



Laboratory Study of Chemicals in Nail Products

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PREPARED BY

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SAFER CONSUMER PRODUCTS PROGRAM



TABLE OF CONTENTS

Executive Summary	3
Introduction.....	4
Background.....	5
DTSC Efforts on Nail Products	6
Purpose of Sampling and Analysis.....	7
General Objectives	7
Specific Research Questions.....	7
Products and Chemicals Evaluated	8
Nail Product Selection and Purchasing.....	8
Analytical Methods.....	9
Results	10
Overview.....	10
Nail Products Containing Toluene, Methyl Methacrylate, or Formaldehyde	11
Other Candidate Chemicals Present in Nail Products	19
Tentatively Identified Compounds (TICs)	20
Comparison of DTSC’s 2012 and Current Nail Products Lab Studies	27
Candidate Chemicals in Nail Products Marketed to Children	28
Comparison of Chemicals Detected with Ingredients on Labels.....	34
Candidate Chemicals in Solvent-Based Professional versus Retail Nail Coatings	42
Comparison of Differently Priced Solvent-Based Nail Coatings and Presence of Candidate Chemicals.....	46
Analysis of Retail Chemical Policies.....	49
Conclusion	55
References.....	57
Appendices	60
Appendix A - Analytical Methods	60
Appendix B - List of Analytes (VOCs and SVOCs).....	73
Appendix C – Detailed Sample List and Data Tables	76
Appendix D – Target Analyte Candidate Chemical Detection Summaries.....	104
Appendix E - Tentatively Identified Compounds.....	111
Appendix F – Tune Criteria	120
Appendix G – Method Information	121

EXECUTIVE SUMMARY

The Department of Toxic Substances Control's (DTSC's) Safer Consumer Products (SCP) Program is concerned about exposure to hazardous chemicals in nail products. To better understand these exposures, SCP has been evaluating the exposure and potential adverse impacts of Candidate Chemicals and other chemicals of interest used in nail products.

In 2012, prior to the creation of the SCP program, DTSC conducted a limited analytical laboratory study of nail products intended for professional use. This study was done in partnership with the San Francisco Environment Department, which in 2010, created a voluntary recognition program for nail salons that seek to use safer nail products. One of the key findings of the 2012 analytical laboratory study was that nail product marketing claims and ingredient labels were sometimes inaccurate.

As part of the SCP Program's continued efforts to evaluate exposures to hazardous chemicals in nail products, SCP conducted a second analytical laboratory study of 156 nail products purchased from online and brick-and-mortar stores. Products were chosen to represent both professional and retail use and diverse product types and prices. They were also chosen for their utility in addressing research questions and exploring various marketing claims (such as "non-toxic" and "n-free"), including nail products marketed to children. We also sought to include products tested in the 2012 analytical laboratory study. Products were also selected based on ingredients listed on product labels and websites, by recommendations from stakeholder groups, and by availability.

In conducting this analytical laboratory study, SCP sought to answer several research questions such as:

- What Candidate Chemicals are present in nail products and at what concentrations?
- What nail products contain toluene or other solvents, methyl methacrylate (MMA), and formaldehyde and at what concentrations?
- What Candidate Chemicals are in products marketed to children?
- Do ingredient labels accurately list the chemicals in products?
- Are there different Candidate Chemicals or concentrations in professional versus retail products?
- Do low-, mid-, and high-priced nail products contain different Candidate Chemicals or concentrations?
- Have retailers met their public commitments to have manufacturers restrict or remove certain chemicals from nail products?

The analytical laboratory study conducted in 2012 highlighted the inaccuracy of ingredient labels and marketing claims. The current study indicates that ingredient labels and marketing claims continue to be inaccurate. For example, nail products marketed to children or marketed as "safe" for children and pregnant women were found to contain various Candidate Chemicals.

Further, some Candidate Chemicals such as toluene and MMA were found both at levels indicative of unintentional contamination and at higher concentrations that suggest they were intentionally added.

In this study, nail products were categorized as “professional” and “retail,” as well as by price range. An analysis of Candidate Chemicals detected across these categories revealed differences in both detection frequency and concentration. For nail products intended for retail and professional use, professional products had more Candidate Chemical detections, and some, such as MMA, were detected at higher concentrations than in retail products. When considering the price point of the nail products, low- and mid-priced products had higher concentrations of Candidate Chemicals than high-priced products.

One additional goal of this study was to determine whether retailers have met their public commitments to have manufacturers restrict or remove certain chemicals from nail products. For example, some retailers set out to have manufacturers restrict or eliminate the use of chemicals such as formaldehyde and toluene from nail products they sell. According to the data in this study, retailers met their public commitments in general.

The findings from this study will help inform DTSC’s efforts to evaluate product-chemical combinations for possible listing as proposed Priority Products and will contribute to the publicly available information about chemicals used in nail products.

INTRODUCTION

The Department of Toxic Substances Control’s (DTSC’s) Safer Consumer Products (SCP) Program is evaluating the potential exposure and adverse impacts of the chemicals present in various nail products. As part of this effort, DTSC’s Environmental Chemistry Laboratory in Berkeley analyzed various products. These products were chosen to represent both professional and retail use and diverse product types and prices. They were also chosen for their utility in addressing research questions and exploring various marketing claims (such as “non-toxic” and “n-free”), including nail products marketed to children. We also sought to include products tested in the 2012 analytical laboratory study. Products were also chosen based on ingredients listed on product labels or websites, recommendations from stakeholder groups, and by availability.

DTSC may use this data as supplementary information to identify product-chemical combinations as proposed Priority Products. Data from this project may also be used to determine whether nail product companies are accurately reporting chemical ingredients in their products that are known or suspected to cause cancer or developmental or other reproductive harm pursuant to the California Safe Cosmetics Act (CDPH 2022).

BACKGROUND

Nail products are frequently used in nail salons and homes. Approximately 100 million Americans use nail products, and annual sales of various nail products from U.S. retail outlets exceed \$1 billion per year (Drug Store News 2016).

The majority of nail product purchasers and users in the United States are female. They represent all ages, and many belong to sensitive subpopulations such as nail salon workers, children, adolescents, and pregnant women (Wu et al. 2010; Ford 2014). Different subpopulations may purchase different nail products and, thus, may be exposed to different chemicals.

Nail industry workers' exposure to chemicals is an issue of environmental injustice and inequity. In California, most nail technicians are of Vietnamese descent, have low socioeconomic status, and are often women of childbearing age. As such, this sensitive subpopulation most likely experiences environmental inequity from occupational exposures in salons and represents an overburdened community. This community experiences multiple factors, including both environmental and socio-economic stressors, that act cumulatively to affect health and contribute to persistent environmental health disparities. Please note that people from other vulnerable populations may also be nail technicians and are not deliberately excluded from this study. Rather, DTSC's intent is to highlight a population that is found to make up the majority of nail technicians in California.

Nail products of different types, manufacturers, brands, and product lines may differ in their ingredients. For instance, there may be differences in the ingredients for the following product types:

- Retail versus professional products;
- Products with n-free (i.e., "free of" specific chemicals) or non-toxic claims;
- Products marketed to children and pregnant women as safe or non-toxic;
- Low-, mid-, and high-price products; and
- Common brands widely sold in retail stores, beauty supply stores, and online.

Prior to 2020, manufacturers of professional nail products were not required to list ingredients on labels. As of July 1, 2020, however, the California Professional Cosmetics Labeling Law (Health and Safety Code Section 110371) requires that all professional cosmetic products manufactured and sold in California meet all labeling requirements of the federal Food, Drug, and Cosmetic Act and the federal Fair Packaging and Labeling Act. Professional and retail products may include marketing claims on their labels such as "non-toxic," "safe," or "n-free."

DTSC Efforts on Nail Products

DTSC has been concerned about potential human health impacts linked to exposure from nail products for more than a decade, especially to salon workers. Below is summary of DTSC's efforts, to date, in connection with evaluating the safety of nail products.

- In 2012, DTSC released the findings from a small scale analytical study of nail products in [Summary of Data and Findings from Testing of a Limited Number of Nail Products](#). Several nail products tested contained toluene and/or dibutyl phthalate (DBP), two chemicals that can interfere with the growth, development, or health of children.
- On November 15, 2016, DTSC held a webinar entitled, "[Help DTSC Research Potential Priority Products](#)," which included a presentation on chemicals in nail products.
- On March 2, 2017, DTSC held a [Public Workshop on Potential Health and Safety Impacts of Chemicals in Nail Products](#).
- In April, 2018, DTSC published [Healthy Nail Salon Recognition \(HNSR\) Program Guidelines](#) to be voluntarily implemented statewide.
- On March 13, 2019, DTSC held a [public workshop](#) and proposed Nail Products Containing Toluene as a Priority Product.
- On February 24, 2020, DTSC held a [public workshop](#) and proposed Nail Products Containing Methyl Methacrylate (MMA) as a Priority Product.
- From 2017 through 2022, DTSC conducted additional chemical screening research on Candidate Chemicals in nail products.
- From 2020 to 2021, DTSC conducted an analytical laboratory study of chemicals in nail products (this report).
- On July 6, 2022, DTSC made public a [background document on chemicals in nail products](#), which summarizes the research findings and decisions made up to that date.
- On July 27, 2022, DTSC held a [public workshop](#) on chemicals in nail products to share its findings from literature research, from an information call-in, and from an analytical laboratory study.
- In April 2023, DTSC released a [report](#) summarizing findings from an [information call-in](#) request, conducted from 2020 to 2021, for manufacturers, assemblers, importers, retailers, and trade associations to provide information on ingredients in nail products. On May 3, 2023, DTSC held a [public webinar](#) to share its findings.

PURPOSE OF SAMPLING AND ANALYSIS

This study conducted an evaluation of chemical ingredients in 21 nail product types. The analyses focused on Candidate Chemicals and other chemicals of interest based on their hazard traits and exposure potential. This study is not a comprehensive evaluation of all chemicals in nail products in California or the U.S.

General Objectives

This study had the following objectives:

- Determine the presence and concentration of Candidate Chemicals and other chemicals of interest in retail and professional-use nail products.
- Follow up on DTSC's 2012 nail product study and evaluate whether ingredients on labels are misreported.
- Support the identification of Priority Products and characterization of chemical ingredients in nail products.

Specific Research Questions

DTSC evaluated the following research questions throughout this analytical study of nail products:

- 1) What Candidate Chemicals are detected in nail products and at what concentrations?
- 2) What nail products contain toluene or other solvents, MMA, or formaldehyde and at what concentrations?
- 3) Is DBP still used in nail coating products where labels indicate otherwise?
- 4) What additional Candidate Chemicals can be tentatively identified by comparing the results to the National Institute of Standards and Technology (NIST) library?
- 5) What Candidate Chemicals are in products marketed to children?
- 6) Do ingredient labels accurately list the chemicals in products?
- 7) Are there different Candidate Chemicals or concentrations in professional versus retail products?
- 8) Do low-, mid-, and high-priced nail products contain different Candidate Chemicals or concentrations?
- 9) Have retailers (including Amazon, Walmart, Target, and others) met their public commitments to have manufacturers remove certain chemicals from nail products?
- 10) Do products that were found to contain DBP or toluene in DTSC's 2012 study still contain those chemicals?

PRODUCTS AND CHEMICALS EVALUATED

Nail Product Selection and Purchasing

DTSC chose the nail products tested in this lab study to represent a broad survey of nail products available in the California market. The products, which were purchased in 2019, were not of uniform size and volume. Nail products were chosen based on the following criteria:

- a product's utility in addressing the research questions outlined above;
- our ability to evaluate a variety of nail products representing a wide array of product types;
- ingredients listed on product labels or websites;
- products identified by stakeholder groups as containing chemicals of interest;
- marketing claims of being non-toxic, n-free, or safe for children;
- products marketed to or used by children;
- products from DTSC's 2012 nail product study; or
- availability.

Some products were chosen based on information provided by the following organizations and published studies:

- San Francisco Department of the Environment;
- California Healthy Nail Salon Collaborative;
- Women's Voices for the Earth;
- California Department of Public Health;
- National Resources Defense Council, Inc.;
- U.S. Food and Drug Administration study (Zhou et al. 2017); and
- Harvard School of Public Health study (Young et al. 2018).

SCP purchased nail products from various retail and beauty supply stores, including retail stores that have policies requiring manufacturers to restrict or remove certain chemicals from their products. While the majority of the products for this study were purchased online, SCP staff purchased a few retail products in person. This combination of online and in-person purchasing allowed SCP to obtain a selection of brands from a variety of manufacturers with varied product lines, including overseas manufacturers whose products are not as available in brick-and-mortar stores. See Appendix B for a complete list of the products purchased.

We purchased a total of 156 nail products from the following categories:

- Acrylic Liquid Monomer (8 items)
- Acrylic Powder (5 items)

- Airbrush Nail Art (5 items)
- Airbrush Cleaner (6 items)
- Airbrush Top Coat (3 items)
- Anti-Nail Bite products (5 items)
- Base Coat (9 items)
- Gel Polish (7 items)
- Hard Gel (5 items)
- Hardener (6 items)
- Multi-Functional (top coat and base coat) (4 items)
- Multi-Functional (top coat, base coat, and hardener) (4 items)
- Nail Art (2 items)
- Nail Dry Spray (5 items)
- Nail Glue (6 items)
- Nail Polish/Lacquer (34 items)
- Nail Prep Dehydrator (6 items)
- Nail Primer (6 items)
- Thinner (6 items)
- Top Coat (15 items)
- UV Gel Polish (9 items)

Each product category includes both retail and professional nail products and, when possible, products marketed to children and products marketed as non-toxic, n-free, or safe. These designations were made based on marketing claims or information provided on product websites or ingredient labels. As such, some products may not be characterized correctly.

The chemicals we are studying – the target analytes listed in Tables B1 and B2 in Appendix B – were chosen for analysis due to being known or suspected ingredients or contaminants in nail products and based on their ability to be measured with the analytical methods used.

ANALYTICAL METHODS

All nail product samples were analyzed using gas chromatography/mass spectrometry (GC/MS) instrumentation to separate, detect, and quantify formaldehyde, other volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs).

A detailed description of the sample preparation and analytical methods can be found in Appendix A.

RESULTS

Overview

SCP initially purchased and analyzed a total of 157 products, one of which we excluded from the results discussed below in this report because it was determined to be a duplicate. The justification for excluding the duplicate is further discussed below. We analyzed the products for 52 target analytes (see Tables B1 and B2 in Appendix B) and for tentatively identified compounds (TICs), using the methods described in Appendix A. Each of these methods had different quantitation limits (Table 1). Tables B1 and B2 in Appendix B list quantitation limits for each target analyte.

Table 1. List of analytical methods and quantitation limits.

Analytical Method	Quantitation Limits ($\mu\text{g}/\text{mL}$)
EPA 8270D with Formaldehyde derivatization	50 – 100 (100 $\mu\text{g}/\text{g}$ for powders)
EPA 8260C	12.5 – 250* (25 – 250 $\mu\text{g}/\text{g}$ for powders)
EPA 8270D	1,000 – 5,000 (998 – 5,000** $\mu\text{g}/\text{g}$ for powders)

*For one sample the quantitation limit was 3,120 $\mu\text{g}/\text{mL}$.

**Triphenyl phosphate had quantitation limits ranging from 4,990 – 5,000 $\mu\text{g}/\text{g}$.

The duplicate product in the initial sample of 157 products was OPI Start to Finish – Original Formula, with sample IDs of SCPNP 73 and SCPNP 132. Table 2 shows relative percentage differences of target analyte concentrations detected in the two samples. Based on the relative differences in percentage, the differences in concentration between the two samples were not significant, indicating that the concentrations of the detected analytes in the two samples were similar. This also indicates that, at least in some instances, there is minimal variability in chemical concentrations across the same product. Additionally, the concentration of toluene in both samples was low and close to or below the quantitation limit. Since toluene was detected in SCPNP 73 at a concentration higher than the quantitation limit (Table 2), and the differences in concentrations between the duplicate samples were not significant, DTSC decided to remove SCPNP132 from the results discussed in this report.

Table 2. Relative Percentage Differences of target analytes detected for SCPNP 73 and SCPNP 132.

Detected target analytes	SCPNP 73 concentration ($\mu\text{g}/\text{mL}$)	SCPNP 132 concentration ($\mu\text{g}/\text{mL}$)	Percent Relative Difference
Formaldehyde	4,760	5,160	8%
1-Butanol	8,710	8,730	0.2%
Butyl acetate	176,000	140,000	23%
r & s-Camphor	8,600	8,620	0.2%

Detected target analytes	SCPMP 73 concentration (µg/mL)	SCPMP 132 concentration (µg/mL)	Percent Relative Difference
Ethyl acetate	162,000	131,000	21%
Isopropyl alcohol (IPA)	44,600	45,000	0.9%
Triphenyl phosphate (TPhP)	15,000	14,500	3%
Toluene	35	ND*	--

*The reported concentration for toluene for SCPMP 132 was below a quantitation limit of 25 µg/mL.

In total, DTSC quantified 29 different target analytes in nail products (see Tables C1 to C21, Appendix C). Of these 29 analytes, 24 were Candidate Chemicals, (see Table D1, Appendix D). Of these 24 Candidate Chemicals, 19 were VOCs and 5 were SVOCs.

As shown in Appendix D - Table D1, there were 10 Candidate Chemicals with detections above 10,000 µg/mL. These are summarized in Table D2 along with the associated product categories. The chemicals with the highest concentrations were acetone (448,000 µg/mL) and ethyl acetate (473,000 to 571,000 µg/mL), which were detected in airbrush cleaners and nail primers, respectively. Ethyl acetate was also detected in other product categories, including gel polishes, hardeners, multifunctional products, nail art products, and thinners, with maximum concentrations of 337,000 µg/mL, 352,000 µg/mL, 315,000 µg/mL, 334,000 µg/mL, and 276,000 µg/mL, respectively. Chemicals detected at much lower concentrations (between 10,000 to 200,000 µg/mL) were 1-butanol, methyl ethyl ketone (MEK), acetone, DBP, ethyl paraben, isopropyl alcohol (IPA), toluene, and triphenyl phosphate (TPhP) (Table D2). Of these 8 chemicals, isopropyl alcohol and TPhP were found in multiple product types such as hardeners, multifunctional products, and top coats.

Table D3 in Appendix D summarizes Candidate Chemicals by product category, detected at concentration ranges between 1,000 to 10,000 µg/mL. These include 1-butanol (6,530 µg/mL), acetonitrile (3,580 µg/mL), ethylbenzene (7,070 µg/mL), formaldehyde (5,160 µg/mL), IPA (9,520 µg/mL), and MMA (4,800 µg/mL), which were detected in nail glues, anti-nail bite products, hardeners, multifunctional products, and UV gel polishes.

Further, as shown in Table D1, we detected some Candidate Chemicals at wide ranging concentrations between 10,000 and greater than 100,000 µg/mL, such as ethyl paraben and MEK, which were detected in anti-nail bite products at concentrations ranging from 30,000 to 126,000 µg/mL and 65,600 to 176,000 µg/mL, respectively.

Nail Products Containing Toluene, Methyl Methacrylate, or Formaldehyde

DTSC has been concerned about the presence of toluene, MMA, and formaldehyde in nail products. These chemicals are commonly used in nail products because of their widespread functional uses;

toluene is used as a solvent, MMA functions as an artificial nail builder, and formaldehyde acts as a hardener by bonding to the keratin in nails (Zhou et al. 2016; FDA 2020). These three chemicals cause adverse health impacts such as irritation of the throat, nose, and skin. Toluene and formaldehyde in particular have been detected in the indoor of nail salons at concentrations above recommended levels set by the National Institute for Occupational Safety and Health (NIOSH) and the Office of Environmental Health Hazard Assessment (OEHHA) (McNary and Jackson 2007; Quach et al. 2011; Alaves et al. 2013; NIOSH 2019). It is because of these concerns that DTSC evaluated detections of toluene, MMA, and formaldehyde in nail products. This data is presented below along with comparisons with other studies of nail products that have measured concentrations of these three chemicals.

Toluene

We detected toluene in 27 out of 156 nail products (17%) at concentrations ranging from 31 to 187,000 µg/mL in a wide range of product types such as acrylic liquid monomers, airbrush top coats, hardeners, and hard gels, with the highest concentration found in an airbrush top coat (187,000 µg/mL) (Table 3). Product types with the most toluene detects were top coats (5 products), UV gel polishes (3 products), and multifunctional products (3 products).

A comparison of the data in Table 3 with other studies indicates two important differences. First, while other studies have reported toluene in nail polishes (DTSC 2012; NIOSH 2019), none of the nail polish/lacquers we tested contained toluene. Second, while this study and another study by Zhou et al. (2016) detected toluene in nail art, base coats, thinners, top coats, gels, and removers, Table 3 shows that this study detected toluene in additional product categories, including acrylic liquid monomers, airbrush top coats, anti-nail bite products, hardeners, hard gels, multifunctional products, nail prep dehydrators, nail glues, and nail primers.

Our testing also detected toluene at concentrations below 500 µg/mL in several products; potentially indicating that the chemical may be present at contaminant levels in these products (Table 3). Additionally, three of the products with toluene detects had marketing claims of either “non-toxic” or “toluene-free.” These included a nail prep dehydrator and two UV gel polishes. These products had toluene concentrations of 2,700 µg/mL, 57 µg/mL, and 44 µg/mL, respectively. This finding is an indication that at least some marketing claims continue to be inaccurate.

Table 3. Toluene Test Results of Nail Products.

Product Type	Product Name	Concentration	Toluene-related Marketing Claims
Acrylic Liquid Monomer	Gelish Hand & Nail Harmony ProHesion Nail Sculpting Liquid	33 µg/mL	--
	Mia Secret Liquid Monomer	33 µg/mL	--

Product Type	Product Name	Concentration	Toluene-related Marketing Claims
Airbrush Top Coat	Tammy Taylor Airbrush Top Coat	187,000 µg/mL	--
	U2 Airbrush Topcoat	117,000 µg/mL	--
Anti-nail Bite Product	Orly No Bite Nail Bite Deterrent	94 µg/mL	--
Hardener	Perfect Formula Pink Gel Coat	169 µg/mL	--
	Quimica Alemana Nail Hardener	161,000 µg/mL	--
Hard Gel	Gelish Hard Gel LED Clear Nail Gel	51 µg/mL	--
	LeChat Pro-Tec UV Gel System - Clear	32 µg/mL	--
Multifunctional (top coat, base coat, and hardener)	OPI Start To Finish - Original Formula	35 µg/mL	--
	LA Colors Nail Treatment Triple Play	31 µg/mL	--
	Nail-Aid 3-in-1 Gel Base +Top Coat + Hardener	890 µg/mL	Toluene-free; Non-Toxic
Nail Art	L.A. Colors Art Deco Nail Art - Limon	106 µg/mL	--
Nail Glue	5 Second Brush On Nail Glue	114 µg/mL	--
Nail Prep Dehydrator	Lily Angel Prep Step Nail Dehydrator	2,700 µg/mL	Non-toxic
Nail Primer	Chéri Bonding Primer Non-Acid (Acrylics & Hard Gels)	35 µg/mL	--
	Mia Secret Xtra Bond Primer	36 µg/mL	--
Thinner	Seche Restore Restoration Thinner	167,000 µg/mL	--
	QT Polish Thinner	176,000 µg/mL	--
Top Coat	CND Vinylux Longwear Top Coat	42 µg/mL	--
	Seche Vive Instant Gel Effect Top Coat	132,000 µg/mL	--
	Lex 45 Second Top Coat	409 µg/mL	--
	QT 45 Second Top Coat	7,320 µg/mL	--
	Seche Vite Dry Fast Top Coat	87,200 µg/mL	--
UV Gel Polish	Elite99 Gel Polish Soak-Off Gel Polish - Conch Shell 674	57 µg/mL	Non-toxic
	Gelish Soak-Off Gel Polish - No Sudden Mauves	55 µg/mL	--
	LeChat Perfect Match Ultra-Thin Varnish Base Gel	44 µg/mL	Toluene-free

*Reported concentrations are in µg/mL for liquids and µg/g for powders.

Methyl Methacrylate

We detected MMA in 33 of 156 nail products (21%), with concentrations ranging from 26 to 8,760 µg/mL in several product categories and 38 to 453 µg/g in acrylic powders (Table 4). MMA concentrations were higher in acrylic liquid monomers than in other product categories, with Mia Secret Liquid Monomer containing the highest concentration (8,760 µg/mL). We also measured elevated concentrations of MMA in an anti-nail bite product and a multifunctional product. Lower MMA concentrations (less than 400 µg/mL) were detected in nail glues, nail polish/lacquers, nail primers, UV gel polishes, hard gels, and top coats, which may indicate that MMA is either present as a residual or as a contaminant in these products. These findings are different from the results of DTSC’s information call-in request, where MMA was only reported in a total of four nail products – in two acrylic liquid monomers at concentrations between 75 and 100% and in two traditional nail polishes as a contaminant or residual with concentrations ranging from 0 to 0.1% (DTSC 2023a).

In addition, we detected MMA in four products that had marketing claims of “non-toxic” or “MMA free.” Two acrylic liquid monomers were labeled as “MMA-free” and had high MMA concentrations (3,260 µg/mL and 3,580 µg/mL, respectively). A UV gel polish and an anti-nail bite product were labeled as “non-toxic” and had MMA concentrations of 72 µg/mL and 2,410 µg/mL, respectively.

Table 4. MMA Test Results of Nail Products.

Product Type	Product Name	Concentration*	MMA-related Marketing Claims
Acrylic Liquid Monomer	Cácee Smooth Set Perfect Liquid	3,260 µg/mL	MMA-free
	Sassi Odorless Acrylic Liquid	102 µg/mL	--
	CND Retention+ Sculpting Liquid	1,650 µg/mL	--
	Gelish Hand & Nail Harmony ProHesion Nail Sculpting Liquid	5,010 µg/mL	--
	Tammy Taylor Nail Liquid - Original	3,580 µg/mL	MMA-free
	Ezflow Maximum Adhesion Q Monomer	2,900 µg/mL	--
	KISS Acrylic Liquid	1,840 µg/mL	--
	Mia Secret Liquid Monomer	8,760 µg/mL	--
Acrylic Powder	Beauty Secrets Acrylic Nail Powder	374 µg/g	--
	Glam and Glits Color Pop Acrylic Collection - Wet Suit-353 (Blue)	38 µg/g	--
	Mia Secret Clear Acrylic Powder	205 µg/g	--
	KISS Acrylic Powder - Clear	453 µg/g	--

Product Type	Product Name	Concentration*	MMA-related Marketing Claims
Airbrush Top Coat	Tammy Taylor Airbrush Top Coat	2,470 µg/mL	--
	U2 Airbrush Topcoat	392 µg/mL	--
Anti-nail Bite Product	Magique NoBite Stop Nail Biting & Thumb Sucking Aid	2,410 µg/mL	Non-toxic
	Orly No Bite Nail Bite Deterrent	63 µg/mL	--
Hard Gel	LeChat Pro-Tec UV Gel System - Clear	90 µg/mL	--
Multifunctional (top coat and base coat)	Mia Secret Luxury UV Base & Top Gel	4,800 µg/mL	--
Nail Glue	Ibd 5 Second Brush On Nail Glue	88 µg/mL	--
	Kiss Brush-On Nail Glue	37 µg/mL	--
	Mia Secret Strong-Jet Clear Nail Glue	35 µg/mL	--
	5 Second Brush On Nail Glue	92 µg/mL	--
	Kiss Powerflex Nail Glue	58 µg/mL	--
Nail Polish/Lacquer	Prim and Pure Fruit and Veggie Nail Polish - Mermaid Tail	26 µg/mL	--
	DND Nail Laquer - Golden Sahara Star #401	26 µg/mL	--
Nail Primer	SuperNail Nail Primer	355 µg/mL	--
Top Coat	Cácee Sun Protection Top Coat	35 µg/mL	--
UV Gel Polish	Elite99 Gel Polish Soak-Off Gel Polish - Conch Shell 674	72 µg/mL	Non-toxic
	CND Shellac Color Coat - Winter Glow	621 µg/mL	--
	LeChat Perfect Match Ultra-Thin Varnish Base Gel	140 µg/mL	--
	OPI Gel Color - Funny Bunny	33 µg/mL	--
	OPI Gel Color - Pink Ladies Rule the School	26 µg/mL	--
	DND Gel Polish - Golden Sahara Star #401	27 µg/mL	--

*Reported concentrations are in µg/mL for liquids and µg/g for powders.

Formaldehyde

We detected formaldehyde in 35 of 156 nail products (22%) at concentrations ranging from 50 to 15,600 µg/mL, except for acrylic powders, where concentrations ranged from 110 to 230 µg/g (Table 5). The highest concentrations were in hardeners (2,700 µg/mL, 8,390 µg/mL, and 15,600 µg/mL). High formaldehyde concentrations were also found in other products, including nail polish/lacquers (1,120 µg/mL and 1,440 µg/mL), airbrush nail art (1,350 µg/mL), and multifunctional products (4,760 µg/mL). Formaldehyde was also detected at contaminant levels (concentrations below 600 µg/mL and 500 µg/g) in several products such as nail polish/lacquers, acrylic powders, and nail glues.

