

EuPIA Suitability List of Photoinitiators for Compliant Printing Inks and Varnishes – July 2018

Some photoinitiators have both compliant performance potential and, by virtue of supportive toxicological data, an evaluated status with recognized migration thresholds. They are listed in Part A of Annex 10 of the Swiss Ordinance 817.023.21.

In order to make use of the official photoinitiator evaluations, EuPIA members should preferably only use photoinitiators with a composition and impurity profile equivalent to those for which the toxicity data was generated, submitted and evaluated by the relevant national body.

Other photo-initiators are not fully evaluated and, accordingly, are in the Part B list of the above Annex. Depending on the application and packaging structure compliance of the final package within the accepted migration limits can be achieved.

In all cases these materials should only be considered as suitable for use if Non-Intentionally Added Substances (NIAS) present can be proven to be migrating below the level deemed to be acceptable for that material, based on a suitable risk assessment process.

It must be remembered that final measurement of migration compliance is the responsibility of the printer, in line with recognised converters' good manufacturing practices, and the end user.

Photoinitiators for use in coatings, inks and varnishes for the non-contact side of food packaging can be grouped as follows:

Group 1 – For all packaging types

Group 1A These photoinitiators have both compliant performance potential and are supported by toxicological data. They have recognised migration thresholds and are listed in Annex 10 of the Swiss Ordinance 817.023.21

Description	CAS N°	SML [mg/kg]
Benzoylbenzoate, esters with branched polyols		0.05
1-(4-[(4-Benzoylphenyl)thio]phenyl)-2-methyl-2-[(4-methylphenyl)sulfonyl]-1-propan-1-one	0272460-97-6	0.05
2-Benzyl-2-dimethylamino-4-morpholino butyrophenone	0119313-12-1	0.15
Di-ester of carboxymethoxy benzophenone and polytetramethyleneglycol 250	0515136-48-8	0.6
Di-ester of carboxymethoxy-benzophenone and polyethylene glycol 200	0515136-49-9	0.6
(Dimethylamino)benzoate, esters with branched polyols		0.05
2-Ethylhexyl-4-dimethylamino benzoate	0021245-02-3	2.4
2-Hydroxy-1-(4-(4-(2-hydroxy-2-methylpropionyl)benzyl)phenyl)-2-methyl-2-propanone	0474510-57-1	0.05
(Methylamino)diethane-2,1-diylbis(4-dimethylamino amino benzoate)	n.a.	0.05
2-(4-Methylbenzyl)-2-dimethylamino-1-(4-morpholinophenyl)-1-butanone	0119344-86-4	0.05
Oligo-[2-Hydroxy-2-methyl-1-((4-(1-methylvinyl)phenyl) propanone]	0163702-01-0	0.05
9-Oxo-9H-thioxanthene-carboxylate, esters with branched polyols		0.05
Phenyl bis(2,4,6-trimethylbenzoyl) phosphine oxide	0162881-26-7	3.3
Poly(oxy-1,4-butanediyl), .alpha.-[2-[(9-oxo-9H-thioxanthenyl)oxy]acetyl]-.omega.-[[2-[(9-oxo-9H-thioxanthenyl)oxy]acetyl]oxy]-	0813452-37-8	0.05
Poly(oxy-1,2 ethanediyl)-alpha-(4-(dimethylamino)benzoyl)-omega-((4-(dimethylamino)benzoyl)oxy)-(9Cl)	0071512-90-8	0.05
Poly[oxy(methyl-12-ethandiyl)],alpha-[4-(di-methylamino)benzoyl-omega-butoxy	0223463-45-4	0.05

The following photo-initiators (Group 1B) are considered suitable for food packaging use as they have low migration potential and/or high molecular weights but are currently awaiting official evaluation.

