

Appendix D. Examples of RSL Failures and Corrective Actions

This appendix draws content from a slide deck of actual RSL failures, with the corrective actions taken to resolve them. It includes recommendations for preventing the failures from happening again. Please note that this information is meant to provide high-level examples of where specific chemistry failures may be found in a range of product categories. This will not provide detailed guidance on how to avoid all such issues in the future. There are two valuable resources in this regard: AFIRM Chemical Information Sheets and Appendix G—Detailed Chemical Guidance Document.

Table of Contents

Substance	Page Numbers
APEOs	21
Azo Dyes	22
Disperse Dyes	22
Chlorinated Phenols	23
Formaldehyde	24
Heavy Metals	26
Organotin Compounds	28
Perfluorinated and Polyfluorinated Chemicals (PFCs)	28
Phthalates	29
Polycyclic Aromatic Hydrocarbons (PAHs)	29
Volatile Organic Compounds (VOCs)	30

Alkylphenol Ethoxylates (APEOs)

FABRIC

Problem

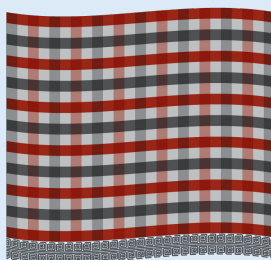
APEOs were found on fabric in excess of the RSL limit.

Many scouring agents, which are used to remove oils and fats from textiles, contain APEOs as a surfactant.

There are many alternatives currently available without APEOs.

Corrective Actions

- Vendor sourced an APEO-alternative scour agent, with no cost increase.
- Brand communicated concern about APEOs to vendor.



SHOE INSOLE

Problem

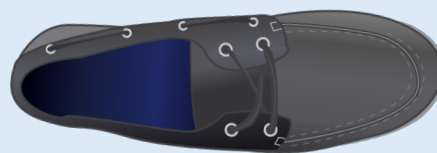
APEO was detected in an insole board.

APEOs occur in many steps of the production process, as they are commonly found in surfactant-based chemistries.

Contamination from APEOs can be a common problem.

Corrective Actions

- Vendor sourced an APEO alternative scour agent with no cost increase.
- Brand communicated concern about APEOs with vendor.



LEATHER BAG

Problem

NPEO was detected in a pigskin handbag.

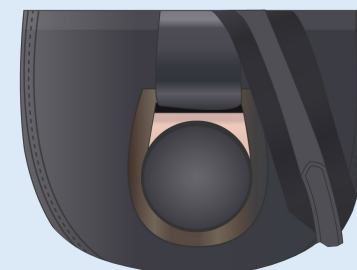
NPEOs are usually associated with degreasing agents.

Root Cause

- Due to a ban on raw material products from Japan, supplier had switched to a new degreasing agent for leather. This formula was found to contain NPEOs.

Corrective Action

- Using the ZDHC chemical gateway, the supplier found a degreasing agent that complied with the ZDHC MRSL and did not contain NPEOs.



Azo Dyes

DRAWCORD

Problem

Cord supplier used a dyestuff that contained prohibited Azo Dyes in a corded adult sweater.

Corrective Actions

- Product was not sold.
- Supplier integrated RSL-compliant dyestuff from a quality chemical company with little to no cost impact.
- RSL requirements were communicated to all suppliers.



Disperse Dyes

WOVEN LABEL

Problem

Restricted disperse dye was found in a woven label.

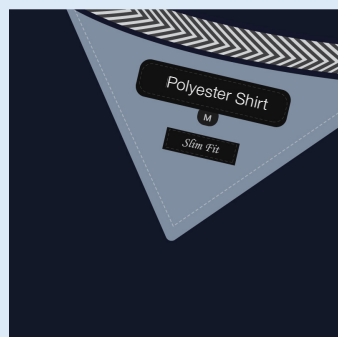
Restricted disperse dyes are used in polyester dyeing and can cause allergic reactions.

Root Cause

- Label was from well-known compliant suppliers, and yarns were not dyed with disperse dyes.
- Backer to label was found to fail for dyes.

