



Restricted Chemicals for Wearables

An important goal at Apple is to make sure that anyone who assembles, uses, or recycles an Apple product can do so safely. We've led the industry in removing many harmful substances from our product designs, and we go to great lengths to continue doing so with every new product. We're constantly designing our products to be better for the environment, better for the people who use them, and better for the people who make them.

We pay special attention to the materials that will be in prolonged skin contact and apply rigorous controls for them. We require our suppliers of those materials to adhere to specifications that restrict the use of certain chemicals. We derive these restrictions from leading standards, recommendations from toxicologists and dermatologists, international laws and directives, and Apple policies. This document lists chemicals Apple tested for in materials in prolonged skin contact.

As part of our testing and evaluation process, both Apple and independent laboratories test materials for the concentration of restricted chemicals. Toxicologists review the test results to evaluate safety. Finally, we take the added step of using independent toxicologists to review the chemical formulation of each material that may come in prolonged contact with the skin.

Only materials that pass these reviews are acceptable for use in Apple products. By setting conservative restrictions, testing for chemicals of concern, and conducting toxicology evaluations, Apple helps to ensure the safety of our customers.

Restricted Chemicals

The following table lists chemicals that are subject to Apple restrictions and testing. The restrictions apply to materials used in wearable devices that will be in prolonged skin contact, including natural and synthetic fibers and polymers, coatings, ink, leather, plastics, adhesives, metals, and ceramics.

Acrylates	CASNumber
Acrylic acid	79-10-7
Methyl acrylate	96-33-3
Ethyl acrylate	140-88-5
Butyl acrylate	141-32-2
tert-Butyl acrylate	1663-39-4
2-Ethylhexyl acrylate	103-11-7
Isobornyl acrylate	5888-33-5
Alkylphenol Ethoxylates and Alkylphenols (APEO/AP)	CASNumber
n-Nonylphenol	2554-52-3
tert-Octylphenol	2793-28-8
Polyethylene glycol nonylphenyl	9016-45-9
Polyethylene glycol octylphenol ether	9002-93-1
Azo Dyes, Arylamines, Anilines	CASNumber
4-Aminoazobenzene	60-09-3
o-Aminoazotoluene	97-56-3
4-Aminodiphenyl	92-67-1
2-Amino-4-nitrotoluene	99-55-8
2-Anisidine	90-04-0
Benzidine	92-87-5
4-Chloroaniline	106-47-8
4-Chloro-2-toluidine	95-69-2
6-Methoxy-m-toluidine (p-Cresidine)	120-71-8
2,4-Diaminoanisole	615-05-4
4,4'-Diaminodiphenylmethane	101-77-9
2,4-Diaminotoluene	95-80-7
3,3'-Dichlorobenzidine	91-94-1
3,3'-Dimethoxybenzidine	119-90-4
3,3'-Dimethylbenzidine	119-93-7
3,3'-Dimethyl-4,4'-diaminodiphenylmethane	838-88-0
4,4'-Methylene-bis-(2-chloroaniline)	101-14-4
2-Naphthylamine	91-59-8
4,4'-Oxydianiline	101-80-4
4,4'-Thiodianiline	139-65-1
2-Toluidine	95-53-4
2,4,5-Trimethylaniline	137-17-7
2,4-Xylidine	95-68-1
2,6-Xylidine	87-62-7
Chlorinated Aromatic Hydrocarbons	CASNumber
Monochlorobenzene	108-90-7
Dichlorobenzenes, including isomers	Several
1,2-Dichlorobenzene	95-50-1
1,3-Dichlorobenzene	541-73-1
1,4-Dichlorobenzene	106-46-7
Trichlorobenzenes, including isomers	Several
1,2,3-Trichlorobenzene	87-61-6

