	Y	Y	N	N	Y	Y				Additive	
	Proprietary B Aryl phosphate		L	L	M*	M*	M	M*	L	H	H	L	M	N	Y	Y	N	Y	N	N				Additive	
	Triphenyl Phosphate CAS # 115-86-6		L	L	L	L	L	M	L	H	H	L	L	Y	Y	Y	Y	Y	Y	Y				Additive	
Ameribrom	FR513																								
	Tribromoneopentyl Alcohol CAS # 36483-57-5		M	L	M	M	M	M	M	M	M	L	L	Y	Y	Y	N	N	Y	Y				Reactive	
Great Lakes	Firemaster 550																								
	Proprietary F Halogenated aryl ester		L	L	M	M	L	M	L	H	H	L <sup>†</sup>	L	N	Y	Y	N	Y	Y	Y				Additive	
	Proprietary G Triaryl phosphate, isopropylated		L	L	M*	M*	M	M*	L	H	H	L	M	N	Y	Y	N	Y	N	N				Additive	
	Triphenyl Phosphate CAS # 115-86-6		L	L	L	L	L	M	L	H	H	L	L	Y	Y	Y	Y	Y	Y	Y				Additive	
	Proprietary H Halogenated aryl ester		L	L	M	M	L	M	L	H	H	L <sup>†</sup>	L	N	Y	Y	N	Y	Y	Y				Additive	
Great Lakes	Firemaster 552																								
	Proprietary F Halogenated aryl ester		L	L	M	M	L	M	L	H	H	L <sup>†</sup>	L	N	Y	Y	N	Y	Y	Y				Additive	
	Proprietary G Triaryl phosphate, isopropylated		L	L	M*	M*	M	M*	L	H	H	L	M	N	Y	Y	N	Y	N	N				Additive	
	Triphenyl Phosphate CAS # 115-86-6		L	L	L	L	L	M	L	H	H	L	L	Y	Y	Y	Y	Y	Y	Y				Additive	
	Proprietary H Halogenated aryl ester		L	L	M	M	L	M	L	H	H	L <sup>†</sup>	L	N	Y	Y	N	Y	Y	Y				Additive	





# Screening Consumer Products for FR Chemicals:



Gas Chromatograph Mass Spectrometer (GC/MS)



# ***Flame Retardants (FRs) Used to Meet California's TB 117***

- Previous research in our laboratory has focused on identifying FR chemical additives in polyurethane foam:

- Baby Products (Stapleton et al. 2011)
- Residential Sofas (Stapleton et al. 2012)



- The most common FRs identified in furniture are:

- PBDEs associated with PentaBDE
- Tris (1,3-dichloro-isopropyl) phosphate (TDCPP)
- Chemicals associated with Firemaster® 550 (FM 550)
- Triphenyl phosphate (TPP) and isomers of tris(4-isobutyl) phenyl phosphate
- Tris (1-chloro-isopropyl) phosphate (TCPP)

Sleep Positioners





# Testing for Flame Retardants in PUF

- A number of consumer products meet CA TB 117 standard
- General public has no access to information on chemical flame retardant applications in these products
- The Superfund Research Center Program is providing support for analytical testing of FRs in PUF

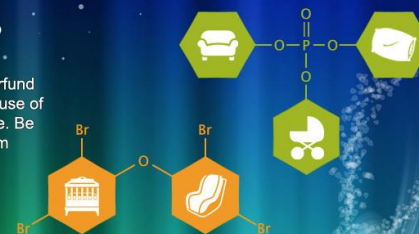
<http://foam.pratt.duke.edu>

Duke SUPERFUND ANALYTICAL CHEMISTRY CORE

Home What can I test? Submit a Sample Our Findings Resources FAQ Bibliography

## What's in my foam?

Scientists at Duke University's Superfund Research Center are examining the use of flame retardant chemicals in furniture. Be part of the study by submitting a foam sample from your home.



### Why should I test my sofa?

In the US, flame retardant chemicals are sometimes intentionally added to the foam filling present in many types of furniture (including some baby furniture) to meet a California state flammability standard commonly known as Technical Bulletin 117 (TB 117). While only residential furniture sold in the state of California is required to meet this standard, manufacturers often make all their furniture to meet this standard [1]. The state of California is currently revising TB 117, and a new standard, referred to as TB 117-2013, will go into effect starting in January 2014 that should reduce the use of these flame retardants in furniture. However, it is currently unclear how the use of these chemicals will change starting in 2014.

### How does this affect me?

Over the past 10-15 years, scientific evidence has demonstrated that some of these flame retardants are released from products and accumulate in indoor environments. People can be exposed to these chemicals indoors through inhalation and unintentional ingestion of dust particles [2,3,4]. The use of one flame retardant known as PentabDE was phased out in 2004 due to concerns about the chemical's persistence, its tendency to concentrate in human tissues, and potential human health effects.

This means other chemicals are currently used to meet flammability standards, but little information is available on how we are exposed to these new flame retardants, or if there are potential health effects. Because manufacturers are not required to label products with the flame retardant applications used, consumers cannot determine if flame retardants are in their products without laboratory testing.

### How does this help me?

Duke's Superfund Research Center can now help you find out what chemicals may be present in the furniture in your home with funding support provided by the National Institute of Environmental Health Sciences (NIEHS).

If you are interested in sending us a sample of your foam for analysis, please complete the [sample submission](#) process.

### How does this help you?

Data collected from this testing will help us to understand which flame retarding chemicals are currently being used in furniture. Once we have a sense of what chemicals are being used, we'll be able to investigate how people are exposed to these chemicals in the home and understand if the chemicals may impact human health.

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**What is the primary route of exposure to flame retardants?**



## ***Is Their High Exposure to FRs a Result of Applications to Polyurethane Foam?***

