



VOLATILE ORGANIC COMPOUNDS (VOCs)

Other Names	Not available
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CAS Number	Substance
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71-43-2	Benzene
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75-15-0	Carbon Disulfide
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56-23-5	Carbon Tetrachloride
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List continued in "Additional Information"

May Be Found In	<ul style="list-style-type: none">• Adhesives and glues• Fabric printing inks• Coating formulations• Leather finishing formulations• Plastic products (e.g., buttons)• Rubber• Synthetic leather
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Volatile Organic Compounds are chemicals that easily enter the air as gases or vapors from solid materials or liquids. VOCs are ingredients in a wide variety of commercial, industrial, and residential products.¹

Uses in the Supply Chain

Within the apparel and footwear supply chains, VOCs are widely used in chemical preparations. Some VOCs are used in adhesives, fabric and leather coatings, screen print inks, and synthetic leather. VOCs may be found as impurities in polystyrene-based resins used in the production of plastic trims. In addition, VOCs may be used in processes such as dry cleaning, as well as finishing and degreasing or cleaning operations.¹

Why VOCs are Restricted

- Legislation in major markets around the world restricts the presence of VOCs in finished products.
- VOCs easily become gases or vapors, and exposure can occur through inhalation. They may also enter the body if you eat or drink contaminated food or water, or when they come into direct contact with the skin.
- VOCs, particularly those that are restricted, are known to have adverse health effects on human health and/or the environment.
- VOCs can cause skin, eye, and respiratory irritation.
- Drowsiness, dizziness, headaches, tremors, confusion, and/or unconsciousness may occur from short term exposure to high VOC levels.
- Chronic exposure to high VOC levels may cause damage to organs, including the central nervous system, liver, and kidney.
- Above certain exposure levels, some VOCs may cause cancer and reproductive harm.
- Some VOCs, such as toluene, may contribute significantly to the formation of smog which has adverse effects on human health and can damage forests and crops.^{2,3}
- Chemical hazard information for many chemicals can be found at the following external databases:
 - GESTIS Substance Database: [Here \(external link\)](#)
 - US National Library of Medicine: [Here \(external link\)](#)
 - US OSHA Occupational Chemical Database: [Here \(external link\)](#)

Sourcing Compliant Materials from Your Suppliers

- Contact your suppliers and explain that you require their manufactured materials to be compliant with the current AFIRM RSL limits.⁴



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- Require suppliers to submit a confirmation of material compliance or a test report from a third-party laboratory.
- When materials are received, consider performing risk-based testing to ensure the current AFIRM RSL limits are met.
- Share this information sheet with your material suppliers so they have full visibility and understand your sourcing requirements.
- Pay special attention to buttons made from polystyrene-based resins. Monomeric styrene may contain toluene, and sometimes benzene, as production impurities.
- Many adhesives contain VOCs. With sufficient drying/curing, VOCs in materials may be removed by evaporation. The best course of action is to avoid their use altogether to prevent workplace safety and environmental issues.
- Any material with a chemical odor should be subject to testing or other scrutiny.

Sourcing Compliant Formulations from Your Chemical Suppliers

- For all formulations, request SDS documentation that meets current GHS requirements.
- Contact your suppliers and explain that you require formulations to be compliant with the current ZDHC MRSL limit whenever applicable.⁵
- Discuss with your chemical supplier whether any safer alternatives are available that are suitable substitutes for your production needs.
- Prior to procuring any formulation, the chemical properties must be reviewed to ensure that proper protective equipment, chemical storage facilities, facility engineering controls, and associated treatment/disposal facilities are appropriate for the chemical(s).
- Pay special attention to chemical formulations that are likely to contain VOCs, such as
 - adhesives
 - polyurethane coatings
 - formulations used in finishing
 - degreasing agents
 - cleaning operations
 - spot cleaners

Safer Alternatives

The following substances have been identified as examples of safer alternatives and may be suitable for your production needs. Any chosen alternative must be ZDHC MRSL compliant whenever applicable.⁵

- Water-based adhesives are available that may require upfront costs to achieve higher drying temperatures, but they use far fewer hazardous chemical ingredients and are the safest alternatives.
- Solvent-based adhesives and fabric coating formulations that are compliant with the ZDHC MRSL may also be feasible alternatives.⁵
- Methylcyclohexane-based adhesives may be used as substitutes for adhesives containing restricted VOCs.
- N-Heptane may be used as an alternative for benzene in paints, paint thinners, synthetic resins, rubber adhesives, and textile finishes.

Additional Information

Spot cleaners can be a source of VOCs in a facility. The spot cleaners in use should be carefully considered and their contents well understood to avoid VOC issues.



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There are multiple definitions of what VOCs are and how to classify them.

- For example, the European Union uses the boiling point, rather than its volatility in its definition of VOCs: “A VOC is any organic compound having an initial boiling point less than or equal to 250° C measured at a standard atmospheric pressure of 101.3 kPa (1 atmosphere at sea level).”⁶
- The World Health Organization defines VOCs by how easily they will be emitted, grouping different chemicals by vapor pressure instead of boiling point.⁷

Continued list of CAS numbers and substance names from first page:

CAS Number	Substance
67-66-3	Chloroform
108-94-1	Cyclohexanone
107-06-2	1,2-Dichloroethane
75-35-4	1,1-Dichloroethylene
100-41-4	Ethylbenzene
76-01-7	Pentachloroethane
630-20-6	1,1,1,2- Tetrachloroethane
79-34-5	1,1,2,2- Tetrachloroethane
127-18-4	Tetrachloroethylene (PERC)
108-88-3	Toluene
71-55-6	1,1,1- Trichloroethane
79-00-5	1,1,2- Trichloroethane
79-01-6	Trichloroethylene
1330-20-7	Xylenes (meta-, ortho-, para-) includes: 108-38-3, 95-47-6, 106-42-3

References

- ¹ United States Agency for Toxic Substances and Disease Registry. (Various). Toxicological Profiles: Benzene, Toluene and Xylene. Retrieved August 15, 2017, from <https://www.atsdr.cdc.gov/toxprofiledocs/index.html>
- ² Classification and Risk Phrases According to CLP Regulation (Regulation (EC) 1272/2008). Retrieved August 15, 2017, from <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:353:0001:1355:en:PDF>
- ³ International Agency for Research on Cancer (IARC) Monographs on the Evaluation of Carcinogenic Risks to Humans. Accessed at http://monographs.iarc.fr/ENG/Classification/latest_classif.php
- ⁴ Apparel and Footwear International RSL Management Group Restricted Substances List (AFIRM RSL) <http://afirm-group.com/afirm-rsl/>
- ⁵ ZDHC Manufacturing Restricted Substances List (ZDHC MRSL) https://www.roadmaptozero.com/mrsl_online/
- ⁶ Directive 2004/42/CE of the European Parliament and the Council; Publications Office of the European Union. <https://op.europa.eu/en/publication-detail/-/publication/08b98185-31f7-4dad-8e41-e643b82e6870/language-en#:~:text=Rate%20this%20publication-Directive%202004%2F42%2FCE%20of%20the%20European%20Parliament%20and%20of.amending%20Directive%201999%2F13%2FEC>
- ⁷ World Health Organization, November 2009. “WHO Guidelines for Indoor Air Quality: Selected Pollutants” ISBN 978 92 890 0213 4 https://www.euro.who.int/_data/assets/pdf_file/0009/128169/e94535.pdf