Potential Alternatives to Toluene in Nail Products

Below is a list of potential alternatives to toluene in nail products. We identified these through our own research as of June 2022. The alternatives included in this summary were identified through a literature search and based on publicly available information. We acknowledge that some of these alternatives have been reported as commercial solvents, while others are listed as ingredients in nail products. However, we could only confirm that some of these compounds are currently used as direct replacements of toluene in nail products.

This is a **non-exhaustive list** of alternatives that Responsible Entities need to evaluate in their Alternatives Analysis, per title 22 of the California Code of Regulations, section 69505.5. The alternative chemicals and products on the list have **not been thoroughly assessed for safety or performance** and including them here does **not constitute an endorsement** by DTSC. Instead, it is the Responsible Entity's duty to assess the safety and performance of these alternatives in the Alternatives Analysis.

Some of the potential alternatives included here, for the sake of thoroughness, are on SCP's Candidate Chemical List, indicating that an authoritative agency has identified a toxicological or environmental concern related to the chemical. In some cases, the listing may be derived from an exposure potential list (e.g., detection in people, animals, or the environment) and warrant further study. Because these chemicals may need additional analysis, if adopted as alternatives to toluene, they may be subject to certain Regulatory Responses (§§69506.3-6, 8).

Chemical Alternatives for Toluene in Nail Products

Function: Toluene is used as a solvent in a variety of nail products. In nail polish, the function of the solvent is to make application easy and dry relatively quickly (Nailpro 2014) and to suspend the color to form a smooth finish across the nail so that the polish can be adhered evenly (Zhou et al. 2016). Thinners containing toluene are sometimes added to nail polish and other coatings to increase fluidity (DTSC 2012).

Water

- **Description:** There are some advantages and disadvantages to water-based nail polishes. Water-based nail polishes may not contain toxic solvents, but they may not last as long as traditional solvent-based polish (Malnou 2014). Challenges with water-based polish include longer drying time, difficulty hardening the polish, lack of polish brilliance, and lack of polish adherence to the nail (Malnou 2014).
- **Example products:** Some products are advertised in the market as "water based" however, these products may be formulated with additional solvents. Examples of water-based polishes include, Sophi nail polish, Acquarella, Suncoat water-based nail polish, Little Ondine, Keeki Pure and Simple, UNT, and Honeybee Gardens (McLintock 2020).

Diacetone Alcohol

- **Description:** Diacetone alcohol (DAA; CAS RN 123-42-2) is a clear, colorless liquid with a minty odor (CIR 2021; PubChem 2022a). DAA is a very hydrophobic molecule, miscible in water, ether, alcohol, and other solvents, and relatively neutral (OECD 2000; CIR 2021; PubChem 2022a). DAA is also used in cellulose ester lacquers, such as nail polishes, where it produces a hard film and brilliant gloss (TMIC 2020). In nail products it is used primarily as a fragrance ingredient and as a solvent. According to the Cosmetic Ingredient Review (CIR), DAA is used at a concentration up to 0.84% in enamel formulations and nail polish (CIR 2021).
- **Known hazard traits:** DAA causes eye irritation (eye irritant category 2A) (ECHA 2022a). However, it is listed by the Environmental Working Group (EWG) with a hazard score of 1 out of 10 using limited data (EWG 2022a), which is an indicator of low hazard.
- **Example products:** Nail products that contain DAA can be found commercially in retail stores and salons. DAA is reported to be found in 51% of all nail polishes (INCI 2022). Examples of retailers include Walmart, Target, Ulta Beauty, and Amazon. Many beauty supply stores that also supply nail salons or nail technicians have products that contain DAA such as Sally Beauty (Sally Beauty 2022). DAA nail products (e.g., OPI, Sally Hansen) are available for use and purchase at local nail salons in California.

Methyl Soyate

- **Description:** Methyl soyate is a mixture of long-chain fatty acid methyl esters. Depending on the manufacturer and the intended use, this mixture can be formulated differently and identified by different CAS numbers, some examples include the following.
    - Methyl soyate and its synonyms (soy methyl esters (SME), rapeseed methyl esters (RME), canola methyl esters (CME), corn oil methyl esters, methyl tallowate, fatty acid methyl esters, fatty acid alkyl esters, FAME, methyl esters and methyl ester) are listed under the CAS RN 67762-26-9 sold by the Renewable Energy Group (Renewable Energy Group 2022). Methyl soyate, as listed on the Safety Data Sheet (SDS) from the Renewable Energy Group, is used as a solvent, fuel, and cleaning agent (Renewable Energy Group 2022).
    - Methyl soyate, as listed on the SDS from Cargill, is also known as soybean oil, methyl ester under the CAS RN 67784-80-9 sold by Cargill (Cargill 2018) is used as a bio solvent.
    - Another variation of methyl soyate, Soyclear 1500 or soybean oil under the CAS RN 68919-53-9 sold by AG Processing Inc. (AGP 2021) is used as a solvent in nail polish removers.