Corrective Action

- Supplier changed backer and destroyed all inventory of failed backer color.



Chlorinated Phenols (PCPs)

SHOE ADHESIVE

Problem

PCPs were detected in shoes.

PCPs can be used as precursors in the manufacturing process for adhesives. If this process is not optimized, Phenols can be found as contaminants. They also can be found as biocides in preservatives.

Root Cause

- PCPs were found as contaminants in the adhesive used to manufacture the shoe.

Corrective Action

- Supplier worked with chemical supplier to obtain a PCP-free adhesive that was compliant with the ZDHC MRSL.



PRINTED SILK FABRIC

Problem

Chlorinated Phenol was detected on printed silk fabric.

Chlorinated phenols can be used as anti-microbials in the guar gum thickeners used in silk production.

Corrective Action

- Printer switched from guar gum to alginate thickener to avoid contamination problems.



Formaldehyde

DISCHARGE SCREEN PRINT

Problem

Discharge screen print failed RSL limit for Formaldehyde.

Many ink systems contain Formaldehyde to break down the color of the garment-dyed fabric.

Root Cause

- Printer found ink system was using Zinc Formaldehyde Sulfoxylate (ZFS) catalyst.

Corrective Actions

- Printer worked with ink supplier to optimize printing concentrations and to find a Formaldehyde-free catalyst system for discharge prints.
- Curing times and temperatures were kept consistent to meet RSL requirements.



BASEBALL HAT

Problem

Backing fabric treated with resin stiffener failed the RSL limit for Formaldehyde.

Urea Formaldehyde resins are common chemicals used in durable press resins.

Corrective Actions

- In the short term, caps were washed to reduce the amount of Formaldehyde.
- Backing fabric was replaced with passing fabric for some of the hats.
- No process control could be established to prevent Formaldehyde failure; new material was developed to meet standards.
- Factory had not switched materials for all customers, so contamination from drying units needed to be monitored.



WRINKLED-FINISH T-SHIRT

Problem

Cotton t-shirt treated with resin stiffener failed the RSL limit for Formaldehyde.

Urea Formaldehyde resins are common chemicals used in durable press resins to produce a wrinkled effect.

Root Cause

- Wrinkle finish was originally cured for too short a period of time and at a lower temperature than recommended.

Corrective Actions

- In the short term, garments were washed to reduce the amount of Formaldehyde.
- Processes were changed to improve durability and RSL compliance
- Conditions were carefully controlled to manage finished product compliance.



Formaldehyde

PIGMENT-PRINTED GARMENTS

Problem

Formaldehyde-releasing melamine resin failed the RSL limit for Formaldehyde.

Formaldehyde-releasing melamine resin is commonly used as a crosslinker in pigment-printed garments.

Corrective Actions

- Diisocyanate crosslinker was employed as an alternative approach.
- Measurements were taken to prevent occupational hazards when utilizing diisocyanate crosslinker alternatives:
 - Proper cure time, correct ratios, controlled printing conditions.
- Chemical supplier provided a Formaldehyde-free option, but EH&S needed to be considered for new chemistries.



COTTON FABRIC

Problem

Cotton fabric failed children's Formaldehyde standard.

Urea Formaldehyde resins are common chemicals used in durable press resins.

Root Cause

- A typo found in the fabric batch formula caused the Formaldehyde concentration to exceed the RSL limit.

Corrective Actions

- Supplier changed quality control procedures to review the formula before commencing production for future orders.
- Testing for affected products was increased during development and production.



LEATHER

Problem

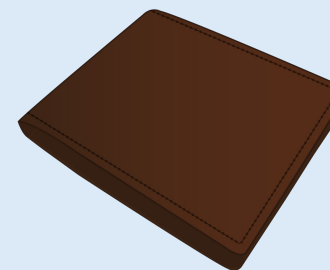
Formaldehyde was found in a full-grain leather wallet.

Root Cause

- Formaldehyde was present in a re-tanning chemical without an intended chemical function.