Group 1B These photoinitiators have compliant performance potential and/or have high molecular weight. They should not migrate into the food above 10ppb. NB. It is possible that traces of monomeric photoinitiators from Group 1C may be present in some of these polymeric products.		
Description	CAS N°	Comment/SML
{a-2-(Phenylcarbonyl)benzoylpoly(oxyethylene)-poly[oxy(1-methylethylene)]-poly(oxyethylene)} 2-(phenylcarbonyl)benzoate	1003557-16-1	>1000 Da
{a-4-(Dimethylamino)benzoylpoly(oxyethylene)-poly[oxy(1-methylethylene)]-poly(oxyethylene)} 4-(dimethylamino)benzoate	1003557-17-2	>1000 Da
1,3-Di({a-2-(phenylcarbonyl)benzoylpoly[oxy(1-methylethylene)]oxy)-2,2-bis({a-2-(phenylcarbonyl)benzoylpoly[oxy(1-methylethylene)]oxymethyl)propane	1003567-82-5	>1000 Da
1,3-Di({-4-(dimethylamino)benzoylpoly[oxy(1-methylethylene)]oxy)-2,2-bis({-4-(dimethylamino)benzoylpoly[oxy(1-methylethylene)]oxymethyl)propane	1003567-84-7	>1000 Da
A mixture of:-1,3-di({a-2-(phenylcarbonyl)benzoylpoly[oxy(1-methylethylene)]oxy)-2,2-bis({a-2-(phenylcarbonyl)benzoylpoly[oxy(1-methylethylene)]oxymethyl)propane and{a-2-(phenylcarbonyl)benzoylpoly(oxyethylene)-poly[oxy(1-methylethylene)]-poly(oxyethylene)} 2-(phenylcarbonyl)benzoate	1003567-82-5 1003557-16-1	>1000 Da
1,3-di({a-[1-chloro-9-oxo-9H-thioxanthen-4-yl]oxy}acetyl)poly[oxy(1-methylethylene)]oxy)-2,2-bis({a-[1-methylethylene]]oxymethyl)propane	1003567-83-6	>1000 Da
A mixture of:- 1,3-di({-4-(dimethylamino)benzoylpoly[oxy(1-methylethylene)]oxy)-2,2-bis({-4-(dimethylamino)benzoylpoly[oxy(1-methylethylene)]oxymethyl)propane and{a-4-(dimethylamino)benzoylpoly(oxyethylene)-poly[oxy(1-methylethylene)]-poly(oxyethylene)} 4-dimethyl-amino)benzoate	1003567-84-7 1003557-17-2	>1000 Da
Poly{1-[4-(phenylcarbonyl)-4'-(methyldiphenylsulphide)]ethylene}		>1000 Da
Poly{1-[4-(phenylcarbonyl)phenyl]ethylene}		>1000 Da
Mixed polymer based on Benzophenone		>1000 Da
Polymer based on piperazino compounds of aminoalkylphenone		>1000 Da
1-[4-(2-Hydroxyethoxy)phenyl]-2-hydroxy-2-methyl-1-propanone	0106797-53-9	0.05 mg/kg
Diphenyl-(2,4,6-trimethylbenzoyl) phosphine oxide	0075980-60-8	0.05 mg/kg
Polymeric Benzophenone derivative		0.05 mg/kg
Polymeric Thioxanthone derivative		0.05 mg/kg
Polymeric Aminobenzoate		0.05 mg/kg
Oxy-phenylacetic acid 2-[2-hydroxy-ethoxy]-ethyl ester	0442536-99-4	0.05 mg/kg
Oxy-phenylacetic acid 2-[2-oxo-2-phenyl-acetoxy-ethoxy]-ethyl	0211510-16-6	0.05 mg/kg
Poly(oxy-1,2-ethanediy), α -(1-oxo-2-propenyl)- ω -(4-benzyloxy)phenoxy	0478549-43-8	Cross-linkable, functional initiator

Group 1C These photoinitiators have been evaluated and have a migration limit in accordance with the Swiss Ordinance 817.023.21 Annex 10.

Description	CAS N°	SML [mg/kg]
Ethyl-4-(dimethylamino)benzoate	0010287-53-3	0.05
Methyl-2-benzoylbenzoate	0000606-28-0	0.05

Group 1D These photoinitiators have been evaluated and have a migration limit in accordance either with Regulation (EU) No 10/2011 and/or Swiss Ordinance 817.023.21 Annex 10, but they are not recommended by EuPIA for use in printing of food contact materials where there is no proven migration barrier (e.g. glass or metal).

Description	CAS N°	SML [mg/kg]
Benzophenone	0000119-61-9	0.6*
Benzophenone, 2-methyl-	0000131-58-8	0.6*
Benzophenone, 3-methyl-	0000643-65-2	0.6*
Benzophenone, 4-methyl-	0000134-84-9	0.6*
2-Isopropyl thioxanthone	0005495-84-1	0.05
4-Isopropyl thioxanthone	0083846-86-0	0.05

Group 2 - Only to be used for packaging (such as some metal packaging) where transfer/migration of <10ppb or other required limits can be achieved.