DTSC's more recent information call-in request yielded some similar results. In the July 2022 call-in, formaldehyde was reported predominantly as a contaminant or residual in traditional nail polishes, removers, top coats, base coats, gel polishes, gel top coats, primers, UV base coats and top coats, and UV gel polishes (DTSC 2023a). Table 5 shows that, our lab study detected formaldehyde at contaminant levels in some of the same product categories, with the exception of removers, base coats, gel top coats, primers, and UV base coats and top coats. In addition to the product categories highlighted in the information call-in request, this analytical laboratory study also detected, formaldehyde at contaminant levels in acrylic powders, airbrush cleaners, some airbrush nail art products, hard gels, nail art products, and nail glues. Further, in DTSC's information call-in request, the only reports of formaldehyde as a hardener and cross-linker were in in nail treatments and nail strengtheners, with concentrations ranging from 1 to 5% (DTSC 2023a). As shown in Table 5, our lab study did not detect formaldehyde in nail treatments and nail strengtheners; as indicated above, hardeners were the only product category that had the highest concentration of formaldehyde.

Additionally, five products were labeled as "formaldehyde-free" but had formaldehyde concentrations ranging from 51 to 4,760 µg/mL. Three products, categorized as airbrush nail art, were also labeled "non-toxic" but had formaldehyde detections, with concentrations of 82 µg/mL, 215 µg/mL, and 1,350 µg/mL.

Table 5. Formaldehyde Test Results of Nail Products.

Product Type	Brand	Product Name	Concentration*	Formaldehyde-related Market Claims
Acrylic Powder	Beauty Secrets	Beauty Secrets Acrylic Nail Powder	142 µg/g	--
	Glam and Glits	Glam and Glits Color Pop Acrylic Collection - Wet Suit-353 (Blue)	230 µg/g	--

Product Type	Brand	Product Name	Concentration*	Formaldehyde-related Market Claims
	Mia Secret	Mia Secret Clear Acrylic Powder	110 µg/g	--
	Young Nails	Young Nails Acrylic Nail Powder - French Pink	132 µg/g	--
	Kiss	KISS Acrylic Powder - Clear	132 µg/g	--
Airbrush Cleaner	Vallejo	Vallejo Airbrush Cleaner	490 µg/mL	--
Airbrush Nail Art	Custom Body Art	Custom Body Art Water Based Acrylic Formulation Airbrush Nail Paint - Pink 100252	215 µg/mL	Non-toxic
	OPHIR	OPHIR Airbrush Ink - Fluorescent Rose	1,350 µg/mL	Non-toxic
	Mist	Mist Airbrush Nail Color - Pearly Purple	82 µg/mL	Non-toxic
Gel Polish	Pink Armor	Pink Armor Nail Gel	50 µg/mL	--
Hardener	Perfect Formula	Perfect Formula Pink Gel Coat	2,700 µg/mL	--
	Probelle	Probelle Nail Hardener Formula 1	15,600 µg/mL	--
	Quimica Alemana	Quimica Alemana Nail Hardener	14,100 µg/mL	--
	OPI	OPI Nail Envy Nail Strengthener Original Formula Maximum-Strength	8,390 µg/mL	--
Hard Gel	Gelish	Gelish Hard Gel LED Clear Nail Gel	76 µg/mL	--
Multi-functional (top coat, base coat, and hardener)	OPI	OPI Start to Finish – Original Formula	4,760 µg/mL	Formaldehyde-free
Nail Art	L.A. Colors	L.A. Colors Art Deco Nail Art - Limon	92 µg/mL	--

Product Type	Brand	Product Name	Concentration*	Formaldehyde-related Market Claims
Nail Glue	Artisan	Artisan Instant Bond Super Fast Nail Glue	177 µg/mL	--
	IBD	Ibd 5 Second Brush On Nail Glue	215 µg/mL	--
	Kiss	Kiss Brush-On Nail Glue	516 µg/mL	--
	Mia Secret	Mia Secret Strong-Jet Clear Nail Glue	218 µg/mL	--
	5 Second	5 Second Brush On Nail Glue	232 µg/mL	--
	Kiss	Kiss Powerflex Nail Glue	94 µg/mL	--
Nail Polish/Lacquer	Elite Pro Beauty	Elite Pro Beauty Glam Colors Nail Polish - Gold Sparkle	118 µg/mL	--
	iGlow	iGlow! Nail Polish - sparkly pink	231 µg/mL	--
	Prim and Pure	Prim and Pure Fruit and Veggie Nail Polish - Mermaid Tail	51 µg/mL	Formaldehyde-free
	China Glaze	China Glaze Nail Polish with Hardener - The Heat is On	1,120 µg/mL	Formaldehyde-free
	ibd	ibd Nail Lacquer - So in Love	1,440 µg/mL	--
	Zoya	Zoya Professional Lacquer - Lola	230 µg/mL	Formaldehyde-free
	Daisy DND	DND Nail Laquer - Golden Sahara Star #401	59 µg/mL	--
Top Coat	Tammy Taylor Nails, Inc.	Tammy Taylor Nail Lacquer - Clear	563 µg/mL	Formaldehyde-free
	CND	CND Vinylux Weekly Top Coat (New Formula)	264 µg/mL	--
UV Gel Polish	OPI	OPI Gel Color Soak-Off Soluble - Polly Want a Lacquer	137 µg/mL	--
		OPI Gel Color - Pink Ladies Rule the School	75 µg/mL	--
	Sensationail	Sensationail Polish to Gel	51 µg/mL	--

*Reported concentrations are in µg/mL for liquids and µg/g for powders.

Other Candidate Chemicals Present in Nail Products

In addition to toluene, MMA, and formaldehyde, we detected other CCs, as shown in Table 6 and Table D1 in Appendix D. Table 6 lists Candidate Chemicals by number of detections in nail products.

Ethyl acetate, a common solvent in nail products, was the most frequently detected CC and was found at high concentrations in airbrush top coats, anti-nail bite products, base coats, gel polishes, hardeners, nail art, and multifunctional products (top coats, base coats, and hardeners) (Tables 6 and D1). The highest concentration of ethyl acetate was in nail prep dehydrators (maximum concentration of 716,000 µg/mL). Nail prep dehydrators, which typically contain ingredients such as ethyl acetate, are used during nail preparation to remove moisture from nails.

Acetone, 1-butanol, and IPA, which are also commonly found solvents in nail products, were the next most frequently detected Candidate Chemicals (Table 6). High concentrations of these chemicals were found in many product categories such as airbrush cleaners, gel polishes, and hardeners (Table D1).

Less frequently detected CCs include acetonitrile, TPhP, meta & para-xylene, dimethyl-p-toluidine (DMPT), N-methyl-2-pyrrolidinone (NMP), tetrahydrofuran, and DBP (Table 6). These chemicals typically function as solvents, nail conditioning agents, and plasticizers. Acetonitrile was found at high concentrations (greater than 1,000 µg/mL) in several product categories, including acrylic liquid monomers, anti-nail bite products, gel polishes, hardeners, and nail polish/lacquers; the highest concentration of acetonitrile was in thinners (98,800 µg/mL) (Table D1). TPhP was found at high concentrations in one anti-nail bite product (46,100 µg/mL), and NMP was detected in one nail polish/lacquer at a concentration of 39,000 µg/mL. High concentrations of meta and para-xylene and DMPT were found in hardeners and acrylic liquid monomers (34,300 µg/mL and 11,300 µg/mL) (Table 6 and Table D1). Tetrahydrofuran was only found in one top coat, at a concentration of 222 µg/mL, and DBP was only detected in one nail hardener, at a concentration of 51,100 µg/mL.

Table 6. Other Candidate Chemical Detections.

Chemical Name	CAS RN	Number of Detections
Ethyl acetate	141-78-6	112
Acetone	67-64-1	92
1-Butanol	71-36-3	85
Isopropyl alcohol (IPA)	67-63-0	82
Acetonitrile	75-05-8	23
Triphenyl phosphate (TPhP)	115-86-6	16
meta & para-Xylene	179601-23-1	11
Ethylbenzene	100-41-4	10

Chemical Name	CAS RN	Number of Detections
Methyl ethyl ketone (MEK)	78-93-3	9
tert-Butyl alcohol (TBA)	75-65-0	9
Benzene	71-43-2	8
Dimethyl-p-toluidine (DMPT)	99-97-8	8
ortho-Xylene	95-47-6	8
Methylene chloride	75-09-2	5
N-Ethyl-2-pyrrolidinone (NEP)	2687-91-4	4
N-Methyl-2-pyrrolidinone (NMP)	872-50-4	2
Methyl isobutyl ketone (MIBK)	108-10-1	2
Ethyl paraben	120-47-8	2
1,3,5-Trimethylbenzene	108-67-8	1
Di-n-butyl phthalate (DBP)	84-74-2	1
Tetrahydrofuran	109-99-9	1

Tentatively Identified Compounds (TICs)

DTSC qualitatively evaluated 154 tentatively identified compounds (TICs) in these same nail products, of which 89 were VOCs and 65 were SVOCs, using the NIST/EPA/NIH mass spectral library (see Table E1, Appendix E). Of the 89 VOC TICs, 13 were Candidate Chemicals, and of the 65 SVOC TICs, 10 were Candidate Chemicals.

Table 7 lists these detected VOC and SVOC Candidate Chemical TICs by number of detections. The most frequently detected VOC Candidate Chemical TICs were heptane, acrylonitrile, isopropyl benzene, butane, and methyl acrylate. Among SVOC Candidate Chemical TICs, isophorone diisocyanate, phthalic dianhydride, and ethylene glycol monobutyl ether were the most frequently detected.

Table 7. Detected TICs in nail product samples – Candidate Chemical VOCs and SVOCs.

VOC TICs			SVOC TICs		
Chemical Name	CASRN	Number of detections	Chemical Name	CASRN	Number of detections
Heptane	142-82-5	7	Isophorone diisocyanate	4098-71-9	9
Acrylonitrile	107-13-1	3	Phthalic anhydride	85-44-9	5
Isopropyl benzene	98-82-8	3	Ethylene glycol monobutyl ether	111-76-2	3
Methyl acrylate	96-33-3	3	Decamethylcyclotetrasiloxane (D5)	541-02-6	3
Butane	106-97-8	3	Ethyl methanesulfonate	62-50-0	2
Isobutane	75-28-5	2	Diethylene glycol dimethyl ether	111-96-6	1
Ethyl acrylate	140-88-5	2	Oxybenzone	131-57-7	1
n-Hexane	110-54-3	2	Pyromellitic dianhydride	89-32-7	1
Octamethylcyclotetrasiloxane (D4)	556-67-2	1	α -Methyl styrene	98-83-9	1
1,2-Dichloroethane	107-06-2	1	Octamethylcyclotetrasiloxane (D4)*	556-67-2	1
Vinyl acetate	108-05-4	1	--	--	--
1-Butanol	71-36-3	1	--	--	--
2-Ethylhexyl acrylate	103-11-7	1	--	--	--

*D4 was detected as both a VOC and SVOC TIC

Tables E2 and E3, Appendix E, list estimated concentrations for VOC and SVOC Candidate Chemical TICs, respectively. For VOC Candidate Chemicals, DTSC estimated concentrations greater than 1,000 µg/mL of butane, heptane, methyl acrylate, isobutane, and octamethylcyclotetrasiloxane (D4) in nail dry sprays, base coats, multifunctional products, and one UV gel polish (see Table E2 in Appendix E). Among SVOC Candidate Chemicals, DTSC estimated concentrations above 1,000 µg/mL of diethylene glycol dimethyl ether, phthalic anhydride, and isophorone diisocyanate in 26 products representing multiple product categories, including acrylic liquid monomers, airbrush cleaners, airbrush nail art products and airbrush top coats (see Table E3 in Appendix E).

Among the VOC Candidate Chemical TICs detected at concentrations greater than 1,000 µg/mL, heptane is commonly used as a solvent, while butane and isobutane function as propellants in cosmetic products (EC 2022a; EC 2022b; EC 2022c). Although heptane is listed by the Centers for Disease Control and Prevention's (CDC) Fourth National Exposure Report on Human Exposure to Environmental Chemicals, there are no clear hazard traits; however, butane and isobutane are listed by the European Commission (EC) Annex VI as category 1A carcinogens and 1B genotoxicants because 1,3-butadiene may be present as a contaminant in butane and isobutane. 1,3-butadiene is listed as a carcinogen and genotoxicant by numerous authoritative bodies (DTSC 2022a; DTSC 2022b). D4, similar to heptane, is a solvent and is known to be a reproductive toxicant and can bioaccumulate (DTSC 2022c; EC 2022d). Further, although no functional use data is available for methyl acrylate, it is listed as a carcinogen by OEHHA and the EC Annex VI as a category 1A carcinogen (DTSC 2023b).

Among the SVOC Candidate Chemical TICs with estimated concentrations higher than 1,000 µg/mL, diethylene glycol dimethyl ether functions as a solvent, and isophorone diisocyanate is used as a film former in cosmetic products (EC 2022e; EC 2022f). While there is no functional use data for phthalic anhydride, it is listed as part of polymer ingredients in many of the nail product samples. Diethylene glycol dimethyl ether, isophorone diisocyanate, and phthalic anhydride are listed by many authoritative bodies as reproductive toxicants, respiratory toxicants, and dermatotoxicants, respectively (DTSC 2022d; DTSC 2022e; DTSC 2022f).

The majority of the Candidate Chemical TICs we detected in nail products (18 of 23) were not listed on ingredient labels (Table 8 below).

The same was true of non-Candidate Chemical TICs; the majority (105 out of 131) were not present on ingredient labels (see Table E4, Appendix E). In fact, we detected non-Candidate Chemical TICs more frequently when they were not on ingredient labels than when they were, with the exception of 2,2,4-trimethyl-1,3-pentanediol diisobutyrate, acetyl tributyl citrate, hydroxycyclohexyl phenyl ketone, ethyl 2-cyano-3,3-diphenylacrylate, and 1,1,1-trimethylolpropane trimethacrylate.

These findings indicate that ingredient labels are inaccurate for TICs, both Candidate Chemical TICs and non-Candidate Chemical TICs. A more in-depth discussion of ingredient label accuracy with Candidate

Chemical target analytes is found in the section titled [Comparison of Chemicals Detected with Ingredients on Labels](#).

Table 8. Candidate Chemical TICs not listed on ingredient labels.

Product Type	Product Name	TIC Name	Estimated Concentration (µg/mL)
Airbrush Cleaner	U.S. Art Supply AC Water Based Airbrush Cleaning Solution	Isophorone diisocyanate	9,572
	Vallejo Airbrush Cleaner	Ethylene glycol monobutyl ether	56,132
Airbrush Nail Art	Holbein Aeroflash Color - Carmine (E002)	Ethylene glycol monobutyl ether	876
Airbrush Top Coat	Badger Air-Opaque Non-Yellowing Transparent Clear Coat Airbrush Finish	Ethylene glycol monobutyl ether	12,370
Base Coat	Essie Here to Stay Base Coat	Heptane	60
Gel Polish	Essie Gel Couture Nail Polish - Fairy Tailor	Phthalic anhydride	1,998
Hard Gel	Gelish Hard Gel LED Clear Nail Gel	Isophorone diisocyanate	3,300
	LeChat Pro-Tec UV Gel System - Clear	Methyl acrylate	100
	NSI Balance UV Gel System - Body Builder Cover Pink Warm	Isophorone diisocyanate	8,118
Multi-functional (top coat, base coat and hardener)	LA Colors Nail Treatment Triple Play	Phthalic anhydride	1,574
Nail Dry Spray	Onyx Professional Nail Dryer - Island Coconut Scent	Isobutane	8,192
Nail Glue	5 Second Brush On Nail Glue	Ethyl methanesulfonate	3,740
	Artisan Instant Bond Super Fast Nail Glue	Acrylonitrile	31
	Ibd 5 Second Brush On Nail Glue	Acrylonitrile	54
		Ethyl methanesulfonate	3,898
	Kiss Brush-On Nail Glue	Butane	27

Product Type	Product Name	TIC Name	Estimated Concentration (µg/mL)
	Mia Secret Strong-Jet Clear Nail Glue	Acrylonitrile	43
Nail Polish/Lacquer	DND Nail Lacquer - Golden Sahara Star #401	Phthalic anhydride	1,356
	Elite Pro Beauty Glam Colors Nail Polish - Lavender	1,2-Dichloroethane	52
		Vinyl acetate	203
	IBN Vegan Varnish – Pink	Diethylene glycol dimethyl ether	2,064
		Isophorone diisocyanate	2,722
	L.A. Colors Color Craze Nail Polish with Hardeners - Glistening Purple	Phthalic anhydride	1,492
Prim and Pure Fruit and Veggie Nail Polish - Mermaid Tail	2-Ethylhexyl acrylate	47	
	alpha-Methylstyrene	1,038	
Nail Primer	Chéri Bonding Primer Non-Acid (Acrylics & Hard Gels)	Isopropyl benzene	53
	ibd UV Bonder	Phthalic anhydride	60,126
	Kiss Acrylic Primer	Pyromellitic dianhydride	5,252
	Mia Secret Xtra Bond Primer	Isopropyl benzene	55
	Sensationail Gel Primer	Isopropyl benzene	60
Ethyl acrylate		33	
Thinner	U2 Polish Thinner	n-Hexane	81
Top Coat	CND Vinylux Weekly Top Coat (New Formula)	Isophorone diisocyanate	2,450
	CND Vinylux Weekly Top Coat (Original Formula)	Isophorone diisocyanate	4,428
	CND Shellac Color Coat - Winter Glow	n-Hexane	28

Product Type	Product Name	TIC Name	Estimated Concentration (µg/mL)
UV Gel Polish	LeChat Perfect Match Ultra-Thin Varnish Base Gel	Ethyl acrylate	28
		Isophorone diisocyanate	27,010
		Methyl acrylate	193
	OPI Gel Color Soak-Off Soluble - Polly Want a Lacquer	Isophorone diisocyanate	2,486
	OPI Gel Color - Pink Ladies Rule the School	Isophorone diisocyanate	6,786
	Sensationail Polish to Gel	Methyl acrylate	1,250

Comparison of DTSC’s 2012 and Current Nail Products Lab Studies

In 2012, DTSC conducted a limited lab study of 25 nail products. Among other objectives, it investigated the accuracy of “3-free” claims (DTSC 2012). Products labeled as “3-free” should theoretically be free of toluene, formaldehyde, and DBP, which are collectively referred to as the “toxic trio.” Of the 25 nail products tested in 2012, seven made “3-free” claims, but only two were actually free of these three compounds (DTSC 2012).

In DTSC’s current study, we retested four of the products tested in 2012 – the only products available for purchase (China Glaze Nail Polish with Hardener, LeChat Dare to Ware Nail Polish, Zoya Professional Nail Polish, and OPI Nail Lacquer) – with a focus on verifying whether toluene or DBP was present. In the analysis presented in Table 9, formaldehyde detections are not compared with each other, because in the 2012 analytical laboratory study, formaldehyde was detected below the reporting limits for VOC analysis (120,000 to 62,000,000 µg/kg). It is important to note that, since there appear to be differences in product names, DTSC sought to purchase similar types of products from the same company. For instance, we tested a silver-colored OPI Nail Lacquer (Birthday Babe) in 2012 and, for the current study, purchased a similar product type from the same company that was labeled OPI Classic Nail Lacquer Gelato on Mind and was light blue in color. As shown in Table 9, toluene was detected in two of the four nail products in the 2012 lab study – China Glaze Nail Polish with Hardener, and LeChat Dare to Ware Nail Polish. In the current study, none of the four similar products contained toluene. Additionally, no DBP was detected in these products in either study.

Table 9. Comparisons of the concentrations of toluene and DBP in DTSC's current and 2012 studies.

Product Name		Chemical	Reported Concentration	
2012 Lab Study	Current Lab Study		2012 Lab Study	Current Lab Study
China Glaze Nail Polish with Hardener	China Glaze Nail Polish with Hardener – The Heat is On	Di-n-butyl phthalate	ND	ND
		Toluene	110,000 µg/kg	ND
LeChat Dare to Ware Nail Polish	Le Chat Dare to Ware Nail Polish – Nude Affair	Di-n-butyl phthalate	ND	ND
		Toluene	1,800,000 µg/kg	ND
Zoya Professional Nail Polish	Zoya Professional Lacquer - Lola	Di-n-butyl phthalate	ND	ND
		Toluene	ND	ND

Product Name		Chemical	Reported Concentration	
2012 Lab Study	Current Lab Study		2012 Lab Study	Current Lab Study
OPI Nail Lacquer	OPI Classic Nail Lacquer Gelato on Mind	Di-n-butyl phthalate	ND	ND
		Toluene	ND	ND

The quantitation limits for toluene were 120,000 to 62,000,000 µg/kg in the 2012 lab study and 12.5 to 250 µg/mL in the current study. The quantitation limits for DBP were 9,300 to 6,200,000 mg/kg in the 2012 lab study and 998 to 1,000 µg/mL in the current study.

Candidate Chemicals in Nail Products Marketed to Children

Seventeen of the 156 products analyzed for this study were either marketed for use by children or labeled as “safe” for children and pregnant women, with the majority being nail polish/lacquers (11 products) and anti-nail bite products (5 products) (Table 10). Specifically, six of these products made marketing claims of “non-toxic,” two of which were also labeled “safe for pregnancy” – nail polish/lacquers IBN Vegan Varnish and Pink and Piggy Paint – Angel Kisses.

As shown in Table 11, we detected 15 Candidate Chemicals in nail products marketed to children. N-Ethyl-2-pyrrolidinone (NEP) and NMP were found in IBN Vegan Varnish – Pink (11,400 µg/mL for NEP and 1,650 µg/mL for NMP). NMP was detected at a concentration of 39,000 µg/mL in Piggy Paint – Angel Kisses. Both of these products made marketing claims of “non-toxic” and “safe for pregnancy.” The remaining four products with claims of “non-toxic” on their labels had detects of at least one of the following: 1-butanol, IPA, NEP, TPhP, ethyl acetate, MMA, and ethyl paraben (Tables 10 and 11). In products with no additional marketing claims, high concentrations (greater than 1,000 µg/mL) of ethyl acetate, 1-butanol, IPA, TPhP, and MEK were detected in some nail polishes/lacquers and in one nail art product (Table 21). Concentrations lower than 800 µg/mL of several chemicals such as acetone, meta and para-xylene, and formaldehyde were also detected, including in products with claims of “non-toxic” or “‘non-toxic’ and ‘safe for pregnancy’” (Tables 10 and 11).

Table 10. Nail Products Marketed for Use by Children.

Product Type	Brand	Product Name	Additional Marketing Claims
Nail Polish/Lacquer	IBN	IBN Vegan Varnish - Pink	Non-toxic; safe for pregnancy
	Piggy Paint	Piggy Paint - Angel Kisses	Non-toxic; safe for pregnancy
	ella + mila	ella + mila Nail Polish, Me Collection - Pretty Princess	--
	Sephora Collection	Sephora Collection Hello Kitty Liquid Nail Art Nail - Minty	--
	OPI	OPI Nail Laquer, Hello Kitty Collection - Spoken From The Heart	--
	Disney Princess	Disney Princess Nail Art Collection Nail Polish - Cinderella Turquoise	--
	Prim and Pure	Prim and Pure Fruit and Veggie Nail Polish - Mermaid Tail	--
	Priti NYC	Priti Princess Polish - Mermaid Blue	Non-toxic
	Emosa	Emosa Water Based Nail Polish - Orange	Non-toxic
	Monster High	Monster High Ghoulicious Have a Bolt Fangtastic Nail Polish	--
	iGlow	iGlow! Nail Polish - sparkly pink	--
Anti-nail Bite Product	SuperNail	SuperNail Bite No More	--
	Probelle	Probelle Anti-Bite Base Coat	--
	Orly	Orly No Bite Nail Bite Deterrent	--
	Magique	Magique NoBite Stop Nail Biting & Thumb Sucking Aid	Non-toxic
		Magique NoBite Bitter Additive	Non-toxic
Nail Art	Sassy + Chic	Sassy + Chic Nail Art Pen - Raspberry Scent	--

Table 11. Reported Candidate Chemical Concentrations ($\mu\text{g}/\text{mL}$) in Products Marketed for Use by Children.

Product Name	N-Ethyl-2-pyrrolidinone	N-Methyl-2-pyrrolidinone	Acetone	1-Butanol	Methyl ethyl ketone	Isopropyl alcohol	Acetonitrile	Triphenyl phosphate	meta & para-Xylene	Ethylbenzene	tert-Butyl alcohol	Ethyl acetate	Formaldehyde	Methyl methacrylate	Ethyl paraben
IBN Vegan Varnish - Pink	11,400	1,650	344	--	--	--	--	--	--	--	--	--	--	--	--
Piggy Paint - Angel Kisses	--	39,000	169	--	--	--	--	--	--	--	--	--	--	--	--
Ella + mila Nail Polish, Me Collection - Pretty Princess	--	--	727	927,000	--	45,000	--	--	--	--	--	--	--	--	--
Sephora Collection Hello Kitty Liquid Nail Art Nail - Minty	--	--	314	30,700	--	20,600	--	--	--	--	--	--	--	--	--
OPI Nail Laquer, Hello Kitty Collection - Spoken From The Heart	--	--	241	24,500	--	50,800	--	29,200	91	25	--	--	--	--	--

Product Name	N-Ethyl-2-pyrrolidinone	N-Methyl-2-pyrrolidinone	Acetone	1-Butanol	Methyl ethyl ketone	Isopropyl alcohol	Acetonitrile	Triphenyl phosphate	meta & para-Xylene	Ethylbenzene	tert-Butyl alcohol	Ethyl acetate	Formaldehyde	Methyl methacrylate	Ethyl paraben
Disney Princess Nail Art Collection Nail Polish - Cinderella Turquoise	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Prim and Pure Fruit and Veggie Nail Polish - Mermaid Tail	--	--	--	--	--	665	--	--	--	--	--	--	51	26	--
Priti Princess Polish - Mermaid Blue	--	--	476	13,600	--	13,200	--	--	--	--	--	156,000	--	--	--
Emosa Water Based Nail Polish - Orange	53,400	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Monster High Ghoulicious Have a Bolt	--	--	151	--	--	--	--	--	--	--	--	43	--	--	--

Product Name	N-Ethyl-2-pyrrolidinone	N-Methyl-2-pyrrolidinone	Acetone	1-Butanol	Methyl ethyl ketone	Isopropyl alcohol	Acetonitrile	Triphenyl phosphate	meta & para-Xylene	Ethylbenzene	tert-Butyl alcohol	Ethyl acetate	Formaldehyde	Methyl methacrylate	Ethyl paraben
Fangtastic Nail Polish															
iGlow! Nail Polish - sparkly pink	--	--	199	17,400	--	--	--	17,300	--	--	673	151,000	231	--	--
SuperNail Bite No More	--	--	630	988	176,000	307,000	--	--	--	--	--	--	--	--	--
Probelle Anti-Bite Base Coat	--	--	--	12,600	118,000	--	3,320	--	--	--	--	--	--	--	--
Orly No Bite Nail Bite Deterrent	--	--	483	4,530	65,600	291,000	3,580	--	--	--	--	73,400	--	63	--
Magique NoBite Stop Nail Biting & Thumb Sucking Aid	--	--	--	622	--	--	--	46,100	--	--	--	280,000	--	2,410	30,000
Magique NoBite Bitter Additive	--	--	--	--	--	--	--	--	--	--	--	93	--	--	126,000

Product Name	N-Ethyl-2-pyrrolidinone	N-Methyl-2-pyrrolidinone	Acetone	1-Butanol	Methyl ethyl ketone	Isopropyl alcohol	Acetonitrile	Triphenyl phosphate	meta & para-Xylene	Ethylbenzene	tert-Butyl alcohol	Ethyl acetate	Formaldehyde	Methyl methacrylate	Ethyl paraben
Sassy + Chic Nail Art Pen - Raspberry Scent	--	--	169	17,600	--	--	--	--	--	--	269	181,000	--	--	--

Comparison of Chemicals Detected with Ingredients on Labels

Another objective of this study was to evaluate whether ingredient labels on nail products or from product websites accurately reflect the chemicals detected in these products. There was a total of 14 detected chemicals that were sometimes listed on ingredient labels, and a total of 15 that were not found on any ingredient labels (Figures 1 and 2). Presence of the detected chemicals on the ingredient label for each product is indicated in Tables C1 to C21 in Appendix C. Of the 156 products tested, 127 contained at least one chemical that was not listed on the label. A comparison of chemical detects with ingredient labels is discussed in more detail below. For the purposes of this comparison, acrylic powders are discussed separately from other product types, since the concentrations reported for acrylic powders are in $\mu\text{g/g}$.

