

# MANUFACTURING RESTRICTED SUBSTANCES LIST VERSION 1.1

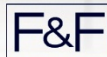
**Ø ZDHC**  
ZERO DISCHARGE  
OF HAZARDOUS  
CHEMICALS PROGRAMME

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# Manufacturing Restricted Substances List Version 1.1

## Zero Discharge of Hazardous Chemicals Programme

### 1 Background

In the Zero Discharge of Hazardous Chemicals (ZDHC) Joint Roadmap, Version 2, ZDHC brands committed to define and develop a Manufacturing Restricted Substances List (MRSL) for the apparel and footwear industry. In doing so, brands recognised the value of addressing hazardous substances potentially used and discharged into the environment during manufacturing and related processes deep within our supply chain – not just those substances that could be present in finished products. In June 2014, the ZDHC brands achieved a significant milestone and published the first version of the ZDHC MRSL.

### 2 Purpose

The intent of the ZDHC MRSL is to provide brands and suppliers with a harmonised approach to managing chemicals during the processing of raw materials within the apparel and footwear supply chain. The ZDHC MRSL achieves this by providing a clear list of priority chemicals and specifying the maximum concentration limit of each substance within commercial chemical formulations.

The ZDHC MRSL is divided into sections that focus on a specific raw material. This accounts for the differences between the creation and processing of the material types used within our industry and the need to set applicable limits to reflect the functional use of these chemicals. The MRSL should be communicated to raw material suppliers, including sub-contractors and factories assembling or manufacturing garments and footwear. To support our goal of using MRSL compliant chemical formulations, ZDHC brands also expect that material suppliers and factories will communicate with their chemical suppliers to ensure that listed substances are not present in chemical formulations above established limits.

Note: The ZDHC MRSL does not replace applicable national environmental or workplace safety restrictions. Worker exposure to chemical substances listed in this document, along with other hazardous substances, must not exceed occupational exposure limits. Chemical formulations also must comply with all applicable legal restrictions, including any subsequent restrictions that establish more strict limits. The ZDHC MRSL does not replace legal or brand-specific restrictions on hazardous substances in finished products.

### 3 Definitions

#### MRSL

The ZDHC MRSL is a list of chemical substances subject to a usage ban (see Usage Ban, page 2). The MRSL applies to chemicals used in facilities that process materials and trim parts for use in apparel and footwear. Chemicals in the ZDHC MRSL include solvents, cleaners, adhesives, paints, inks, detergents, dyes, colourants, auxiliaries, coatings and finishing agents used during raw material production, wet-processing, maintenance, wastewater treatment, sanitation and pest control. There should be no intentional use of MRSL-listed substances in facilities that process materials used in the production of apparel and footwear. MRSL limits apply to substances in commercially available chemical formulations and not those from earlier stages of chemical synthesis.

Note: Threshold Limit values on restricted substances in chemical formulations are in some cases substantially higher than limits on restricted substances in finished products. This is because restricted substances in finished products are almost always found in smaller concentrations than in the chemical formulations used to produce them. Chemical formulations are highly concentrated before being diluted upon application to textiles and other materials.

## Chemical Substance

A chemical substance is a chemical element and its compounds in the natural state or obtained by any manufacturing process (REACH, 2014).<sup>1</sup> A chemical substance is usually identifiable by a single, unique Chemical Abstracts Service (CAS) number or Colour Index (CI) number. The ZDHC MRSL will primarily focus on chemical substances listed by CAS number and CI number, but also will include groups of substances for which listing individual substances is not practical.

## Commercial Chemical Formulation

A commercial chemical formulation is usually a proprietary blend of several chemical substances that is available for purchase from chemical suppliers under their own trade name.

## Usage Ban

A usage ban indicates that the ZDHC MRSL-listed chemical substance or group of substances may not be used to achieve a desired function or effect during production of the raw material or product (that is, no intentional use). This usage ban extends to other uses within a facility like cleaning and maintenance. Due to the existence of manufacturing impurities in chemical formulations, a minor or trace amount of the restricted substance is permitted. Chemical formulations containing restricted substances that exceed limits are not compliant with the ZDHC MRSL.

## 4 MRSL Creation Process

The ZDHC MRSL includes relevant substances from the original 11 priority chemical groups in the Joint Roadmap<sup>2</sup> along with additional substances discussed with qualified experts from the ZDHC Technical Advisory Committee (TAC) and signatory brands. Several of the listed substances are regulated in finished products and have been successfully restricted by ZDHC brands for years. Though already restricted by ZDHC brands, their inclusion on the list keep it consistent with existing industry standards. Where possible, the content of the ZDHC MRSL was peer-reviewed by independent third-party technical experts and industry associations related to the production of our key raw materials. Collaboration with leading technical experts allows the ZDHC Programme to develop a MRSL that pragmatically represents progress and supports our long-term goal of zero discharge.

## 5 MRSL Instructions

### MRSL Chapters

- **Chapter 1: MRSL for Textiles and Synthetic Leather Processing**

This section applies to chemical formulations and substances used during the creation and wet processing of textile fibres and during the creation and processing of synthetic leather.

- **Chapter 2: MRSL for Natural leather Processing**

This section applies to chemical formulations and substances used throughout the production of natural leather, from raw-hide to finished leather.

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<sup>1</sup> "A chemical element and its compounds in the natural state or obtained by any manufacturing process, including any additive necessary to preserve its stability and any impurity deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition."  
[http://www.reachonline.eu/REACH/EN/REACH\\_EN/article3.html](http://www.reachonline.eu/REACH/EN/REACH_EN/article3.html). Accessed May 8, 2014.