    According to a report from OMNI Tech (Wildes 2007), methyl soyate can be applied as a carrier solvent and replace hydrocarbons (e.g., toluene) and methyl ethyl ketone (MEK). Due to its properties and its compatibility with other organic solvents, it could also potentially replace mineral spirits, methylene chloride, trichloroethylene, and d-limonene (Boumahdi 2019). Based on the reviewed information, it is unclear whether methyl soyate could replace toluene in nail polish or thinners.

- **Known hazard traits:** There are no epidemiological or animal studies investigating cancer risk related to methyl soyate exposure and no *in vitro* or *in vivo* studies on mutagenicity (NTP 2001). However, there are reports of slight irritation to the skin and eyes (AGP 2021).
- **Example products:** There is evidence of methyl soyate availability in the market as an ingredient in nail polish removers and advertised as non-toxic. Some examples include pretty clean shop, Priti NYC 916-Soy Nail Polish Remover, among others.

2,2,5,5-tetramethyloxolane

- **Description:** 2,2,5,5-tetramethyloxolane (TMO; CAS RN 15045-43-9; synonym: 2,2,5,5-tetramethyltetrahydrofuran) is a nonpolar solvent (a cyclic ether) with physical-chemical properties similar to toluene. TMO has been described as "a non-polar, non-peroxide forming ether replacement for hazardous hydrocarbon solvents" (Byrne et al. 2017).
- **Known hazard traits:** TMO is a highly flammable liquid and vapor and harmful if swallowed (acute oral toxicity), irritant (LOTUS 2022).
- **Example products:** None identified.

Propyl acetate

- **Description:** Propyl acetate (CAS RN 109-60-4) is designated as low concern solvent on the Safer Chemical Ingredient List compiled by the United States Environmental Protection Agency (U.S. EPA) (U.S. EPA 2022). This solvent evaporates the second fastest among a group of solvents evaluated in nail products (Nails Magazine 2011).

  Based on the products in the EWG's Skin Deep Database, propyl acetate may not be the primary solvent or may be used in conjunction with other solvents to achieve the properties needed in nail products. It is co-listed with other solvents including isopropanol, butyl alcohol, ethyl acetate, butyl acetate, and possibly other solvents (EWG 2022b). The chemical consulting firm SRC's summary on PubChem specifically mentions that a major function of propyl acetate is as a solvent for nitrocellulose (PubChem 2022b), which is the primary polymer used to form the coating on nails (Nails Magazine 2011; Brunning 2017) but it is unclear whether that is its primary role in nail products. Propyl acetate can be found in top coats, base coats, nail primers, nail lacquers, nail enamels, nail polishes, and nail treatments (EWG 2022b). It is unclear whether propyl acetate is used in nail polish thinners. It has been reported that nail polish thinners are made of the same solvents found in nail polish (Easy Nail Tech 2020), while another source argues that thinner usually contains ethyl or butyl acetate (Lab Muffin Beauty Science 2012). Propyl acetate is naturally produced during the fruit ripening process (PubChem 2022b). It is an

"FDA approved substance added to food" and may be used to impart pear, floral, red fruit, and celery flavors or scents (PubChem 2022b).

- **Known hazard traits:** Propyl acetate is highly flammable, causes serious eye irritation, and may cause drowsiness or dizziness (PubChem 2022b). It is volatile and has the potential for inhalation and dermal absorption (PubChem 2022b). In the air propyl acetate has a predicted half-life of 4.7 days. In water it readily biodegrades but is highly mobile (PubChem 2022b).
- **Example products:** It is currently found in numerous products, for example, Super Chic Lacquer, Revlon Multicare Base + Top Coat (EWG 2022b), Revlon Nail Care Treat & Boost (EWG 2022b), and Orly Nail Defense Strengthener (EWG 2022b).