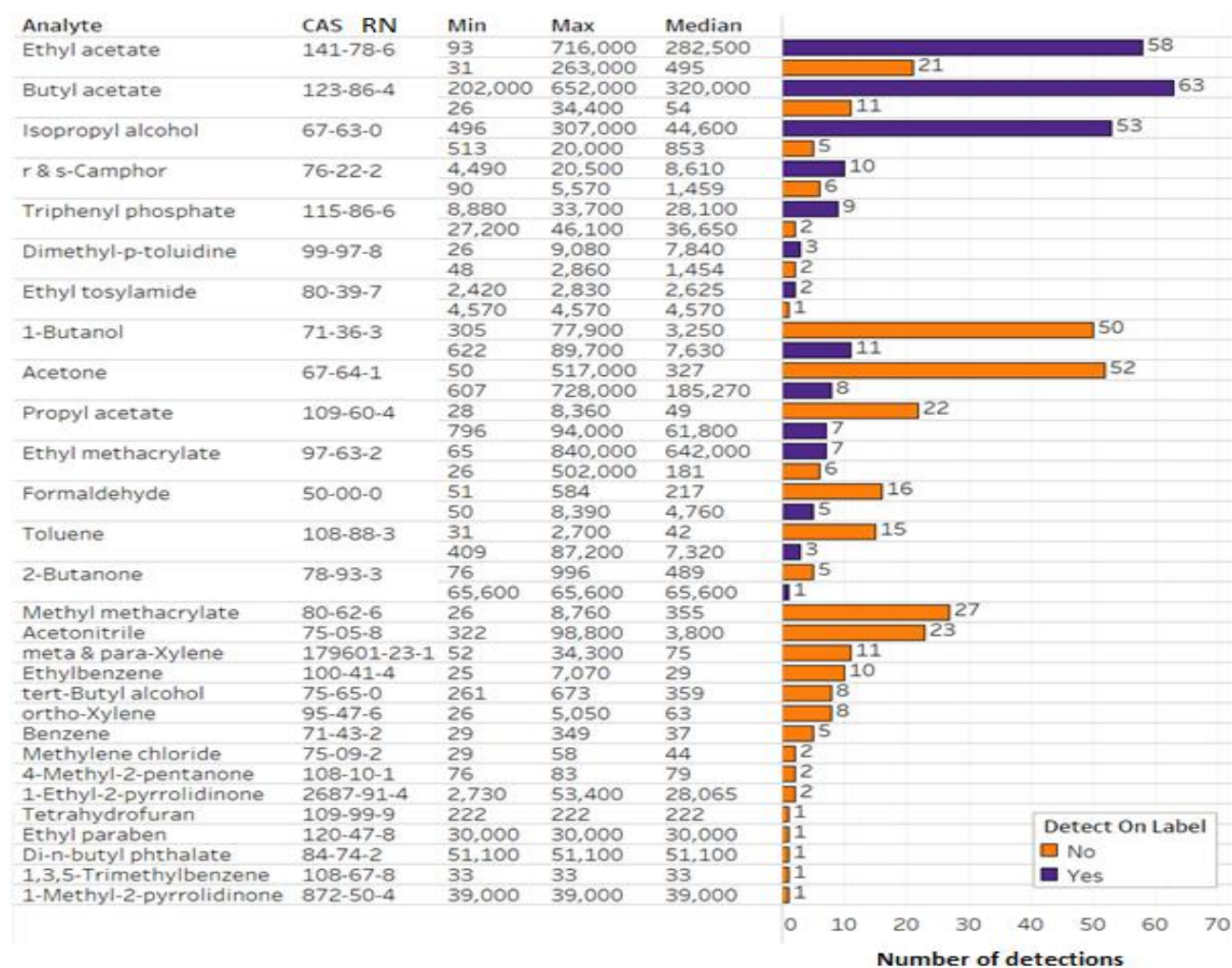


Figure 1. Comparison of chemical detects and ingredient labels for non-powdered nail products. Chemicals detected in samples and present on ingredient labels or product websites are depicted in purple, and chemicals detected in samples but not on ingredient labels or product websites are shown in orange. Reported concentrations in $\mu\text{g/mL}$ are shown for each measured analyte.

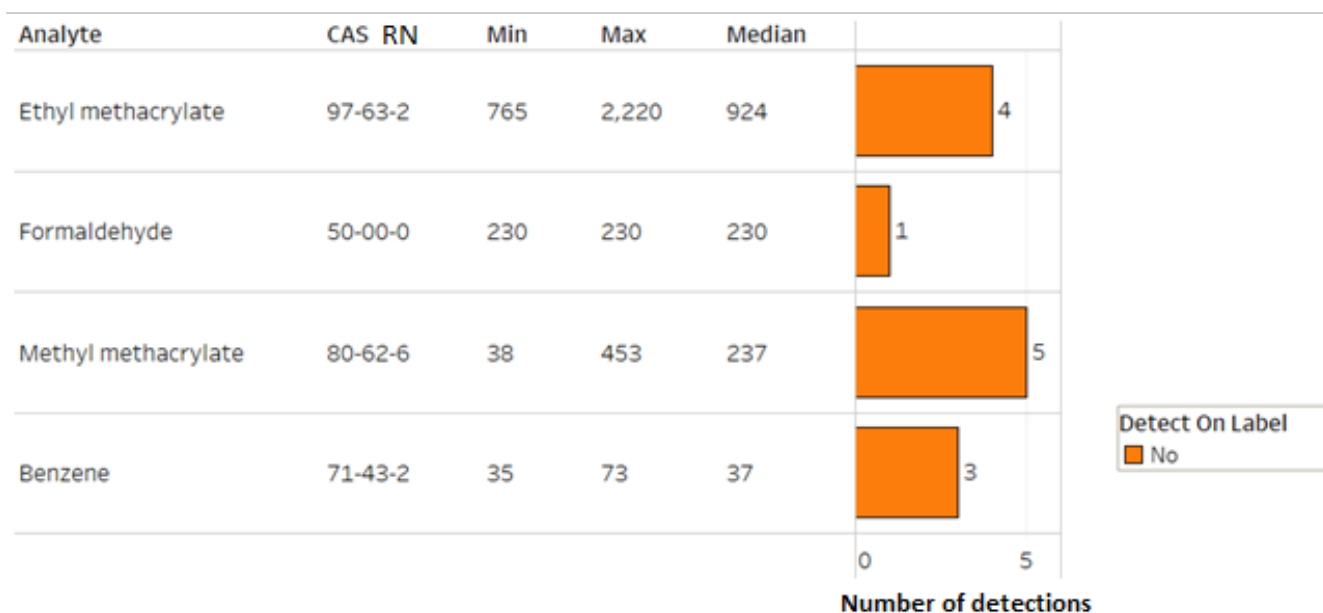


Figure 2. Comparison of chemical detects in acrylic powders not appearing on ingredient labels or product websites. Reported concentrations in $\mu\text{g/g}$ are shown for each measured analyte.

The accuracy of ingredient labels varied a great deal for different chemicals and may be associated with the frequency of detection and the range of chemical concentrations. For example, apart from TPhP and ethyl tosylamide, chemicals that were correctly listed on ingredient labels or product websites tended to be detected at higher frequencies and concentration ranges compared to the same chemicals when not listed on labels. Other chemicals that were not listed on any ingredient labels, such as MMA, acetonitrile, and tert-butyl alcohol (TBA), were detected at lower frequencies and concentration ranges and may be contaminants or residuals.

Non-Powdered Samples

An additional analysis of the chemicals that were sometimes included on ingredient labels is presented in Figures 3 and 4 and Tables 12 and 13. Figure 3 and Table 12 depict chemical detects at low concentration ranges, and Figure 4 and Table 13 depict chemical detects at high concentration ranges.

Based on this analysis, concentration ranges for chemicals present and absent on ingredient labels were very similar, except for propyl acetate, toluene, MEK, formaldehyde, butyl acetate, ethyl methacrylate, and acetone. The minimum, maximum, and median concentrations for these chemicals were higher in products that listed them on the ingredient label. For example, in samples where propyl acetate was on the label, the minimum, maximum and median concentrations were 796, 94,000, and 61,800 $\mu\text{g/mL}$, respectively, while those concentrations in samples where propyl acetate was not on the label were 28, 8,360, and 49 $\mu\text{g/mL}$. Two exceptions to this trend are TPhP and ethyl tosylamide, where the concentration range was higher in samples where these two chemicals were not listed

(27,200 to 46,100 µg/mL for TPhP and 4,570 for ethyl tosylamide) than in samples where they were on the label (8,880 to 33,700 µg/mL for TPhP and 2,420 to 2,830 µg/mL for ethyl tosylamide) (Figure 3 and Table 12).

Further, there were more samples with TPhP and ethyl tosylamide detects where these chemicals were not listed as ingredients (9 TPhP and 2 ethyl tosylamide samples) than when they were on the label (2 TPhP samples and 1 ethyl tosylamide sample). This may be an indication of the inaccuracy of ingredient labeling for these two chemicals. However, in the case of toluene, MEK, formaldehyde, and acetone, we found that there were more samples containing these chemicals when they were on the ingredient label (Tables 12 and 13). This could indicate that, at least in some cases, these chemicals are accurately labeled.

Figure 5 and Table 14 show concentration ranges and the number of samples for target analyte detects that were not found on any ingredient labels or product websites. According to this data, the most frequently detected target analytes were acetonitrile (322 to 98,000 µg/mL), MMA (26 to 8,760 µg/mL), meta & para-xylene (52 to 34,300 µg/mL), and ethylbenzene (25 to 7,070 µg/mL). Less frequently detected target analytes include NEP, NMP, DBP, and ethyl paraben, which had concentrations above 1,000 µg/mL but was detected in few samples. The other target analytes shown in Figure 5 and Table 14, such as methyl isobutyl ketone (MIBK) and benzene, were detected at concentrations lower than 1,000 µg/mL.

Finally, one interesting note is that while tetrahydrofuran was listed as an ingredient on the label of one product, Kiss Powerflex Nail Glue, it was not detected in that sample. Tetrahydrofuran was detected, however, in another product sample, CND Vinylux Weekly Top Coat (New Formula), but was not listed on the ingredient label, as shown in Figure 5 and Table 14.

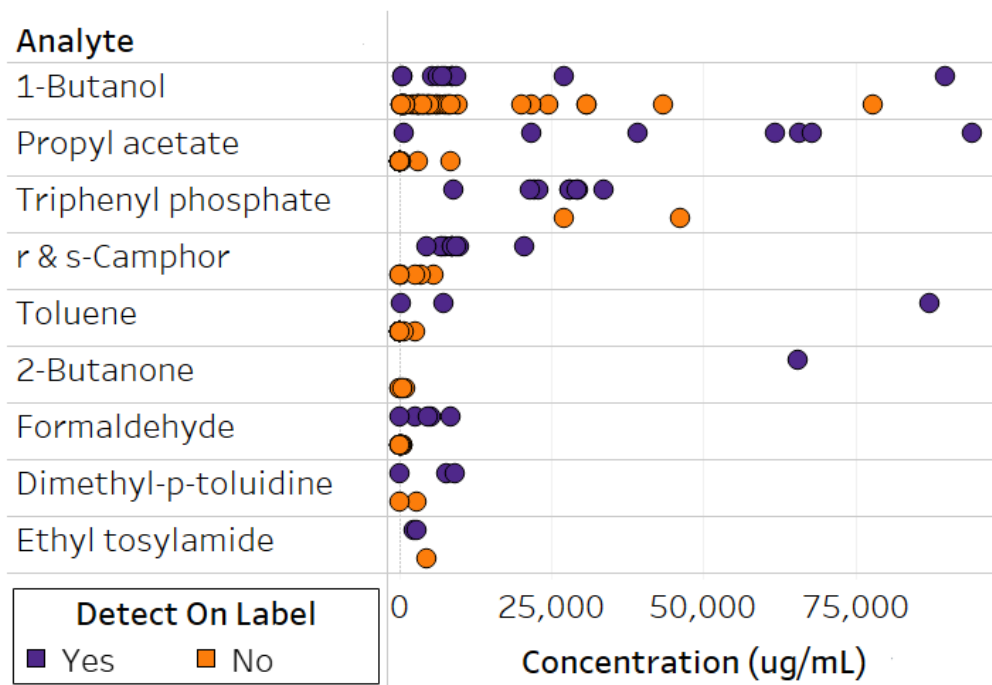


Figure 3. Comparison of chemical inclusion on product ingredient labels with detects at low concentration ranges (between 0 to 90,000 µg/mL). Chemicals detected in samples and present on ingredient labels or product websites are depicted in purple circles, and chemicals detected in samples but not on ingredient labels or product websites are shown in orange circles.

Table 12. Comparison of chemicals detected at low concentration ranges (between 0 to 90,000 ug/mL) and their presence or absence on ingredient labels.

Analyte	CAS RN	Detected analyte was not on the label				Detected analyte was on the label			
		n	Min concentration (µg/mL)	Max concentration (µg/mL)	Median concentration (µg/mL)	n	Min concentration (µg/mL)	Max concentration (µg/mL)	Median concentration (µg/mL)
1-Butanol*	71-36-3	51	305	77,900	3,270	11	622	89,700	7,630
Propyl acetate	109-60-4	22	28	8,360	49	7	796	94,000	61,800
Triphenyl phosphate*	115-86-6	2	27,200	46,100	36,650	9	8,880	33,700	28,100
r & s-Camphor	76-22-2	6	90	5,570	1,459	10	4,490	20,500	8,610
Toluene*	108-88-3	15	31	2,700	42	3	409	87,200	7,320
Methyl ethyl ketone*	78-93-3	5	76	996	489	1	65,600	65,600	65,600
Formaldehyde*	50-00-0	16	51	584	217	5	50	8,390	4,760
Dimethyl-p-toluidine*	99-97-8	2	48	2,860	1,454	3	26	9,080	7,840
Ethyl tosylamide	80-39-7	1	4,570	4,570	4,570	2	2,420	2,830	2,625

*Candidate Chemicals.

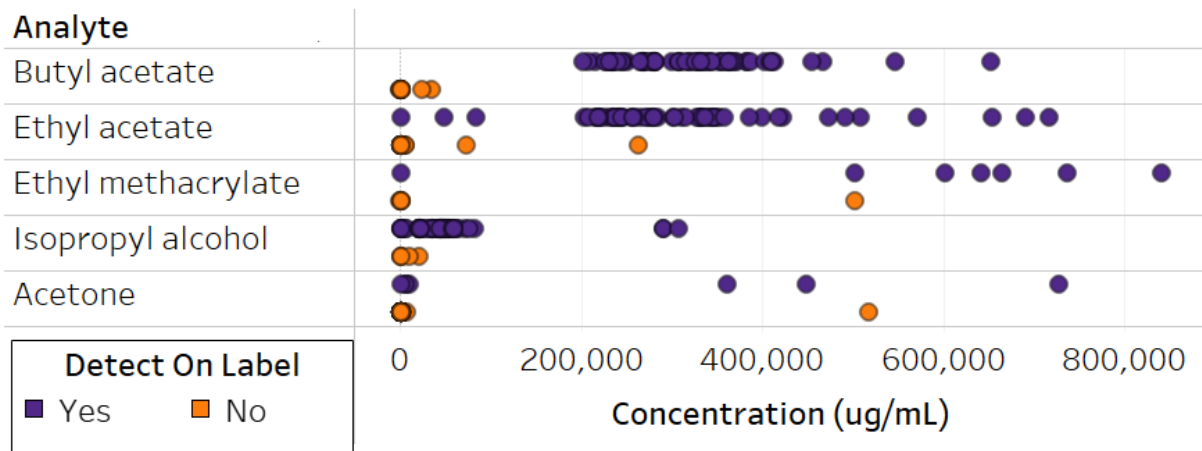


Figure 4. Comparison of chemical inclusion on ingredient labels with detects at high concentration ranges (between 0 to 800,000 $\mu\text{g}/\text{mL}$). Chemicals detected in samples and present on ingredient labels or product websites are depicted in purple circles, and chemicals detected in samples but not listed on ingredient labels or product websites are shown in orange circles.

Table 13. Comparison of chemicals detected at high concentration ranges (between 0 to 800,000 ug/mL) and their presence or absence on ingredient labels.

Analyte	CAS RN	Detected analyte was not on the label			Detected analyte was on the label				
		n	Min concentration (µg/mL)	Max concentration (µg/mL)	Median concentration (µg/mL)	n	Min concentration (µg/mL)	Max concentration (µg/mL)	Median concentration (µg/mL)
Acetone*	67-64-1	52	50	517,000	327	7	607	728,000	185,270
Butyl acetate	123-86-4	11	26	34,400	54	63	202,000	652,000	320,000
Ethyl acetate*	141-78-6	21	31	263,000	495	58	93	716,000	282,500
Ethyl methacrylate	97-63-2	6	26	502,000	181	7	65	840,000	642,000
Isopropyl alcohol*	67-63-0	5	513	20,000	853	53	496	307,000	44,600

*Candidate Chemicals

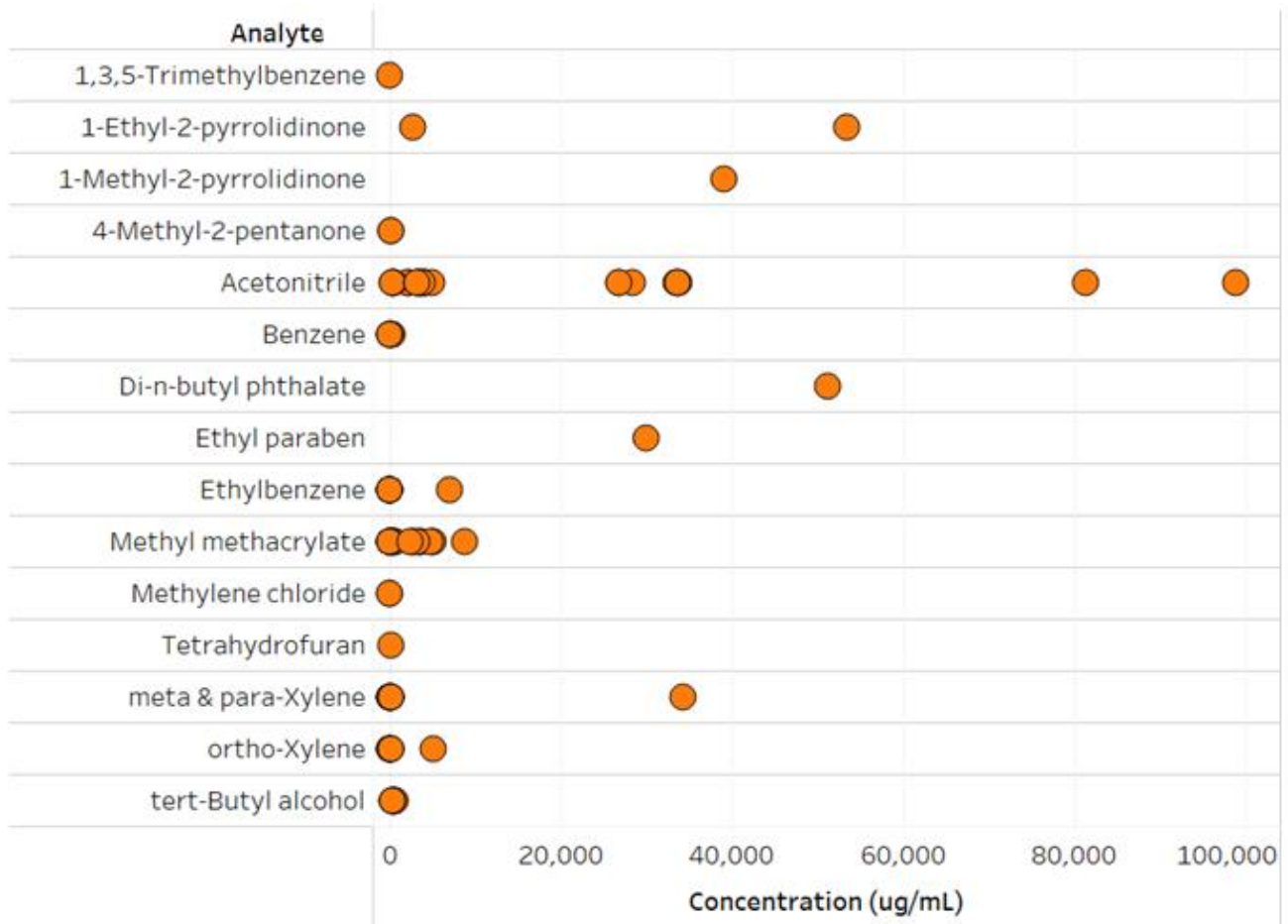


Figure 5. Chemical detects in samples that do not appear on ingredient labels or product websites.

Table 14. Concentrations of chemicals detected in samples but not present on ingredient labels.

Analyte	CAS RN	n	Min concentration (µg/mL)	Max concentration (µg/mL)	Median concentration (µg/mL)
N-Ethyl-2-pyrrolidinone*	2687-91-4	2	2,730	53,400	28,065
N-Methyl-2-pyrrolidinone*	872-50-4	1	39,000	39,000	39,000
1,3,5-Trimethylbenzene*	108-67-8	1	33	33	33
Methyl isobutyl ketone*	108-10-1	2	76	83	79
Acetonitrile*	75-05-8	23	322	98,800	3,800
Benzene*	71-43-2	5	29	349	37
Di-n-butyl phthalate*	84-74-2	1	51,100	51,100	51,100

Analyte	CAS RN	n	Min concentration (µg/mL)	Max concentration (µg/mL)	Median concentration (µg/mL)
Ethyl paraben*	120-47-8	1	30,000	30,000	30,000
Ethylbenzene*	100-41-4	10	25	7,070	29
meta & para-Xylene*	179601-23-1	11	52	34,300	75
Methyl methacrylate*	80-62-6	27	26	8,760	355
Methylene chloride*	75-09-2	2	29	58	44
ortho-Xylene*	95-47-6	8	26	5,050	63
tert-Butyl alcohol*	75-65-0	8	261	673	359
Tetrahydrofuran*	109-99-9	1	222	222	222

*Candidate Chemicals.

Powdered Samples

Table 15, below, displays concentration data for acrylic powders. None of the detected target analytes in acrylic powders were listed as ingredients.

Table 15. Concentrations of chemicals detected in acrylic powders but not present on ingredient labels.

Analyte	CAS RN	n	Min concentration (µg/g)	Max concentration (µg/g)
Benzene*	71-43-2	3	37	73
Ethyl methacrylate	97-63-2	4	765	2,220
Formaldehyde*	50-00-0	1	230	230
Methyl methacrylate*	80-62-6	5	38	453

*Candidate Chemicals.

Candidate Chemicals in Solvent-Based Professional versus Retail Nail Coatings

In this study, we categorized products as “Professional,” “Retail,” or “Professional and Retail.”¹ This analysis only includes solvent-based nail polish/lacquers, top coats, base coats, hardeners, and multifunctional products that are classified as nail coatings. Only these types of products are included because of stakeholder interest and because these products made up a greater portion of the sample size. Additionally, for this analysis, nail coatings that were categorized as “Professional” and

¹ These designations were based on information found on websites and product labels. Some products may be unintentionally misidentified.

“Professional and Retail” were combined into the “Professional” category, since there was a limited number of samples in these two categories.

To determine whether there were differences between professional and retail solvent-based coatings, DTSC compared how frequently Candidate Chemicals were detected as well as their concentrations. To compare detection frequency, DTSC first calculated the detection frequency of chemicals in each category and then calculated the ratio of the detection frequency of chemicals between the two categories. For concentration comparisons, DTSC calculated the ratio of median concentrations between professional and retail nail coatings. We used median concentration for the comparison because there were relatively few chemical detects and there were wide ranges of concentrations. The results of this analysis, shown in Figures 6 and 7 below, only include chemicals that were detected at least twice as often in one type of nail coating (professional or retail) than in the other or for which the median concentration of chemicals was five times higher in one type of nail coating (professional or retail) than the other.

As shown in Figure 6, propyl acetate and MMA were detected at higher concentrations in professional solvent-based nail coatings than in retail coatings, with concentrations ranging from less than 100 µg/mL to approximately 100,000 µg/mL for propyl acetate, and less than 100 µg/mL to 5,000 µg/mL for MMA. In retail nail coatings, concentrations for propyl acetate ranged from less than 100 µg/mL to approximately 40,000 µg/mL, and less than 100 µg/mL for MMA (Figure 6A and 6B).

In contrast, as shown in Figures 6C and 6D, NEP and toluene were found at higher concentrations in retail samples than in professional samples. NEP was detected at concentrations between less than 100 to greater than 50,000 µg/mL, while toluene concentrations ranged from less than 100 to greater than 50,000 µg/mL. In professional nail coatings, NEP was detected in a single sample, with a concentration of less than 100 µg/mL, while toluene was found in three samples, all at concentrations below 100 µg/mL. Further, compared to professional nail coatings, the concentration range detected for toluene in retail samples was much higher, with a maximum concentration of 150,000 µg/mL.

Figure 7 shows chemicals that were detected at least twice as often in one type of nail coating (professional or retail) than the other. As shown in Figure 7, MMA, ethyl tosylamide, and TPhP were detected more frequently in professional samples than in retail samples. Ethylbenzene was detected at higher frequencies in retail samples.

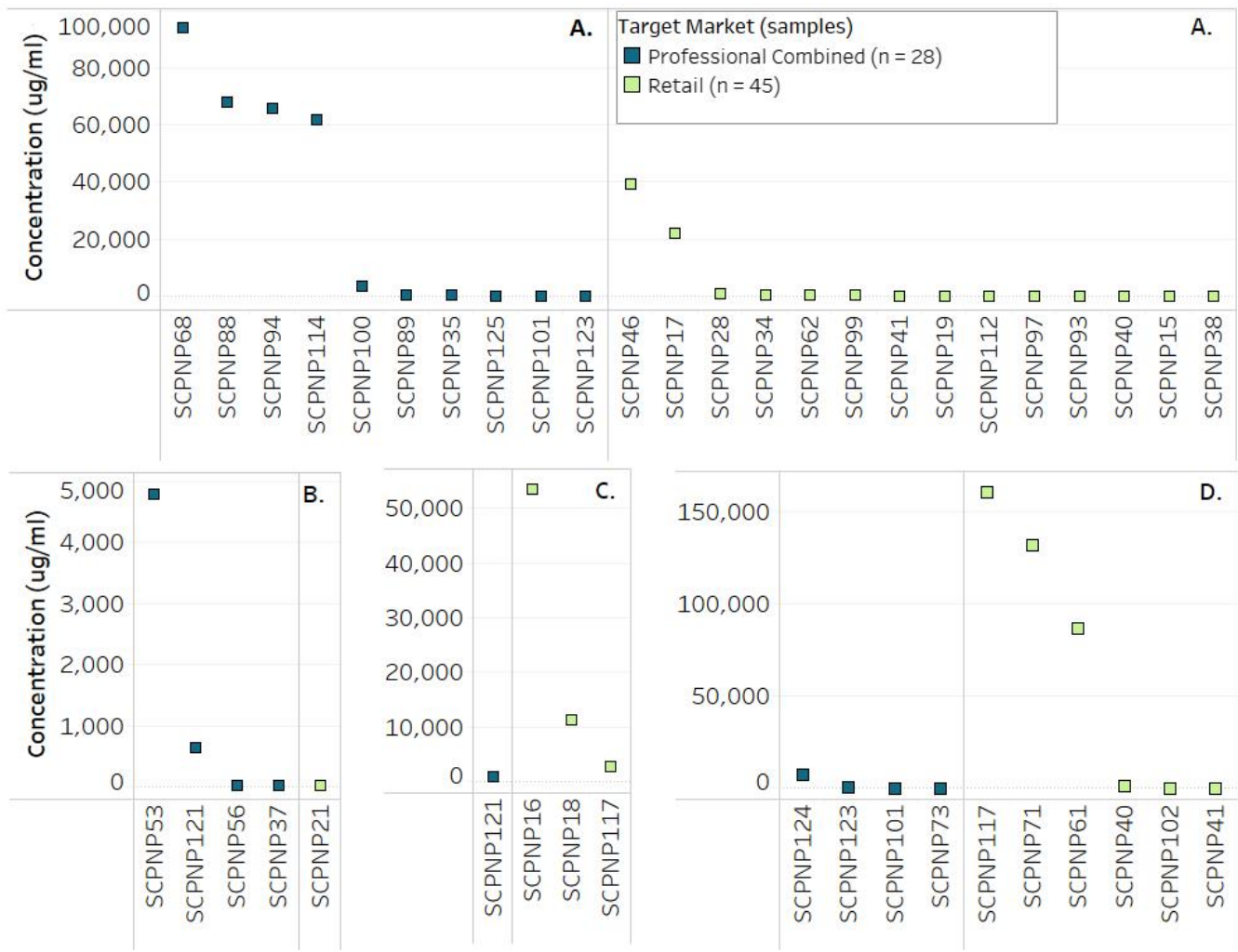


Figure 6. Comparison of concentrations of detects of (A.) propyl acetate, (B.) MMA, (C.) N-ethyl-2-pyrrolidone (NEP), and (D.) toluene in professional and retail solvent-based nail coatings depicted by sample ID. The chemicals shown are those for which the median concentration was five times higher in one type of nail coating (professional or retail) than the other.