<sup>2</sup> These are alkylphenol ethoxylates/alkylphenols (APEOs/APEs), brominated and chlorinated flame retardants, chlorinated solvents, chlorobenzenes, chlorophenols, heavy metals, organotin compounds (e.g., TBT), perfluorinated and polyfluorinated chemicals (PFCs), phthalates (ortho-phthalates), short-chain chlorinated paraffins (SCCPs) and azo dyes that may release carcinogenic amines as defined in Annex XVII of REACH.

## MRSL Groups

- **Group A: Raw Material and Finished Product Supplier Guidance**

Group A substances are banned from intentional use in facilities that process raw materials and manufacture finished products. Please refer to the AFIRM guidance document for the lowest agreed upon material or finished product limits among AFIRM brands: <http://www.afirm-group.com/rsl-guidance/>. See brand RSLs for individual requirements.

- **Group B: Chemical Supplier Formulation Limit**

Group B substances are restricted to concentration limits in chemical formulations commercially available from chemical suppliers. These limits ban intentional use while allowing for reasonable expected manufacturing impurities that should be consistently achievable by responsible chemical manufacturers.<sup>3</sup>

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<sup>3</sup> Safety Data Sheets (SDS) only list substances present at concentrations of 1000 ppm or greater. Suppliers must communicate with chemical suppliers to ensure MRSL limits are met.

# CHAPTER 1: MRSL for Textiles and Synthetic Leather Processing

CAS No.	Substance	Group A: Raw Material and Finished Product Supplier Guidance	Group B: Chemical Supplier Commercial Formulation Limit	Potential Uses in Apparel and Footwear Textile Processing	General Techniques for Analysing Chemicals
<b>Alkylphenol (AP) and Alkylphenol Ethoxylates (APEOs): including all isomers</b>					
104-40-5 11066-49-2 25154-52-3 84852-15-3	Nonylphenol (NP), mixed isomers	No intentional use	250 ppm	APEOs can be used as or found in: detergents, scouring agents, spinning oils, wetting agents, softeners, emulsifier/dispersing agents for dyes and prints, impregnating agents, degumming for silk production, dyes and pigment preparations, polyester padding and down/feather fillings.	Liquid chromatography-mass spectrometry (LC-MS), gas chromatography-mass spectrometry (GC-MS)
140-66-9 1806-26-4 27193-28-8	Octylphenol (OP), mixed isomers		250 ppm		
9002-93-1 9036-19-5 68987-90-6	Octylphenol ethoxylates (OPEO)		500 ppm		
9016-45-9 26027-38-3 37205-87-1 68412-54-4 127087-87-0	Nonylphenol ethoxylates (NPEO)		500 ppm		
<b>Chlorobenzenes and Chlorotoluenes</b>					
95-50-1	1,2-dichlorobenzene	No intentional use	1000 ppm	Chlorobenzenes and chlorotoluenes (chlorinated aromatic hydrocarbons) can be used as carriers in the dyeing process of polyester or wool/polyester fibres. They can also be used as solvents.	GC-MS
Other isomers of mono-, di-, tri-, tetra-, penta- and hexa-chlorobenzene and mono-, di-, tri-, tetra- and penta- chlorotoluene			Sum = 200 ppm		

CAS No.	Substance	Group A: Raw Material and Finished Product Supplier Guidance	Group B: Chemical Supplier Commercial Formulation Limit	Potential Uses in Apparel and Footwear Textile Processing	General Techniques for Analysing Chemicals
<b>Chlorophenols</b>					
25167-83-3	Tetrachlorophenol (TeCP)	No intentional use	Sum = 20 ppm	Chlorophenols are polychlorinated compounds used as preservatives or pesticides.  Pentachlorophenol (PCP) and tetrachlorophenol (TeCP) have been used in the past to prevent mould when storing/ transporting, raw hides and leather. They are now regulated and should not be used.	GC-MS  EN ISO 17070
87-86-5	Pentachlorophenol (PCP)				
4901-51-3	2,3,4,5-tetrachlorophenol				
58-90-2	2,3,4,6-tetrachlorophenol				
935-95-5	2,3,5,6-tetrachlorophenol				
95-57-8	2-chlorophenol				
120-83-2	2,4-dichlorophenol				
583-78-8	2,5-dichlorophenol				
87-65-0	2,6-dichlorophenol				
95-95-4	2,4,5-trichlorophenol				
88-06-2	2,4,6-trichlorophenol				
591-35-5	3,5-dichlorophenol				
576-24-9	2,3-dichlorophenol				
95-77-2	3,4-dichlorophenol				
108-43-0	3-chlorophenol				
106-48-9	4-chlorophenol				
15950-66-0	2,3,4-trichlorophenol				
933-78-8	2,3,5-trichlorophenol				
609-19-8	3,4,5-trichlorophenol	Sum = 50 ppm			