Ethyl lactate

- **Description:** Ethyl lactate (CAS RN 97-64-3) is generally manufactured via an esterification reaction of ethanol and lactic acid (Dai et al. 2019). It is typically used as a solvent but can also be used as a fragrance ingredient (EWG 2022c). Ethyl lactate is a biodegradable and a renewable solvent (Abdullah et al. 2021).
- **Known hazard traits:** According to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) developed by the United Nations Economic Commission for Europe (UNECE), ethyl lactate is classified as an eye irritant (GHS H318: Causes serious eye damage); respiratory irritant (GHS H335: May cause respiratory irritation) and flammable (GHS H226: Flammable liquid and vapor).
- **Example products:** Nail products containing ethyl lactate are available commercially, including Nailtural Nail Color Remover (Nailtural), Nailtural Natural Nail Polish Remover (Nailtural), and Sally Hansen No More Mistakes Manicure Clean-Up Pen (Sally Hansen 2022).

n–butyl alcohol

- **Description:** n-Butyl alcohol (CAS RN 71-36-3; Synonyms: 1-butanol, butanol, n-butanol) is used as a solvent in nail care products. The Mintel Global New Products Database (GNPD) identified uses of butanol as a denaturant, solvent, and as a perfuming agent in cosmetics (Mintel 2022a).

- **Known hazard traits:** N-butyl alcohol was assigned a GreenScreen Benchmark Score of 2 ("use but search for safer substitutes") by the company ToxServices (ToxServices LLC 2014). This score was based on the following hazard score combinations: Very High score for group II human toxicity (Very High eye irritation, IrE) and data gaps for endocrine activity (E) and respiratory sensitization (SnR) (ToxServices LLC 2014).
- **Example products:** The Mintel GNPD identifies 125 nail color cosmetics (e.g., nail polish, gel polish, and nail care kits) containing n-butyl alcohol as ingredients which entered the U.S. market within the last 3 years (Mintel 2022a). Some brands include Channel le vernis, China Glaze, OPI Nail Lacquer, Nails Inc., Sally Hansen, and Yves Saint Laurent. These products are available for purchase in California from a variety of beauty and retail stores.

Dipropylene glycol

Description: Dipropylene glycol (DPG; CAS RN 25265-71-8) is colorless, nearly odorless, and slightly viscous liquid with a high boiling point. It is completely soluble in water and can also dissolve oils. DPG is used as a solvent and can also function as a plasticizer (U.S. EPA 2020). Because of its measured vapor pressure, DPG is expected to be volatile when present as an undiluted substance at ambient temperatures. However, when DPG is present in a dilute form, volatilization is expected to be minimal, hence exposure through inhalation is expected to be minimal as well (U.S. EPA 2020). The U.S. EPA's Office of Chemical Safety and Pollution Prevention (OCSPP) designated DPG as one of the 20 proposed substances as low priority (U.S. EPA 2020) and the U.S. EPA's Safer Choice Program's Safer Chemical Ingredients List (SCIL) includes DPG under the functional class of solvents, with a green circle, which means that the chemical has been verified to be of low concern based on experimental and modeled data (U.S. EPA 2022). It is important to distinguish DPG's use as a solvent from dipropylene glycol dibenzoate (CAS RN 27138- 31-4), which is used as a plasticizer and has been proposed as an alternative to phthalates (Nestler and Heine 2019).

- **Known hazard traits:** There are low concerns for reproductive and developmental toxicity, genotoxicity, carcinogenicity, neurotoxicity, skin and respiratory sensitization, and eye and skin irritation according to an evaluation carried out by U.S. EPA (U.S. EPA 2020). Furthermore, DPG is

expected to have low environmental hazard for acute and chronic aquatic toxicity. The EWG has assigned a score of 1-2 (low) hazard depending on the type of products it is used as an ingredient (e.g., given the potential for causing irritation, there is higher concern for products like eye cream and make up) (EWG 2022d).

- **Example products:** The EWG has reported DPG as an ingredient in some nail products (e.g., Revlon nail polish) (EWG 2022d).

γ-valerolactone

- **Description:** γ-Valerolactone (gamma-valerolactone; GVL) is a lactone (i.e., a cyclic ester). According to Wikipedia, it "is readily obtained from cellulosic biomass and is a potential fuel and green solvent." GVL is used as a fragrance and flavor ingredient and occurs naturally in plants (e.g., grape, coffee, and mango) as well as in fungus (e.g., chrysanthemum bud rot or cob rot of maize) (LOTUS 2022). GVL has been reported to be an excellent solvent and today can be made sustainably with potential applications on cosmetics (Kerkel et al. 2021).
- **Example products:** None identified.