Chlorinated Aromatic Hydrocarbons continued	CAS Number
1,2,4-Trichlorobenzene	120-82-1
1,3,5-Trichlorobenzene	108-70-3
Tetrachlorobenzenes, including isomers	Several
1,2,3,4-Tetrachlorobenzene	634-66-2
1,2,3,5-Tetrachlorobenzene	634-90-2
1,2,4,5-Tetrachlorobenzene	95-94-3
Pentachlorobenzene	608-93-5
Hexachlorobenzene	118-74-1
Monochlorotoluenes, including isomers	Several
2-Chlorotoluene	95-49-8
3-Chlorotoluene	108-41-8
4-Chlorotoluene	106-43-4
Dichlorotoluenes, including isomers	Several
2,4-Dichlorotoluene	95-73-8
2,6-Dichlorotoluene	118-69-4
3,4-Dichlorotoluene	95-75-0
Trichlorotoluenes, including isomers	Several
2,3,6-Trichlorotoluene	2077-46-5
a,a,a-Trichlorotoluene	98-07-7
Tetrachlorotoluenes, including isomers	Several
a,a,a,2-Tetrachlorotoluene	2136-89-2
a,a,a,4-Tetrachlorotoluene	5216-25-1
Pentachlorotoluene	877-11-2
Chlorinated Paraffins	CAS Number
Chlorinated Paraffins, C ₁₀ -C ₁₃	85535-84-8
Chlorinated Paraffins, C ₁₄ -C ₁₇	85535-85-9
Chlorinated Paraffins, C ₁₈ -C ₂₈	85535-86-0
Chlorinated Phenols	CAS Number
Trichlorophenol, including isomers	25167-82-2
Tetrachlorophenol, including isomers	25167-83-3
Pentachlorophenol	87-86-5
Colorants	CAS Number
Acid Red 26	3761-53-3
Basic Red 9	569-61-9
Basic Violet 14	632-99-5
Direct Black 38	1937-37-7
Direct Blue 6	2602-46-2
Direct Red 28	573-58-0
Direct Yellow 1	6472-91-9
Disperse Blue 1	2475-45-8
Disperse Orange 11	82-28-0
Disperse Yellow 3	2832-40-8
Pigment Yellow 34	1344-37-2
Pigment Red 104	12656-85-8
Disperse Blue 3	2475-46-9
Disperse Blue 7	3179-90-6
Disperse Blue 26	3860-63-7
Disperse Blue 35	12222-75-2
Disperse Blue 102	12222-97-8
Disperse Blue 106	12223-01-7
Disperse Blue 124	61951-51-7

Colorants continued	CAS Number
Disperse Brown 1	23355-64-8
Disperse Orange 1	2581-69-3
Disperse Orange 3	730-40-5
Disperse Orange 37/59/76	12223-33-5
Disperse Red 1	2872-52-8
Disperse Red 11	2872-48-2
Disperse Red 17	3179-89-3
Disperse Yellow 1	119-15-3
Disperse Yellow 9	6373-73-5
Disperse Yellow 39	12236-29-2
Disperse Yellow 49	54824-37-2
Pigment Black 25	68186-89-0
Pigment Yellow 157	68610-24-2
Solvent Yellow 14	842-07-9
Disperse Yellow 23	6250-23-3
Disperse Orange 149	8586-74-9
Navy Blue	18685-33-9
Acid Violet 49	1694-09-3
Basic Blue 26	2580-56-5
Malachit Green	10309-95-2
Basic Violet 1	8004-87-3
Basic Violet 3	548-62-9, 603-48-5, 14426-25-6
Solvent Blue 4	6786-83-0
Flame Retardants	CAS Number
Tris(2,3-dibromopropyl)phosphate (TRIS)	126-72-7
Triethylenephosphoramidate (TEPA)	545-55-1
Tetrabromodiphenyl ether (TetraBDE)	40088-47-9
Pentabromodiphenyl ether (PentaBDE)	32534-81-9
Hexabromodiphenyl ether (HexaBDE)	36483-60-0
Heptabromodiphenyl ether (HeptaBDE)	68928-80-3
Octabromodiphenyl ether (OctaBDE)	32536-52-0
Decabromodiphenyl ether (DecaBDE)	1163-19-5
Bis(2,3-dibromopropyl) phosphate	5412-25-9
Hexabromocyclododecanes (HBCDDs)	25637-99-4
Tetrabromobisphenol A	79-94-7
Tris(chloroethyl)phosphate	115-96-8
Halogenated Biphenyls, Terphenyls, and Naphthalenes	CAS Number
Polybrominated biphenyls (PBBs)	59536-65-1
Polychlorinated biphenyls (PCBs)	1336-36-3
Polychlorinated terphenyls (PCTs)	61788-33-8
Polybrominated terphenyls (PBTs)	Several
Polychlorinated naphthalenes (PCNs)	Several
Polybrominated naphthalenes (PBNs)	Several
Halogenated Diarylalkanes	CAS Number
Monomethyl-dibromo-diphenyl methane	99688-47-8
Monomethyl-dichloro-diphenyl methane	81161-70-8
Monomethyl-tetrachloro-diphenyl methane	76253-60-6
Halogens	CAS Number
Bromine, total	7726-95-6
Chlorine, total	7782-50-5