CAS No.	Substance	Group A: Raw Material and Finished Product Supplier Guidance	Group B: Chemical Supplier Commercial Formulation Limit	Potential Uses in Apparel and Footwear Textile Processing	General Techniques for Analysing Chemicals
<b>Dyes – Azo (Forming Restricted Amines)</b>					
101-14-4	4,4'-methylene-bis-(2-chloro-aniline)	No intentional use	150 ppm	Azo dyes and pigments are colourants that incorporate one or several azo groups (-N=N-) bound with aromatic compounds. Thousands of azo dyes exist, but only those that degrade to form the listed cleavable amines are restricted. Azo dyes that release these amines are regulated and should no longer be used for dyeing of textiles.	LC, GC
101-77-9	4,4'-methylenedianiline		150 ppm		
101-80-4	4,4'-oxydianiline		150 ppm		
106-47-8	4-chloroaniline		150 ppm		
119-90-4	3,3'-dimethoxybenzidine		150 ppm		
119-93-7	3,3'-dimethylbenzidine		150 ppm		
120-71-8	6-methoxy-m-toluidine		150 ppm		
137-17-7	2,4,5-trimethylaniline		150 ppm		
139-65-1	4,4'-thiodianiline		150 ppm		
60-09-3	4-aminoazobenzene		150 ppm		
615-05-4	4-methoxy-m-phenylenediamine		150 ppm		
838-88-0	4,4'-methylenedi-o-toluidine		150 ppm		
87-62-7	2,6-xylydine		150 ppm		
90-04-0	o-anisidine		150 ppm		
91-59-8	2-naphthylamine		150 ppm		
91-94-1	3,3'-dichlorobenzidine		150 ppm		
92-67-1	4-aminodiphenyl		150 ppm		
92-87-5	Benzidine		150 ppm		
95-53-4	o-toluidine		150 ppm		
95-68-1	2,4-xylydine		150 ppm		
95-69-2	4-chloro-o-toluidine	150 ppm			
95-80-7	4-methyl-m-phenylenediamine	150 ppm			
97-56-3	o-aminoazotoluene	150 ppm			
99-55-8	5-nitro-o-toluidine	150 ppm			
<b>Dyes – Navy Blue Colourant</b>					
118685-33-9	Component 1: C39H23ClCrN7O12S2Na	No intentional use	250 ppm	Navy Blue colourants are regulated and should no longer be used for dyeing of textiles.	LC
Not Allocated	Component 2: C46H30CrN10O20S2.3Na				

CAS No.	Substance	Group A: Raw Material and Finished Product Supplier Guidance	Group B: Chemical Supplier Commercial Formulation Limit	Potential Uses in Apparel and Footwear Textile Processing	General Techniques for Analysing Chemicals
<b>Dyes – Carcinogenic or Equivalent Concern</b>					
1937-37-7	C.I. Direct Black 38	No intentional use	250 ppm	Most of these substances are regulated and should no longer be used for dyeing of textiles.	LC
2602-46-2	C.I. Direct Blue 6		250 ppm		
3761-53-3	C.I. Acid Red 26		250 ppm		
569-61-9	C.I. Basic Red 9		250 ppm		
573-58-0	C.I. Direct Red 28		250 ppm		
632-99-5	C.I. Basic Violet 14		250 ppm		
2475-45-8	C.I. Disperse Blue 1		250 ppm		
2475-46-9	C.I. Disperse Blue 3		250 ppm		
2580-56-5	C.I. Basic Blue 26 (with Michler's Ketone > 0.1%)		250 ppm		
569-64-2	C.I. Basic Green 4 (malachite green chloride)		250 ppm		
2437-29-8	C.I. Basic Green 4 (malachite green oxalate)		250 ppm		
10309-95-2	C.I. Basic Green 4 (malachite green)		250 ppm		
82-28-0	Disperse Orange 11		250 ppm		
<b>Dyes – Disperse (Sensitising)</b>					
119-15-3	Disperse Yellow 1	No intentional use	250 ppm	Disperse dyes are a class of water-insoluble dyes that penetrate the fibre system of synthetic or manufactured fibres and are held in place by physical forces without forming chemical bonds. Disperse dyes are used in synthetic fibre (e.g., polyester, acetate, polyamide). Restricted disperse dyes are suspected of causing allergic reactions and should no longer be used for dyeing of textiles.	LC
12222-97-8	Disperse Blue 102		250 ppm		
12223-01-7	Disperse Blue 106		250 ppm		
12236-29-2	Disperse Yellow 39		250 ppm		
13301-61-6	Disperse Orange 37/59/76		250 ppm		
23355-64-8	Disperse Brown 1		250 ppm		
2581-69-3	Disperse Orange 1		250 ppm		
2832-40-8	Disperse Yellow 3		250 ppm		
2872-48-2	Disperse Red 11		250 ppm		
2872-52-8	Disperse Red 1		250 ppm		
3179-89-3	Disperse Red 17		250 ppm		
3179-90-6	Disperse Blue 7		250 ppm		
3860-63-7	Disperse Blue 26		250 ppm		
54824-37-2	Disperse Yellow 49		250 ppm		
12222-75-2	Disperse Blue 35		250 ppm		
61951-51-7	Disperse Blue 124		250 ppm		
6373-73-5	Disperse Yellow 9		250 ppm		
730-40-5	Disperse Orange 3		250 ppm		
56524-77-7	Disperse Blue 35		250 ppm		