Corrective Actions

- In the short term, the leather supplier decreased the percent of Formaldehyde-containing tanning chemical in the material formula to reduce Formaldehyde amount in finished products.
- Leather supplier found a Formaldehyde-free chemical to replace the contaminated chemical in the re-tanning process.



Heavy Metals

CADMIUM IN PVC PRODUCT

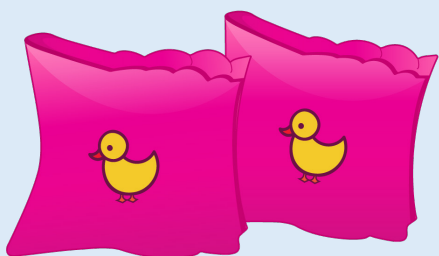
Problem

Cadmium exceeded the RSL limit in Polyvinyl Chloride (PVC) product.

PVC contains Heavy Metal stabilizers, such as Cadmium, and Phthalates for flexibility. Cadmium may also be used in pigments.

Corrective Actions

- PVC layer was substituted with a thermoplastic polyurethane (TPU).
- New material substitutes were investigated.



LEAD IN INFANT SHOES

Problem

Red paint on trim of an infant shoe contained Lead in excess of RSL limits.

Lead, which is acutely toxic in high concentrations, can be used as a pigment in paints.

Corrective Actions

- In the short term, the brand recalled the product.
- Factory began a more comprehensive testing program for sourced raw materials.



LEAD IN PU-COATED FABRIC

Problem

Polyurethane (PU) coated fabric contained high levels of Lead.

The presence of Lead could be due to its use as a stabilizer or pigment; it is not likely caused by contamination.

Corrective Actions

- Increased testing of raw materials.
- Brand gave RSL requirements to garment factory and communicated requirements with PU fabric vendor.



Heavy Metals

LEAD IN SOCK LINERS

Problem

Lead was detected in the coating on the top cover fabric of sock liners.

Heavy metals, including lead, are often used in low-cost pigments and inks.

Root Cause

- Lead was used in the heat transfer print on the sock liner.

Corrective Actions

- Factories communicated brand requirements to upstream suppliers.
- Products were strategically tested at all stages of production.



CHROMIUM IN WOOL & NYLON FABRICS

Problem

Chromium was detected on wool and nylon fabrics.

Chromium can be used in metalized dyes.

Root Cause

- Chemicals were tested and no metalized dye was used. Mill had old non-compliant fabric in the factory that was incorrectly sent for testing.

Corrective Actions

- Supplier implemented a better inventory management system, storing non-compliant materials in clearly marked areas.
- Long term, only compliant materials should be produced to avoid contamination issues.



CHROMIUM (VI) IN LEATHER SHOES

Problem

Chromium (VI) was detected in leather shoes above the RSL limit.

Chromium (III) can oxidize into Cr(VI) with high temperatures, exposure to sunlight, and low humidity.

Root Cause

- Article was originally tested without using an aging preparation and no Chromium VI was detected. When the sample was re-tested with an aging step, Chromium VI was found.

Corrective Action

- The tannery was alerted to the issue and improved their processes to minimize the risk of Chromium VI formation. Subsequent batches of leather from this tannery were closely monitored using the aging preparation of the leather to ensure the issue did not arise again.



Heavy Metals

MERCURY IN HEAT TRANSFER

Problem

Printed heat transfer failed for mercury.

Mercury can be used as a pigment but often contamination is the reason for Mercury failures.

Root Cause

- The source of mercury was a cleaning solvent that contaminated a mixing beaker.

Corrective Actions

- In the short term, the heat transfer supplier eliminated the suspected cleaning agent.
- Processes were changed to mix inks in disposable mixing containers.
- Time frames were established for keeping custom-mixed inks.



Organotin Compounds

FOIL SCREEN PRINT

Problem

Foil screen prints on children's t-shirts were found to contain Organotins.

Organotins are often used as heat stabilizers in low-quality adhesives and prints used in printing and transfer processes. Many non-Organotin alternatives exist.