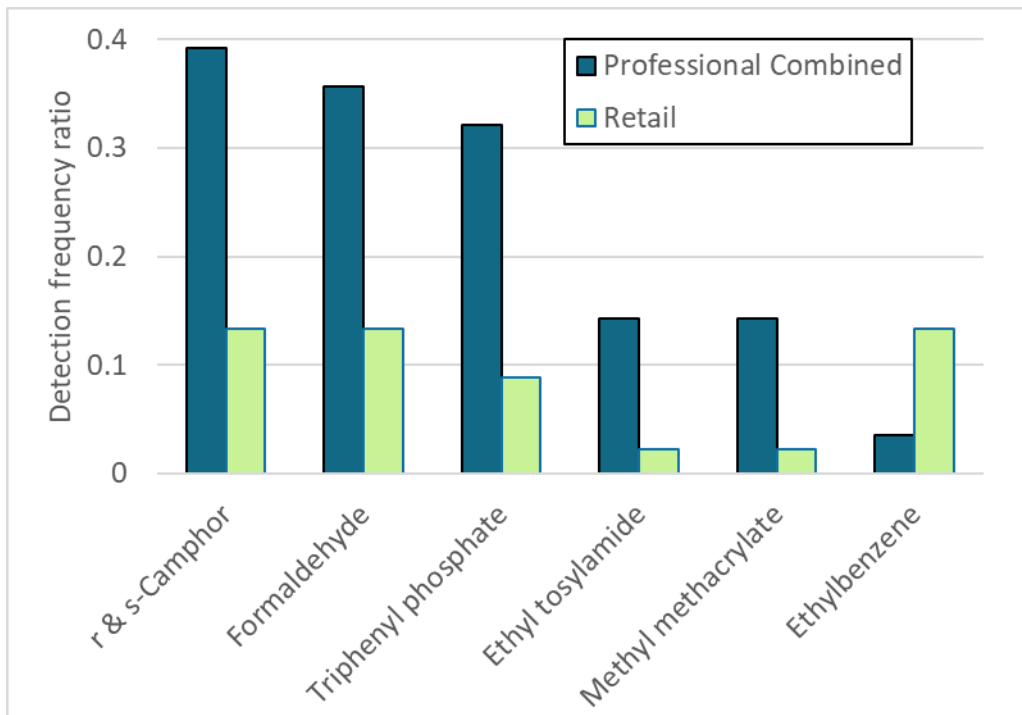


Figure 7. Comparison of detection frequencies in solvent-based coatings categorized as professional or retail. The chemicals shown are those detected at least twice as frequently in professional or retail samples.

Furthermore, five additional chemicals were detected in a small number of products. These chemicals, their detection frequencies, and their concentrations are displayed in Table 16 below. The majority of these, except for tetrahydrofuran, were detected in retail nail coatings.

Table 16. Chemicals detected in either professional or retail solvent-based nail coatings.

Analyte	Retail	Professional combined
N-methyl-2-pyrrolidone	2/45* (1650; 39,000)**	0/28*
Methyl isobutyl ketone	1/45* (83)	0/28*
Benzene	3/45* (29; 37; 349)**	0/28*
Di-n-butyl phthalate	1/45* (51,100)**	0/28*
Tetrahydrofuran	0/45*	1/28* (222)**

* A/B = detects per sample in category

** (Z) = detected concentrations, in $\mu\text{g/mL}$

Comparison of Differently Priced Solvent-Based Nail Coatings and Presence of Candidate Chemicals

Because price tends to influence what consumers purchase, DTSC decided to compare Candidate Chemical detections by price range. We categorized solvent-based nail coatings as low-priced if they cost less than \$5, mid-priced if they cost \$5 to \$15, and high-priced if they cost more than \$15. As mentioned above, solvent-based nail coatings encompass the product categories of nail polish/lacquers, top coats, base coats, hardeners, and multifunctional products. As with the analysis of professional and retail samples, DTSC calculated the ratio of the median concentrations of chemicals between low-priced, mid-priced, and high-priced samples, and the ratio of the detection frequencies between solvent-based nail coatings in any two price categories. We selected Candidate Chemicals for discussion here if they were detected at least twice as frequently in one or more price categories or if there was a five times difference in the median concentration between each price category. The results of this analysis are shown in Figures 8 and 9.

As shown in Figure 8, there were differences in the concentrations of formaldehyde, NEP, toluene, and o-xylene among the differently priced solvent-based nail coatings. Formaldehyde was detected at slightly higher concentrations in mid-priced samples, ranging from approximately 20,000 µg/mL to 30,000 µg/mL. o-Xylene was only detected at a somewhat high concentration in one mid-priced product, less than 1,000 µg/mL. Toluene, on the other hand, was found at much higher levels in mid-priced samples compared to formaldehyde and o-xylene, with concentrations between less than 1,000 µg/mL and 16,000 µg/mL. The concentrations for these three chemicals were found to be similar in high-priced and low-priced products. In contrast, NEP was detected at higher concentrations in two low-priced samples (50,000 and 10 10 µg/mL).

As shown in Figure 9, acetonitrile and ethyl tosylamide were more frequently detected in low-priced samples. Ethyl tosylamide was not detected in high-priced samples at all. In contrast, NEP, toluene, MMA, and o-xylene were detected at a higher frequency in high-priced products than in low- and mid-priced samples. Of all these chemicals, acetonitrile had the highest detection frequency.

We detected ten additional Candidate Chemicals in a small number of products in each price category. The detection frequencies and concentrations are displayed in Table 17. The detection frequencies were centered in specific price points. While MEK was detected only in low-priced and high-priced products, ethyl tosylamide, ethylbenzene, methylene chloride, TBA, and NMP were only found in low-priced and mid-priced samples. The remaining chemicals listed in Table 27 were only detected in mid-priced products.

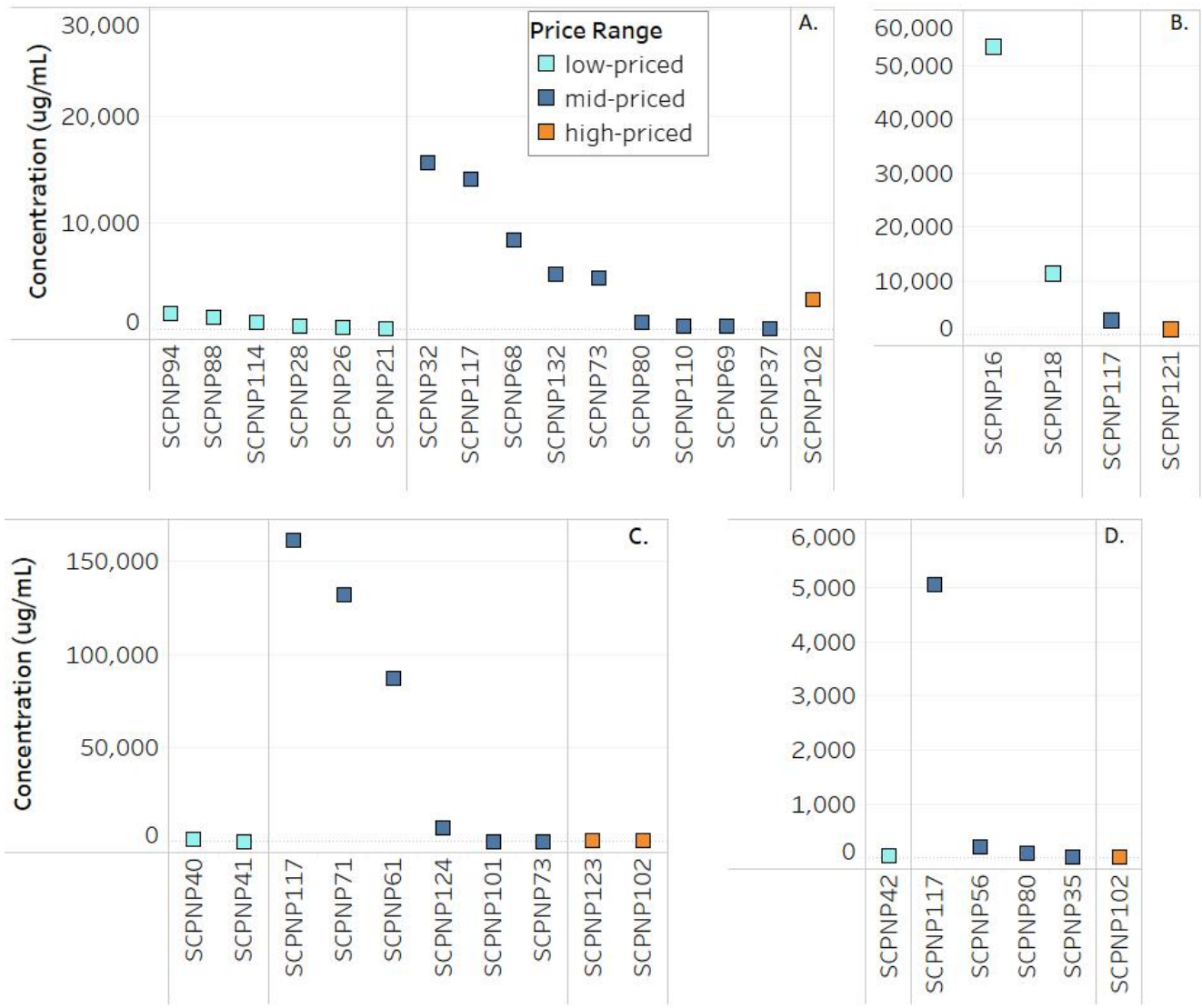


Figure 8. Comparison of concentrations of detects of (A.) formaldehyde, (B.) N-ethyl-2-pyrrolidone (NEP), (C.) toluene, and (D.) o-xylene in low-priced, mid-priced, and high-priced solvent-based nail coatings designated by sample ID. The chemicals shown here are those where there is at least a five times difference in the median concentration between low-priced, mid-priced, and high-priced samples.

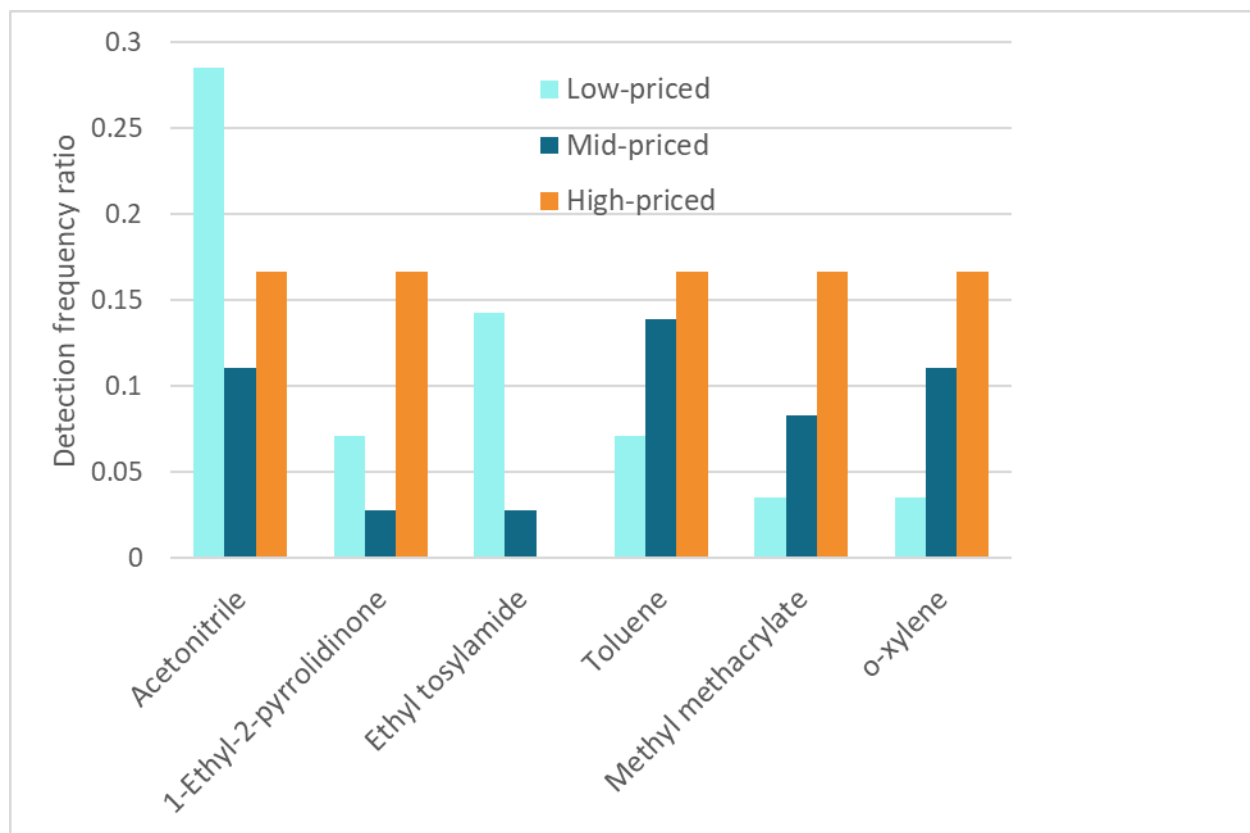


Figure 9. Comparison of detection frequencies in solvent-based coatings categorized as low-priced, mid-priced, and high-priced. The chemicals shown here are those detected at least twice as frequently in any two price categories.

Table 17. Chemicals detected at low frequencies in solvent-based nail coatings from each price category.

Analyte	Low-priced	Mid-priced	High-priced
Methyl ethyl ketone (MEK)	3/28* (489; 651; 996)	0/36*	1/6* (124)**
Ethyl tosylamide	4/28* (1710; 1920; 2420; 2,830)**	1/36* (4,570)**	0/6*
Ethylbenzene	2/28* (28; 34)**	5/36* (25; 27; 28; 29; 7,070)**	0/6*
Methylene chloride	1/28* (58)*	2/36* (29; 157)**	0/6*

Analyte	Low-priced	Mid-priced	High-priced
tert-Butyl alcohol	3/28* (261; 522; 673)**	3/36* (262; 302; 415)**	0/6*
N-Methyl-2-pyrrolidinone	1/28* (1,650)**	1/36* (39,000)**	0/6*
Methyl isobutyl ketone	0/28*	1/36* (83)**	0/6*
Benzene	0/28*	3/36* (29; 37; 349)**	0/6*
Di-n-butyl phthalate	0/28*	1/36* (51,100)**	0/6*
Tetrahydrofuran	0/28*	1/36* (222)**	0/6*

*A/B = detects per sample in category

** (Z) = detected concentrations, in µg/mL

Analysis of Retail Chemical Policies

Of the 12 combined online and brick-and-mortar retailers from which nail products were purchased, only four (Amazon, Target, Walmart, and Dollar Tree) have clear chemical policies and claims specific to certain chemicals that could be compared to target analyte detects (Table 18). While Amazon's chemical policy applies to private labels, it has also indicated that it seeks to encourage third party vendors to remove chemicals from their products (Amazon 2022). Table 18 provides a comparison of retailer chemical policies, and chemical detects found in nail products are shown in Table 19.

Table 18. Retailer chemical policies applicable to nail products.

Retailer	Chemical Policy	Reference
Amazon	Specific chemicals are restricted and grouped according to chemical class. Examples of chemical classes include antiseptics, formaldehyde donor preservatives, and parabens. Toluene is included as miscellaneous.	(Amazon 2020)
Target	Encourages manufacturers to formulate beauty and personal care products without phthalates, propylparaben, butylparaben, formaldehyde and formaldehyde donors, and nonylphenol ethoxylates.	(Target 2017)
Walmart	The following eight chemicals are identified as High Priority Chemicals (HPCs): propylparaben, nonylphenol ethoxylates, formaldehyde, butylparaben, toluene, triclosan, diethyl phthalate and dibutyl phthalate. Private brand suppliers are encouraged to reduce, restrict, and eliminate use of these chemicals.	(Walmart 2017)
Dollar Tree	Seeks to eliminate the following chemicals in products: formaldehyde, trichloroethylene, triclocarban, propylparaben, butylparaben, toluene, nonylphenol ethoxylates, and triclosan.	(Dollar Tree 2022)

In general, Amazon, Target, Walmart, and Dollar Tree did meet their chemical policies for nail products with detects of formaldehyde, toluene, and DBP. There were only seven products purchased from two of these companies with toluene and formaldehyde concentrations above 1,000 µg/mL, and these chemicals were listed as ingredients. Six of these (Probelle Nail Hardener Formula 1, Quimica Alemana Nail Hardener, Perfect Formula Pink Gel Coat, Probelle Nail Hardener Formula, Pink Armor Nail Gel, and Seche Restore Restoration Thinner) were purchased through Amazon, and one (Seche Vive Instant Gel Effect Top Coat) was purchased from Walmart. In addition, Quimica Alemana Nail Hardener, a product purchased through Amazon, had a DBP detect of 51,100 µg/mL, but DBP was not listed as an ingredient.

Table 19. Comparison of retailer chemical policies and chemical detects.

Retailer	Samples from retailer	Chemical listed in retailer policy	Samples with detects	Concentration (µg/mL)	Chemical on Label	Brand	Product Name
Amazon	62	Dibutyl phthalate (DBP)	1	51,100	No	Quimica Alemana	Quimica Alemana Nail Hardener
		Formaldehyde	17	15,600	Yes	Probelle	Probelle Nail Hardener Formula 1
				14,100	Yes	Quimica Alemana	Quimica Alemana Nail Hardener
				2,700	Yes	Perfect Formula	Perfect Formula Pink Gel Coat
				516	No	Kiss	Kiss Brush-On Nail Glue
				490	No	Vallejo	Vallejo Airbrush Cleaner
				230	No	Glam and Glits	Glam and Glits Color Pop Acrylic Powder, Wet Suit-353 (Blue)
				218	No	Mia Secret	Mia Secret Strong-Jet Clear Nail Glue
				215	No	Custom Body Art	Custom Body Art Water Based Acrylic Formulation Ready-to-Spray 8 Bottle 6 Color Nail Paint Starter Set - Pink Pigment
				215	No	IBD	Ibd 5 Second Brush On Nail Glue
177	No	Artisan	Artisan Instant Bond Nail Glue 20 Pack				

Retailer	Samples from retailer	Chemical listed in retailer policy	Samples with detects	Concentration (µg/mL)	Chemical on Label	Brand	Product Name
				142	No	Beauty Secrets	Beauty Secrets Clear Acrylic Nail Powder Clear
				132	No	Young Nails	Young Nails Acrylic Nail Powder - French Pink
				110	No	Mia Secret	Mia Secret Professional Acrylic Nail System Clear Acrylic Powder
				76	No	Gelish	Gelish Hard Gel LED Clear Nail Gel
				51	No	Prim and Pure	Prim and Pure Nail Polish Brand, Fruit and Veggie Nail Polish, Mermaid Tail - Blue)
				50	Yes	Pink Armor	Pink Armor Nail Gel
		Toluene	9	167,000	Yes	Seche	Seche Restore Restoration Thinner
				161,000	No	Quimica Alemana	Quimica Alemana Nail Hardener
				2,700	No	RedDhong	Lily Angel PrepStep Nail Dehydrator
				169	No	Perfect Formula	Perfect Formula Pink Gel Coat
				57	No	Elite99	Elite99 Soak-Off Gel Polish, Conch Shell 674
				51	No	Gelish	Gelish Hard Gel LED Clear Nail Gel

Retailer	Samples from retailer	Chemical listed in retailer policy	Samples with detects	Concentration (µg/mL)	Chemical on Label	Brand	Product Name
				36	No	Mia Secret	Mia Secret Xtra Bond No Burn Acid-Free Primer for Acrylics and UV Gels
				35	No	Cheri	CHERI Bonding Primer Non-Acid (Acrylics and Hard Gels)
				42	No	CND	CND Vinylux Longwear Top Coat
Dollar Tree	3	Formaldehyde	1	92	No	L.A. Colors	L.A. Colors Art Deco Nail Art - Limon
		Toluene	1	106	No	L.A. Colors	L.A. Colors Art Deco Nail Art - Limon
Target	10	Formaldehyde	1	51	No	Sensationail	Sensationail Polish to Gel
Walmart	33	Formaldehyde	6	264	No	CND	CND Vinylux Weekly Top Coat (New Formula)
				232	No	5 Second	5 Second Brush On Nail Glue
				132	No	Kiss	KISS Acrylic Powder - Clear
				94	No	Kiss	Kiss Powerflex Nail Glue
				82	No	Mist	Mist Airbrush Nail Color - Pearly Purple
		59	No	Daisy DND	DND Nail Laquer - Golden Sahara Star #401		
		Toluene	6	132,000	Yes	Seche	Seche Vive Instant Gel Effect Top Coat

Retailer	Samples from retailer	Chemical listed in retailer policy	Samples with detects	Concentration ($\mu\text{g}/\text{mL}$)	Chemical on Label	Brand	Product Name
				890	No	Nail-Aid	Nail-Aid 3-in-1 Gel Base + Top Coat + Hardener
				114	No	5 Second	5 Second Brush On Nail Glue
				94	No	Orly	Orly No Bite Nail Bite Deterrent
				33	No	Mia Secret	Mia Secret Liquid Monomer
				31	No	L.A. Colors	LA Colors Nail Treatment Triple Play

CONCLUSION

In total, 156 nail products were purchased online and from brick-and-mortar stores. These were chosen to represent both professional and retail use and diverse product types and prices. They were also chosen for their utility in addressing research questions and exploring various marketing claims (such as “n-free” and “non-toxic”), including products marketed to children or marketed as “safe” to children. We also sought to include products tested in the 2012 analytical laboratory study. Products were also chosen based on ingredients listed on product labels or websites, recommendations from stakeholder groups, and by availability. The products were analyzed by DTSC with the intention of:

1. evaluating ingredient label accuracy by comparing ingredient labels with target analyte detects and confirmed TICs;
2. evaluating detection frequencies and concentrations of Candidate Chemicals, including toluene, formaldehyde, MMA, and Candidate Chemical TICs in products;
3. evaluating concentrations of Candidate Chemicals found in nail products that are marketed for use by children;
4. evaluating the presence of DBP and toluene in products that were also tested in DTSC’s 2012 analytical laboratory study;
5. evaluating differences in Candidate Chemicals and concentrations in solvent-based nail coatings categorized by price range and by professional or retail use; and
6. verifying the accuracy of retailer chemical policies applicable to nail products.

As with the 2012 analytical laboratory study, the results of this study indicate that marketing claims and ingredient labels continue to be inaccurate. DTSC recommends full ingredient disclosure on nail product labels or on product websites which, as was highlighted in the 2012 analytical laboratory study, would help nail salon technicians and consumers identify hazardous ingredients in nail products.

Another key finding in this study is the detection of several non-Candidate Chemical TICs in nail products. Although an evaluation of the hazard traits and functional uses of these chemicals was outside the scope of this report, it is possible that these chemicals are being used by nail product manufacturers as safer alternatives to Candidate Chemicals with similar functional uses.

Further, nail products in this study were categorized by price and as either professional or retail. In this report, DTSC limited its analysis of differences in Candidate Chemical detections in the professional or retail and price categories to solvent-based nail coatings because more products were purchased from this product type and because of stakeholder interest. According to this analysis, DTSC discovered distinct differences in Candidate Chemical detections in solvent-based nail coatings categorized both by price and as professional or retail. The analysis suggests that professional solvent-based nail coatings have higher detections of Candidate Chemicals compared to retail solvent-based nail coatings, with some Candidate Chemicals, such as MMA, detected at elevated concentrations. Additionally, the results indicate that, while high-priced solvent-based nail coatings had more Candidate Chemical detections, the concentrations of Candidate Chemicals in solvent-based nail coatings in the low-

and mid-priced categories were higher than in the high-priced category. This suggests a relationship between price and Candidate Chemical concentration. However, one limitation of this analysis was the limited number of samples in all categories. To better understand these trends, the number of products in the professional or retail and price categories should be expanded. Additionally, for the analysis of Candidate Chemical detections by price category, DTSC categorized nail products as either low-priced, mid-priced, or high-priced. However, DTSC discovered that a variation exists between price and product size. This variation was not considered for this analysis; however, in the future, DTSC may consider basing its analysis of differences in Candidate Chemical detections in solvent-based nail coatings on both price and product size.

In addition, DTSC detected the presence of phthalic anhydride in the analysis of Candidate Chemical TICs in nail products. Phthalic anhydride was found to be a constituent of polymer ingredients in the nail product samples analyzed. This may indicate that either these polymer ingredients depolymerize once in the product or that they may be present as contaminants. Future analysis of chemicals in nail products should investigate the potential for polymers to depolymerize and release Candidate Chemicals.

Finally, the results of this study further complemented the findings of DTSC's information call-in request by identifying Candidate Chemical detections at both high concentrations and at contaminant levels. This study and the information call-in request, therefore, help DTSC to better understand the difference between intentionally added ingredients and contaminants or residuals in nail products, particularly when proposing product-chemical combinations for potential listing as Priority Products. For example, using the data from this study and the informational call-in request, DTSC established Alternative Analysis Thresholds (AATs) for toluene and methyl methacrylate as contaminants or residuals in nail products.

In conclusion, the findings of this analytical laboratory study provide insight into the concentrations and detections of Candidate Chemicals in different nail product types. This information may help DTSC to further prioritize the evaluation of additional Candidate Chemicals in nail products for potential listing as Priority Products. Additionally, the findings of this study may also be beneficial in seeking safer alternatives to Candidate Chemicals with similar functional uses in nail products.

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APPENDICES

Appendix A - Analytical Methods

DTSC analyzed all nail product samples using gas chromatography/mass spectrometry (GC/MS) instrumentation to separate, detect, and quantify formaldehyde, other volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs). Details of each of these three methods are described in detail below.

Additionally, samples were prepared and analyzed based on guidance from one or more of the following methods:

- U.S. Environmental Protection Agency (EPA) Method 5000 for guidance on sample preparation for VOCs;
- U.S. EPA Method 5035A for guidance on instrument sample introduction using purge-and-trap for solid samples;
- U.S. EPA Method 5030C for guidance on instrument sample introduction using purge-and-trap for aqueous samples;
- U.S. EPA Method 8000 for guidance on analytical chromatography and description of calibration and quality control requirements;
- modified U.S. EPA Method 8260D for VOCs;
- modified U.S. EPA Method 8270D for SVOCs; or
- modified U.S. EPA Method 8270D for formaldehyde with sample derivatization.

The target analytes for GC/MS analysis of VOCs and SVOCs are shown in Appendix B – List of Analytes (VOCs and SVOCs).

Samples were also analyzed by GC/MS in full-scan mode for tentative identification of VOC and SVOC chemical ingredients that were not included in the target analyte list but are detectable via GC/MS. Mass spectra data were visually reviewed and evaluated using Agilent MassHunter software based on NIST²/EPA³/NIH⁴ Mass Spectral Library software. The tentatively identified compounds (TICs) were identified using major ions in the library reference spectrum that were present in the sample spectrum at similar relative intensities. The estimated concentrations were then calculated using the integrated area of the sample's primary ion and the integrated area of the internal standard with the nearest of the retention time.

² NIST = National Institute of Standards and Technology

³ EPA = U.S. Environmental Protection Agency

⁴ NIH = National Institutes of Health

Quality Control (QC) Requirements

The following quality controls were used in the methods for VOC, SVOC, and formaldehyde analysis.

Calibration Standards

The initial calibration (ICAL) determines the instrument response over a range of known analytes and their concentrations prepared from a certified standard solution and analyzed on the instrument prior to any samples.

The initial calibration verification (ICV) standard is a certified solution from a source other than that used for the initial calibration standards and is used to verify the accuracy of the initial calibration.

The continuous calibration verification (CCV) standard is a mid-range, known concentration standard analyzed before, during, and at the end of an analytical batch and verifies that the instrument response has not drifted from the initial calibration response.

Surrogates

We used surrogate standards to monitor the efficiency of derivatization, extraction, and analytical procedures. A standard is a precisely known concentration of a given substance, and a surrogate standard is a pure analyte that is unlikely to be found in the sample. For this analysis, surrogate standards were added to every sample and to every QC standard. Each product sample, method blank, sample duplicate, laboratory control sample, laboratory control sample duplicate, matrix spike, and matrix spike duplicate was spiked with a surrogate standard prior to extraction and analysis.

Further, surrogate standards were also added to ICAL, ICV, and CCV standards.

Method Blank (MB)

We prepared a method blank for each batch of 20 or fewer samples. A method blank is an analyte-free matrix to which all standards were added in the same volumes as used in sample processing. We used a method blank to demonstrate that the derivatization, extraction, and analytical procedures did not contribute to any detected sample results.