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<b>Flame Retardants</b>					
115-96-8	Tris(2-chloroethyl)phosphate (TCEP)	No intentional use	250 ppm	Flame retardant chemicals are rarely used to meet flammability requirements in children's clothing and adult products. They should no longer be used in apparel and footwear.	GC-MS
1163-19-5	Decabromodiphenyl ether (DecaBDE)		250 ppm		
126-72-7	Tris(2,3-dibromopropyl)-phosphate (TRIS)		250 ppm		
32534-81-9	Pentabromodiphenyl ether (PentaBDE)		250 ppm		
32536-52-0	Octabromodiphenyl ether (OctaBDE)		250 ppm		
5412-25-9	Bis(2,3-dibromopropyl)phosphate (BIS)		250 ppm		
545-55-1	Tris(1-aziridinyl)phosphine oxide (TEPA)		250 ppm		
59536-65-1	Polybromobiphenyls (PBB)		250 ppm		
79-94-7	Tetrabromobisphenol A (TBBPA)		250 ppm		
3194-55-6	Hexabromocyclodecane (HBCDD)		250 ppm		
3296-90-0	2,2-bis(bromomethyl)-1,3-propanediol (BBMP)		250 ppm		
13674-87-8	Tris(1,3-dichloro-isopropyl) phosphate (TDCP)		250 ppm		
85535-84-8	Short-chain chlorinated Paraffins (SCCP) (C10-C13)		50 ppm		
<b>Glycols</b>					
111-96-6	Bis(2-methoxyethyl)-ether	No intentional use	50 ppm	In apparel and footwear, glycols have a wide range of uses including as solvents for finishing/cleaning, printing agents, and dissolving and diluting fats, oils and adhesives (e.g., in degreasing or cleaning operations).	High-performance liquid chromatography (HPLC), LC-MS
110-80-5	2-ethoxyethanol		50 ppm		
111-15-9	2-ethoxyethyl acetate		50 ppm		
110-71-4	Ethylene glycol dimethyl ether		50 ppm		
109-86-4	2-methoxyethanol		50 ppm		
110-49-6	2-methoxyethylacetate		50 ppm		
70657-70-4	2-methoxypropylacetate		50 ppm		
112-49-2	Triethylene glycol dimethyl ether		50 ppm		
<b>Halogenated Solvents</b>					
107-06-2	1,2-dichloroethane	No intentional use	5 ppm	In apparel and footwear, solvents are used as finishing/cleaning and printing agents, for dissolving and diluting fats, oils and adhesives (e.g., in degreasing or cleaning operations).	GC-MS
75-09-2	Methylene chloride		5 ppm		
79-01-6	Trichloroethylene		40 ppm		
127-18-4	Tetrachloroethylene		5 ppm		

CAS No.	Substance	Group A: Raw Material and Finished Product Supplier Guidance	Group B: Chemical Supplier Commercial Formulation Limit	Potential Uses in Apparel and Footwear Textile Processing	General Techniques for Analysing Chemicals
<b>Organotin Compounds</b>					
Multiple	Dibutyltin (DBT)	No intentional use	20 ppm	Organotins are a class of chemicals combining tin and organics such as butyl and phenyl groups. Organotins are predominantly found in the environment as antifoulants in marine paints, but they can also be used as biocides (e.g., antibacterials), catalysts in plastic and glue production and heat stabilisers in plastics/rubber. In textiles and apparel, organotins are associated with plastics/rubber, inks, paints, metallic glitter, polyurethane products and heat transfer material.	GC-MS, low resolution mass spectrometry (LRMS)
Multiple	Mono-, di- and tri-methyltin derivatives		5 ppm		
Multiple	Mono-, di- and tri-butyltin derivatives		5 ppm		
Multiple	Mono-, di- and tri-phenyltin derivatives		5 ppm		
Multiple	Mono-, di- and tri-octyltin derivatives		5 ppm		
<b>Polycyclic Aromatic Hydrocarbons (PAHs)</b>					
50-32-8	Benzo[a]pyrene (BaP)	No intentional use	20 ppm	Polycyclic aromatic hydrocarbons (PAHs) are natural components of crude oil and are a common residue from oil refining. PAHs have a characteristic smell similar to the smell of car tires or asphalt. Oil residues containing PAHs are added to rubber and plastics as a softener or extender and may be found in rubber, plastics, lacquers and coatings. PAHs are often found in the outsoles of footwear and in printing pastes of screen prints. PAHs can be present as impurities in Carbon Black. They also may be formed from thermal decomposition of recycled materials during reprocessing.  <u>Naphthalene</u> : Dispersing agents for textile dyes may contain high residual naphthalene concentrations due to the use of low quality naphthalene derivatives (e.g., poor quality naphthalene sulphonate formaldehyde condensation products).	GC-MS
120-12-7	Anthracene				
129-00-0	Pyrene				
191-24-2	Benzo[ghi]perylene				
192-97-2	Benzo[e]pyrene				
193-39-5	Indeno[1,2,3-cd]pyrene				
205-82-3	Benzo[j]fluoranthene				
205-99-2	Benzo[b]fluoranthene				
206-44-0	Fluoranthene				
207-08-9	Benzo[k]fluoranthene				
208-96-8	Acenaphthylene				
218-01-9	Chrysene				
53-70-3	Dibenz[a,h]anthracene				
56-55-3	Benzo[a]anthracene				
83-32-9	Acenaphthene				
85-01-8	Phenanthrene				
86-73-7	Fluorene				
91-20-3	Naphthalene	Sum = 200 ppm			