These photoinitiators have not been fully evaluated	
Description	CAS N°
Anthraquinone, 2-ethyl-	0000084-51-5
1H-Azepine-1-propanoic acid, hexahydro-, 2,2-bis[[(1-oxo-2-propenyl)oxy]methyl]butyl ester	0073003-78-8
Benzophenone, 4,4'-bis(diethylamino)-	0000090-93-7
Bis (eta(5)-cyclopentadienyl)-bis(2,6-difluoro-3-[pyrrol-1-yl]-phenyl)titanium	0125051-32-3
2,2-Bis-(2-chlorophenyl)-4,4',5,5'-tetraphenyl -1,2-bimidazolyl	0007189-82-4
Bis(2,6-dimethoxybenzoyl)-2,4,4-trimethylpentylphosphin oxide	0145052-34-2
Bis(4-diphenylsulphonium)phenylsulphide-bis (hexafluorophosphate)	0074227-35-3
Bis(4-dodecylphenyl)iodonium hexafluoroantimonate	0071786-70-4
Bis-(4-Methylphenyl)-iodonium hexafluorophosphate	0060565-88-0
Bis(4-tert-butylphenyl) iodonium hexafluorophosphate	0061358-25-6
4,4'-Bis(methylethylamino)benzophenone	0194655-98-6
Butoxyethyl-4-(dimethylamino) benzoate	0067362-76-9
d,l-Camphorquinone	0010373-78-1
1-Chloro-4-propoxythioxanthone	0142770-42-1
9,10-Dibutoxyanthracene	0076275-14-4
2,2-Diethoxy acetophenone	0006175-45-7
2,4-Diethyl-9H-thioxanthen-9-on	0082799-44-8
2,3-Dihydroxy-6-(2-hydroxy-2-methyl-1-oxopropyl)-1,1,3-trimethyl-3-[4-(2-hydroxy-2-methyl-1-oxopropyl)phenyl]-1H-indene	n.a
2,2-Dimethoxy-2-phenyl acetophenone	0024650-42-8
2-(Dimethylamino)ethylbenzoate	0002208-05-1
1-[4-(1,1-Dimethylethyl)phenyl]-2-hydroxy-2-methylpropan-1-one	0068400-54-4
Diphenyl(4-phenylthiophenyl)sulfonium hexafluoro phosphate	0068156-13-8
Diphenyl[(phenylthio)phenyl]sulfonium hexafluorophosphate	0075482-18-7
Erbium oxide sulfide (Er ₂ O ₂ S)	0012345-97-0
2-Ethylantraquinone	0000084-51-5
Ethylbenzoylformate	0001603-79-8
2-Hydroxy-[4'-(2-Hydroxypropoxy) phenyl]-2-methylpropanone	n.a.
2-Hydroxy-2-methyl propiophenone	0007473-98-5
1-Hydroxycyclohexyl-phenyl-ketone	0000947-19-3
Iodonium, (4-methylphenyl)[4-(2-methylpropyl) phenyl]-hexafluorophosphate-(1-)	0344562-80-7
Methylbenzoylformate	0015206-55-0