Matrix Spike (MS) / Matrix Spike Duplicate (MSD)

We prepared and analyzed an MS/MSD pair with every batch of 20 or fewer samples. We spiked a sample with a known concentration of target analytes to evaluate for matrix interferences.⁵

Laboratory Control Sample (LCS) / Laboratory Control Sample Duplicate (LCSD)

We analyzed an LCS/LCSD pair with each batch of 20 or fewer samples. The LCS/LCSD verifies the effectiveness of the derivatization, extraction, and analytical procedures in the absence of matrix

⁵ *Matrix interference occurs when non-target chemicals in the sample or physical/chemical characteristics of a sample prevent or affect quantification of the chemicals of interest.*

interferences.

Sample Duplicates

We analyzed a sample duplicate with each batch of 20 or fewer samples to evaluate the reproducibility of the measured values of the sample.

VOC Solutions Preparation and Analysis

The procedure used to prepare the samples and measure the concentrations of VOCs was based on guidelines in EPA Methods 5000, 5030C, 5035A, modified 8260D, and 8000D.

Calibration and QC Standard Preparation

We analyzed a 4-bromofluorobenzene (BFB) tune standard solution at the beginning of each 12-hour analytical period to verify that the mass spectrometer was within the instrument tune criteria parameters. See Appendix F – Tune Criteria for BFB tune criteria. A BFB tune is a specific mass spectral tune check designed to meet the instrument tuning requirements of U.S. EPA Method 8260D. We used the surrogate standard as the tune check since it already contained BFB. The quality criteria are listed in Appendix F – Tune Criteria.

We injected all samples, including QC standards and calibration standards, into the GC within 12 hours of the injection of the associated, acceptable tune check standard. Samples and QC standards that were not injected within the 12-hour time window were not reported.

We prepared the initial calibration (ICAL) standards in concentration ranges of 5-200 µg/L for all analytes found in Table A1 except for ketones, which were at a concentration range of 12.5-500 µg/L, and acetonitrile and alcohols, which were at a range of 50 -2000 µg/L.

The same ICAL standards were also used for the continuing calibration verification (CCV) and LCS/LCSD/MS/MSD. We made the ICV as a secondary source with the same concentrations as the ICAL standards.

We made the surrogate standard from the stock surrogate mix by diluting it with methanol to a final concentration of 25 µg/mL.

We prepared the standard solutions from the stock standards prepared from the materials listed in Table A1. We stored sample extracts in amber glass containers under refrigeration at ≤ 6 °C and analyzed them within 14 days of extraction.

Table A1. Volatile organic compound (VOC) stock standard material.

Standard	Description	Vendor	Catalog/ Part Number
BFB Standard	4-Bromofluorobenzene standard	Restek	30067
Internal Standard	8260 Internal standard mix	Restek	30074
Surrogates	Volatile organic analysis surrogate spike mix	Restek	30004
Primary Source	502.2 CAL2000 mega mix	Restek	30431
	Volatile organic analysis calibration mix #1 (ketones)	Restek	30006
	Methyl-tert-butyl ether	Restek	30402
	Tetrahydrofuran	Restek	30414
	Acetate mix	Restek	30477
	Nitriles mix	Restek	30215
	Acetonitrile	Restek	30495
	t-butanol	Restek	30470
	1-butanol	Restek	30474
	2-propanol	Restek	30473
	1,2,3, Trimethylbenzene	TCI	T0468
	R-camphor	TCI	C0010
	S-camphor	TCI	C1251
	Dimethyl-p-toluidine	TCI	D0807
Secondary Source	Volatile Organic Compound Standard (Mega-mix)	Agilent	DWM-589N
	Drinking water calibration standard (Ketones)	Agilent	DWM-527-1
	Methyl-tert-butyl ether	Agilent	STS-440-1
	Tetrahydrofuran	Spex	S-3460
	Ethyl methacrylate	Spex	S-1975
	Methyl methacrylate	Spex	S-2435
	Acetonitrile	Spex	S-145
	Propyl acetate	Alfa Aesar	L15355
	Butyl acetate	EMD Millipore	BX1735
	1,2,3, Trimethylbenzene	Spex	S-3717
	R-camphor	Alfa Aesar	A10708
	S-camphor	Alfa Aesar	B23469
	Dimethyl-p-toluidine	Alfa Aesar	A11988

Sample Preparation

We allowed the nail product samples to come to room temperature and gently shook them prior to sample preparation and analysis.

Using a disposable pipet, we prepared the liquid nail product samples for analysis by diluting 0.5 mL of sample into 5 mL of methanol. Depending on the concentration range of the chemicals in the sample, we manually diluted the sample extracts 5,000-fold, 62,500-fold, or 2.5-million-fold dilution with water.

We prepared the solid nail product samples for analysis by weighing 0.5 g of the nail product sample and dissolving it into 5 mL of methanol. Depending on the concentration range of the chemicals in the sample, we manually diluted the sample extracts 5,000-fold, 62,500-fold, up to a 2.5-million-fold with water.

We additionally diluted samples to the approximate analyte concentration if the analysis indicated the concentrations were outside of the known calibration range of the ICAL.

We stored the sample extracts in amber glass containers under refrigeration at ≤ 6 °C and analyzed them within 40 days of extraction.

Instrument and Operating Parameters

We analyzed the samples using GC equipped with a split/splitless injector, temperature programmable oven, MS, purge-and-trap, and autosampler.

The equipment manufacturers and instrument parameters are described in Table A2 and Table A3 below.

Table A2. Instrumentation and manufacturers.

Equipment Description	Manufacturer and Instrument Model
Autosampler	OI/Xylem 4100 Autosampler with the 4760 Purge and Trap
Gas chromatograph equipped with split/splitless injector and temperature programmable oven	Agilent 7890A GC
GC Column	Restek RXI-624 Sil MS 30 m x 0.25 mm x 1.40 μ m
Mass Spectrometer	Agilent 5975C MSD

Table A3. Gas chromatograph and mass spectrometer instrument parameters.

Property	Value
Desorption	Desorb Time: 0.5 min, Trap Temp: 190 °C
Bake	Time: 8 min, Trap Temp: 210 °C
Front Split/Splitless Inlet	Split Ratio: 30:1, Split flow: 30 mL/min
Gas: Helium	Septum Purge flow: 0.5 mL/min
	Heater Temp: 225 °C
GC	Flow: 1 mL/min
Oven	Equilibration Time: 0 min, Max Temp: 260 °C
Oven Program	Initial: 40 for 4.8 min
	Ramp 1: 11 min to 97 °C for 0 min
	Ramp 2: 7 °C/min to 120 °C for 0 min
	Ramp 3: 20 °C /min to 220 °C for 2 min
	Run Time: 20.268 min
MSD Transfer Line	Heater: On, Temp: 230 °C
MS Information	Solvent Delay: 1.57 min, EMV Mode: Gain Factor
	Gain Factor: 5:00, Resulting EM Voltage: 1929 eV
MS Scan Parameters	Low Mass: 35.0 amu, High Mass: 300.0 amu
MS Source	230 °C, Max Temp 350 °C
MS Quadrupole	150 °C, Max Temp 200 °C

Sample Analysis

We placed the samples into an autosampler, which automatically added 5 mL of water and 2 µL of internal and surrogate standard mix, at the time of analysis. We heated the samples to 40 °C and purged them with nitrogen in the purge-and-trap system. We used an autosampler to inject a 5 mL aliquot of the purged sample extract into the GC/MS. The MS detector then measured retention time and response of the eluent. We then compared the response from the sample eluent to the response from initial calibration standards. We then corrected the measured sample concentration for sample initial volume, final volume, and any additional dilutions or corrections performed on the sample to determine the final corrected concentration of each target chemical analyte in each nail product sample.

We ran one or more blanks after a high concentration sample or QC sample or standard.

SVOC Solutions Preparation and Analysis

The procedure used to prepare the samples and measure the concentrations of SVOCs was based on guidelines from EPA Method 8270D and 8000D.

Calibration and QC Standard Preparation

We analyzed a decafluorotriphenylphosphine (DFTPP) tune standard solution at the beginning of each 12-hour period to verify that the mass spectrometer was within the instrument tune criteria parameters in Appendix F for tune criteria. A DFTPP tune is a specific MS tune check designed to meet the instrument tuning requirements of EPA Method 8270.

The DFTPP tune working standard (50 µg/mL of DFTPP, pentachlorophenol, benzidine, and DDT solution) was introduced into the GC/MS by automated direct injection. Once the DFTPP tune run was complete, the results were evaluated. The tune quality criteria information is listed in Appendix F – Tune Criteria.

We prepared the initial calibration (ICAL) standards in concentration ranges of 5-200 µg/mL for all analytes found in Table A4 except for triphenyl phosphate, which had a range of 25-1000 µg/mL.

The same ICAL standards were also used for the continuing calibration verification (CCV) and LCS/LCSD/MS/MSD. The ICV was made as a secondary source with the same concentrations as the ICAL standards.

The surrogate standard was made by combining 1 mL of B/N Surrogate mix and 1 mL of Acid Surrogate Mix and diluting them to a final volume of 10 mL with methylene chloride. The surrogate concentration was 50/100 µg/mL.

All samples, including QC standards and calibration standards, were injected into the GC within 12 hours of the injection of the associated, acceptable tune check standard. Samples and QC standards that were not injected within the 12-hour time window were not reported.

Table A4. SVOC standard materials.

Standard	Description	Vendor	Catalog/Part Number
DFTPP Tune Standard	(DFTPP) GC/MS Tuning Mixture	Restek	31615
Internal STD	SV Internal Standard Mix	Restek	31006
Surrogates	Acid Surrogate Mix (4/89 SOW)	Restek	31087
	B/N Surrogate Mix (4/89 SOW)	Restek	31086
Primary Source	Propyl Paraben	TCI	H0219
	Ethyl Tosylamide	TCI	E0674
	4-Methoxyphenol (MEHQ)	TCI	M0123
	4-Ethoxyphenol	Acros Organics	09670250

Standard	Description	Vendor	Catalog/Part Number
	Hydroquinone	Acros Organics	409670250
	Diphenyl Phosphate	Acros Organics	25690050
	Methyl Paraben	TCI	H0216
	Ethyl Paraben	TCI	H0216
	Butyl Paraben	TCI	H0210
	Ethyl-2-Pyrrolidone	TCI	E0358
	Methyl-2-Pyrrolidone	TCI	M0418
	Ethylhexyl-diphenyl-phosphate	TCI	P1021
	Methyl-2-Isothiazolin-3-one	TCI	45997050
	Triphenyl phosphate	Acros Organics	P0272
	Benzyl Alcohol	TCI	B2378
	606 Phthalate Esters Calibration Mix	Retek	31031
	Secondary Source	Propyl Paraben	Sigma-Aldrich
Ethyl Tosylamide		Alfa Aesar	H61905
4-Methoxyphenol (MEHQ)		TCI	M0123
4-Ethoxyphenol		Alfa Aesar	B20584
Hydroquinone		Alfa Aesar	A11411
Diphenyl Phosphate		Alfa Aesar	L02121
Methyl Paraben		Sigma-Aldrich	PHR1012
Ethyl Paraben		Sigma-Aldrich	PHR1011
Butyl Paraben		Sigma-Aldrich	PHR1022
Ethyl-2-Pyrrolidone		Alfa Aesar	B24548
Methyl-2-Pyrrolidone		Acros Organics	39068
Ethylhexyl-diphenyl-phosphate		Crescent Analytics	3773M
Methyl-2-Isothiazolin-3-one		Frontier Scientific	220473
Triphenyl phosphate		SPEXertificate	S-3765
Benzyl Alcohol		SPEXertificate	S-460

Sample Preparation

We allowed the nail product samples to come to room temperature and gently shook them by hand prior to sample preparation and analysis.

Using a disposable pipet, we prepared the liquid nail product samples for analysis by diluting 0.5 mL of sample into 5 mL of methanol.

We prepared the solid nail product samples for analysis by weighing 0.5 g of nail product sample on a mass balance and dissolving it into 5 mL of methanol.

We stored the sample extracts in amber glass containers under refrigeration at ≤ 6 °C and analyzed them within 40 days of extraction.

We transferred a volume of 200 μL of each sample extract into a glass insert in an autosampler vial. 10 μL of IS was then added to the extract.

Samples were placed in the autosampler and run by GC/MS under the instrument method parameters as described in Table A5 and Table A6.

We ran one or more blanks after a high concentration sample or QC sample or standard.

Instrument and Operating Parameters

We analyzed the samples using GC equipped with a split/splitless injector, temperature programmable oven, MS, and autosampler.

The equipment manufacturers and instrument parameters are described in Table A5 and Table A6 below.

Table A5. Instrumentation used and manufacturers.

Equipment	Manufacturer and Instrument model
Autosampler	Agilent PAL LSI 85 Autosampler
Gas chromatograph equipped with split/splitless injector and temperature programmable oven	Agilent 7890B GC
GC Column	Hewlett Packard 5MS UI 30 m X 0.25 mm X 0.25 μm
Mass Spectrometer	Agilent 5977B MSD
Autosampler	Agilent PAL LSI 85 Autosampler

Table A6. Gas chromatograph and mass spectrometer instrument parameters.

Property	Value
Front Split/Splitless Inlet Gas: Helium	Split Ratio: 10:1, Split flow: 12 mL/min
	Septum Purge flow: 3 mL/min
	Total flow: 16.2 mL/min
	Heater Temp: 250 $^{\circ}\text{C}$
	Pressure \sim 10.7 psi
GC	Constant Flow: 1.2 mL/min
Oven	Equilibration Time: 0 min, Max Temp: 260 $^{\circ}\text{C}$
Oven Program	Initial: 40 for 1.5 min
	Ramp 1: ramp 20 $^{\circ}\text{C}/\text{min}$ to 290 $^{\circ}\text{C}$, hold 0 min
	Ramp 2: ramp 2 $^{\circ}\text{C}/\text{min}$, to 303 $^{\circ}\text{C}$, hold 0 min
	Ramp 3: ramp 10 $^{\circ}\text{C}/\text{min}$, to 320 $^{\circ}\text{C}$, hold 0.8 min
	Run Rime: 23 min
MSD Transfer Line	Heater: On, Temp: 320 $^{\circ}\text{C}$

Property	Value
MS Source	230 °C
MS Quad	150 °C

Sample Analysis

We used an autosampler to inject a 1 µL aliquot of the sample extract into the GC/MS and measured the retention time and response of the eluent with the MS detector. We then compared the response from the sample eluent to the response from initial calibration standards. We then corrected the measured sample concentration for sample initial volume, final volume, and any additional dilutions or corrections performed on the sample to determine the final corrected concentration of each target chemical analyte in each nail product sample.

Samples were additionally diluted to the approximate analyte concentration if the analysis indicated the concentrations were outside of the known calibration range of the ICAL.

We ran one or more blanks after a high concentration sample or QC sample or standard.

Formaldehyde Solutions Preparation and Analysis

Calibration and QC Standard Preparation

We analyzed a DFTPP tune standard solution at the beginning of each 12-hour period to verify that the mass spectrometer was within the tune criteria parameters. See Appendix F – Tune Criteria for DFTPP tune standard criteria.

The DFTPP tune standard (50 µg/mL of DFTPP, pentachlorophenol, benzidine, and DDT solution) was introduced into GC/MS by direct injection or by auto-injection. Once the DFTPP tune run was complete, the results were evaluated. The quality criteria are listed in Appendix G – Method Information.

The initial calibration (ICAL) standards were prepared at concentration ranges of 0.5-100 µg/mL for formaldehyde and surrogates, propionaldehyde and butyraldehyde. These are the actual concentrations before the derivatization and extraction by hexane.

The same ICAL standards were also used for the continuing calibration verification (CCV) and LCS/LCSD/MS/MSD.

The ICV was made as a secondary source with the same concentrations as the ICAL standards.

We injected all samples, including QC standards and calibration standards, into the GC within 12 hours of the injection of the associated, acceptable tune check standard. Samples and QC standards that were not injected within the 12-hour time window were not reported.

Table A7. Formaldehyde standard materials.

Standard	Description	Vendor	Catalog/Part Number
DFTPP Tune Standard	GC/MS Tuning Mixture	Restek	31615
Internal STD	SV Internal Standard Mix	Restek	31006
Surrogate	Butyraldehyde	Acros Organics	10809
Surrogate	Propionaldehyde	Acros Organics	42721
Derivatization Agent	O-(2,3,4,5,6-Pentafluorobenzyl) hydroxylamine hydrochloride (PFBHA)	TCI America	P0822
Primary Source	Formaldehyde solution 37%	J.T. Baker	2106-04
Secondary Source	Formaldehyde O-pentafluorophenylmethyl-oxime	Sigma-Aldrich	41558-10MG

Sample Preparation

We allowed the nail product samples to come to room temperature and gently shook them by hand prior to sample preparation and analysis.

Using a disposable pipet, we prepared the liquid nail product samples for analysis by adding 0.2 mL of sample into a 1.5 mL vial that contained 0.8 mL of methanol (this is a five-fold sample dilution).⁶

We prepared the solid nail product samples for analysis by weighing 0.5 g of the nail product sample and dissolving it into 5 mL of methanol.

The formaldehyde in nail product samples was derivatized to the oxime derivative pentafluorophenylmethyl-oxime. This was done by combining 50 μ L of sample extract and 50 μ L of 500 μ g/mL surrogate solution in an 8 mL glass vial. The solution was then spiked with 1 mL of PFBHA reagent to create the sample solution. The product sample solutions were then added into a beaker filled with water in a Branson 3510 sonicator. The sonicator was set to 35 ± 2 °C. The samples were then sonicated for one hour.

We extracted the oxime derivative pentafluorophenylmethyl-oxime by adding 1 mL of hexane into each individual 8 mL vial. Each vial was then shaken by hand for one minute. After one minute, the vials were opened and allowed to equilibrate to room temperature until the aqueous and hexane layers had separated. Using a disposable pipet, we removed 200 μ L of the aqueous layer and inserted it

⁶ If a 5-fold dilution of the sample was impossible due to the sample matrix, a 10-fold diluted solution was prepared.

into a 1.5 mL vial. We then added 10 μL of 800 $\mu\text{g}/\text{mL}$ internal standard into the 200 μL of sample extract.

Samples were additionally diluted to the approximate analyte concentration if the analysis indicated the concentrations were outside of the known calibration range of the ICAL.

The sample extracts were stored in amber glass containers under refrigeration at ≤ 6 $^{\circ}\text{C}$. The sample extracts were analyzed within 40 days of extraction.

Instrument and Operating Parameters

The samples were analyzed using GC equipped with a split/splitless injector, temperature programmable oven, MS, and autosampler.

The equipment manufacturers and instrument parameters are described in Table A8 and Table A9 below.

Table A8. Instrumentation used and manufacturers.

Equipment	Manufacturer
Autosampler	Agilent PAL LSI 85 Autosampler
Gas chromatograph equipped with split/splitless injector and temperature programmable oven	Agilent 7890B GC
GC Column	Hewlett Packard 5MS UI 30 m X 0.25 mm X 0.25 μ m
Guard Column	Restek Siltek 5 m X 0.25 mm
Mass Spectrometer	Agilent 5977B MSD

Table A9. Gas chromatograph and mass spectrometer instrument parameters.

Property	Value
Front Split/Splitless Inlet	Split Ratio: 10:1, Split flow: 12 mL/min
Gas: Helium	Septum Purge flow: 3 mL/min Total flow: 16.2 mL/min Heater Temp: 250 °C Inlet Pressure ~10.3 psi
GC	Constant Flow: 1.2 mL/min Pressure ~10.6 psi Avg. velocity ~37.3 cm/sec
Oven	Equilibration Time: 0 min, Max Temp: 260 °C
Oven Program	Initial: 40 °C for 1.5 min Hold time 1.5 min, post run 0.7 ml/min, post run temp 180 °C Ramp 1: ramp 20 °C/min, to 200 °C, hold 0 min Ramp 2: ramp 50 °C/min, to 310 °C, hold 2 min Run Rime: 13.7 min
MSD Transfer Line	Heater: On, Temp: 320 °C
MS Source	230 °C
MS Quad	150 °C

Sample Analysis

An autosampler injected a 1 μ L aliquot of hexane sample extract into the GC/MS, and the MS detector measured the sample eluent for retention time and response. The response from a sample eluent was compared to the response from initial calibration standards. We then corrected the measured sample concentration for sample initial volume, final volume, and any additional dilutions or corrections performed on the sample to determine the final corrected concentration of each target chemical analyte in each nail product sample.

We ran one or more blanks after a high concentration sample or QC sample or standard.

Appendix B - List of Analytes (VOCs and SVOCs)

Table B1. List of Target Analytes, VOCs.

Analyte	CAS RN	Candidate Chemical	Quantitation Limits (µg/mL)
1-Butanol	71-36-3	Yes	125 – 3120* (250 µg/g for powders)
1,1,1-Trichloroethane	71-55-6	Yes	12.5 – 25.0 (25.0 µg/g for powders)
1,1,1,2-Tetrachloroethane	630-20-6	Yes	12.5 – 25.0 (25.0 µg/g for powders)
1,1,2-Trichloroethane	79-00-5	Yes	12.5 – 25.0 (25.0 µg/g for powders)
1,2,3-Trichloropropane	96-18-4	Yes	12.5 – 25.0 (25.0 µg/g for powders)
1,2,3-Trimethylbenzene	526-73-8	Yes	25.0 (25.0 µg/g for powders)
1,2,4-Trimethylbenzene	95-63-6	Yes	12.5 – 25.0 (25.0 µg/g for powders)
1,3,5-Trimethylbenzene	108-67-8	Yes	12.5 – 25.0 (25.0 µg/g for powders)
Methyl ethyl ketone (MEK)	78-93-3	Yes	31.2 – 62.5 (62.4 – 62.5 µg/g for powders)
2-Hexanone	591-78-6	Yes	31.2 – 62.5 (62.4 – 62.5 µg/g for powders)
Methyl isobutyl ketone (MIBK)	108-10-1	Yes	31.2 – 62.5 (62.4 – 62.5 µg/g for powders)
Acetone	67-64-1	Yes	31.2 – 62.5 (62.4 – 62.5 µg/g for powders)
Acetonitrile	75-05-8	Yes	125 – 250 (250 µg/g for powders)
Acrolein	107-02-8	Yes	12.5 – 25.0 (25.0 µg/g for powders)
Benzene	71-43-2	Yes	12.5 – 25.0 (25.0 µg/g for powders)
Butyl acetate	123-86-4	No	12.5 – 25.0 (25.0 µg/g for powders)
Dimethyl-p-toluidine (DMPT)	99-97-8	Yes	12.5 – 25.0 (25.0 µg/g for powders)
Ethyl acetate	141-78-6	Yes	12.5 – 25.0 (25.0 µg/g for powders)
Ethyl methacrylate	97-63-2	No	12.5 – 25.0
Ethylbenzene	100-41-4	Yes	12.5 – 25.0 (25.0 µg/g for powders)
Formaldehyde	50-00-0	Yes	50 – 100 (100 µg/g for powders)
Isopropyl alcohol (IPA)	67-63-0	Yes	125 – 250 (250 µg/g for powders)

Analyte	CAS RN	Candidate Chemical	Quantitation Limits (µg/mL)
meta & para-Xylene	179601-23-1	Yes	25.0 – 50.0 (49.9 – 50.0 µg/g for powders)
Methyl methacrylate (MMA)	80-62-6	Yes	12.5 – 25.0
Methyl tert-butyl ether	1634-04-4	Yes	31.2 – 62.5 (62.4 and 62.5 µg/g for powders)
Methylene chloride	75-09-2	Yes	12.5 – 25.0 (25.0 µg/g for powders)
ortho-Xylene	95-47-6	Yes	12.5 – 25.0 (25.0 µg/g for powders)
Propyl acetate	109-60-4	No	12.5 – 25.0 (25.0 µg/g for powders)
r & s-Camphor	76-22-2	No	12.5 – 50.0 (49.9 – 50.0 µg/g for powders)
tert-Butyl alcohol (TBA)	75-65-0	Yes	125 – 250 (250 µg/g for powders)
Tetrahydrofuran	109-99-9	Yes	50.0 (49.9 – 50.0 µg/g for powders)
Toluene	108-88-3	Yes	12.5 – 25.0 (25.0 µg/g for powders)

**The upper quantitation limit for the EPA 8260C method was 250 µg/mL. However, for 1-butanol, a higher quantitation limit was required.*

Table B2. List of Target Analytes, SVOCs.

Analyte	CASRN	Candidate Chemical	Quantitation Limits (µg/mL)
N-Ethyl-2-pyrrolidinone (NEP)	2687-91-4	Yes	1,000 (998 – 1,000 µg/g for powders)
N-Methyl-2-pyrrolidinone (NMP)	872-50-4	Yes	1,000 (998 – 1,000 µg/g for powders)
4-Ethoxyphenol	622-62-8	No	1,000 (998 – 1,000 µg/g for powders)
4-Methoxyphenol	150-76-5	No	1,000 (998 – 1,000 µg/g for powders)
Benzyl alcohol	100-51-6	No	1,000 (998 – 1,000 µg/g for powders)
bis(2-Ethylhexyl)phthalate	117-81-7	Yes	1,000 (998 – 1,000 µg/g for powders)
Butyl benzyl phthalate	85-68-7	Yes	1,000 (998 – 1,000 µg/g for powders)
Butyl paraben	94-26-8	Yes	1,000 (998 – 1,000 µg/g for powders)
Di-n-butyl phthalate (DBP)	84-74-2	Yes	1,000 (998 – 1,000 µg/g for powders)
Di-n-octyl phthalate	117-84-0	Yes	1,000 (998 – 1,000 µg/g for powders)
Diethyl phthalate	84-66-2	Yes	1,000 (998 – 1,000 µg/g for powders)

Analyte	CASRN	Candidate Chemical	Quantitation Limits (µg/mL)
Dimethyl phthalate	131-11-3	Yes	1,000 (998 – 1,000 µg/g for powders)
Diphenyl ethylhexyl phosphate	1241-94-7	No	1,000 (998 – 1,000 µg/g for powders)
Ethyl paraben	120-47-8	Yes	1,000 (998 – 1,000 µg/g for powders)
Ethyl tosylamide	80-39-7	No	1,000 (998 – 1,000 µg/g for powders)
Hydroquinone	123-31-9	Yes	1,000 (998 – 1,000 µg/g for powders)
Methyl paraben	99-76-3	Yes	1,000 (998 – 1,000 µg/g for powders)
Methylisothiazolinone	2682-20-4	No	1,000 (998 – 1,000 µg/g for powders)
Propylparaben	94-13-3	Yes	1,000 (998 – 1,000 µg/g for powders)
Triphenyl phosphate (TPhP)	115-86-6	Yes	5,000 (4,990 – 5,000 µg/g for powders)

Appendix C – Detailed Sample List and Data Tables

Table C1. Product Type: Acrylic Liquid Monomer. Units of measurement: ug/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchase Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPHP)	Ethyl tosylamide*	
SCPNP33	Cácee Smooth Set Perfect Liquid, 4 fl oz	Amazon	P	--	--	--	--	--	3,800**	--	11,200	127	--	--	--	--	3,260**	--	--	--	--	--	602,000	--	--	--	--	--	--	--	--	--	--
SCPNP78	CND Retention+ Sculpting Liquid, 4 fl oz	Buynail.com	P	--	--	--	--	2,000**	33,400**	--	48**	5,470**	--	--	--	--	1,650	--	--	--	--	28**	665,000	--	--	--	--	--	--	--	--	--	--
SCPNP57	Ezflow Maximum Adhesion Q Monomer, 4 fl oz	Walmart	P	--	--	--	--	--	4,140**	--	9,080	3,060**	--	--	--	--	2,900**	--	--	--	--	--	502,000	--	--	--	--	--	--	--	--	--	--
SCPNP77	Gelish Hand & Nail Harmony ProHesion Nail Sculpting Liquid, 4 fl oz	Buynail.com	P	--	--	--	--	91**	33,700**	--	11,000	1,460	--	--	--	--	5,010**	--	--	--	--	33**	64**	642,000	--	--	--	--	--	--	--	--	--
SCPNP129	KISS Acrylic Liquid, 0.5 fl oz	Walmart	R	--	--	--	--	--	--	--	7,840	--	--	--	--	--	1,840	--	--	--	--	181	737,000	--	--	--	--	--	--	--	--	--	--
SCPNP52	Mia Secret Liquid Monomer, 1 fl oz	Walmart	P	--	--	--	--	--	4,940**	--	--	4,950**	--	--	--	--	8,760**	--	--	--	--	33**	--	502,000**	--	--	--	--	--	--	--	--	--
SCPNP119	Sassi Odorless Acrylic Liquid, 2 oz	Amazon	P	--	--	--	--	151	--	--	2,860**	--	--	--	--	--	102	--	--	--	--	--	860**	--	--	--	--	--	--	--	--	--	--
SCPNP79	Tammy Taylor Nail Liquid - Original, 4 oz	Buynail.com	P	--	--	--	--	--	26,800**	--	11,300	83	--	--	--	--	3,580**	--	--	--	--	--	840,000	--	--	--	--	--	--	--	--	--	--