CAS No.	Substance	Group A: Raw Material and Finished Product Supplier Guidance	Group B: Chemical Supplier Commercial Formulation Limit	Potential Uses in Apparel and Footwear Textile Processing	General Techniques for Analysing Chemicals
<b>Perfluorinated and Polyfluorinated Chemicals (PFCs)</b>					
Durable water, oil and stain repellent finishes and soil release finishes (fluorinated polymers) based on long-chain technology are banned from intentional use. Long-chain compounds according to the Organisation for Economic Co-operation and Development (OECD) definition ( <a href="http://www.oecd.org/ehs/pfc/">http://www.oecd.org/ehs/pfc/</a> ) are based on long-chain perfluorocarboxylic acids (C8 and higher) and on long-chain perfluoroalkyl sulfonates (C6 and higher).					
The main contaminants of this technology include: Perfluoroalkyl sulfonates (PFASs) with carbon chain lengths C6 and higher (e.g., PFOS, perfluorooctane sulfonate) Perfluorocarboxylic acids with carbon chain lengths C8 and higher (e.g., PFOA, perfluorooctanoic acid)					
Multiple	Perfluorooctane sulfonate (PFOS) and related substances	No intentional use	Sum = 2 ppm	PFOA and PFOS may be present as unintended by-products in long-chain commercial water, oil and stain repellent agents. PFOA also may be in use for polymers like polytetrafluoroethylene (PTFE).	LC-MS
Multiple	Perfluorooctanoic acid (PFOA) and related substances		2 ppm		
<b>Phthalates – including all other esters of ortho-phthalic acid</b>					
117-81-7	Di(ethylhexyl) phthalate (DEHP)	No intentional use	Sum of all phthalates = 250 ppm	Esters of ortho-phthalic acid (phthalates) are a class of organic compounds commonly added to plastics to increase flexibility. They sometimes are used to facilitate moulding of plastic by decreasing its melting temperature.  Phthalates can be found in: <ul style="list-style-type: none"> <li>• Flexible plastic components (e.g., PVC)</li> <li>• Print pastes</li> <li>• Adhesives</li> <li>• Plastic buttons</li> <li>• Plastic sleeveings</li> <li>• Polymeric coatings</li> </ul>	GC-MS
117-82-8	Bis(2-methoxyethyl) phthalate (DMEP)				
117-84-0	Di-n-octyl phthalate (DNOP)				
26761-40-0	Di-iso-decyl phthalate (DIDP)				
28553-12-0	Di-isononyl phthalate (DINP)				
84-75-3	Di-n-hexyl phthalate (DnHP)				
84-74-2	Dibutyl phthalate (DBP)				
85-68-7	Butyl benzyl phthalate (BBP)				
84-76-4	Dinonyl phthalate (DNP)				
84-66-2	Diethyl phthalate (DEP)				
131-16-8	Di-n-propyl phthalate (DPRP)				
84-69-5	Di-isobutyl phthalate (DIBP)				
84-61-7	Di-cyclohexyl phthalate (DCHP)				
27554-26-3	Di-iso-octyl phthalate (DIOP)				
68515-42-4	1,2-benzenedicarboxylic acid, di-C7-11-branched and linearalkyl esters (DHNUP)				
71888-89-6	1,2-benzenedicarboxylic acid, di-C6-8-branched alkyl esters, C7-rich (DIHP)				

CAS No.	Substance	Group A: Raw Material and Finished Product Supplier Guidance	Group B: Chemical Supplier Commercial Formulation Limit	Potential Uses in Apparel and Footwear Textile Processing	General Techniques for Analysing Chemicals
<b>Total Heavy Metals</b>					
Listed metals are banned from intentional use in textile manufacturing/finishing. Additionally, residual traces of antimony, zinc, copper, nickel, tin, barium, cobalt, iron, manganese, selenium and silver in colourants are expected to comply with the Ecological and Toxicological Association of Dyes and Organic Pigments Manufacturers (ETAD) concentration limits ( <a href="http://www.etad.com/">http://www.etad.com/</a> ).					
7440-38-2	Arsenic (As)	No intentional use	50 ppm	Arsenic and its compounds can be used in some preservatives, pesticides and defoliants for cotton. It is also associated with synthetic fibres, paints, inks, trims and plastics.	Inductively coupled plasma-optical emission spectrometry (ICP-OES), atomic absorption spectroscopy (AAS)
7440-43-9	Cadmium (Cd)		20 ppm (50 ppm for pigments)	Cadmium compounds are found in or used as: pigments (particularly red, orange, yellow and green), a stabiliser for PVC plastic and in fertilisers, biocides and paints (e.g., surface paints on zippers and buttons).	
7439-97-6	Mercury (Hg)		4 ppm (25 ppm for pigments)	Mercury compounds can be present in pesticides and can be found as contamination in caustic soda (NaOH). Mercury compounds may be used in paints (e.g., surface paints on zippers and buttons).	
7439-92-1	Lead (Pb)		100 ppm	In apparel and footwear, lead may be associated with plastics, paints, inks, pigments and surface coatings.	
18540-29-9	Chromium (VI)		10 ppm	Although typically associated with leather tanning, chromium VI also may be used in the dyeing of wool (after the chroming process).	
<b>Volatile Organic Compounds (VOC)</b>					
71-43-2	Benzene	No intentional use	50 ppm	These volatile organic compounds should not be used in textile auxiliary chemical preparations. They are associated with solvent-based processes like solvent-based polyurethane coatings and glues/adhesives. They should not be used for any kind of facility cleaning or spot cleaning.	GC-MS
1330-20-7	Xylene		500 ppm		
95-48-7	o-cresol		500 ppm		
106-44-5	p-cresol		500 ppm		
108-39-4	m-cresol		500 ppm		

## Chapter 2: MRSL for Leather Processing

CAS No.	Substance	Group A: Raw Material and Finished Product Supplier Guidance	Group B: Chemical Supplier Commercial Formulation Limit	Potential Uses in Leather Processing for Apparel and Footwear	General Techniques for Analysing Chemicals within commercial formulations
<b>Alkylphenol (AP) and Alkylphenol Ethoxylates (APEOs): including all isomers</b>					
104-40-5 11066-49-2 25154-52-3 84852-15-3	Nonylphenol (NP), mixed isomers	No intentional use	250 ppm	APEOs can be used in leather processing or found in a variety of formulations such as detergents, wetting agents, emulsifier/dispersing agents/dedusting agents for dyes and prints, dyes and pigment preparations, degreasing and fur scouring agents, fat liquors and greases, water borne dispersions and emulsions used in the beamhouse and finishing agents.  NP and OP are not used by the leather industry, but could be present as contaminants.	Liquid chromatography-mass spectrometry (LC-MS), gas chromatography-mass spectrometry (GC-MS)  EN ISO 18219 -1 EN ISO 18219 – 2
140-66-9 1806-26-4 27193-28-8	Octylphenol (OP), mixed isomers		250 ppm		
9002-93-1 9036-19-5 68987-90-6	Octylphenol ethoxylates (OPEO)		500 ppm		
9016-45-9 26027-38-3 37205-87-1 68412-54-4 127087-87-0	Nonylphenol ethoxylates (NPEO)		500 ppm		
<b>Chlorobenzenes and Chlorotoluenes</b>					
95-50-1	1,2-dichlorobenzene	No intentional use	1000 ppm	Chlorobenzenes and chlorotoluenes can be used for degreasing sheep and pig skins. They can also be used as solvents (e.g., in chemical synthesis).	GC-MS
Other isomers of mono-, di-, tri-, tetra-, penta- and hexa-chlorobenzene and mono-, di-, tri-, tetra- and penta-chlorotoluene			Sum = 200 ppm		