Isocyanates	CAS Number
Diphenylmethane-4,4-di-isocyanate (MDI)	101-68-8
Diphenylmethane-2,2-di-isocyanate (2,2-MDI)	2536-05-2
Diphenylmethane-2,4-di-isocyanate (2,4-MDI)	5873-54-1
MDI mixed isomers	26447-40-5
Technical grade MDI	9016-87-9
Hexamethylene diisocyanate (HMDI)	822-06-0
Isophorone diisocyanate (IPDI)	4098-71-9
Tetramethylxylene diisocyanate (TMXDI)	2778-42-9
Toluene-2,4-diisocyanate (2,4-TDI)	584-84-9
Toluene-2,6-diisocyanate (2,6-TDI)	91-08-7
2,4-/2,6-TDI mixture	26471-62-5
2,6-Diisopropylphenyl-isocyanate	28178-42-9
4,4-Methylenedicyclohexyl-di-isocyanate (4,4-MDI)	524-30-1
Napthylene-1,5-di-isocyanate (1,5-NDI)	3173-72-6
Phenylisocyanate	103-71-9
Metals	CAS Number
Antimony	7440-36-0
Arsenic	7440-38-2
Barium (soluble)	7440-39-3
Beryllium	7440-41-7
Cadmium	7440-43-9
Chromium VI (Cr6+)	18540-29-9
Chromium, extractable	7440-47-3
Cobalt	7440-48-4
Copper	7440-50-8
Lead	7439-92-1
Mercury	7439-97-6
Nickel	7440-02-0
Methacrylates	CAS Number
Methacrylic acid	79-41-4
Methyl methacrylate	80-62-6
Ethyl methacrylate	97-63-2
Butyl methacrylate	97-88-1
N-Nitrosamine	CAS Number
N-Nitrosodibutylamine	924-16-3
N-Nitrosodiethanolamine	116-54-7
N-Nitrosodiethylamine	55-18-5
N-Nitrosodiisopropylamine	601-77-4
N-Nitrosodimethylamine	62-75-9
N-Nitrosodipropylamine	621-64-7
N-Nitrosoethylphenylamine	612-64-6
N-Nitrosomethylethylamine	10595-95-6
N-Nitrosomethylphenylamine	614-00-6
N-Nitrosomorpholine	59-89-2
N-Nitrosopiperidine	100-75-4
N-Nitrosopyrrolidine	930-55-2

