

# Polybrominated Diphenyl Ethers (PBDEs) & Other Flame Retardant Standards

## Polybrominated Diphenyl Ethers (PBDE's) & Other Flame Retardants

Polybrominated Diphenyl Ethers (PBDE's) are a subgroup of the wider brominated flame retardant family. Structurally, they are similar to Polychlorinated Biphenyls (PCB's) and like PCB's there are, in total, 209 different congeners or isomers. The compounds are classified according to the average number of Bromine atoms in the molecule.

The congeners occur as mono-, di-, tri-, tetra-, penta-, hexa-, hepta-, octa-, nono-, and decabromodiphenyl ethers and the numbers of each respectively are 3, 12, 24, 42, 46, 42, 24, 12, 3, and 1, all adding up to 209 in total. The three main commercial mixtures that were available on the market include pentaBDE, octaBDE and decaBDE. The pentaBDE mixture contains tetrabromates, hexabromates and traces of tribromates in addition to the pentabromates. OctaBDE includes hexa, hepta, nona and decabromates as well as the octa congeners. There are no known natural sources of PBDE's, although some evidence exists in the literature that PBDE variants may be produced by marine organisms, but all commercial mixtures were man made.

PBDE's have been used in a wide variety of products as flame retardants, including building materials, electronics, furnishings, motor vehicles, household appliances, plastics, foams and textiles. Like PCB's, these products exhibit high lipophilicity and therefore accumulate in fatty tissues. Unlike PCB's, they are easier to degrade because of the weaker bromine bonds and unlike PCB's there is less concern about their toxicity upon degradation.

There is evidence from animal studies that PBDE's are injurious to health, but the evidence is spurious, and specific effects are not clearly elucidated. There is evidence of the products acting as endocrine disruptors, possibilities that they may act as a teratogen and some studies have identified neurodevelopmental toxicity in mice.

Humans may either ingest orally or through the respiratory tract. Waters used in the manufacture of PBDE containing products are at high risk of contamination and pose risks if ingested. Staff in repair or recycling plants are also at risk but inhalation or food ingestion in a domestic context also poses potential health hazards. The products have also been detected in dust, sludge and wastewater effluent and there is no doubt about their ability to bioaccumulate. Detection methods include GC, GC-MS and various LC combinations.

## Native PBDEs

Product No.	Description	Concentration	Pack Size
REPBDE001	2-Bromodiphenyl ether (PBDE-1)	50µg/mL in isooctane	1ml
REPBDE002	3-Bromodiphenyl ether (PBDE-2)	50µg/mL in isooctane	1ml
REPBDE003	4-Bromodiphenyl ether (PBDE-3)	50µg/mL in isooctane	1ml
REPBDE003N	4-Bromodiphenyl ether (PBDE-3)	Neat	5mg
REPBDE007	2,4-Dibromodiphenyl ether (PBDE-7)	50µg/mL in isooctane	1ml
REPBDE0013	3,4'-Dibromodiphenyl ether (PBDE-13)	50µg/mL in isooctane	1ml
REPBDE0015	4,4'-Dibromodiphenyl ether (PBDE-15)	50µg/mL in isooctane	1ml
REPBDE0015N	4,4'-Dibromodiphenyl ether (PBDE-15)	Neat	5mg
REPBDE0017	2,2',4-Tribromodiphenyl ether (PBDE-17)	50µg/mL in isooctane	1ml