**Chemicals detected in nail products but not present on ingredient labels

Table C2. Product Type: Acrylic Powder. Units of measurement: ug/g. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchase Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*	
SCPNP137	Beauty Secrets Acrylic Nail Powder - Clear, 36 g	Amazon	P&R	--	--	--	--	--	--	73**	--	--	--	142	--	--	374**	--	--	--	--	--	--	1,110	--	--	--	--	--	--	--	--	--
SCPNP149	Glam and Glits Color Pop Acrylic Collection - Wet Suit-353 (Blue), 28 g	Amazon	P	--	--	--	--	--	--	--	--	--	--	230**	--	--	38**	--	--	--	--	--	--	856**	--	--	--	--	--	--	--	--	--
SCPNP136	KISS Acrylic Powder - Clear, 7.5 g	Walmart	R	--	--	--	--	--	--	37**	--	--	--	132	--	--	453**	--	--	--	--	--	--	2,220**	--	--	--	--	--	--	--	--	--
SCPNP148	Mia Secret Clear Acrylic Powder, 118 g	Amazon	P	--	--	--	--	--	--	35**	--	--	--	110	--	--	205**	--	--	--	--	--	--	765**	--	--	--	--	--	--	--	--	--
SCPNP145	Young Nails Acrylic Nail Powder - French Pink, 45 g	Amazon	P	--	--	--	--	--	--	--	--	--	--	132	--	--	237**	--	--	--	--	--	--	991**	--	--	--	--	--	--	--	--	--

**Chemicals detected in nail products but not present on ingredient labels

Table C3. Product Type: Airbrush Cleaner. Units of measurement: ug/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchase Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*	
SCPNP01	Createx Colors 5618 Airbrush Cleaner, 8 oz	Amazon	R	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP108	U.S. Art Supply AC Water Based Airbrush Cleaning Solution, 1 fl oz/30 mL	Amazon	P & R	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP02	Iwata Medea Airbrush Cleaner, 8 oz	Amazon	R	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP122	QT Brush Cleaner, 16 oz	eBuyNails.com	P	--	--	--	--	448,000	--	--	26	133,000	--	--	--	--	3,470**	--	--	--	--	--	156,000	--	58**	--	--	--	--	--	--	--	--
SCPNP113	U.S. Art Supply Airbrush Colors Water Based Airbrush Cleaning Solution, 1 oz	Walmart	P & R	--	--	--	--	--	--	--	--	54	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP104	Vallejo Airbrush Cleaner, 85 mL	Amazon	P & R	--	--	--	--	--	--	--	--	--	--	490	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**Chemicals detected in nail products but not present on ingredient labels

Table C4. Product Type: Airbrush Nail Art. Units of measurement: ug/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchase Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*	
SCPNP03	Badger Air-Opaque Ready-to-Use Airbrush Colors - Yellow 7-21, 1 oz	Amazon	P & R	305**	--	--	--	50**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP107	Custom Body Art Water Based Acrylic Formulation Airbrush Nail Paint - Pink 100252, 1 fl oz	Amazon	P	--	--	--	--	--	--	--	--	--	--	215	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP103	Holbein Aeroflash Color - Carmine (E002), 35 mL	Walmart	P	434**	--	--	--	--	--	--	--	--	--	--	15,700	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP120	Mist Airbrush Nail Color - Pearly Purple, 1 oz	Walmart	P	--	--	--	--	--	--	--	--	--	--	82**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP131	OPHIR Airbrush Ink - Fluorescent Rose, 10 mL	eBay	P	--	--	--	--	--	--	--	--	--	--	1,350	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**Chemicals detected in nail products but not present on ingredient labels

Table C5. Product Type: Airbrush Top Coat. Units of measurement: ug/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchase Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (IPA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*	
SCPNP04	Badger Air-Opaque Non-Yellowing Transparent Clear Coat Airbrush Finish, 4 fl oz	Amazon	P & R	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP81	Tammy Taylor Airbrush Top Coat, 0.5 fl oz	Buynail .com	P	3,270**	--	--	--	156	--	--	--	--	--	--	--	--	2,470**	--	--	1,990	--	187,000	320,000	75**	--	--	--	--	--	--	--	--	--
SCPNP90	U2 Airbrush Topcoat, 0.5 fl oz	Buynail .com	P	501**	--	--	--	--	--	--	--	144,000	--	--	1,160	--	392**	--	--	--	--	117,000	300,000	--	--	--	--	--	--	--	--	--	--

**Chemicals detected in nail products but not present on ingredient labels

Table C6. Product Type: Anti-nail Bite Products. Units of measurement: ug/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchase Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate *	Ethyl Methacrylate *	Propyl Acetate *	r & s-Camphor *	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide *
SCPNP06	Magique NoBite Bitter Additive, 0.1 oz	Amazon	R	--	--	--	--	--	--	--	--	93	--	--	--	--	--	--	--	--	--	--	184	--	--	--	--	--	--	126,000	--	--
SCPNP05	Magique NoBite Stop Nail Biting & Thumb Sucking Aid, 0.5 oz	Amazon	R	622	--	--	--	--	--	--	--	280,000	--	--	--	--	2,410 **	--	--	--	--	--	332,000	--	65 **	--	--	--	--	30,000 **	46,100 **	--
SCPNP50	Orly No Bite Nail Bite Deterrent, 0.6 oz	Walmart	R	4,530 **	--	65,600	--	483 **	3,580 **	--	--	73,400 **	--	--	291,000	--	63 **	--	--	--	--	94 **	309,000	--	--	4,490	--	--	--	--	--	--
SCPNP55	Probelle Anti-Bite Base Coat, 0.5 fl oz	Walmart	R	12,600	--	118,000	--	--	3,320 **	--	--	236,000	--	--	161,000	--	--	--	--	--	--	--	182,000	--	--	--	--	--	--	--	--	--
SCPNP07	SuperNail Bite No More, 14 mL/0.5 fl oz	Amazon	R	988 **	--	176,000	--	630 **	--	--	--	--	--	--	307,000	--	--	--	--	--	--	--	202,000	65	--	--	--	--	--	--	--	--

**Chemicals detected in nail products but not present on ingredient labels

Table C7. Product Type: Base Coat. Units of measurement: ug/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchase Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*		
SCPNP76	CND Stickey Anchoring Base Coat, 9.8 mL/0.33 oz	Buynail.com	P	403**	--	--	--	146	--	--	--	177,000	--	--	14,500	--	--	--	--	261**	--	--	115,000	--	--	--	--	--	--	--	--	--	--	
SCPNP62	Essie Here to Stay Base Coat, 13.5 mL/0.46 fl oz	Target	R	975**	--	--	--	792**	--	--	--	118,000	--	--	6,610	--	--	--	--	415**	--	--	227,000	--	132	--	--	--	--	--	--	--	--	
SCPNP85	LeChat Undercover Basecoat, 15 mL/0.5 oz	Buynail.com	P	11,600	--	489**	--	617**	462**	--	--	310,000	--	--	43,700	52**	--	--	--	--	--	--	362,000	--	--	6,730	--	--	--	--	--	--	--	
SCPNP125	Lexi Base Coat, 16 oz	eBuyNails.com	P	11,300	--	--	--	641**	--	--	--	220,000	--	--	14,000	--	--	--	--	--	--	--	269,000	--	38**	--	--	--	--	--	--	--	--	
SCPNP08	OPI Natural Nail Base Coat, 15 mL/0.5 fl oz	Amazon	P & R	888**	--	--	--	--	--	--	--	219,000	--	--	22,400	--	--	--	--	262**	--	--	177,000	--	--	13,000	--	--	--	--	--	--	--	--
SCPNP09	Orly Bonder Rubberized Base Coat, 0.6 fl oz	Amazon	P & R	709**	--	--	--	--	--	--	--	83,800	--	--	175,000	--	--	--	--	--	--	--	230,000	--	--	--	--	--	--	--	--	--	--	--
SCPNP47	Sally Hansen Big Primer Base Coat, 0.4 fl oz	Walmart	R	15,300	--	--	--	234**	--	--	--	162,000	--	--	40,500	--	--	--	--	--	--	--	402,000	--	--	--	--	--	--	--	--	--	--	--
SCPNP10	Seche Clear Crystal Clear Base Coat, 14 mL/0.5 oz.	Amazon	P & R	918**	--	--	--	--	--	--	--	207,000	--	--	58,800	--	--	--	--	302**	--	--	151,000	--	--	--	--	--	--	--	17,700	--	--	--
SCPNP98	Wet n Wild Wildshine Protective Base Coat, 0.41 fl oz	Rite Aid	R	3,190**	--	996**	--	156	--	--	--	422,000	--	--	606	--	--	--	--	--	--	--	149,000	--	--	--	--	--	--	--	--	--	--	--

**Chemicals detected in nail products but not present on ingredient labels

Table C8. Product Type: Gel Polish. Units of measurement: ug/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchase Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*
SCPNP115	CND Vinylux Long Wear Polish - Hot Pop Pink, 0.5 fl oz	Buy nail .com	P & R	2,180**	--	--	--	133	--	--	--	140,000	--	--	16,300	--	--	--	--	--	--	--	340,000	--	52**	--	--	--	--	--	--	--
SCPNP12	Deborah Lippmann Gel Lab Pro - Love At First Sight, 0.5 fl oz	Amazon	R	30,800**	--	--	--	696**	1,900	--	--	257,000	--	--	58,300	--	--	--	--	--	--	--	265,000	--	14,800	--	--	--	--	--	27,200**	--
SCPNP45	Essie Gel Couture Nail Polish - Fairy Tailor, 0.46 fl oz	Walmart	R	4,880**	--	--	--	607	--	--	--	242,000	--	--	30,100	--	--	--	--	--	--	--	281,000	--	1,080	--	--	--	--	--	--	13,300
SCPNP11	Pink Armor Nail Gel, 0.45 fl oz	Amazon	R	8,540**	--	--	--	114	--	--	--	337,000	--	50	58,200	--	--	--	--	--	--	--	240,000	--	--	--	--	--	--	--	--	--
SCPNP48	Revlon ColorStay Gel Envy Longwear Nail Enamel - Full House, 0.4 fl oz	Walmart	R	8,110**	--	--	--	120	--	--	--	146,000	--	--	17,100	--	--	--	--	626**	--	--	455,000	--	--	--	--	--	--	--	--	--
SCPNP63	Sally Hansen Miracle Gel Nail Polish - Top Coat, 0.5 oz	Target	R	4,080**	--	--	--	--	--	--	--	240,000	--	--	20,100	--	100**	--	--	--	--	--	355,000	--	28**	--	--	--	--	--	--	--
SCPNP67	Sally Hansen Miracle Gel - Pink Cadillaquer, 0.5 fl oz	Ulta Beauty	R	1,440	--	--	--	136	--	--	--	255,000	--	--	49,700	--	--	--	--	--	--	--	278,000	--	233**	--	--	--	--	8,880	--	--

**Chemicals detected in nail products but not present on ingredient labels

Table C9. Product Type: Hard Gel. Units of measurement: ug/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchase Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*	
SCPNP84	CND Brisa Gel Sculpting Gel - Clear 14 g/0.5 oz	Buynail.com	P	--	--	--	--	291**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP106	Gelish Hard Gel LED Clear Nail Gel, 15mL/0.5 fl oz	Amazon	P	--	--	--	--	144	--	--	--	549	--	76**	--	--	--	--	--	--	--	51**	--	--	--	--	--	--	--	--	--	--	--
SCPNP116	ibd Hard Gel LED/UV - Clear, 15 g/0.5oz	Buynail.com	P	--	--	--	--	104	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP83	LeChat Pro-Tec UV Gel System - Clear, 2 oz	Buynail.com	P	--	--	--	--	100**	--	--	--	--	--	--	--	--	90**	--	--	--	--	32**	--	--	--	--	--	--	--	--	--	--	--
SCPNP134	NSI Balance UV Gel System - Body Builder Cover Pink Warm, 7 g	Buynail.com	P	--	--	76**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	103	--	--	--	--	--	--	--	--	--	--

**Chemicals detected in nail products but not present on ingredient labels

Table C10. Product Type: Hardener. Units of measurement: ug/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchase Location	Professional (P) or Retail (R)	1-Butanol	1,3-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*
SCPNP114	Essie Millionails Primer, 0.46 oz.	Buynail .com	P & R	5,010**	--	--	--	1,230	--	--	--	215,000	--	584**	19,200	--	--	--	--	--	--	--	251,000	--	61,800	7,180	--	--	--	--	22,200	1,710
SCPNP68	OPI Nail Envy Nail Strengthener Original Formula Maximum-Strength, 15 mL/0.5 fl oz.	Ulta Beauty	P & R	18,400	--	--	--	167	--	--	--	270,000	--	8,390	52,800	--	--	--	--	--	--	--	281,000	--	94,000	10,700	--	--	--	--	29,500	--
SCPNP102	Perfect Formula Pink Gel Coat, 0.6 fl oz.	Amazon	R	8,220**	--	--	--	149	1,000	--	--	352,000	--	2,700	19,000	93**	--	--	26**	--	--	169	371,000	--	--	--	--	--	--	--	--	--
SCPNP32	Probelle Nail Hardener Formula 1, 0.5 fl oz/15 mL	Amazon	R	21,700**	--	--	--	77**	--	--	--	279,000	--	15,600	63,600	--	--	--	--	--	--	--	308,000	--	--	--	--	--	--	--	--	--
SCPNP117	Quimica Alemana Nail Hardener, 0.47 fl oz.	Amazon	R	627	--	--	83**	--	--	349**	--	47,800	7,070**	14,100	20,000**	34,300**	--	--	5,050**	--	--	161,000	187,000	--	--	20,500**	2,730	--	51,100**	--	--	--
SCPNP66	Sally Hansen Hard as Nails Hardener, 0.45 fl oz.	Target	R	89,700	--	--	--	409**	1,040**	--	--	136,000	--	--	131,000	--	--	--	--	--	--	--	273,000	--	--	8,680	--	--	--	--	--	--

**Chemicals detected in nail products but not present on ingredient labels

Table C11. Product Type: Multi-functional (top coat and base coat). Units of measurement: ug/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchase Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*	
SCP53	Mia Secret Luxury UV Base & Top Gel for Natural Nails Soak Off Clear Gel, 0.5 fl oz/15 ml	Walmart	P	--	--	--	--	262**	3,500**	--	--	595**	--	--	--	--	4,800**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCP13	Orly Top 2 Bottom, 0.6 oz/18 mL	Amazon	P & R	13,500	--	--	--	140	--	--	--	259,000	--	--	43,300	78**	--	--	--	--	--	--	410,000	--	--	--	--	--	--	--	--	--	--
SCP70	Sally Hansen Diamond Shine Base & Top Coat, 0.45 fl oz/13.3 mL	Ulta Beauty	R	441**	--	--	--	--	--	--	--	224,000	--	--	35,400	--	--	--	--	--	--	--	170,000	--	--	--	--	--	--	--	13,500	1,920	
SCP51	Wet n' Wild Wild Shine Clear Nail Protector, 0.41 fl oz/12.3 mL	Walmart	R	43,300**	--	651**	--	--	--	--	--	346,000	--	--	982	--	--	--	--	--	--	--	320,000	--	--	--	--	--	--	--	--	--	

**Chemicals detected in nail products but not present on ingredient labels

Table C12. Product Type: Multi-functional (top coat, base coat and hardener). Units of measurement: ug/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchase Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*	
SCPNP96	Essie All-in-One, 13.5 mL/0.46 fl oz.	Rite Aid	R	5,530	--	--	--	84**	--	--	--	152,000	--	--	47,200	--	--	--	--	--	--	--	330,000	--	--	--	--	--	--	--	--	--	--
SCPNP41	L.A. Colors Nail Treatment Triple Play, 0.44 fl oz.	Walmart	R	10,100	--	--	--	--	--	--	--	315,000	--	--	111,000	--	--	--	--	--	--	31**	207,000	--	88**	9,410	--	--	--	--	--	--	--
SCPNP40	Nail-Aid 3-in-1 Gel Base + Top Coat + Hardener, 0.55 fl oz.	Walmart	R	17,300	--	--	--	340**	1,480**	--	--	302,000	--	--	26,500	52**	--	--	--	--	--	890**	336,000	--	36**	2,660**	--	--	--	--	--	--	--
SCPNP73	OPI Start To Finish - Original Formula, 15 mL/0.5 fl oz.	Buynail.com	P & R	8,710	--	--	--	--	--	--	--	162,000	--	4,760	44,600	--	--	--	--	--	--	35**	176,000	--	--	8,600	--	--	--	--	15,000	--	--

**Chemicals detected in nail products but not present on ingredient labels

Table C13. Product Type: Nail Art. Units of measurement: ug/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchase Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (IPA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*	
SCPNP31	L.A. Colors Art Deco Nail Art - Limon, 0.25 fl oz/7.5 mL	Dollar Tree	R	20,000**	--	--	--	831**	3,130**	--	--	334,000	--	92**	34,400	--	--	137	--	--	--	106	330,000	--	--	--	--	--	--	--	--	--	--
SCPNP29	Sassy + Chic Nail Art Pen - Raspberry Scent, 0.17 fl oz/5 mL	Dollar Tree	R	17,600	--	--	--	169	--	--	--	181,000	--	--	--	--	--	--	--	269**	--	--	409,000	--	--	--	--	--	--	--	--	--	--

**Chemicals detected in nail products but not present on ingredient labels

Table C14. Product Type: Nail Dry Spray. Units of measurement: ug/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchase Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*			
SCPNP154	Demert Nail Enamel Dryer, 7.5 oz	Amazon	P	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
SCPNP147	Golden Rose Nail Color Quick Dryer Spray , 55 mL	Amazon	R	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SCPNP139	Jessica Speed Dry Spray, 120 mL/4 fl oz	Amazon	P & R	--	--	--	--	64**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SCPNP150	Onyx Professional Nail Dryer - Island Coconut Scent, 2 oz	Amazon	R	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP146	OPI Rapidry Nail Polish Dryer, 55mL/1.8 fl oz	Amazon	R	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**Chemical detected in nail products but not present on ingredient labels

Table C15. Product Type: Nail Glue. Units of measurement: ug/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchase Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*		
SCPNP72	5 Second Brush On Nail Glue, 6 g/0.2 oz	Walmart	R	3,140**	--	--	--	--	--	--	--	1,540	--	232**	--	--	92**	--	--	--	--	114	23,200**	--	--	--	--	--	--	--	--	--	--	
SCPNP127	Artisan Instant Bond Super Fast Nail Glue, 2 mL	Amazon	P	--	--	--	--	--	--	--	--	77	--	177	--	--	--	--	--	--	--	--	33**	--	--	--	--	--	--	--	--	--	--	
SCPNP105	lbd 5 Second Brush On Nail Glue, 6 g/0.21 oz	Amazon	P	6,530**	--	--	--	--	2,200**	--	--	829**	--	215**	--	--	88**	--	--	--	--	--	34,400**	--	--	--	--	--	--	--	--	--	--	--
SCPNP156	Kiss Brush-On Nail Glue, 5 g/0.17 oz	Amazon	R	--	--	--	--	--	--	--	--	31	--	516**	--	--	37**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP128	Kiss Powerflex Nail Glue, 5 g/0.17 oz	Walmart	R	--	--	--	--	--	--	--	--	316	--	94**	--	--	58**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP144	Mia Secret Strong-Jet Clear Nail Glue, 0.5 oz/14 g	Amazon	P	--	--	--	--	--	--	--	--	--	--	218**	--	--	35**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**Chemicals detected in nail products but not present on ingredient labels

Table C16. Product Type: Nail Polish/Lacquer. Units of measurement: ug/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchasing Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPHP)	Ethyl tosylamide*	
SCPNP95	Avon True Color Pro+ Nail Enamel - Pastel Pink, 12 mL/0.406 fl oz	Amazon	P & R	6,090**	--	--	--	125	2,120**	--	--	348,000	--	--	19,700	--	--	29**	--	--	--	--	280,000	--	--	--	--	--	--	--	--	--	--
SCPNP91	Broadway Nails Lightning Speed Nail Polish - Mooded, 13 mL/0.44 fl oz	Dollar General	R	7,510**	--	--	--	143	--	--	--	418,000	35**	--	21,000	99**	--	--	--	--	--	--	127,000	--	--	--	--	--	--	--	--	--	--
SCPNP14	butter LONDON Nail Lacquer - Mermaid, 6 mL/0.2 fl oz	Amazon	R	16,100	--	--	--	201**	--	--	--	220,000	--	--	76,500	--	--	--	--	--	--	--	362,000	--	--	--	--	--	--	--	--	--	--
SCPNP38	Chanel Le Vernis Velvet Nail Colour - 636 Ultime, 13 mL/0.4 fl oz	Macy's	R	7,030	--	--	--	112	--	--	--	358,000	--	--	46,600	--	--	--	--	--	--	--	246,000	--	30**	--	--	--	--	--	--	--	--
SCPNP88	China Glaze Nail Polish with Hardener - The Heat is On, 14 mL/0.5 fl oz	Buynail.com	P & R	5,350**	--	--	--	385**	28,300**	--	--	217,000	--	1,120	35,400	--	--	--	--	--	--	--	234,000	--	67,900	9,910	--	--	--	--	28,100	2,830	
SCPNP121	CND Shellac Color Coat – Beckoning Begonia, 7.3 mL/0.25 fl oz	eBuyNails.com	P	638**	--	124	--	--	--	--	--	--	--	--	--	--	646**	--	--	--	--	--	236,000	--	--	--	1,020	--	--	--	--	--	--

Sample ID	Product Name	Purchasing Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*
SCPNP44	CoverGirl Outlast Stay Brilliant Nail Gloss - Tickled Pink 165, 11 mL/0.37 fl oz	Walmart	R	7,630	--	--	--	123	--	--	--	148,000	--	--	16,600	--	--	--	--	--	--	--	357,000	--	--	--	--	--	--	--	--	--
SCPNP37	DND Nail Laquer - Golden Sahara Star #401	Walmart	P	41,600	--	--	--	143	--	--	--	275,000	--	59	52,600	--	26	--	--	--	--	--	232,000	--	--	--	--	--	--	--	--	--
SCPNP65	Defy & Inspire Nail Lacquer - Nail Polish Ladies Who Lunch, 0.5 fl oz/14.7 mL	Target	R	15,300	--	--	--	215**	--	--	--	173,000	--	--	62,600	--	--	--	--	--	--	--	413,000	--	--	--	--	--	--	--	--	--
SCPNP39	Dior Vernis Couture Colour Gel Shine and Long Wear Nail Lacquer - Muguet 108, 10 mL/0.33 fl oz	Macy's	R	10,700	--	--	--	218**	--	--	--	198,000	--	--	43,400	--	--	--	--	--	--	--	368,000	--	--	--	--	--	--	--	--	--
SCPNP54	Disney Princess Nail Art Collection Nail Polish - Cinderella Turquoise, 0.17 fl oz/5 mL	Walmart	R	--	--	--	--	--	--	--	--	61**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP26	Elite Pro Beauty Glam Colors Nail Polish - Gold Sparkle	99 Cent Only Stores	R	--	--	--	--	--	--	--	--	202	--	118	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP27	Elite Pro Beauty Glam Colors Nail Polish - Lavender	99 Cent Only Stores	R	--	--	--	--	106	--	--	--	--	--	--	--	--	--	--	--	--	--	--	36**	--	--	--	--	--	--	--	--	--

Sample ID	Product Name	Purchasing Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*
SCPNP15	ella+mila Nail Polish, Me Collection - Pretty Princess, 0.24 fl oz/7 mL	Amazon	R	27,000	--	--	--	727**	--	--	--	122,000	--	--	45,000	--	--	--	--	--	--	--	325,000	--	34**	--	--	--	--	--	--	--
SCPNP16	Emosa Water Based Nail Polish - Orange, 10 mL/0.34 fl oz	Amazon	R	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	53,400**	--	--	--	--	--	--
SCPNP94	ibd Nail Lacquer - So in Love, 8.5 mL/0.3 fl oz	Buynail.com	P	12,400	--	--	--	528**	4,170**	--	--	203,000	--	1,440	5,100	--	--	--	--	--	--	--	232,000	--	65,700	7,430	--	--	--	--	22,900	2,420
SCPNP18	IBN Vegan Varnish - Pink, 10 mL	Amazon	R	--	--	--	--	344**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11,400	1,650	--	--	--	--	--
SCPNP28	iGlow! Nail Polish - sparkly pink, 0.25 fl oz/7 mL	99 Cent Only Stores	R	17,400	--	--	--	199	--	--	--	151,000	--	231**	--	--	--	--	--	673**	--	--	315,000	--	796	--	--	--	--	--	17,300	--
SCPNP42	L.A. Colors Color Craze Nail Polish with Hardeners - Glistening Purple, 0.44 fl oz/13 mL	Walmart	R	9,440	--	--	--	107	322**	--	--	301,000	28**	--	45,900	122	--	--	46**	--	--	--	154,000	--	--	--	--	--	--	--	--	--
SCPNP19	L'Oreal Paris Colour Riche Nail Gold Dust Nail Color - 140 Diamond In The Rough, 0.39 fl oz	Amazon	R	13,800	--	--	--	234**	--	--	--	131,000	--	--	21,600	--	--	--	--	--	--	--	226,000	--	52**	--	--	--	--	--	--	--

Sample ID	Product Name	Purchasing Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*
SCPNP35	LeChat Dare to Wear Nail Polish - Nude Affair, 0.50 fl oz/15 mL	Walmart	P	12,800	--	--	--	159	3,200**	--	--	237,000	29**	--	52,400	119	--	--	31**	--	--	--	365,000	--	95**	--	--	--	--	--	--	--
SCPNP30	Monster High Ghoulicious Have a Bolt Fangtastic Nail Polish, 0.15 fl oz/4.4 mL	Dollar Tree	R	--	--	--	--	151	--	--	--	43	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP34	OPI Nail Laquer, Hello Kitty Collection - Spoken From the Heart, 15 mL/0.5 fl oz	Walmart	R	24,500**	--	--	--	241**	--	--	--	263,000**	25**	--	50,800	91**	--	--	--	--	--	--	244,000	--	384**	--	--	--	--	--	29,200	--
SCPNP89	OPI Nail Lacquer - Gelato on My Mind, 15 mL/0.5 fl oz	Buynail.com	P & R	1,030	--	--	--	136	--	--	--	265,000	--	--	48,400	--	--	--	--	--	--	--	387,000	--	103	--	--	--	--	--	--	--
SCPNP130	Pacifica 7 Free Nail Color - Bianca, 0.45 fl oz/12 mL	Amazon	R	13,300	--	--	--	913**	--	--	--	102,000	--	--	15,000	--	--	--	--	--	--	--	333,000	--	--	258	--	--	--	--	--	--
SCPNP20	Piggy Paint - Angel Kisses, 0.5 fl oz/15 mL	Amazon	R	--	--	--	--	169	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	39,000**	--	--	--	--	--
SCPNP21	Prim and Pure Fruit and Veggie Nail Polish - Mermaid Tail, 7 mL	Amazon	R	--	--	--	--	--	--	--	--	--	--	51**	665**	--	26**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Sample ID	Product Name	Purchasing Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*
SCPNP22	Priti Princess Polish - Mermaid Blue, 8 mL/2.8 fl oz	Amazon	R	13,600	--	--	--	476**	--	--	--	156,000	--	--	13,200	--	--	--	--	--	--	--	344,000	--	--	--	--	--	--	--	--	--
SCPNP46	Revlon Nail Enamel - Vixen 570, 0.5 fl oz/14.7 mL	Walmart	R	2,760	--	--	--	702	--	--	--	327,000	--	--	72,000	--	--	--	--	--	--	--	216,000		39,100	--	--	--	--	--	--	--
SCPNP64	Sally Hansen Insta-Dri Nail Color - 433 Cherry Fast, 0.31 fl oz	Target	R	9,750**	--	--	--	138	--	--	--	236,000	--	--	54,800	--	--	--	--	--	--	--	352,000	--	--	--	--	--	--	--	--	--
SCPNP17	Sephora Collection Hello Kitty Liquid Nail Art Nail - Minty	Amazon	R	30,700	--	--	--	314	--	--	--	245,000	--	--	20,600	--	--	--	--	--	--	--	184,000	--	21,800	202	--	--	--	--	33,700	--
SCPNP93	Sinful Colors Professional Nail Polish - No Text Red, 0.5 fl oz/15 mL	Walmart	R	6,350	--	--	--	99**	--	--	--	175,000	--	--	21,200	--	--	58**	--	--	--	--	342,000	--	40**	--	--	--	--	--	--	--

Sample ID	Product Name	Purchasing Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*
SCPNP92	Wet n Wild Wild Shine Nail Color - Putting on Airs, 0.41 fl oz/12.3 mL	Dollar General	R	6,250**	--	--	--	389**	--	--	--	243,000	--	--	15,400	--	--	--	--	--	--	--	268,000	--	--	--	--	--	--	--	--	--
SCPNP69	Zoya Professional Lacquer - Lola, 0.5 fl oz	Ulta Beauty	P & R	12,300	--	--	--	212**	--	--	--	194,000	--	230**	55,000	--	--	--	--	--	--	--	328,000	--	--	--	--	--	--	--	--	--