Organotin Compounds	CAS Number
Monobutyltin (MBT)	Several
Monooctyltin (MOT)	
Dibutyltin (DBT)	
Diocetyl tin (DOT)	
Tributyltin (TBT)	
Triphenyltin (TPhT)	
Tetrabutyltin (TeBT)	
Tetraoctyltin (TeOT)	
Tricyclohexyltin (TCyT)	
Perfluorinated Compounds	CAS Number
Perfluorooctanoic acid (PFOA)	335-67-1
Perfluorooctane sulfonates (PFOS)	1763-23-1
Pesticides	CAS Number
Aldrine	309-00-2
Azinphos methyl	86-50-0
Azinphos ethyl	2642-71-9
Bromophos-ethyl	4824-78-6
Captafol	2425-06-1
Carbaryl	63-25-2
Chlordane	54-74-9
Chlordecone	143-50-0
Chlordimeform	6164-98-3
Chlorfenvinphos	470-90-6
Coumaphos	56-72-4
Cyfluthrin	68359-37-5
Cyhalothrin—lambda	91465-08-6
Cypermethrin	5235-07-8
Deltamethrin	52918-63-5
Demeton	919-86-8
Diazinon	333-41-5
o,p'-Dichlorodiphenyldichloroethane (o,p'-DDD)	53-19-0
p,p'-Dichlorodiphenyldichloroethane (p,p'-DDD)	72-54-8
o,p'-Dichlorodiphenyldichloroethylene (o,p'- DDE)	3424-82-6
p,p'-Dichlorodiphenyldichloroethylene (p,p'- DDE)	72-55-9
o,p'-Dichlorodiphenyltrichloroethane (o,p'-DDT), including isomers	789-02-6
p,p'-Dichlorodiphenyltrichloroethane (p,p'-DDT), including isomers	50-29-3
2,4-Dichlorophenoxyacetic acid, its salts and compounds	94-75-7
Dichlorprop	120-36-5
Dicrotophos	141-66-2
Dieldrine	60-57-1
Dimethoate	60-51-5
Dinoseb and salts	88-85-7
Endosulfan, alpha	959-98-8
Endosulfan, beta	3328-65-9
Endrine	72-20-8
Esfenvalerate	66230-04-4
Fenvalerate	51630-58-1
Heptachlor	76-44-8
Heptachloroepoxide	1024-57-3
Hexachlorobenzene	118-74-1

Pesticides continued	CAS Number
Hexachlorocyclohexane (HCH), including isomers	608-73-1
Isodrin	465-73-6
Kelevane	4234-79-1
Lindane	58-89-9
Malathion	121-75-5
MCPA	94-74-6
MCPB	94-81-5
Mecoprop	93-65-2
Methamidophos	10265-92-6
Methoxychlor	72-43-5
Methyl parathion	298-00-0
Mevinophos	7786-34-7
Mirex	2385-85-5
Monocrotophos	6923-22-4
Ethyl parathion	56-38-2
Perthane	72-56-0
Profenophos	4198-08-7
Propetamphos	3028-83-4
Quinalphos	13593-03-8
Quintozene (pentachlorobenzene)	82-68-8
Strobane	8001-50-1
Telodrin	297-78-9
Toxaphene	8001-35-2
Tribufos (DEF)	78-48-8
2,4,5-Trichlorophenoxyacetic acid, salts and compounds	93-76-5
2-(2,4,5-Trichlorophenoxy)propionic acid, salts and compounds	93-72-1
Trifluralin	1582-09-8
Plasticizers	CAS Number
Butylbenzyl phthalate (BBP)	85-68-7
Dibutyl phthalate (DBP)	84-74-2
Diethyl phthalate (DEP)	84-66-2
Diethylhexyl phthalate (DEHP)	17-81-7
Diisobutyl phthalate (DIBP)	84-69-5
Di-isodecyl phthalate (DIDP)	6855-49-1 / 26761-40-0
Diisononyl phthalate (DINP)	28553-12-0 / 6855-48-0
Dimethyl phthalate (DMP)	131-11-3
Di-n-Octyl phthalate (DNOP)	17-84-0
1,2-Benzenedicarboxylic acid, di-C6-8-branched alkyl esters, C7-rich (DIHP)	71888-89-6
1,2-Benzenedicarboxylic acid, di-C7-11-branched and linear alkyl esters (DHNUP)	6855-42-4
Di-n-hexyl phthalate (DnHP)	84-75-3
Bis-(2-methoxyethyl) phthalate (DMEP)	17-82-8
Di-iso-pentyl phthalate (DIPP)	605-50-5
Di-n-pentyl phthalate (DnPP)	131-18-0
n-Pentyl-isopentyl phthalate (nPIPP)	776297-69-9
1,2-Benzenedicarboxylic acid, dipentylester, branched and linear (DPP)	84777-06-0