Root Cause

- The cheap adhesive used in the original foil print contained Organotins as a heat stabilizer.

Corrective Action

- Supplier used a higher quality adhesive that had a non-Organotin heat stabilizer.



Perfluorinated and Polyfluorinated Chemicals (PFCs)

WATER-REPELLENT FABRIC

Problem

PFOA was detected in a webbing fabric.

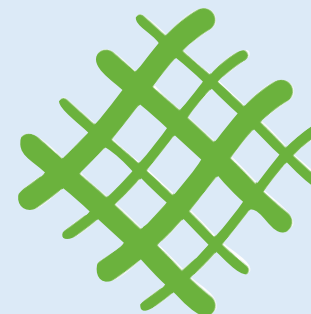
Long-chain Perfluorinated and Polyfluorinated Chemicals (PFCs), such as PFOA, are used as cheaper alternatives to short-chain PFCs in DWR treatments. They can also be found as contaminants in short-chain PFC finishes.

Root Cause

- After checking the SDS, the supplier found PFOA was in the DWR finishing chemical formula.

Corrective Action

- Supplier substituted an MRSL-compliant alternative, which was free of long-chain PFCs (PFOS / PFOA).



Phthalates

SCREEN PRINTS

Problem

In testing, screen-print inks containing PVC failed for DEHP (Phthalate).

Phthalates are often used to soften ink and prevent cracking. There are many non-Phthalate plasticizers available.

Root Cause

- The spray adhesive used to hold the garment in place during printing contained DEHP, contaminating the finished garment.

Corrective Actions

- Printer substituted a different spray adhesive to achieve compliance.
- Supplier then looked to substitute a silicone-based print for the PVC-based screen print.



PLASTIC SOLE

Problem

Company received consumer complaints that flip-flop sandals had a sticky feeling and were removing finishes on wood floors.

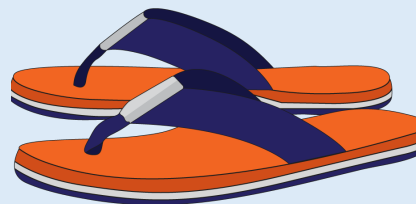
Plasticizers are commonly used in plastics and foams to increase flexibility and improve performance. Many Phthalate-based plasticizers have been banned. Suppliers can use safer alternatives such as Acetyltributylcitrate (ATBC).

Root Cause

- Manufacturer claimed to use ATBC as a plasticizer in the sole of the flip-flop, but instead used TBC as a cheaper substitute. TBC is known as a solvent that de-coats furniture.

Corrective Action

- Brand communicated with manufacturers that chemical substitutions should not be made based on price alone without looking at safety, quality, and performance impacts.



Polycyclic Aromatic Hydrocarbons

RUBBER LOGO

Problem

Molded black rubber logo failed testing for Polycyclic Aromatic Hydrocarbons (PAHs).

PAHs can be found as a contaminant in carbon black and are sometimes used in rubber production.

Root Cause

- Supplier found that Naphthenic oil was used to produce the rubber.

Corrective Action

Supplier reformulated material and substituted Naphthenic oil out of the formula.



Volatile Organic Compounds

SCREEN PRINT

Problem

Small amounts of Volatile Organic Compounds (VOCs) were detected in the ink at screen-print facility.

VOCs are often used in solvents for a variety of manufacturing processes.

Root Cause

- Printer investigated and discovered contamination from its solvent supplier's recycling tanks.

Corrective Actions

- Tools were better handled, stored, and sanitized to prevent contamination.



BLACK SOCKS

Problem

Consumers complained of a solvent smell in cotton-rayon socks. Testing revealed they contained Dimethylformamide (DMFa) and Methylene Chloride.

Root Cause

- Supplier was lubricating the knitting yarn with an unlabeled solvent with no SDS information. When the yarn was tested, it contained restricted VOCs.

Corrective Actions

- Production was stopped immediately.
- All current stock and shipments were destroyed.
- The supplier switched to an RSL-compliant lubricant.