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<b>Chlorophenols</b>					
25167-83-3	Tetrachlorophenol (TeCP)	No intentional use	Sum = 20 ppm	<p>Chlorophenols are polychlorinated compounds used as preservatives or pesticides.</p> <p>Pentachlorophenol (PCP) and tetrachlorophenol (TeCP) have been used in the past to prevent mould when storing/transporting, raw hides and leather. They are now regulated and should not be used.</p>	<p>GC-MS</p> <p>EN ISO 17070</p>
87-86-5	Pentachlorophenol (PCP)				
4901-51-3	2,3,4,5-tetrachlorophenol				
58-90-2	2,3,4,6-tetrachlorophenol				
935-95-5	2,3,5,6-tetrachlorophenol				
95-57-8	2-chlorophenol				
120-83-2	2,4-dichlorophenol				
583-78-8	2,5-dichlorophenol				
87-65-0	2,6-dichlorophenol				
95-95-4	2,4,5-trichlorophenol				
88-06-2	2,4,6-trichlorophenol				
591-35-5	3,5-dichlorophenol				
576-24-9	2,3-Dichlorophenol				
95-77-2	3,4-Dichlorophenol				
108-43-0	3-Chlorophenol				
106-48-9	4-Chlorophenol				
15950-66-0	2,3,4-Trichlorophenol		Sum = 50 ppm		
933-78-8	2,3,5-Trichlorophenol				
609-19-8	3,4,5-Trichlorophenol				

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<b>Dyes – Azo (Forming Restricted Amines)</b>					
101-14-4	4,4'-methylene-bis-(2-chloro-aniline)	No intentional use	150 ppm	Azo dyes and pigments are colourants that incorporate one or several azo groups (-N=N-) bound with aromatic compounds. Thousands of azo dyes exist, but only those which degrade to form the listed cleavable amines are restricted. Azo dyes that release these amines are regulated and should no longer be used for dyeing of leather.  Restricted amines also may be present or formed during cleavage of unintended impurities in raw materials used for dyestuff production.	LC, GC-MS EN ISO 17234 – 1 EN ISO 17234 – 2
101-77-9	4,4'-methylenedianiline		150 ppm		
101-80-4	4,4'-oxydianiline		150 ppm		
106-47-8	4-chloroaniline		150 ppm		
119-90-4	3,3'-dimethoxybenzidine		150 ppm		
119-93-7	3,3'-dimethylbenzidine		150 ppm		
120-71-8	6-methoxy-m-toluidine		150 ppm		
137-17-7	2,4,5-trimethylaniline		150 ppm		
139-65-1	4,4'-thiodianiline		150 ppm		
60-09-3	4-aminoazobenzene		150 ppm		
615-05-4	4-methoxy-m-phenylenediamine		150 ppm		
838-88-0	4,4'-methylenedi-o-toluidine		150 ppm		
87-62-7	2,6-xylidine		150 ppm		
90-04-0	o-anisidine		150 ppm		
91-59-8	2-naphthylamine		150 ppm		
91-94-1	3,3'-dichlorobenzidine		150 ppm		
92-67-1	4-aminodiphenyl		150 ppm		
92-87-5	Benzidine		150 ppm		
95-53-4	o-toluidine		150 ppm		
95-68-1	2,4-xylidine		150 ppm		
95-69-2	4-chloro-o-toluidine	150 ppm			
95-80-7	4-methyl-m-phenylenediamine	150 ppm			
97-56-3	o-aminoazotoluene	150 ppm			
99-55-8	5-nitro-o-toluidine	150 ppm			
<b>Dyes – Navy Blue Colourant</b>					
118685-33-9	Component 1: C39H23ClCrN7O12S·2Na	No intentional use	250 ppm	Navy Blue colourants are regulated, were not sold commercially, and should not have been used for dyeing of leather	LC (No test reference available)
Not Allocated	Component 2: C46H30CrN10O20S2·3Na				

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<b>Dyes – Carcinogenic or Equivalent Concern</b>					
1937-37-7	C.I. Direct Black 38	No intentional use	250 ppm	Most of these substances are regulated in many countries. All should no longer be used for dyeing of leather.	LC
2602-46-2	C.I. Direct Blue 6		250 ppm		
3761-53-3	C.I. Acid Red 26		250 ppm		
569-61-9	C.I. Basic Red 9		250 ppm		
573-58-0	C.I. Direct Red 28		250 ppm		
632-99-5	C.I. Basic Violet 14		250 ppm		
2475-45-8	C.I. Disperse Blue 1		250 ppm		
2475-46-9	C.I. Disperse Blue 3		250 ppm		
2580-56-5	C.I. Basic Blue 26 (with Michler's Ketone > 0.1%)		250 ppm		
569-64-2	C.I. Basic Green 4 (malachite green chloride)		250 ppm		
2437-29-8	C.I. Basic Green 4 (malachite green oxalate)		250 ppm		
10309-95-2	C.I. Basic Green 4 (malachite green)		250 ppm		
82-28-0	Disperse Orange 11	250 ppm			
<b>Dyes – Disperse (Sensitizing)</b>					
Disperse dyes have no applicability to leather processing.					
<b>Fat liquoring agents</b>					
85535-84-8	Short-chain chlorinated paraffin (C <sub>10</sub> – C <sub>13</sub> )	No intentional use	250 ppm	Short-chain chlorinated paraffins can be found as contaminants within long-chain chlorinated paraffins and sulfo-chlorinated paraffin's, used as fat liquoring agents.	Gas chromatography/ electron capture negative ion-mass spectrometry (GC/ECNI-MS)  EN ISO 18219