Polycyclic Aromatic Hydrocarbons (PAHs)	CAS Number
Acenaphthylene	208-96-8
Acenaphthene	83-32-9
Anthracene	120-12-7
Benzo(a)anthracene	56-55-3
Chrysene	218-01-9
Benzo[a]pyrene	50-32-8
Benzo[b]fluoranthene	205-99-2
Benzo[e]pyrene	192-97-2
Benzo[g,h,i]perylene	191-24-2
Benzo[j]fluoranthene	205-82-3
Benzo[k]fluoranthene	207-08-9
Fluoranthene	206-44-0
Dibenzo[a,h]anthracene	53-70-3
Fluorene	86-73-7
Indeno[1,2,3-cd]pyrene	193-39-5
Naphthalene	91-20-3
Phenanthrene	85-01-8
Pyrene	129-00-0
Solvents	CAS Number
N,N-Dimethylformamide (DMF)	68-12-2
N-Methylpyrrolidone (NMP)	872-50-4
Toluene	108-88-3
2-Ethoxyethyl acetate	11-15-9
2-Ethoxyethanol	110-80-5
2-Methoxyethanol	109-86-4
Trichloroethylene	79-01-6
Miscellaneous	CAS Number
2-phenyl-2-propanol	617-94-7
Acrylamide	79-06-1
Bisphenol A	80-05-7
Dimethylfumarate (DMFu)	624-49-7
Diphenylamine	122-39-4
Diphenylthiourea	102-08-9
Ethylenediamine	107-15-3
Formaldehyde	50-00-0
Hexamethylenetetramine	100-97-0
Latex, natural rubber	Latex Proteins
2-Naphthylphenylamine	135-88-6
Mercaptobenzothiazole	149-30-4
p-Phenylenediamine	106-50-3
o-Phenylphenol	90-43-7
Polyvinylchloride (PVC)	9002-86-2
Selenium	7782-49-2
Thiourea	62-56-6

References

Apple Regulated Substances Specification, Apple Inc.

ASTM D6499: Standard Test Method for the Immunological Measurement of Antigenic Protein in Natural Rubber and Its Products.

bluesign® system substances list (BSSL): Consumer Safety Limits. bluesign technologies ag. www.bluesign.com.

California Prop 65: The Safe Drinking Water and Toxic Enforcement Act of 1986, California Health and Safety Code, Division 20, Chapter 6.5, sections 25249.5 through 25249.8. Websites: http://oehha.ca.gov/prop65/prop65_list/Newlist.html; www.oehha.org/prop65/getNSRLs.html.

CAS Number: Chemical Abstract Service registry numbers that identify unique substances.

CLP Regulation (Classification, Labelling and Packaging) Regulation (EC) No 1272: Complements REACH Directive and replaces the Dangerous Substances Directive (67/548/EEC) and the Dangerous Preparations Directive (1999/45/EC).

DIN CEN/TS 15968: Determination of extractable perfluorooctanesulfonate (PFOS) in coated and impregnated solid articles, liquids, and firefighting foams—Method for sampling, extraction, and analysis by LC-qMS or LC-tandem/MS.

DIN EN ISO 18254: Textiles—Method for the detection and determination of alkylphenolethoxylates (APEO).

DIN 54232: Textiles—Determination of the content of bonds based on chlorobenzene and chlorotoluene or Solvent Extraction // GC-MS.

DIN 54321: Testing of textiles—Determination of felting shrinkage for assessing the felting behavior of single and plied yarns made from wool or containing wool by a washing test. Used to identify colorants.

EHCA website for list of SVHC: <http://echa.europa.eu/candidate-list-table>.

EN 71-3: Safety of toys—Migration of certain elements.

EN 1122: Plastics—Determination of cadmium—Wet decomposition method.

prEN 16711-2: Textiles—Determination of metal content—Part 2: Determination of metals extracted by acidic artificial perspiration solution. (Use draft standard until finalized.)