Product No.	Description	Concentration	Pack Size
REPBDE0017N	2,2',4-Tribromodiphenyl ether (PBDE-17)	Neat	5mg
REPBDE0025	2,3',4-Tribromodiphenyl ether (PBDE-25)	50µg/mL in isooctane	1ml
REPBDE0025N	2,3',4-Tribromodiphenyl ether (PBDE-25)	Neat	5mg
REPBDE0028	2,4,4'-Tribromodiphenyl ether (PBDE-28)	50µg/mL in isooctane	1ml
REPBDE0028N	2,4,4'-Tribromodiphenyl ether (PBDE-28)	Neat	5mg
REPBDE0033	3,3',4-Tribromodiphenyl ether (PBDE-33)	50µg/mL in isooctane	1ml
REPBDE0033N	3,3',4-Tribromodiphenyl ether (PBDE-33)	Neat	5mg
REPBDE0047	2,2',4,4'-Tetrabromodiphenyl ether (PBDE-47)	50µg/mL in isooctane	1ml
REPBDE0047N	2,2',4,4'-Tetrabromodiphenyl ether (PBDE-47)	Neat	5mg
REPBDE0049	2,2',4,5'-Tetrabromodiphenyl ether (PBDE-49)	50µg/mL in isooctane	1ml
REPBDE0049N	2,2',4,5'-Tetrabromodiphenyl ether (PBDE-49)	Neat	5mg
REPBDE0066	2,3',4,4'-Tetrabromodiphenyl ether (PBDE-66)	50µg/mL in isooctane	1ml
REPBDE0066N	2,3',4,4'-Tetrabromodiphenyl ether (PBDE-66)	Neat	5mg
REPBDE0071	2,3',4',6-Tetrabromodiphenyl ether (PBDE-71)	50µg/mL in isooctane	1ml
REPBDE0071N	2,3',4',6-Tetrabromodiphenyl ether (PBDE-71)	Neat	5mg
REPBDE0075	2,4,4',6-Tetrabromodiphenyl ether (PBDE-75)	50µg/mL in isooctane	1ml
REPBDE0075N	2,4,4',6-Tetrabromodiphenyl ether (PBDE-75)	Neat	5mg
REPBDE0077	3,3',4,4'-Tetrabromodiphenyl ether (PBDE-77)	50µg/mL in isooctane	1ml
REPBDE0077N	3,3',4,4'-Tetrabromodiphenyl ether (PBDE-77)	Neat	5mg
REPBDE0085	2,2',3,4,4'-Pentabromodiphenyl ether (PBDE-85)	50µg/mL in isooctane	1ml
REPBDE0085N	2,2',3,4,4'-Pentabromodiphenyl ether (PBDE-85)	Neat	5mg
REPBDE0099	2,2',4,4',5-Pentabromodiphenyl ether (PBDE-99)	50µg/mL in isooctane	1ml
REPBDE0099N	2,2',4,4',5-Pentabromodiphenyl ether (PBDE-99)	Neat	5mg
REPBDE0100	2,2',4,4',6-Pentabromodiphenyl ether (PBDE-100)	50µg/mL in isooctane	1ml
REPBDE0100N	2,2',4,4',6-Pentabromodiphenyl ether (PBDE-100)	Neat	5mg
REPBDE0118	2,3',4,4',5-Pentachlorobiphenyl ether (PBDE-118)	50µg/mL in isooctane	1ml
REPBDE0119	2,3',4,4',6-Pentabromodiphenyl ether (PBDE-119)	50µg/mL in isooctane	1ml
REPBDE0119N	2,3',4,4',6-Pentabromodiphenyl ether (PBDE-119)	Neat	5mg
REPBDE0138	2,2',3,4,4',5-Hexabromodiphenyl ether (PBDE-138)	50µg/mL in isooctane	1ml
REPBDE0138N	2,2',3,4,4',5-Hexabromodiphenyl ether (PBDE-138)	Neat	5mg
REPBDE0153	2,2',4,4',5,5'-Hexabromodiphenyl ether (PBDE-153)	50µg/mL in isooctane	1ml
REPBDE0153N	2,2',4,4',5,5'-Hexabromodiphenyl ether (PBDE-153)	Neat	5mg
REPBDE0154	2,2',4,4',5,6'-Hexabromodiphenyl ether (PBDE-154)	50µg/mL in isooctane	1ml
REPBDE0154N	2,2',4,4',5,6'-Hexabromodiphenyl ether (PBDE-154)	Neat	5mg
REPBDE0181	2,2',3,4,4',5,6-Heptabromodiphenyl ether (PBDE-181)	50µg/mL in isooctane	1ml
REPBDE0183	2,2',3,4,4',5',6-Heptabromodiphenyl ether (PBDE-183)	50µg/mL in isooctane	1ml
REPBDE0183N	2,2',3,4,4',5',6-Heptabromodiphenyl ether (PBDE-183)	Neat	5mg
REPBDE0190	2,3,3',4,4',5,6-Heptabromodiphenyl ether (PBDE-190)	50µg/mL in isooctane	1ml
REPBDE0190N	2,3,3',4,4',5,6-Heptabromodiphenyl ether (PBDE-190)	Neat	5mg
REPBDE0195	2,2',3,3',4,4',5,6-Octabromodiphenyl ether (PBDE-195)	50µg/mL in isooctane	1ml
REPBDE0196	2,2',3,3',4,4',5,6'-Octabromodiphenyl ether (PBDE-196)	50µg/mL in isooctane	1ml
REPBDE0203	2,2',3,4,4',5,5',6'-Octabromodiphenyl ether (PBDE-203)	50µg/mL in Isooctane	1ml
REPBDE0203N	2,2',3,4,4',5,5',6'-Octabromodiphenyl ether (PBDE-203)	Neat	5mg