Butyl acetate

- **Description:** Butyl acetate (CAS RN 123-86-4; synonyms: n-butyl acetate, acetic acid butyl ester) is the ester of butyl alcohol and acetic acid. In nail products, butyl acetate is used as a solvent for nitrocellulose, which is the basic film-forming material in nail polish. Butyl acetate gives a desirable texture and uniform distribution of colors to the polish. Butyl acetate's slow evaporation rate allows the polish to bind onto the nail surface and flow evenly. According to data submitted to U.S. Food and Drug Administration and summarized by the Cosmetic Ingredient Review Panel, concentrations of butyl acetate in nail products are approximately 10-25% (CIR 1989). A recent study in 2019 reported concentration ranges of butyl acetate at 24% in nail polish, 31% in top coat, and 25% in base coats (Zhong et al. 2019).
- **Known hazard traits:** According to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) developed by UNECE, butyl acetate is classified as flammable (GHS H226: Flammable liquid and vapor) and a single exposure specific target organ toxicant (GHS H336: May

cause drowsiness or dizziness). Prolonged or frequently repeated exposures may lead to dryness of the skin. Inhalation exposure of butyl acetate produces irritation to respiratory passages and eyes, which may cause headaches, dizziness and nausea (PubChem 2022c).

- **Example products:** This alternative is currently commercially available and nail products containing butyl acetate are sold in retail stores such as Walmart, Target, and Walgreens. The Mintel GNPD identifies 553 nail color cosmetics products (e.g., polish, top coat, base coat, and lacquer) containing butyl acetate in their ingredient lists in the US market within the last 5 years (Mintel 2022b). The EWG's Skin Deep Database shows 788 nail products that contain butyl acetate. These products include nail polishes, topcoats, gel polishes, base coats, and nail polish thinners. Some brands with products that contain butyl acetate are Essie, Wet n Wild, Revlon, OPI, and Ella+Mia (EWG 2022e). Some product examples include Ella + Mila Nail Polish Thinner, Essie Speed Setter Ultra-Fast Dry Top Coat, Sally Hansen Double Duty Base & Top Coat, Wet n Wild MegaLast Salon Nail Color, and Rooted Woman Nail Polish (EWG 2022e).

Chemical alternatives for toluene in nail products that are currently in SCP's Candidate Chemical List

The following alternatives are included on SCP's Candidate Chemical List, indicating that an authoritative agency has identified them as being of potential concern. Since these chemicals have been linked to potential human or environmental adverse impacts, if they are adopted as alternatives to toluene, they may be subject to certain Regulatory Responses (§§69506.3-6, 8).

Isopropanol

- **Description:** Isopropanol (CAS RN 67-63-0; Synonym: isopropyl alcohol) is listed on U.S. EPA's Safer Chemical Ingredients List (SCIL) as a chemical of low concern based on experimental and modeled data (U.S. EPA 2022). Isopropanol is one of the most common members of the alcohol family of organic compounds (Wade 2018) and is used as a cleaning agent, a solvent, an antiseptic, and an astringent (Clifton 2018). Isopropanol is used as a solvent for nail products such as nail polish, top and base coats, and nail polish thinners. Most nail polishes are made up of

five components: a film former, a thermoplastic resin, a plasticizer, a solvent-extender, and a pigment. The solvent-extender makes up about 75% of the polish and is a mixture of isopropanol and either toluene, butyl acetate, or ethyl acetate (Moossavi and Scher 2001). This mixture will allow the other components in the polish to remain in a liquid phase while the isopropanol will most likely evaporate once the polish is applied on the nail. Although isopropanol is rarely used in nail polish thinners, a couple drops of isopropanol can help thin old, clumpy polish (Brittney 2021).