EN 1811+AC:2012: Reference test method for release of nickel from all post assemblies which are articles intended to come into direct and prolonged contact with the skin. Replaces BS EN 1811:1998+A1:2008.

EN 12472: Method for the simulation of wear and corrosion for the detection of nickel release from coated items.

EN 12868: Methods for determining the release of N-nitrosamines and N-nitrosatable substances from elastomer rubber, 1999.

EN 13130-8: Determination of isocyanates in plastics, 2004.

EN 14362-1: Textiles—Methods for determination of certain aromatic amines derived from azo colorants—Part 1: Detection of the use of certain azo colorants accessible with and without extracting the fibres.

EN 14362-3: Textiles—Methods for determination of certain aromatic amines derived from azo colorants. Detection of the use of certain azo colorants, which may release 4-aminoazobenzene.

EN 14582: Characterization of waste. Halogen and sulfur content. Oxygen combustion in closed systems and determination methods. British Standards Institute, 2007

EN ISO 17075: Leather—Chemical tests—Determination of Chromium(VI) content (ISO17075).

EPA 8081B: Organochlorine Pesticides by Gas Chromatography.

EPA 8151A: Chlorinated Herbicides Analysis by GC Using Methylation or Pentafluorobenzoylation Derivatization.

Commission Regulation (EU) No 757/2010 of 24 August 2010: Amending Regulation (EC) No 850/2004 of the European Parliament and of the Council on persistent organic pollutants (perfluorooctane sulfonates).

IEC 62321: Determination levels of six regulated substances (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, polybrominated diphenyl ethers).

ISO 3613: Metallic and other inorganic coatings—Chromate conversion coatings on zinc, cadmium, aluminum-zinc alloys, and zinc-aluminum alloys—Test methods.

ISO 13365: Leather—Chemical tests—Determination of the preservative (TCMTB, PCMC, OPP,OIT) content in leather by liquid chromatography.

ISO 14184-1: Textiles—Determination of formaldehyde content—Part 1: Free and hydrolyzed formaldehyde (water extraction method).

ISO 14362-1: Textiles—Methods for determination of certain aromatic amines derived from azo colorants—Part 1: Detection of the use of certain azo colorants accessible with and without extracting the fibres.

ISO 14389: Textiles—Determination of the phthalate content—Tetrahydrofuran method.

ISO/TS 16179: Footwear—Critical substances potentially present in footwear and footwear components—Determination of organotin compounds in footwear materials.

ISO/TS 16186: Footwear—Critical substances potentially present in footwear and footwear components—Test method to quantitatively determine dimethyl fumarate (DMFu) in footwear materials.

ISO 17070: Leather—Chemical tests—Determination of pentachlorophenol content.

ISO 17072-1: Leather—Chemical determination of metal content—Part 1: Extractable metals.

ISO 17226-1: Leather—Chemical determination of formaldehyde content—Part 1: Method using high-performance liquid chromatography.

ISO 17234-1: Leather—Chemical tests for the determination of certain azo colorants in dyed leathers—Part 1: Determination of certain aromatic amines derived from azo colorants.

ISO 17234-2: Leather—Chemical tests for the determination of certain azo colorants in dyed leathers—Part 2: Determination of 4-aminoazobenzene.

ISO 17353: Water quality—Determination of selected organotin compounds—Gas chromatographic method.

ISO 18218-1: Leather—Determination of ethoxylated alkylphenols—direct method.

ISO 18218-2: Leather—Determination of ethoxylated alkylphenols—indirect method.

ISO 18219: Leather—Determination of chlorinated hydrocarbons in leather—Chromatographic method for short-chain chlorinated paraffins (SCCP).

REACH: Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH).

REACH Annex XVII: Annex XVII of Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH).

§ 64 LFGB—82.02-8: Textiles—Detection of chlorinated phenols.

ZEK 014-08: Testing and Validation of Polycyclic Aromatic Hydrocarbons (PAH) in the course of GS-Mark Certification.

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