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<b>Flame Retardants</b>					
115-96-8	Tris(2-chloroethyl)phosphate (TCEP)	No intentional use	250 ppm	Flame retardant chemicals are rarely used to meet flammability requirements in children's clothing and adult products, but they could be used in processing leather for technical/ industrial purposes (e.g., drive belts) and upholstery leather for trains and planes. The mentioned substances should no longer be used in apparel and footwear.	GC-MS
1163-19-5	Decabromodiphenyl ether (DecaBDE)		250 ppm		
126-72-7	Tris(2,3,-dibromopropyl)-phosphate (TRIS)		250 ppm		
32534-81-9	Pentabromodiphenyl ether (PentaBDE)		250 ppm		
32536-52-0	Octabromodiphenyl ether (OctaBDE)		250 ppm		
5412-25-9	Bis(2,3-dibromopropyl)phosphate (BIS)		250 ppm		
545-55-1	Tris(1-aziridinyl)phosphine oxide) (TEPA)		250 ppm		
59536-65-1	Polybromobiphenyls (PBB)		250 ppm		
79-94-7	Tetrabromobisphenol A (TBBPA)		250 ppm		
3194-55-6	Hexabromocyclodecane (HBCDD)		250 ppm		
3296-90-0	2,2-bis(bromomethyl)-1,3-propanediol (BBMP)		250 ppm		
13674-87-8	Tris(1,3-dichloro-isopropyl) phosphate (TDCP)	250 ppm			
<b>Glycol Ethers</b>					
111-96-6	Bis(2-methoxyethyl)-ether	No intentional use	50 ppm	In apparel and footwear, glycol ethers have a wide range of uses including as solvents for finishing/cleaning, printing agents and dissolving and diluting fats, oils and adhesives (e.g., in degreasing or cleaning operations). Some polar solvents (glycol ethers) are necessary for the use of water-based leather finishing systems.  The mentioned glycol ethers are classified as carcinogenic, mutagenic or reprotoxic substances and should not be used in processing leather.	High-performance liquid chromatography (HPLC), LC-MS
110-80-5	2-ethoxyethanol		50 ppm		
111-15-9	2-ethoxyethyl acetate		50 ppm		
110-71-4	Ethylene glycol dimethyl ether		50 ppm		
109-86-4	2-methoxyethanol		50 ppm		
110-49-6	2-methoxyethylacetate		50 ppm		
112-49-2	Triethylene glycol dimethyl ether	50 ppm			
70657-70-4	2-methoxypropylacetate		1000 ppm		
<b>Halogenated Solvents</b>					
107-06-2	1,2-dichloroethane	No intentional use	5 ppm	In apparel and footwear, solvents are used as finishing/cleaning and printing agents, for dissolving and diluting fats, oils and adhesives (e.g., in degreasing or cleaning operations).	GC-MS
75-09-2	Methylene chloride		5 ppm		
79-01-6	Trichloroethylene		40 ppm		
127-18-4	Tetrachloroethylene		5 ppm		

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<b>Organotin Compounds</b>					
Multiple	Dibutyltin (DBT)	No intentional use	20 ppm (*EXCEPTION* 100 ppm for polyurethane based thickeners used at <20% loading)	Organotins are a class of chemicals combining tin and organics such as butyl and phenyl groups. Organotins are predominantly found in the environment as antifoulants in marine paints, but they can also be used as biocides (e.g., antibacterials), catalysts in plastic and glue productions and heat stabilizers in plastics/rubber.  Polyurethane thickeners, which could contain traces of DBT, are commonly used for viscosity adjustments of leather chemicals formulations.	GC-MS, low resolution mass spectrometry (LRMS)
Multiple	Mono-, di- and tri-methyltin derivatives		5 ppm		
Multiple	Mono-, di- and tri-butyltin derivatives		5 ppm		
Multiple	Mono-, di- and tri-phenyltin derivatives		5 ppm		
Multiple	Mono-, di- and tri-octyltin derivatives		5 ppm		
<b>Polycyclic Aromatic Hydrocarbons (PAHs)</b>					
50-32-8	Benzo[a]pyrene (BaP)	No intentional use	20 ppm	Polycyclic aromatic hydrocarbons (PAHs) are natural components of crude oil and are a common residue from oil refining. PAHs are typically found as contaminants within leather formulations.	GC-MS
120-12-7	Anthracene				
129-00-0	Pyrene				
191-24-2	Benzo[ghi]perylene				
192-97-2	Benzo[e]pyrene				
193-39-5	Indeno[1,2,3-cd]pyrene				
205-82-3	Benzo[j]fluoranthene				
205-99-2	Benzo[b]fluoranthene				
206-44-0	Fluoranthene				
207-08-9	Benzo[k]fluoranthene				
208-96-8	Acenaphthylene				
218-01-9	Chrysene				
53-70-3	Dibenz[a,h]anthracene				
56-55-3	Benzo[a]anthracene				
83-32-9	Acenaphthene				
85-01-8	Phenanthrene				
86-73-7	Fluorene				
91-20-3	Naphthalene		300 ppm	In the leather chemical industry, naphthalene is used as a raw material for manufacture of synthetic tanning agents (syntans) and for manufacture of active substances in dispersing agents used during leather processing.	GC-MS, LC