* as sum of all these four benzophenone photoinitiators

[4-(1-Methylethyl)phenyl](4-methylphenyl)-iodonium tetrakis(pentafluorophenyl)borate	0178233-72-2
4-(4-Methylphenylthio)-benzophenone	0083846-85-9
Mix. of 1-Propanone, 2-hydroxy-2-methyl-1-[4-(1-methylethenyl)]phenyl- homopolymer with 2-Hydroxy-2-methyl-1-phenylpropan-1-one	0149260-52-6
Mixture of : Phenoxyethylacrylate, Methyl-2-benzoylbenzoate, 2-Benzyl-2-(dimethylamino)-4-morpholino butyrophephenone, Ethyl-4-Dimethylaminobenzoate	0048145-04-6/ 0000606-28-0/ 0119313-12-1/ 0010287-53-3
Mixture of 3-(4-(2-Hydroxy-2-methylpropionyl)phenyl)-1,1,3-trimethylindan-6-yl 2-hydroxyprop-2-yl ketone and 3-(4-(2-Hydroxy-2-methylpropionyl)phenyl)-1,1,3-trimethylindan-5-yl 2-hydroxyprop-2-yl ketone	000402-990-3
Mixture of less 3-(4-(2-Hydroxy-2-methylpropionyl)phenyl)-1,1,3-trimethylindan-6-yl 2-hydroxyprop-2-yl ketone and 3-(4-(2-Hydroxy-2-methylpropionyl)phenyl)-1,1,3-trimethylindan-5-yl 2-hydroxyprop-2-yl ketone	0164578-07-8
Mixture of phenylsulfonium hexafluorophosphates <40%	0617711-03-2
A mixture of: bis[4-diphenylsulfoniumphenyl]sulfide bishexafluoroantimonate; thiophenoxyphenylsulfonium hexafluoroantimonate	0159120-95-3
1-Phenyl-1,2-propanedione-2-(O-ethoxycarbonyl)oxim	0065894-76-0
4-Phenylbenzophenone	0002128-93-0
Phosphine oxide, triphenyl-	0000791-28-6
Poly(oxy-1,2-ethanediyl), a-[2-(4-chlorobenzoyl)benzoyl]-w-[[2-(4-chlorobenzoyl)benzoyl]oxy]-	1007306-69-5
2-Propenoic acid, (1-methyl-1,2-ethanediyl)bis[oxy(methyl-2,1-ethanediyl)] ester, reaction products with diethylamine	0111497-86-0
2-Propenoic acid, 1,6-hexanediyl ester, polymer with 2-aminoethanol	0067906-98-3
2-Propenoic acid, 2-ethyl-2-[[[(1-oxo-2-propenyl)oxy]methyl]-1,3-propanediyl ester, reaction products with diethylamine	0068002-34-6
2-Propenoic acid, polymer with 1,2-ethanediamine, N-ethylethanamine and a,a',a''-1,2,3-propanetriyltris[w-hydroxypoly[oxy(methyl-1,2-ethanediyl)]]	0144177-00-4
2-Propenoic acid, polymer with 2,2-bis(hydroxymethyl)-1,3-propanediol, (chloromethyl)oxirane and 4,4'-(1-methylethylidene)bis[phenol], reaction products with diethylamine	0068002-33-5
2-Propenoic acid, polymer with 2,2-bis(hydroxymethyl)-1,3-propanediol, 2-(chloromethyl)oxirane and 4,4'-(1-methylethylidene)bis[phenol], reaction products with N-ethylethanamine	0068797-56-8
2-Propenoic acid, polymer with 2-aminoethanol, (chloromethyl)oxirane, 2-ethyl-2-(hydroxymethyl)-1,3-propanediol, 4,4'-(1-methylethylidene)bis[phenol] and oxirane	0194944-42-8
2-Propenoic acid, polymer with 2-aminoethanol, 1,2-ethanediol and 2-ethyl-2-(hydroxymethyl)-1,3-propanediol	0156376-93-1
2-Propenoic acid, polymer with 2-ethyl-2-(hydroxymethyl)-1,3-propanediol and methyloxirane, reaction products with N-ethylethanamine	0103694-73-1
Reaction product from ethoxylated dipentaerythritol with 10-Biphenyl-4-yl-2-Isopropyl-9-Oxo-9H-Thioanthen-10-ium Hexafluorophosphate	n.a.
Thiobis(4,1-phenylene)- S,S,S',S'-tetraphenyldisulfonium bishexafluoroantimonate	0089452-37-9
Thiophenoxyphenylsulfonium hexafluoro phosphate	0068156-13-8
4-Thiophenyl diphenyl sulfonium hexafluoroantimonate	0071449-78-0
Thioxanthen-9-one, 2-chloro-	0000086-39-5
9H-Thioxanthen-2-carboxylic acid, 9-oxo-, ethyl ester	0083817-60-1
9H-Thioxanthenium, 10-[1,1'biphenyl]-4-yl-2-(1-methylethyl)-9-oxo, hexafluorophosphate	0591773-92-1
2,4,6-Trimethylbenzophenone and others	0000954-16-5
2,4,6-Trimethylbenzoylphenylphosphinicacidethylester	0084434-11-7
Triphenyl sulfonium hexafluorophosphate (mono+di)salts	0086481-78-9
Triphenylsulfonium hexafluorophosphate	0104558-95-4