

Summary of flame retardant uses, health effects, and highest levels reported

Chemical	Uses	Health Effects				Highest reported levels ^a
		Cancer	Endocrine disruption	Neurotoxicity	Reproductive toxicity	
Polybrominated Diphenyl Ethers (PBDEs)						
BDE 47	Component of PentaBDE. Used in furniture foam before chemical phase out in 2005 in US [1].		●	●	●	✓
BDE 99	(see BDE 47)		●	●	●	✓
BDE 100	(see BDE 47)		●	●	●	✓
BDE 183	Component of OctaBDE. Used in electronics, plastics before chemical phase out in 2005 in US [1].		●	●	●	
BDE 209	Component of DecaBDE. Used in adhesives, construction equipment, electronics, textiles. Manufacturers have committed to reduce sales and imports [2] and US EPA has proposed to limit its use [3].		●	●	●	✓
Other Brominated Flame Retardants						
EH-TBB	Component of Firemaster 550 [®] (replacement for PentaBDE [4]). Used in building material, furniture foam. ^b	●			●	
BEH-TBEP	Component of Firemaster 550 [®] (replacement for PentaBDE [4]). Used in building materials, electronics, furniture foam, ^b plastics.	●			●	
TBBPA	Used in electronics, plastics and rubber.	●	●	●	●	✓
BTBPE	Alternative for OctaBDE ^b [4].		●			
DBDPE	Alternative to DecaBDE ^b [4]. Used in electronics, rubber and plastic, paints, textiles.				●	✓
Phosphate Flame Retardants						
TCEP	Used in furniture foam, ^b plastics, textiles.	●			●	
TCIPP	Used in electronics, furniture foam, ^b paint, textiles.	●				✓
TDCIPP	Used in furniture foam, ^b plastic and rubber, textiles.	●				
TPHP	Component of Firemaster 550 [®] (replacement for PentaBDE). Used in furniture foam, ^b plastics.			●	●	
Dechlorane Plus (DP)						
DP	Used in adhesives, electronics, plastic and rubber.	●				✓
Hexabromocyclododecane (HBCDD)						
HBCDD	Used in building insulation, rubber and plastic, textiles. US EPA limited its use in 2015 [5].		●	●	●	✓

Health effects were obtained from the California Safer Consumer Products Candidate Chemical list, which includes health hazards and toxicological endpoints designated by authoritative lists in North America and Europe.[6]

Chemical uses include uses reported to U.S. regulatory agencies, obtained from US EPA's CPCat (Chemical and Product Categories) database [7].

^aWe compared levels found in our study to dust levels published in the last 10 years.

^bThe primary flammability standard that led to the use of flame retardants in polyurethane foam changed as of Jan. 1, 2014 [8], so foam produced after this date may not contain added flame retardants.

1. U.S. Environmental Protection Agency, *Polybrominated Diphenyl Ethers (PBDEs) Action Plan*. 2009, U.S. Environmental Protection Agency.
2. U.S. Environmental Protection Agency. *DecaBDE Phase-out Initiative*. 2012 [cited 2012 July 30, 2012]; Available from: <http://www.epa.gov/oppt/existingchemicals/pubs/actionplans/deccadbe.html>.
3. U.S. Environmental Protection Agency, *Certain Polybrominated Diphenylethers; Significant New Use Rule and Test Rule*. 2012, Federal Register.
4. Covaci, A., et al., *Novel brominated flame retardants: a review of their analysis, environmental fate and behaviour*. *Environ Int*, 2011. **37**(2): p. 532-56.
5. EPA, *Significant New Use Rules: Hexabromocyclododecane and 1,2,5,6,9,10-Hexabromocyclododecane*, U.S.E.P. Agency, Editor. 2015: Washington, D.C.
6. State of California, *California Code of Regulations, in Division 4.5, Title 22, Chapter 55, 69502.2*. 2013.
7. U.S. Environmental Protection Agency, *CPCat: Chemical and Product Categories*.
8. State of California, *Technical Bulletin 117-2013: Requirements, Test Procedure and Apparatus for Testing the Smolder Resistance of Materials Used in Upholstered Furniture*, B.o.H.F.a.T.I. Department of Consumer Affairs, Editor. 2013: Sacramento, CA.

Reference: Dodson, R.E., K.M. Rodgers, G. Carey, J.G.C. Laurent, A. Covaci, G. Poma, G. Malarvannan, J.D. Spengler, R.A. Rudel, J. G. Allen. 2017. ["Flame Retardant Chemicals in College Dormitories: Flammability Standards Influence Dust Concentrations."](https://doi.org/10.1021/acs.est.7b00429) *Environmental Science & Technology*. doi:10.1021/acs.est.7b00429