**Chemicals detected in nail products but not present on ingredient labels

Table C17. Product Type: Nail Prep Dehydrator. Units of measurement: ug/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchasing Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*	
SCPNP151	Chéri Nail Prep Dehydrator (Natural Nails), 0.5 oz/15 mL	Amazon	P	--	--	--	--	--	--	--	--	716,000	--	--	2,460	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP142	Gelish pH Bond Nail Prep, 0.5 fl oz	Amazon	P & R	--	--	--	--	--	--	--	--	653,000	--	--	625	--	--	--	--	--	--	--	32**	--	--	--	--	--	--	--	--	--	--
SCPNP143	ibd Dehydrate, 14 mL/0.5 fl oz	Amazon	P	--	--	--	--	64**	--	--	--	273,000	--	--	290,000	--	--	--	--	--	--	--	89**	--	--	--	--	--	--	--	--	--	--
SCPNP140	Mia Secret Nail Prep Dehydrate, 0.5 fl oz/15 mL	Amazon	P	--	--	--	--	--	--	--	--	690,000	--	--	496	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP157	Lily Angel Prep Step Nail Dehydrator, 15mL	Amazon	P	--	--	--	--	--	26,800**	--	--	399,000	--	--	--	--	--	1,050	--	--	--	2,700**	54**	--	--	--	--	--	--	--	--	--	--
SCPNP58	Sensationail Gel Cleanser, 14.6 mL	Target	R	--	--	--	--	293**	81,300**	--	--	257**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**Chemicals detected in nail products but not present on ingredient labels

Table C18. Product Type: Nail Primer. Units of measurement: µg/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchasing Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*		
SCPNP152	Chéri Bonding Primer Non-Acid (Acrylics & Hard Gels), 0.5 oz/15 mL	Amazon	P	--	--	--	--	635**	--	--	--	508,000	--	--	853**	--	--	--	--	--	--	35**	--	--	--	--	--	--	--	--	--	--	--	
SCPNP153	ibd UV Bonder, 14 mL/0.5 fl oz	Amazon	P	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SCPNP138	Kiss Acrylic Primer, 10 mL/0.33 fl oz	Amazon	R	--	--	--	--	728,000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
SCPNP155	Mia Secret Xtra Bond Primer, 0.5 fl oz	Amazon	P	--	--	--	--	--	--	--	--	571,000	--	--	--	--	--	--	--	--	--	36**	--	26**	--	--	--	--	--	--	--	--	--	--
SCPNP59	Sensationa il Gel Primer, 3.54 mL	Target	R	--	--	--	--	312**	--	--	--	473,000	--	--	--	--	--	--	--	--	--	--	503**	286**	--	--	--	--	--	--	--	--	--	
SCPNP141	Supernail Nail Primer, 7 mL/0.25 fl oz	Amazon	P & R	--	--	--	--	--	--	--	--	--	--	--	--	--	355**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**Chemicals detected in nail products but not present on ingredient labels

Table C19. Product Type: Thinner. Units of measurement: µg/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchasing Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*
SCPNP118	Beauty Secrets Nail Polish Thinner, 118 mL/4 fl oz	Amazon	P & R	712**	--	--	--	118	--	--	--	246,000	--	--	--	--	--	--	--	--	--	--	383,000	--	31**	--	--	--	--	--	--	--
SCPNP111	OPI Nail Lacquer Thinner, 60 mL/2 fl oz	Walmart	R	593**	--	--	76**	--	--	--	--	276,000	--	--	--	--	--	--	--	--	--	--	652,000	--	--	--	--	--	--	--	--	--
SCPNP24	Orly Nail Lacquer Thinner, 2 fl oz/59 mL	Amazon	P & R	--	--	--	--	290**	98,800**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP126	QT Polish Thinner, 16 oz	eBuyNails.com	P	--	--	--	--	361,000	--	--	--	--	26**	--	--	--	--	--	--	--	--	176,000	125,000	--	--	--	--	--	--	--	--	--
SCPNP23	Seche Restore Restoration Thinner, 59 mL/2 fl oz	Amazon	P	3,770**	--	--	--	--	--	37**	--	--	--	--	49,500	--	--	--	--	--	--	167,000	547,000	--	--	--	--	--	--	--	--	--
SCPNP86	U2 Polish Thinner, 16 oz	Buynail.com	P	--	--	--	--	517,000**	33,800**	--	--	--	--	--	513**	--	--	--	--	--	--	--	236,000	44**	--	--	--	--	--	--	--	--

**Chemicals detected in nail products but not present on ingredient labels

Table C20. Product Type: Top Coat. Units of measurement: µg/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchasing Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*
SCPNP56	Cácee Sun Protection Top Coat, 15 mL/0.5 fl oz	Walmart	P	590**	--	--	--	--	--	--	--	340,000	--	--	--	--	35**	--	213**	--	--	--	147,000	--	--	--	--	--	--	--	21,400	--
SCPNP101	CND Vinylux Longwear Top Coat, 0.5 fl oz/15 mL	Amazon and Target***	P & R	968**	--	--	--	5,910	--	--	--	126,000	--	--	82,700	--	--	--	--	--	--	42**	466,000	--	34**	--	--	--	--	--	--	--
SCPNP110	CND Vinylux Weekly Top Coat (New Formula), 15 mL/0.52 fl oz	Walmart	P & R	393**	--	--	--	6,500	--	--	--	285,000	--	264**	101,000	--	--	--	--	--	222**	--	282,000	--	--	--	--	--	--	--	--	--
SCPNP109	CND Vinylux Weekly Top Coat (Original Formula), 15 mL/0.5 fl oz	Target	P & R	--	--	--	--	9,540	--	--	--	385,000	--	--	124,000	--	--	--	--	--	--	--	139,000	--	--	--	--	--	--	--	--	--
SCPNP97	Essie Matte About You Top Coat, 13.5 mL/0.46 fl oz	Rite Aid	R	1,100	--	--	--	374**	--	--	--	491,000	--	--	42,700	54**	--	--	--	--	--	--	119,000	--	41**	--	--	--	--	--	--	--
SCPNP123	Lex 45 Second Top Coat, 16 oz	eBuyNails.com	P	--	--	--	--	843**	--	--	--	345,000	--	--	123,000	--	--	--	--	--	--	409	119,000	--	29**	3,640**	--	--	--	--	--	--
SCPNP100	OPI Matte Top Coat, 15 mL/0.5 fl oz	Amazon	P & R	1,820	--	--	--	167	--	--	--	332,000	--	--	34,600	75**	--	--	--	--	--	--	107,000	--	3,210**	--	--	--	--	--	--	--

Sample ID	Product Name	Purchasing Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*	
SCPNP112	Pacifica Matte 7 Free Top Coat, 0.4 fl oz/12 mL	Ulta Beauty	R	12,900	--	--	--	707**	355**	--	--	156,000	--	--	12,800	--	--	--	--	--	--	--	383,000	--	47**	--	--	--	--	--	--	--	
SCPNP124	QT 45 Second Top Coat, 16 oz	eBuyNails.com	P	4,730**	--	--	--	743**	--	--	--	330,000	--	--	168,000	--	--	--	--	--	--	7,320	166,000	--	--	5,570	--	--	--	--	--	--	
SCPNP49	Revlon ColorStay Gel Envy Diamond Top Coat, 0.4 fl oz/11.7 mL	Walmart	R	3,190**	--	--	--	179	12,500	--	--	332,000	--	--	21,700	--	--	--	--	522**	--	--	280,000	--	--	--	--	--	--	--	--	--	--
SCPNP99	Revlon Nail Enamel Top Coat - Matte 790, 0.5 fl oz /14.7 mL	Rite Aid	R	3,990**	--	--	--	6,610**	--	--	--	343,000	--	--	49,500	--	--	157	--	--	--	--	269,000	--	91**	--	--	--	--	--	--	--	--
SCPNP61	Seche Vite Dry Fast Top Coat, 14 mL/0.5 fl oz	Target	R	713**	--	--	--	76**	--	37**	--	253**	27**	--	168,000	63**	--	--	--	--	--	87,200	307,000	--	--	--	--	--	--	--	--	--	--
SCPNP71	Seche Vive Instant Gel Effect Top Coat, 14mL/0.5 fl oz	Walmart	R	542**	--	--	--	--	--	29**	--	886**	28**	--	147,000	68**	--	--	--	--	--	132,000	362,000	--	--	--	--	--	--	--	--	--	--
SCPNP43	Sinful Colors Professional Nail Polish - Clear Coat, 0.5 fl oz/15 mL	Walmart	R	3,230**	--	--	--	179	466**	--	--	116,000	--	--	20,600	--	--	--	--	--	--	--	115,000	--	--	--	--	--	--	--	--	--	--

Sample ID	Product Name	Purchasing Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*
SCPNP80	Tammy Taylor Nail Lacquer - Clear, 0.5 fl oz/15 mL	Buynail.com	P & R	77,900**	--	--	--	730**	--	--	--	230,000	--	563**	48,300	--	--	--	98**	--	--	--	103,000	--	--	10,800	--	--	--	--	28,100	4,570**

** Chemicals detected in nail products but not present on ingredient labels

*** CND Vinylux Longwear Top Coat was purchased from both Walmart and Target.

Table C21. Product Type: UV Gel Polish. Units of measurement: µg/mL. Chemicals with * are not Candidate Chemicals. All products listed in this table were purchased in 2019.

Sample ID	Product Name	Purchasing Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*
SCPNP74	CND Shellac Color Coat - Winter Glow, 7.3 mL/0.25 fl oz	Buynail.com	P	492**	--	90**	--	--	--	--	--	118	--	--	--	--	621**	--	--	--	--	--	267,000	--	--	--	--	--	--	--	--	--
SCPNP36	DND Gel Polish - Golden Sahara Star #401	Walmart	P	--	--	--	--	--	--	--	--	75	--	--	--	--	27	--	--	--	--	--	78	--	--	--	--	--	--	--	--	--

Sample ID	Product Name	Purchasing Location	Professional (P) or Retail (R)	1-Butanol	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Dimethyl-p-toluidine (DMPT)	Ethyl Acetate	Ethylbenzene	Formaldehyde	Isopropyl Alcohol (IPA)	meta & para-Xylene	Methyl Methacrylate (MMA)	Methylene Chloride	ortho-Xylene	tert-Butyl Alcohol (TBA)	Tetrahydrofuran	Toluene	Butyl Acetate*	Ethyl Methacrylate*	Propyl Acetate*	r & s-Camphor*	N-Ethyl-2-pyrrolidinone (NEP)	N-Methyl-2-pyrrolidinone (NMP)	Di-n-butyl phthalate (DBP)	Ethyl paraben	Triphenyl phosphate (TPhP)	Ethyl tosylamide*			
SCPNP25	Elite99 Gel Polish Soak-Off Gel Polish - Conch Shell 674, 15 mL/0.5 oz	Amazon	R	--	--	--	--	--	--	--	--	--	30	--	--	138	72**	--	80**	--	--	57**	--	--	--	--	--	--	--	--	--	--	--		
SCPNP82	Gelish Soak-Off Gel Polish - No Sudden Mauves, 15 mL/0.5 fl oz	Buynail.com	P	3,620**	33**	--	--	141	--	--	--	133,000	--	--	9,520**	--	--	--	--	--	--	55**	139,000	--	8,360**	90**	--	--	--	--	11,100	--	--		
SCPNP75	LeChat Perfect Match Ultra-Thin Varnish Base Gel, 0.5 oz/15 mL	Buynail.com	P	--	--	--	--	--	--	62**	--	--	54	--	--	124	140	--	29**	--	--	44**	--	--	--	--	--	--	--	--	--	--	--	--	
SCPNP135	OPI Gel Color - Pink Ladies Rule the School, 15 mL/0.5 fl oz	Buynail.com	P	--	--	--	--	236**	--	--	--	495	--	75**	--	--	26**	--	--	--	--	--	26**	--	--	--	--	--	--	--	--	--	--	--	
SCPNP133	OPI Gel Color Soak-Off Soluble - Polly Want a Lacquer, 15 mL/0.5 fl oz	Buynail.com	P	--	--	--	--	77**	--	--	--	121	--	137	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP87	OPI Gel Color - Funny Bunny, 15 mL/0.5 fl oz	Buynail.com	P	--	--	--	--	268**	--	--	--	306**	--	--	--	--	33**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCPNP60	Sensationail Polish to Gel, 7.39 mL	Target	R	--	--	--	--	284**	--	--	--	638**	--	51**	--	--	5,060**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**Chemicals detected in nail products but not present on ingredient labels

Appendix D – Target Analyte Candidate Chemical Detection Summaries

Table D1. Concentrations (µg/mL) of Candidate Chemicals in Nail Products. The median provided in this table is the median of detects.

Product Type	--	1-Butanol	N-Ethyl-2-pyrrolidone (NEP)	N-Methyl-2-pyrrolidone (NMP)	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Di-n-butyl phthalate (DBP)	Dimethyl-p-toluidine (DMPT)	Ethyl acetate	Ethyl paraben	Ethylbenzene	Formaldehyde	Isopropyl alcohol (IPA)	meta & para-Xylene	Methyl methacrylate (MMA)	Methylene chloride	ortho-Xylene	tert-Butyl alcohol (TBA)	Tetrahydrofuran	Toluene	Triphenyl phosphate (TPHP)
Acrylic Liquid Monomer	Min	--	--	--	--	--	--	91	3,800	--	--	48	83	--	--	--	--	--	102	--	--	--	--	33	--
	Max	--	--	--	--	--	--	2,000	33,700	--	--	11,300	5,470	--	--	--	--	--	8,760	--	--	--	--	33	--
	Median	--	--	--	--	--	--	151	15,870	--	--	9,080	2,260	--	--	--	--	--	3,080	--	--	--	--	33	--
Acrylic Powder*	Min	--	--	--	--	--	--	--	--	35	--	--	--	--	--	110	--	--	38	--	--	--	--	--	--
	Max	--	--	--	--	--	--	--	--	73	--	--	--	--	--	230	--	--	453	--	--	--	--	--	--
	Median	--	--	--	--	--	--	--	--	37	--	--	--	--	--	132	--	--	237	--	--	--	--	--	--
Airbrush Cleaner	Min	--	--	--	--	--	--	448,000	--	--	--	26	54	--	--	490	--	--	3,470	--	--	--	--	--	--
	Max	--	--	--	--	--	--	448,000	--	--	--	26	133,000	--	--	490	--	--	3,470	--	--	--	--	--	--
	Median	--	--	--	--	--	--	448,000	--	--	--	26	66,527	--	--	490	--	--	3,470	--	--	--	--	--	--
Airbrush Nail Art	Min	305	--	--	--	--	--	50	--	--	--	--	--	--	--	82	15,700	--	--	--	--	--	--	--	--
	Max	434	--	--	--	--	--	50	--	--	--	--	--	--	--	1,350	15,700	--	--	--	--	--	--	--	--
	Median	370	--	--	--	--	--	50	--	--	--	--	--	--	--	215	15,700	--	--	--	--	--	--	--	--
Airbrush Top Coat	Min	501	--	--	--	--	--	156	--	--	--	--	144,000	--	--	--	1,160	--	392	--	--	1,990	--	117,000	--
	Max	3,270	--	--	--	--	--	156	--	--	--	--	144,000	--	--	--	1,160	--	2,470	--	--	1,990	--	187,000	--
	Median	1,886	--	--	--	--	--	156	--	--	--	--	144,000	--	--	--	1,160	--	1,431	--	--	1,990	--	152,000	--
Anti-nail Bite Product	Min	622	--	--	--	65,600	--	483	3,320	--	--	--	93	30,000	--	--	161,000	--	63	--	--	--	--	94	46,100
	Max	12,600	--	--	--	176,000	--	630	3,580	--	--	--	280,000	126,000	--	--	307,000	--	2,410	--	--	--	--	94	46,100
	Median	2,759	--	--	--	118,000	--	557	3,450	--	--	--	154,700	78,000	--	--	291,000	--	1,237	--	--	--	--	94	46,100
Base Coat	Min	403	--	--	--	489	--	146	462	--	--	--	83,800	--	--	--	606	52	--	--	--	261	--	--	17,700
	Max	15,300	--	--	--	996	--	792	462	--	--	--	422,000	--	--	--	175,000	52	--	--	--	415	--	--	17,700

Product Type	-	1-Butanol	N-Ethyl-2-pyrrolidone (NEP)	N-Methyl-2-pyrrolidone (NMP)	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Di-n-butyl phthalate (DBP)	Dimethyl-p-toluidine (DMPT)	Ethyl acetate	Ethyl paraben	Ethylbenzene	Formaldehyde	Isopropyl alcohol (IPA)	meta & para-Xylene	Methyl methacrylate (MMA)	Methylene chloride	ortho-Xylene	tert-Butyl alcohol (TBA)	Tetrahydrofuran	Toluene	Triphenyl phosphate (TPhP)
Gel Polish	Median	975	--	--	--	743	--	426	462	--	--	--	207,000	--	--	--	22,400	52	--	--	--	282	--	--	17,700
	Min	1,440	--	--	--	--	--	114	1,900	--	--	--	140,000	--	--	50	16,300	--	100	--	--	626	--	--	8,880
	Max	30,800	--	--	--	--	--	696	1,900	--	--	--	337,000	--	--	50	58,300	--	100	--	--	626	--	--	27,200
Hard Gel	Median	4,880	--	--	--	--	--	135	1,900	--	--	--	242,000	--	--	50	30,100	--	100	--	--	626	--	--	18,040
	Min	--	--	--	--	76	--	100	--	--	--	--	549	--	--	76	--	--	90	--	--	--	--	32	--
	Max	--	--	--	--	76	--	291	--	--	--	--	549	--	--	76	--	--	90	--	--	--	--	51	--
Hardener	Median	--	--	--	--	76	--	124	--	--	--	--	549	--	--	76	--	--	90	--	--	--	--	42	--
	Min	627	2,730	--	--	--	83	77	1,000	349	51,100	--	47,800	--	7,070	584	19,000	93	--	--	26	--	--	169	22,200
	Max	89,700	2,730	--	--	--	83	1,230	1,040	349	51,100	--	352,000	--	7,070	15,600	131,000	34,300	--	--	5,050	--	--	161,000	29,500
Multi-functional (top coat and base coat)	Median	13,310	2,730	--	--	--	83	167	1,020	349	51,100	--	242,500	--	7,070	8,390	36,400	17,197	--	--	2,538	--	--	80,585	25,850
	Min	441	--	--	--	651	--	140	3,500	--	--	--	595	--	--	--	982	78	4,800	--	--	--	--	--	13,500
	Max	43,300	--	--	--	651	--	262	3,500	--	--	--	346,000	--	--	--	43,300	78	4,800	--	--	--	--	--	13,500
Multi-functional (top coat, base coat and hardener)	Median	13,500	--	--	--	651	--	201	3,500	--	--	--	241,500	--	--	--	35,400	78	4,800	--	--	--	--	--	13,500
	Min	5,530	--	--	--	--	--	84	1,480	--	--	--	152,000	--	--	4,760	26,500	52	--	--	--	--	--	31	15,000
	Max	17,300	--	--	--	--	--	340	1,480	--	--	--	315,000	--	--	4,760	111,000	52	--	--	--	--	--	890	15,000
Nail Art	Median	9,405	--	--	--	--	--	212	1,480	--	--	--	232,000	--	--	4,760	45,900	52	--	--	--	--	--	35	15,000
	Min	17,600	--	--	--	--	--	169	3,130	--	--	--	181,000	--	--	92	34,400	--	--	137	--	269	--	106	--
	Max	20,000	--	--	--	--	--	831	3,130	--	--	--	334,000	--	--	92	34,400	--	--	137	--	269	--	106	--
	Median	18,800	--	--	--	--	--	500	3,130	--	--	--	257,500	--	--	92	34,400	--	--	137	--	269	--	106	--
	Min	--	--	--	--	--	--	64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Product Type	-	1-Butanol	N-Ethyl-2-pyrrolidone (NEP)	N-Methyl-2-pyrrolidone (NMP)	1,3,5-Trimethylbenzene	Methyl ethyl ketone (MEK)	Methyl isobutyl ketone (MIBK)	Acetone	Acetonitrile	Benzene	Di-n-butyl phthalate (DBP)	Dimethyl-p-toluidine (DMPT)	Ethyl acetate	Ethyl paraben	Ethylbenzene	Formaldehyde	Isopropyl alcohol (IPA)	meta & para-Xylene	Methyl methacrylate (MMA)	Methylene chloride	ortho-Xylene	tert-Butyl alcohol (TBA)	Tetrahydrofuran	Toluene	Triphenyl phosphate (TPhP)
Nail Dry Spay	Max	--	--	--	--	--	--	64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Median	--	--	--	--	--	--	64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nail Glue	Min	3,140	--	--	--	--	--	--	2,200	--	--	--	31	--	--	94	--	--	35	--	--	--	--	114	--
	Max	6,530	--	--	--	--	--	--	2,200	--	--	--	1,540	--	--	516	--	--	92	--	--	--	--	114	--
	Median	4,835	--	--	--	--	--	--	2,200	--	--	--	316	--	--	217	--	--	58	--	--	--	--	114	--
Nail Polish / Lacquer	Min	638	1,020	1,650	--	124	--	99	322	--	--	--	43	--	25	51	665	91	26	29	31	673	--	--	17,300
	Max	41,600	53,400	39,000	--	124	--	913	28,300	--	--	--	418,000	--	35	1,440	76,500	122	646	58	46	673	--	--	33,700
	Median	11,500	11,400	20,325	--	124	--	201	3,200	--	--	--	210,000	--	29	230	43,400	109	26	44	38	673	--	--	28,100
Nail Prep Dehydrator	Min	--	--	--	--	--	--	64	26,800	--	--	--	257	--	--	--	496	--	--	1,050	--	--	--	2,700	--
	Max	--	--	--	--	--	--	293	81,300	--	--	--	716,000	--	--	--	290,000	--	--	1,050	--	--	--	2,700	--
	Median	--	--	--	--	--	--	179	54,050	--	--	--	526,000	--	--	--	1,543	--	--	1,050	--	--	--	2,700	--
Nail Primer	Min	--	--	--	--	--	--	312	--	--	--	--	473,000	--	--	--	853	--	355	--	--	--	--	35	--
	Max	--	--	--	--	--	--	728,000	--	--	--	--	571,000	--	--	--	853	--	355	--	--	--	--	36	--
	Median	--	--	--	--	--	--	635	--	--	--	--	508,000	--	--	--	853	--	355	--	--	--	--	35	--
Thinner	Min	593	--	--	--	--	76	118	33,800	37	--	--	246,000	--	26	--	513	--	--	--	--	--	--	167,000	--
	Max	3,770	--	--	--	--	76	517,000	98,800	37	--	--	276,000	--	26	--	49,500	--	--	--	--	--	--	176,000	--
	Median	712	--	--	--	--	76	180,645	66,300	37	--	--	261,000	--	26	--	25,007	--	--	--	--	--	--	171,500	--
Top Coat	Min	393	--	--	--	--	--	76	355	29	--	--	253	--	27	264	12,800	54	35	157	98	522	222	42	21,400
	Max	77,900	--	--	--	--	--	9,540	12,500	37	--	--	491,000	--	28	563	168,000	75	35	157	213	522	222	132,000	28,100
	Median	1,820	--	--	--	--	--	730	466	33	--	--	330,000	--	28	414	66,100	65	35	157	156	522	222	7,320	24,750
UV Gel Polish	Min	492	--	--	33	90	--	77	--	62	--	--	75	--	30	51	9,520	124	26	--	29	--	--	44	11,100
	Max	3,620	--	--	33	90	--	284	--	62	--	--	133,000	--	54	137	9,520	138	5,060	--	80	--	--	57	11,100

Product Type																									
-	Median	2,056	--	--	33	90	--	236	--	62	--	--	306	--	42	75	9,520	131	72	--	54	--	--	55	11,100
1-Butanol																									
N-Ethyl-2-pyrrolidone (NEP)																									
N-Methyl-2-pyrrolidone (NMP)																									
1,3,5-Trimethylbenzene																									
Methyl ethyl ketone (MEK)																									
Methyl isobutyl ketone (MIBK)																									
Acetone																									
Acetonitrile																									
Benzene																									
Di-n-butyl phthalate (DBP)																									
Dimethyl-p-toluidine (DMPT)																									
Ethyl acetate																									
Ethyl paraben																									
Ethylbenzene																									
Formaldehyde																									
Isopropyl alcohol (IPA)																									
meta & para-Xylene																									
Methyl methacrylate (MMA)																									
Methylene chloride																									
ortho-Xylene																									
tert-Butyl alcohol (TBA)																									
Tetrahydrofuran																									
Toluene																									
Triphenyl phosphate (TPhP)																									

*Concentrations of Candidate Chemicals detected in acrylic powders were reported in µg/g rather than µg/mL.

Table D2. Concentrations of Candidate Chemicals in Nail Products detected above 10,000 ug/mL.

Product Type	--	1-Butanol	Methyl ethyl ketone (MEK)	Acetone	Acetonitrile	Dibutyl phthalate (DBP)	Ethyl acetate	Ethyl paraben	Isopropyl alcohol (IPA)	Toluene	Triphenyl phosphate (TPhP)
Airbrush Cleaner	Min	--	--	448,000	--	--	--	--	--	--	--
	Max	--	--	448,000	--	--	--	--	--	--	--
Airbrush Nail Art	Min	--	--	--	--	--	--	--	15,700	--	--
	Max	--	--	--	--	--	--	--	15,700	--	--
Airbrush Top Coat	Min	--	--	--	--	--	144,000	--	--	117,000	--
	Max	--	--	--	--	--	144,000	--	--	187,000	--
Anti-nail Bite Product	Min	--	65,600	--	--	--	--	30,000	161,000	--	46,100
	Max	--	176,000	--	--	--	--	126,000	307,000	--	46,100
Base coat	Min	--	--	--	--	--	83,800	--	--	--	17,700
	Max	--	--	--	--	--	422,000	--	--	--	17,700
Gel Polish	Min	--	--	--	--	--	140,000	--	16,300	--	--
	Max	--	--	--	--	--	337,000	--	58,300	--	--
Hardener	Min	--	--	--	--	51,100	47,800	--	19,000	--	22,200
	Max	--	--	--	--	51,100	352,000	--	131,000	--	29,500
Multi-functional (top coat, base coat and hardener)	Min	--	--	--	--	--	152,000	--	26,500	--	15,000
	Max	--	--	--	--	--	315,000	--	111,000	--	15,000
Nail Art	Min	17,600	--	--	--	--	181,000	--	34,400	--	--
	Max	20,000	--	--	--	--	334,000	--	34,400	--	--
Nail Polish/Lacquer	Min	--	--	--	--	--	--	--	--	--	17,300
	Max	--	--	--	--	--	--	--	--	--	33,700
Nail Prep Dehydrator	Min	--	--	--	26,800	--	--	--	--	--	--
	Max	--	--	--	81,300	--	--	--	--	--	--
Nail Primer	Min	--	--	--	--	--	473,000	--	--	--	--
	Max	--	--	--	--	--	571,000	--	--	--	--

Product Type	-	1-Butanol	Methyl ethyl ketone (MEK)	Acetone	Acetonitrile	Dibutyl phthalate (DBP)	Ethyl acetate	Ethyl paraben	Isopropyl alcohol (IPA)	Toluene	Triphenyl phosphate (TPhP)
Thinner	Min	--	--	--	33,800	--	246,000	--	--	167,000	--
	Max	--	--	--	98,800	--	276,000	--	--	176,000	--
Top Coat	Min	--	--	--	--	--	--	--	12,800	--	21,400
	Max	--	--	--	--	--	--	--	168,000	--	28,100
UV Gel Polish	Min	--	--	--	--	--	--	--	--	--	11,100
	Max	--	--	--	--	--	--	--	--	--	11,100

Table D3. Concentrations of Candidate Chemicals in Nail Products detected between 1,000 and 10,000 µg/mL.