## Native PBDEs

Product No.	Description	Concentration	Pack Size
REPBDE0205	2,3,3',4,4',5,5',6-Octabromodiphenyl ether (PBDE-205)	50µg/mL in isooctane	1ml
REPBDE0205N	2,3,3',4,4',5,5',6-Octabromodiphenyl ether (PBDE-205)	Neat	5mg
REPBDE0206	2,2',3,3',4,4',5,5',6-Nonabromodiphenyl ether (PBDE-206)	50µg/mL in isooctane	1ml
REPBDE0207	2,2',3,3',4,4',5,5',6,6'-Nonabromodiphenyl ether (PBDE-207)	50µg/mL in isooctane	1ml
REPBDE0208	2,2',3,3',4,5,5',6,6'-Nonabromodiphenyl ether (PBDE-208)	50µg/mL in isooctane	1ml
REPBDE0209	Decabromodiphenyl ether (PBDE-209)	50µg/mL in toluene	1ml
REPBDE0209N	Decabromodiphenyl ether (PBDE-209)	Neat	5mg

## Halogenated Flame Retardants

Product No.	Description	Concentration	Pack Size
REPBDE0400	2,2-Bis[3,5-dibromo-4-(2,3-dibromopropoxy)phenyl]propane	50µg/mL in toluene	1ml
REPBDE0401	1,2-Bis(2,4,6-tribromophenoxy)ethane	50µg/mL in toluene	1ml
REPBDE0402	Butyldiphenylphosphate	1000µg/mL in isopropanol	1ml
REPBDE0403	Decabromodiphenylethane	50µg/mL in chlorobenzene	1ml
REPBDE0404	Dechlorane plus	50µg/mL in toluene	1ml
REPBDE0405	Dibromoneopentylglycol	50µg/mL in isopropanol	1ml
REPBDE0406	Dibutylphenylphosphate	1000µg/mL in isopropanol	1ml
REPBDE0407	Ethylene bis(tetrabromophthalamide	Neat	10mg
REPBDE0408	1,2,3,4,5,6-Hexabromocyclohexane	50µg/mL in isooctane	1ml
REPBDE0409	1,2,5,6,9,10-Hexabromocyclododecane	1000µg/mL in toluene	1ml
REPBDE0410	Pentabromoethylbenzene	50µg/mL in isooctane	1ml
REPBDE0411	3,3',5,5'-Tetrabromobisphenol A	50µg/mL in isooctane	1ml
REPBDE0412	2,2',6,6'-Tetrabromobisphenol A diallyl ether	50µg/mL in toluene	1ml
REPBDE0413	3,3',5,5'-Tetrabromobisphenol A dimethyl ether	50µg/mL in isooctane	1ml
REPBDE0414	3,3',5,5'-Tetrabromobisphenol A bis(2,3-dibromopropyl) ether	50µg/mL in isooctane	1ml
REPBDE0415	3,3',5,5'-Tetrabromobisphenol A bis(2-hydroxyethyl) ether	50µg/mL in isooctane	1ml
REPBDE0416	2,4,6-Tribromophenylallyl ether	50µg/mL in isooctane	1ml
REPBDE0417	Tetrabromophthalic anhydride	50µg/mL in isooctane	1ml
REPBDE0418	Tetradecabromo-1,4-diphenoxybenzene	50µg/mL in cyclohexane	1ml