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<b>Perfluorinated and Polyfluorinated Chemicals (PFCs)</b>					
Durable water, oil and stain repellent finishes and soil release finishes (fluorinated polymers) based on long-chain technology are banned from intentional use. Long-chain compounds according to the Organisation for Economic Co-operation and Development (OECD) definition ( <a href="http://www.oecd.org/ehs/pfc/">http://www.oecd.org/ehs/pfc/</a> ) are based on long-chain perfluorocarboxylic acids (C8 and higher) and on long-chain perfluoroalkyl sulfonates (C6 and higher).					
The main contaminants of this technology include: Perfluoroalkyl sulfonates (PFASs) with carbon chain lengths C6 and higher (e.g., PFOS, perfluorooctane sulfonate) Perfluorocarboxylic acids with carbon chain lengths C8 and higher (e.g., PFOA, perfluorooctanoic acid)					
Multiple	Perfluorooctane sulfonate (PFOS) and related substances	No intentional use	Sum = 2 ppm	PFOA and PFOS may be present as unintended by-products in long-chain commercial water, oil and stain repellent agents. PFOA also may be in use for polymers like polytetrafluoroethylene (PTFE).	LC-MS
Multiple	Perfluorooctanoic acid (PFOA) and related substances		2 ppm		
<b>Phthalates – including all other esters of ortho-phthalic acid</b>					
117-81-7	Di(ethylhexyl) phthalate (DEHP)	No intentional use	Sum of all phthalates = 250 ppm	Esters of ortho-phthalic acid (phthalates) are a class of organic compounds commonly added to plastics to increase flexibility. They are sometimes used to facilitate moulding of plastic by decreasing its melting temperature.  Polymeric coatings for leather finishing, dedusting agents in colourants, fat liquors and greases could be a source for phthalates in formulations for leather processing.	GC-MS
117-82-8	Bis(2-methoxyethyl) phthalate (DMEP)				
117-84-0	Di-n-octyl phthalate (DNOP)				
26761-40-0	Di-iso-decyl phthalate (DIDP)				
28553-12-0	Di-isononyl phthalate (DINP)				
84-75-3	Di-n-hexyl phthalate (DnHP)				
84-74-2	Dibutyl phthalate (DBP)				
85-68-7	Butyl benzyl phthalate (BBP)				
84-76-4	Dinonyl phthalate (DNP)				
84-66-2	Diethyl phthalate (DEP)				
131-16-8	Di-n-propyl phthalate (DPRP)				
84-69-5	Di-isobutyl phthalate (DIBP)				
84-61-7	Di-cyclohexyl phthalate (DCHP)				
27554-26-3	Di-iso-octyl phthalate (DIOP)				
68515-42-4	1,2-benzenedicarboxylic acid, di-C7-11-branched and linearalkyl esters (DHNUP)				
71888-89-6	1,2-benzenedicarboxylic acid, di-C6-8-branched alkyl esters, C7-rich (DIHP)				

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<b>Total Heavy Metals</b>					
Listed metals are banned from intentional use in textile manufacturing/finishing. Additionally, residual traces of antimony, zinc, copper, nickel, tin, barium, cobalt, iron, manganese, selenium and silver in colourants are expected to comply with the Ecological and Toxicological Association of Dyes and Organic Pigments Manufacturers (ETAD) concentration limits ( <a href="http://www.etad.com/">http://www.etad.com/</a> ).					
7440-38-2	Arsenic (As)	No intentional use	50 ppm	Arsenic and its compounds can be used in some preservatives, pesticides and defoliant for cotton. It is also associated with synthetic fibres, paints, inks, trims and plastics.  Arsenic is not a typical residue in leather chemicals.	Inductively coupled plasma-optical emission spectrometry (ICP-OES), atomic absorption spectroscopy (AAS)  Cr (III) Tanning agents can be monitored for Cr(VI)  EN ISO 17075 (Current Use) ISO/DIS 19071 (Draft)
7440-43-9	Cadmium (Cd)		20 ppm (50 ppm for pigments)	Cadmium compounds are found in or used as: pigments (particularly red, orange, yellow and green), a stabiliser for PVC plastic and in fertilisers, biocides and paints (e.g., surface paints on zippers and buttons).	
7439-97-6	Mercury (Hg)		4 ppm (25 ppm for pigments)	Mercury compounds can be present in pesticides and can be found as contamination in caustic soda (NaOH). Mercury compounds may be used in paints (e.g., surface paints on zippers and buttons).  Mercury is not a typical residue in leather chemicals.	
7439-92-1	Lead (Pb)		100 ppm	In apparel and footwear, lead may be associated with plastics, paints, inks, pigments and surface coatings.	
18540-29-9	Chromium (VI)		10 ppm	The two-bath process for tanning using potassium dichromate (VI) is no longer used by the leather industry.  Potassium dichromate (VI) and other chromium (VI) compounds are banned and chromium (VI) residues in chromium (III) tanning agents are restricted.	

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<b>Volatile Organic Compounds (VOC)</b>					
71-43-2	Benzene	No intentional use	50 ppm	These volatile organic compounds should not be used in textile and leather auxiliary chemical preparations. They are associated with solvent-based processes like solvent-based polyurethane coatings and glues/adhesives. They should not be used for any kind of facility cleaning or spot cleaning.	GC-MS
95-48-7	o-cresol		500 ppm		
106-44-5	p-cresol		500 ppm		
108-39-4	m-cresol		500 ppm		