Product Type	-	1-Butanol	N-Ethyl-2-pyrrolidone (NEP)	Acetonitrile	Ethylbenzene	Formaldehyde	Isopropyl alcohol (IPA)	Methyl methacrylate (MMA)	Methylene chloride	tert-Butyl alcohol (TBA)	Toluene
Airbrush Cleaner	Min	--	--	--	--	--	--	3,470	--	--	--
	Max	--	--	--	--	--	--	3,470	--	--	--
Airbrush Top Coat	Min	--	--	--	--	--	1,160	--	--	1,990	--
	Max	--	--	--	--	--	1,160	--	--	1,990	--
Anti-nail Bite Product	Min	--	--	3,320	--	--	--	--	--	--	--
	Max	--	--	3,580	--	--	--	--	--	--	--
Gel Polish	Min	--	--	1,900	--	--	--	--	--	--	--
	Max	--	--	1,900	--	--	--	--	--	--	--
Hardener	Min	--	2,730	1,000	7,070	--	--	--	--	--	--

Product Type	--	1-Butanol	N-Ethyl-2-pyrrolidone (NEP)	Acetonitrile	Ethylbenzene	Formaldehyde	Isopropyl alcohol (IPA)	Methyl methacrylate (MMA)	Methylene chloride	tert-Butyl alcohol (TBA)	Toluene
	Max	--	2,730	1,040	7,070	--	--	--	--	--	--
Multi-functional (top coat and base coat)	Min	--	--	3,500	--	--	--	4,800	--	--	--
	Max	--	--	3,500	--	--	--	4,800	--	--	--
Multi-functional (top coat, base coat and hardener)	Min	--	--	1,480	--	4,760	--	--	--	--	--
	Max	--	--	1,480	--	5,160	--	--	--	--	--
Nail Art	Min	--	--	3,130	--	--	--	--	--	--	--
	Max	--	--	3,130	--	--	--	--	--	--	--
Nail Glue	Min	3,140	--	2,200	--	--	--	--	--	--	--
	Max	6,530	--	2,200	--	--	--	--	--	--	--
Nail Prep Dehydrator	Min	--	--	--	--	--	--	--	1,050	--	2,700
	Max	--	--	--	--	--	--	--	1,050	--	2,700
UV Gel Polish	Min	--	--	--	--	--	9,520	--	--	--	--
	Max	--	--	--	--	--	9,520	--	--	--	--

Appendix E - Tentatively Identified Compounds

Table E1. List of VOC and SVOC TICs identified in nail product samples using the NIST Mass Spectral Library.

VOC TICs			SVOC TICs		
Chemical Name	CASRN	Candidate Chemical	Chemical Name	CASRN	Candidate Chemical
1-Butanol	71-36-3	Yes	1,1,1-Trimethylolpropane trimethacrylate	3290-92-4	No
1-Butoxy-1-ethoxyethane	57006-87-8	No	1,2-Propylene glycol	57-55-6	No
1-Butoxy-2-propanol	5131-66-8	No	1,6-Hexanediol diacrylate	13048-33-4	No
1-Ethoxy-2-methylpropane	627-02-1	No	Pyromellitic dianhydride	89-32-7	Yes
1,1-Diethoxybutane	3658-95-5	No	Diethylene glycol monomethyl ether	111-90-0	No
1,1-Dimethoxyethane	534-15-6	No	2-((2-Methyl-1-oxoallyl)oxy)ethyl acetoacetate	21282-97-3	No
1,2-Dichloroethane	107-06-2	Yes	2-Butoxyethanol	111-76-2	Yes
1,3-Dimethylcyclopentane	2453-00-1	No	2-Ethyl-1-hexanol	104-76-7	No
2-Ethyl-1-hexanol	104-76-7	No	2-Ethylhexyl-2-cyano-3,3-diphenylacrylate	6197-30-4	No
2-Ethyl-3-hydroxyhexyl 2-methylpropanoate	74367-31-0	No	2-Hydroxy-4-methoxybenzophenone	131-57-7	Yes
2-Ethyl-4-methyl-1,3-dioxolane	4359-46-0	No	2-Hydroxyethyl acrylate	818-61-1	No
2-Ethylhexyl acetate	103-09-3	No	2-Hydroxyethyl methacrylate	868-77-9	No
2-Ethylhexyl acrylate	103-11-7	Yes	2-Hydroxypropyl 2-methylacrylate	923-26-2	No
2-Heptanone	110-43-0	No	2-Phenoxyethanol	122-99-6	No
2-Methylbutane	78-78-4	No	2-tert-Butyl-4-methoxyphenol	121-00-6	No
2-Methylbutyl acetate	624-41-9	No	2,2-Dimethoxybutane	3453-99-4	No
2,2-Dimethyl decane	17302-37-3	No	2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	6846-50-0	No
2,2-Dimethylhexane	590-73-8	No	2,2,4,4-Tetramethyloctane	62183-79-3	No
2,2,4-Trimethyl-1,3-dioxolane	1193-11-9	No	2,2,4,6,6-Pentamethylheptane	13475-82-6	No
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	6846-50-0	No	2,3,3-Trimethylpentane	560-21-4	No
2,2,4,6,6-Pentamethylheptane	13475-82-6	No	2,3,4-Trimethylpentane	565-75-3	No
2,3-Dimethylpentane	565-59-3	No	2,4-Dihydroxybenzophenone	131-56-6	No
2,3,4-Trimethylpentane	565-75-3	No	2,5-Dimethylhexane	592-13-2	No
2,4-Dimethylhexane	589-43-5	No	Acetyl tributyl citrate	77-90-7	No
2,4-Dimethyl-3-pentanone	565-80-0	No	alpha-Methylstyrene	98-83-9	Yes
2,4,4-trimethylpentan-1,3-diol-diisobutyrate	74381-40-1	No	Benzoic acid	65-85-0	No
2,5-Dimethylhexane	592-13-2	No	Benzoic acid, allyl ester	583-04-0	No
3-Ethylpentane	617-78-7	No	Butylated hydroxytoluene	128-37-0	No

VOC TICs			SVOC TICs		
Chemical Name	CASRN	Candidate Chemical	Chemical Name	CASRN	Candidate Chemical
3-Hydroxy-2,4,4-trimethylpentyl 2-methylpropanoate	74367-34-3	No	D-alpha-Tocopheryl acetate	58-95-7	No
3-Methylbutyl 3-methylbutanoate	659-70-1	No	Decamethylcyclopentasiloxane	541-02-6	Yes
3-Methylbutyl acetate	123-92-2	No	Diacetone alcohol	123-42-2	No
3-Methylhexane	589-34-4	No	Diethylene glycol dimethyl ether	111-96-6	Yes
3,3-Dimethyl-8,9-dinorbornan-2-yl acetate	13851-11-1	No	Dipropylene glycol monobutyl ether	29911-28-2	No
4-Heptanone	123-19-3	No	Dipropylene glycol monomethyl ether	20324-32-7	No
Acetal	105-57-7	No	Ethyl 2-cyano-3,3-diphenylacrylate	5232-99-5	No
Acrylonitrile	107-13-1	Yes	Ethyl 2-cyanopropionate	1572-99-2	No
Butane	106-97-8	Yes	Ethyl cyanoacetate	105-56-6	No
Butyl acrylate	141-32-2	No	Ethyl cyanoacrylate	7085-85-0	No
Butyl butyrate	109-21-7	No	Ethyl dodecanoate	106-33-2	No
Butyl ether	142-96-1	No	Ethyl methacrylate	97-63-2	No
Butyl formate	592-84-7	No	Ethyl methanesulfonate	62-50-0	Yes
Butyl isbutyrate	97-87-0	No	Ethylcyclopentane	1640-89-7	No
Butyl isobutyrate	97-87-0	No	Ethylene glycol dimethacrylate	97-90-5	No
Butyl methacrylate	97-88-1	No	Hydroxycyclohexyl phenyl ketone	947-19-3	No
Butyl propionate	590-01-2	No	Isobornyl acrylate	5888-33-5	No
Butylated hydroxytoluene	128-37-0	No	Isobornyl methacrylate	7534-94-3	No
Camphene	79-92-5	No	Isobutyl acetate	110-19-0	No
Cumene	98-82-8	Yes	Isophorone diisocyanate	4098-71-9	Yes
Cis-1,3-Dimethylcyclopentane	2532-58-3	No	Lidocaine	137-58-6	No
D-Limonene	5989-27-5	No	Methyl crotonate	18707-60-3	No
Diisopropoxymethane	2568-89-0	No	Methylcyclohexane	108-87-2	No
Ethanol	64-17-5	No	N-Ethyl-o-toluenesulfonamide	1077-56-1	No
Ethyl acrylate	140-88-5	Yes	N-Ethyl-p-methylbenzenesulfonamide	80-39-7	No
Ethyl butyrate	105-54-4	No	N,N-Dimethylacrylamide	2680-03-7	No
Ethyl isobutyrate	97-62-1	No	Neopentyl glycol diacetate	13431-57-7	No
Ethyl methyl ether	540-67-0	No	o-Toluenesulfonamide	88-19-7	No
Ethyl propionate	105-37-3	No	Octamethylcyclotetrasiloxane	556-67-2	Yes
Ethylcyclopentane	1640-89-7	No	p-Toluenesulfonamide	70-55-3	No
Ethylene glycol dimethacrylate	97-90-5	No	p-Toluenesulfonylmethyl isocyanide	36635-61-7	No

VOC TICs			SVOC TICs		
Chemical Name	CASRN	Candidate Chemical	Chemical Name	CASRN	Candidate Chemical
Heptane	142-82-5	Yes	Phthalic anhydride	85-44-9	Yes
Heptene	25339-56-4	No	Propyl acetate	109-60-4	No
Hexyl acetate	142-92-7	No	Tetrahydrofurfuryl methacrylate	2455-24-5	No
Hexyl acrylate	2499-95-8	No	Tributyl citrate	77-94-1	No
Isobornyl acrylate	5888-33-5	No	Triethyl phosphate	78-40-0	No
Isobornyl methacrylate	7534-94-3	No	Triethylene glycol dimethacrylate	109-16-0	No
Isobutane	75-28-5	Yes	--	--	--
Isobutyl acetate	110-19-0	No	--	--	--
Isopropyl acetate	108-21-4	No	--	--	--
Isopropyl butyrate	638-11-9	No	--	--	--
Isopropyl formate	625-55-8	No	--	--	--
Isopropyl isobutyrate	617-50-5	No	--	--	--
Isopropyl methacrylate	4655-34-9	No	--	--	--
Isopropyl propionate	637-78-5	No	--	--	--
Methyl acetate	79-20-9	No	--	--	--
Methyl acrylate	96-33-3	Yes	--	--	--
Methylcyclohexane	108-87-2	No	--	--	--
n-Hexane	110-54-3	Yes	--	--	--
Norbornane	279-23-2	No	--	--	--
Octamethylcyclotetrasiloxane	556-67-2	Yes	--	--	--
Pentane	109-66-0	No	--	--	--
2,3,3-trimethylpentane	560-21-4	No	--	--	--
Pentyl acetate	628-63-7	No	--	--	--
Propane	74-98-6	No	--	--	--
propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	74367-33-2	No	--	--	--
sec-Butyl acetate	105-46-4	No	--	--	--
Tetradecane	629-59-4	No	--	--	--
trans-1,2-Dimethylcyclopentane	822-50-4	No	--	--	--
Undecane	1120-21-4	No	--	--	--
Vinyl acetate	108-05-4	Yes	--	--	--

Table E2. Estimated concentrations (µg/mL) of VOC Candidate Chemical TICs in nail products.

Product Type	Product name	1-Butanol	1,2-Dichloroethane	2-Ethylhexyl acrylate	Acrylonitrile	Butane	Isopropyl benzene	Ethyl acrylate	Heptane	Methyl acrylate	n-Hexane	Vinyl acetate	Isobutane	D4
Base Coat	CND Sticky Anchoring Base Coat	--	--	--	--	--	--	--	31,541	--	--	--	--	--
	Essie Here to Stay Base Coat	--	--	--	--	--	--	--	60	--	--	--	--	--
	OPI Natural Nail Coat	--	--	--	--	--	--	--	6,376	--	--	--	--	--
	Seche Clear Crystal Clear Base Coat	--	--	--	--	--	--	--	11,854	--	--	--	--	--
Hard Gel	LeChat Pro-Tec UV Gel System - Clear	--	--	--	--	--	--	--	100	--	--	--	--	--
Multifunctional (top coat and base coat)	Sally Hansen Diamond Shine Base & Top Coat	--	--	--	--	--	--	--	9,755	--	--	--	--	--
Multifunctional (top coat, base coat and hardener)	OPI Star To Finish – Original Formula	--	--	--	--	--	--	--	15,877	--	--	--	--	--
Nail Dry Spray	Demert Nail Enamel Dryer	--	--	--	--	35,414	--	--	--	--	--	--	1,625	1,747
	Onyx Professional Nail Dryer – Island Coconut Scent	--	--	--	--	36,321	--	--	--	--	--	--	8,192	--
Nail Glue	Artisan Instant Bond Super Fast Nail Glue	--	--	--	31	--	--	--	--	--	--	--	--	--
	Ibd 5 Second Brush On Nail Glue	--	--	--	54	--	--	--	--	--	--	--	--	--
	Mia Secret Strong-Jet Clear Nail Glue	--	--	--	43	--	--	--	--	--	--	--	--	--
	Kiss Brush-On Nail Glue	--	--	--	--	27	--	--	--	--	--	--	--	--
Nail Polish/Lacquer	Elite Pro Beauty Glam Colors Nail Polish - Lavender	--	52	--	--	--	--	--	--	--	--	203	--	--
	Prim and Pure Fruit and Veggie Nail Polish – Mermaid Tail	--	--	47	--	--	--	--	--	--	--	--	--	--
Nail Primer	Cheri Bonding Primer Non-Acid (Acrylics & Hard Gels)	--	--	--	--	--	53	--	--	--	--	--	--	--
	Mia Secret Xtra Bond Primer	--	--	--	--	--	55	--	--	--	--	--	--	--
	Sensational Gel Primer	--	--	--	--	--	60	33	--	--	--	--	--	--
Thinner	Beauty Secrets Nail Polish Thinner	--	--	--	--	--	--	--	261	--	--	--	--	--
	U2 Polish Thinner	--	--	--	--	--	--	--	--	--	81	--	--	--
Top Coat	Pacifica Matte 7 Free Top Coat	790	--	--	--	--	--	--	--	--	--	--	--	--
UV Gel Polish	CND Shellac Color Coat – Winter Glow	--	--	--	--	--	--	--	--	--	28	--	--	--
	LeChat Perfect Match Ultra-Thin Varnish Base Gel	--	--	--	--	--	--	28	--	193	--	--	--	--
	Sensational Polish to Gel	--	--	--	--	--	--	--	--	1,250	--	--	--	--

Table E3. Estimated concentrations (µg/mL) of SVOC Candidate Chemical TICs in nail products.

Product Type	Product name	Pyromellitic dianhydride	Ethylene glycol monobutyl ether	Oxybenzone	alpha-Methylstyrene	D5	Diethylene glycol dimethyl ether	Ethyl methanesulfonate	Isophorone diisocyanate	D4	Phthalic anhydride
Acrylic Liquid Monomer	KISS Acrylic Liquid	--	--	5,202	--	--	--	--	--	--	--
Airbrush Cleaner	Vallejo Airbrush Cleaner	--	56,132	--	--	--	--	--	--	--	--
	U.S. Art Supply AC Water Based Airbrush Cleaning Solution	--	--	--	--	--	--	--	9,752	--	--
Airbrush Nail Art	Holbein Aeroflash Color – Carmine (E002)	--	876	--	--	--	--	--	--	--	--
Airbrush Top Coat	Badger Air – Opaque Non-Yellowing Transparent Clear Coat Airbrush Finish	--	12,370	--	--	--	--	--	--	--	--
Gel Polish	Essie Gel Couture Nail Polish – Fairy Tailor	--	--	--	--	--	--	--	--	--	1,998
Hard Gel	Gelish Hard Gel LED Clear Nail Gel	--	--	--	--	--	--	--	3,300	--	--
	NSI Balance UV Gel System – Body Builder Cover Pink Warm	--	--	--	--	--	--	--	8,118	--	--
Multifunction (top coat, base coat and hardener)	LA Colors Nail Treatment Triple Play	--	--	--	--	--	--	--	--	--	1,574
Nail Dry Spray	Demert Nail Enamel Dryer	--	--	--	--	1,646	--	--	--	14,428	--
	Golden Rose Nail Color Quick Dryer Spray	--	--	--	--	8,000	--	--	--	--	--
	Onyx Professional Nail Dryer – Island Coconut Scent	--	--	--	--	1,300	--	--	--	--	--
Nail Glue	5 Second Brush On Nail Glue	--	--	--	--	--	--	3,740	--	--	--
	Ibd 5 Second Brush On Nail Glue	--	--	--	--	--	--	3,890	--	--	--
Nail Polish/Lacquer	Prim and Pure Fruit and Veggie Nail Polish-Mermaid Tail	--	--	--	1,038	--	--	--	--	--	--
	IBN Vegan Varnish - Pink	--	--	--	--	--	2,064	--	2,722	--	--
	DND Nail Lacquer – Golden Sahara Star #401	--	--	--	--	--	--	--	--	--	1,356
	L.A. Colors Color Graze Nail Polish with Hardeners – Glistening Purple	--	--	--	--	--	--	--	--	--	1,492
	ibd UV Bonder	--	--	--	--	--	--	--	--	--	60,126
Nail Primer	Kiss Acrylic Primer	5,252	--	--	--	--	--	--	--	--	--
Top Coat	CND Vinylux Weekly Top Coat (New Formula)	--	--	--	--	--	--	--	2,450	--	--

Product Type	Product name	Pyromellitic dianhydride	Ethylene glycol monobutyl ether	Oxybenzone	alpha-Methylstyrene	D5	Diethylene glycol dimethyl ether	Ethyl methanesulfonate	Isophorone diisocyanate	D4	Phthalic anhydride
	CND Vinylux Weekly Top Coat (Original Formula)	--	--	--	--	--	--	--	4,428	--	--
UV Gel Polish	LeChat Perfect Match Ultra-Thin Varnish Base Gel	--	--	--	--	--	--	--	27,010	--	--
	OPI Gel Color Soak-Off Soluble – Polly Want a Lacquer	--	--	--	--	--	--	--	2,486	--	--
	OPI Gel Color – Pink Ladies Rule the School	--	--	--	--	--	--	--	6,786	--	--

Table E4. Detection frequency of non-Candidate Chemical TICs when present on ingredient labels compared to when not present on ingredient labels. Detection frequencies are given as A/B where B is the total number of detections and A is the number of detections when the TIC is either on the ingredient label or not on the ingredient label.

Chemical Name	CASRN	Frequency of detection when on ingredient label	Frequency of detection when not on ingredient label
1-Butoxy-1-ethoxyethane	57006-87-8	--	1/1
1-Butoxy-2-propanol	5131-66-8	--	1/1
1-Ethoxy-2-methylpropane	627-02-1	--	7/7
1,1-Diethoxybutane	3658-95-5	--	3/3
1,1-Dimethoxyethane	534-15-6	--	3/3
1,1,1-Trimethylolpropane trimethacrylate	3290-92-4	2/3	1/3
1,2-Propylene glycol	57-55-6	--	4/4
1,3-Dimethylcyclopentane	2453-00-1	--	1/1
1,6-Hexanediol diacrylate	13048-33-4	--	1/1
2-((2-Methyl-1-oxoallyl)oxy)ethyl acetoacetate	21282-97-3	--	2/2
2-(2-Ethoxyethoxy)ethanol	111-90-0	--	1/1
2-Ethyl-1-hexanol	104-76-7	--	4/4
2-Ethyl-3-hydroxyhexyl 2-methylpropanoate	74367-31-0	--	1/1
2-Ethyl-4-methyl-1,3-dioxolane	4359-46-0	--	1/1
2-Ethylhexyl-2-cyano-3,3-diphenylacrylate	6197-30-4	1/1	--
2-Ethylhexyl acetate	103-09-3	--	4/4
2-Heptanone	110-43-0	--	1/1
2-Hydroxyethyl acrylate	818-61-1	--	2/2
2-Hydroxyethyl methacrylate	868-77-9	1/1	--
2-Hydroxypropyl 2-methylacrylate	923-26-2	--	1/1
2-Methylbutane	78-78-4	--	2/2
2-Methylbutyl acetate	624-41-9	--	5/5
2-Phenoxyethanol	122-99-6	1/1	--
2-tert-Butyl-4-methoxyphenol	121-00-6	--	1/1
2,2-Dimethoxybutane	3453-99-4	--	2/2
2,2-Dimethyl decane	17302-37-3	--	1/1
2,2-Dimethylhexane	590-73-8	--	1/1
2,2,4-Trimethyl-1,3-dioxolane	1193-11-9	--	1/1
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	6846-50-0	25/25	--
2,2,4,4-Tetramethyloctane	62183-79-3	--	1/1
2,2,4,6,6-Pentamethylheptane	13475-82-6	--	5/5
2,3-Dimethylpentane	565-59-3	--	5/5
2,3,3-Trimethylpentane	560-21-4	--	1/1
2,3,4-Trimethylpentane	565-75-3	--	1/1
2,4-Dihydroxybenzophenone	131-56-6	1/1	--
2,4-Dimethylhexane	589-43-5	--	6/6
2,4-Dimethylpentan-3-one	565-80-0	--	1/1
2,4,4-trimethylpentan-1,3-diol-diisobutyrate	74381-40-1	--	4/4
2,5-Dimethylhexane	592-13-2	--	1/1
3-Ethylpentane	617-78-7	--	3/3
3-Hydroxy-2,4,4-trimethylpentyl 2-methylpropanoate	74367-34-3	--	1/1
3-Methylbutyl 3-methylbutanoate	659-70-1	--	1/1
3-Methylbutyl acetate	123-92-2	--	1/1
3-Methylhexane	589-34-4	--	9/9
3,3-Dimethyl-8,9-dinorbornan-2-yl acetate	13851-11-1	--	1/1
4-Heptanone	123-19-3	--	1/1
Acetal	105-57-7	--	2/2
Acetyl tributyl citrate	77-90-7	13/16	3/16
Benzoic acid	65-85-0	--	6/6
Benzoic acid, allyl ester	583-04-0	--	1/1
Butyl acrylate	141-32-2	--	2/2

Chemical Name	CASRN	Frequency of detection when on ingredient label	Frequency of detection when not on ingredient label
Butyl butyrate	109-21-7	--	16/16
Butyl ether	142-96-1	--	31/31
Butyl formate	592-84-7	--	20/20
Butyl isbutyrate	97-87-0	--	8/8
Butyl methacrylate	97-88-1	--	9/9
Butyl propionate	590-01-2	--	28/28
Butylated hydroxytoluene	128-37-0	2/6	4/6
Camphene	79-92-5	--	2/2
Cyclopentane, 1,3-dimethyl-, (1R,3S)-rel-	2532-58-3	--	1/1
D-alpha-Tocopherol acetate	58-95-7	1/1	--
D-Limonene	5989-27-5	--	2/2
Diacetone alcohol	123-42-2	--	1/1
Diisopropoxymethane	2568-89-0	--	5/5
Dipropylene glycol monobutyl ether	29911-28-2	--	4/4
Dipropylene glycol monomethyl ether	20324-32-7	--	2/2
Ethanol	64-17-5	4/11	7/11
Ethyl 2-cyano-3,3-diphenylacrylate	5232-99-5	--	1/1
Ethyl 2-cyanopropionate	1572-99-2	--	1/1
Ethyl butyrate	105-54-4	--	2/2
Ethyl cyanoacetate	105-56-6	--	4/4
Ethyl cyanoacrylate	7085-85-0	6/6	--
Ethyl dodecanoate	106-33-2	--	1/1
Ethyl isobutyrate	97-62-1	--	8/8
Ethyl methacrylate	97-63-2	1/1	
Ethyl methyl ether	540-67-0	--	1/1
Ethyl propionate	105-37-3	--	2/2
Ethylcyclopentane	1640-89-7	--	2/2
Ethylene glycol dimethacrylate	97-90-5	2/7	5/7
Heptene	25339-56-4	--	1/1
Hexyl acetate	142-92-7	--	1/1
Hexyl acrylate	2499-95-8	--	1/1
Hydroxycyclohexyl phenyl ketone	947-19-3	6/7	1/7
Isobornyl acrylate	5888-33-5	--	1/1
Isobornyl methacrylate	7534-94-3	1/5	4/5
Isobutyl acetate	110-19-0	2/67	65/67
Isopropyl acetate	108-21-4	--	69/69
Isopropyl butyrate	638-11-9	--	3/3
Isopropyl formate	625-55-8	--	40/40
Isopropyl isobutyrate	617-50-5	--	3/3
Isopropyl methacrylate	4655-34-9	--	2/2
Isopropyl propionate	637-78-5	--	1/1
Lidocaine	137-58-6	--	1/1
Methyl acetate	79-20-9	1/18	17/18
Methyl crotonate	18707-60-3	--	1/1
Methylcyclohexane	108-87-2	--	8/8
N-Ethyl-o-toluenesulfonamide	1077-56-1	2/4	2/4
N-Ethyl-p-methylbenzenesulfonamide	80-39-7	1/1	--
N,N-Dimethylacrylamide	2680-03-7	1/1	--
Neopentyl glycol diacetate	13431-57-7	--	3/3
Norbornane	279-23-2	--	1/1
o-Toluenesulfonamide	88-19-7	--	5/5
p-Toluenesulfonamide	70-55-3	1/11	10/11
p-Toluenesulfonylmethyl isocyanide	36635-61-7	--	1/1
Pentane	109-66-0	--	2/2

Chemical Name	CASRN	Frequency of detection when on ingredient label	Frequency of detection when not on ingredient label
Pentane, 2,3,3-trimethyl-	560-21-4	--	1/1
Pentyl acetate	628-63-7	--	1/1
Propane	74-98-6	2/2	--
Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	74367-33-2	--	2/2
Propyl acetate	109-60-4	1/2	1/2
sec-Butyl acetate	105-46-4	--	1/1
Tetradecane	629-59-4	--	1/1
Tetrahydrofurfuryl methacrylate	2455-24-5	2/2	--
trans-1,2-Dimethylcyclopentane	822-50-4	--	1/1
Tributyl citrate	77-94-1	1/19	18/19
Triethyl phosphate	78-40-0	--	1/1
Triethylene glycol dimethacrylate	109-16-0	1/1	--
Undecane	1120-21-4	--	1/1

Appendix F – Tune Criteria

Table F1. Tune acceptance criteria for 4-bromofluorobenzene (BFB)

Mass	Intensity (relative abundance)
95	50 to 200% of mass 174
96	5 to 9% of m/z 95 (5 to 15% when using H2 carrier)
173	< 2% of m/z 174
174	50 to 200% of mass 95
175	5 to 9% of m/z 174
176	95 to 105% of m/z 174
177	5 to 10% of m/z 176

Table F2. Tune acceptance criteria for DFTPP

Mass	Intensity (relative abundance)
51	10 to 80% of mass 198
68	< 2% of mass 69
70	< than 2% of mass 69
127	10 to 80% of mass 198
197	< 2% of mass 198
198	> 50% of mass 442
199	5 to 9% of mass 198
275	10 to 60% of mass 198
365	> 1% of mass 198
441	0.01 to 24 % of mass 442
442	> 50% of mass 198
443	15 to 24% of mass 442

Appendix G – Method Information

Table G1. Summary of tune and calibration criteria for VOC analysis.

QC Type	Frequency	Requirement	Corrective Action(s)	Qualifier Flagging	Comments
Auto Tune	As needed Recommend after instrument prolonged idling	No criteria to be met Generate report upon completion	N/A	N/A	--
BFB Tune	Prior to ICAL and sample analysis, and every 12 hours after	Meet BFB ion ratio criteria. See Appendix F.	Reinject BFB standard Perform instrument maintenance	N/A	Do not start ICAL or sample analysis until acceptance criteria are met
DFTPP Tune	Prior to ICAL and sample analysis, and every 12 hours after	Peak tailing: 2% DDT: Breakdown products < 20%	Reinject DFTPP standard Perform instrument maintenance	--	--
ICAL	As needed	5 points minimum for RF and linear regressions 6 points minimum for quadratic regressions Avg. RF= 20% RSD of RFs Linear or quadratic regression: R= 0.995 or R ² = 0.99 LOQ standard refit is within ± 50% of true value All other standards within ±30% of true value	Re-run calibration Troubleshoot and correct issues before re-run calibration	N/A	--
ICV	Immediately after ICAL	Within ± 30% of true value	Re-analyze ICV standard Prepare new ICV standard and analyze up to two times Re-run ICAL	N/A	From different source of standard than ICAL
CCV	Before sample analysis and every 12 hours	Within ± 20% of true value	Re-analyze CCV standard Prepare new CCV standard and analyze up to two times Re-run ICAL	--	At midpoint ICAL, normally use same source as ICAL
ISTD	Add to each sample, QC, calibration standards	Response is within 50-200% of midpoint ICAL, or most recent CCV	Re-analyze sample Re-analyze sample with further dilution Perform instrument maintenance	If criteria not met, apply J flag	--
RT	Evaluate every sample	ISTD RT < 30 sec. to midpoint ICAL Analyte RT < 10 sec. to midpoint ICAL or CCV	Re-analyze sample Perform instrument maintenance	If criteria not met, apply J flag	If ISTD or analytes are outside of retention time due to visible matrix effect, narrate the qualified data.

N/A = Not applicable

BFB = 4-bromofluorobenzene

DFTPP = decafluorotriphenylphosphine

ICAL = Initial calibration

ICV = Initial calibration verification

CCV = Continuous calibration verification

ISTD = Internal standard

RT = Retention time

RF = Response factor

J flag = Data qualifier flag. The reported result is estimated.