## Flame Retardants / F-PBDE Internal Standards

Product No.	Description	Concentration	Pack Size
REPBDE0300	2-Fluorodiphenyl ether	50µg/mL in isooctane	1ml
REPBDE0301	4-Fluorodiphenyl ether	50µg/mL in isooctane	1ml
REPBDE0302	2,4'-Difluorodiphenyl ether	1000µg/mL in isooctane	1ml
REPBDE0303	3,3'-Difluorodiphenyl ether	1000µg/mL in isooctane	1ml
REPBDE0304	3-Bromo-4'-fluorodiphenyl ether	50µg/mL in isooctane	1ml
REPBDE0305	3'-Fluoro-2,4-dibromodiphenyl ether	50µg/mL in isooctane	1ml
REPBDE0306	3'-Fluoro-3,4-dibromodiphenyl ether	50µg/mL in isooctane	1ml
REPBDE0307	4'-Fluoro-2,3,4-tribromodiphenyl ether	50µg/mL in isooctane	1ml
REPBDE0308	4'-Fluoro-2,3,6-tribromodiphenyl ether	50µg/mL in isooctane	1ml
REPBDE0309	2'-Fluoro-2,4,4'-tribromodiphenyl ether	50µg/mL in toluene	1ml
REPBDE0310	2'-Fluoro-2,4,4'-tribromodiphenyl ether	50µg/mL in isooctane	1ml
REPBDE0311	6-Fluoro-2,2',4,4'-tetrabromodiphenyl ether	50µg/mL in toluene	1ml
REPBDE0312	6-Fluoro-2,2',4,4'-tetrabromodiphenyl ether	50µg/mL in isooctane	1ml
REPBDE0313	5,5'-Difluoro-2,2',4,4'-tetrabromodiphenyl ether (2,2',4,4'-Tetrabromo-5,5'-difluorodiphenyl ether)	50µg/mL in toluene	1ml
REPBDE0314	5,5'-Difluoro-2,2',4,4'-tetrabromodiphenyl ether (2,2',4,4'-Tetrabromo-5,5'-difluorodiphenyl ether)	50µg/mL in isooctane	1ml
REPBDE0315	6-Fluoro-2,3',4,4'-tetrabromodiphenyl ether	50µg/mL in isooctane	1ml
REPBDE0316	4'-Fluoro-2,3',4,6-tetrabromodiphenyl ether	50µg/mL in isooctane	1ml
REPBDE0317	5,6-Difluoro-2,2',3,4,4'-pentabromodiphenyl ether (2,2',3,4,4'-Pentabromo-5,6-difluorodiphenyl ether)	50µg/mL in isooctane	1ml
REPBDE0318	3,6-Difluoro-2,2',4,4',5-pentabromodiphenyl ether (2,2',4,4',5-Pentabromo-3,6-difluorodiphenyl ether)	50µg/mL in isooctane	1ml
REPBDE0319	3-Fluoro-2,2',4,4',6-pentabromodiphenyl ether	50µg/mL in toluene	1ml
REPBDE0320	3-Fluoro-2,2',4,4',6-pentabromodiphenyl ether	50µg/mL in isooctane	1ml
REPBDE0321	3-Fluoro-2,3',4,4',6-pentabromodiphenyl ether	50µg/mL in Isooctane	1ml
REPBDE0322	3,5-Difluoro-2,3',4,4',6-pentabromodiphenyl ether (2,3',4,4',6-Pentabromo-3,5-difluorodiphenyl ether)	50µg/mL in isooctane	1ml
REPBDE0323	4'-Fluoro-2,3,3',4,5,6-hexabromodiphenyl ether	50µg/mL in toluene	1ml
REPBDE0324	3-Fluoro-2,2',4,4',5,5',6-heptabromodiphenyl ether	50µg/mL in toluene	1ml
REPBDE0325	4',6-Difluoro-2,2',3,3',4,5,5',6'-octabromodiphenyl ether	50µg/mL in toluene	1ml
REPBDE0326	4'-Fluoro-2,2',3,3',4,5,5',6,6'-nonabromodiphenyl ether	50µg/mL in isooctane	1ml
REPBDE0327	4'-Fluoro-2,2',3,3',4,5,5',6,6'-nonabromodiphenyl ether	50µg/mL in toluene	1ml

## Phosphor-Phosphate-based Flame Retardants

Product No.	Description	Concentration	Pack Size
REPBDE0500	Bis(2,3-dibromopropyl)phosphate, tech.	50µg/mL in isooctane	1ml
REPBDE0501	Bis(2,3-dibromopropyl)phosphate	50µg/mL in isooctane	1ml
REPBDE0502	Bisphenol A bis(diphenyl)phosphate	50µg/mL in methanol	1ml
REPBDE0503	9,10-Dihydro-9-Oxa-10-Phosphaphenantrene-10-Oxide	50µg/mL in isooctane	1ml
REPBDE0504	2-Ethylhexyldiphenylphosphate	Neat	1g
REPBDE0505	Isopropylated trisphenyl phosphate (Phenol, isopropylated, phosphate)	Neat	1g
REPBDE0506	Phenoxyterminated carbonate oligomer of tetrabromobisphenol A	Neat	1g
REPBDE0507	Polyphosphoric acids ammonium salt	Neat	1g
REPBDE0508	2,4,6-Tribromophenylterminated tetrabromobisphenol	Neat	1g
REPBDE0509	Tetraphenylrecorcinol bis(diphenylphosphate)	50µg/mL in methanol	1ml
REPBDE0510	Tris-(aziridinyl)-phosphineoxide	100µg/mL in methanol	1ml
REPBDE0511	Tris-(aziridinyl)-phosphineoxide	500µg/mL in methanol	1ml
REPBDE0512	Tris(2,3-dibromopropyl)phosphate, tech.	Neat	100mg
REPBDE0513	Tris(2,3-dibromopropyl)phosphate	50µg/mL in methanol	1ml
REPBDE0514	Tris(2,3-dichloropropyl)phosphate	1000µg/mL in methanol	1ml
REPBDE0515	Tris(2-ethylhexyl)phosphate	1000µg/mL in methanol	1ml
REPBDE0516	Tri-n-butylphosphate-d27	100µg/mL in isooctane	1ml
REPBDE0517	Triethylphosphate-d15	100µg/mL in isooctane	1ml
REPBDE0518	Trimethylphosphate-d9	100µg/mL in isooctane	1ml
REPBDE0519	Triphenylphosphate-d15	100µg/mL in isooctane	1ml
REPBDE0520	Tri-n-propylphosphate-d21	100µg/mL in isooctane	1ml