- **Authoritative basis for Candidate Chemical listing:** Office of Environmental Health Hazard Assessment (OEHHA) Reference Exposure Levels (RELs).
- **Known hazard traits:** Respiratory irritation, eye irritation, nephrotoxicity, and developmental toxicity are the basis for OEHHA's RELs (OEHHA 2008a; OEHHA 2008b).
- **Example products:** Nail products containing isopropanol include base coats, cuticle softeners, nail creams and lotions, nail polish and enamel, nail polish and enamel removers, and ultraviolet (UV) gel nail polish. The Mintel GNPD identifies 562 nail color cosmetic products (polish, top coat, and base coat) containing isopropanol as an ingredient in the U.S. market within the last 5 years (Mintel 2022c). Some product examples include Ella + Mila Nail Polish Ready Set Prep, Ella + Mila Nail Polish Thinner, Essie Speed Setter Ultra-Fast Dry Top Coat, Rooted Woman Nail Polish, Sally Hansen Double Duty Base & Top Coat, Wet n Wild Wildshine Nail Polish (EWG 2022f).

Ethyl acetate

- **Description:** Ethyl acetate (CAS RN 141-78-6) is an organic solvent commonly used in nail polish, base coats, nail polish removers, and other nail products. It is a clear liquid with a fruity odor (NOAA 2022). Ethyl acetate is a solvent for nitrocellulose, the primary film-forming material in nail polish (CIR 1989). Because ethyl acetate is volatile, it makes polishes mobile and allows them to spread easily and dry quickly (CIR 1989). As the polish dries, it evaporates to leave behind dry lacquer. This solvent evaporates the fastest among several solvents evaluated in nail products (Nails Magazine 2011). According to data submitted to U.S. Food and Drug Administration and summarized by the Cosmetic Ingredient Review Panel, ethyl acetate is typically used in nail product formulations at concentrations of greater than 5-10% (CIR 1989; DTSC 2021).

- **Authoritative basis for Candidate Chemical listing:** Centers for Disease Control and Prevention (CDC) 4th National Report on Human Exposure to Environmental Chemicals (4th National Exposure Report)
- **Known hazard traits:** Ethyl acetate is highly flammable, causes serious eye irritation, and may cause drowsiness or dizziness (ECHA 2022b). It may also cause irritation of the skin, nose, and throat; narcosis; and dermatitis (CDC 2019).
- **Example products:** The Mintel GNPD reports that ethyl acetate is an ingredient in 78 to 89% of new nail products introduced to the North American market between 2017 and 2022. Ethyl acetate is often used in conjunction with other solvents to achieve the properties needed in nail products. Of the 3,426 nail products containing ethyl acetate identified in Mintel, 99% also contained butyl acetate and 96% contained isopropyl alcohol (Mintel 2022d).

Methyl chloroform

- **Description:** Methyl chloroform (CAS RN: 71-55-6; Synonym: 1,1,1-trichloroethane) is a solvent typically used as a solvent/degreaser in household cleaners, glues, and aerosol sprays (PubChem 2022d). Methyl chloroform is categorized as very persistent, very mobile, and toxic (Arp and Hale 2019). A Bioaccumulation Factor (BAF) of 6.9 L/kg to 10 L/kg for methyl chloroform indicates a low potential for bioaccumulation (U.S. EPA 2015) of 6.9 L/kg to 10 L/kg for methyl chloroform indicates a low potential for bioaccumulation (U.S. EPA 2015).
- **Authoritative basis for Candidate Chemical listing**: International Agency for Research on Cancer (IARC) Group 2A; OEHHA RELs; U.S. EPA's Integrated Risk Information System (IRIS) Neurotoxicant; Agency for Toxic Substances and Disease Registry's (ATSDR) Toxic Substances Portal, Health Effects of Toxic Substances and Nervous System; CDC 4th National Report on Human Exposure to Environmental Chemicals; California Toxic Air Contaminants (CA TAC); California Maximum Contaminant Levels (CA MCLs); priority pollutant under the federal Clean Water Act sections 303(c)/303(d).
- **Known hazard traits:** Effects to the nervous system are noted as a concern by ATSDR and the basis of OEHHA's acute and chronic RELs (ATSDR 2006; OEHHA 2008a; OEHHA 2008b). IARC

recently reclassified methyl chloroform as a Group 2A carcinogen ("probably carcinogenic to humans") (IARC 2022).

- **Example products:** None identified.

Methyl Ethyl Ketone (MEK)

- **Description:** Methyl ethyl ketone (MEK; CAS RN 78-93-3; Synonym: 2-butanone) is an important industrial solvent for many substances, especially resinous materials, and has a wide variety of applications including solvent-based adhesives, paints, coatings, glues, paint removers or thinners, and printing inks (IHS 2021; PubChem 2021). In nail products, MEK is found in nail polishes, nail polish removers, UV gel polishes, thinners, nail treatments, and prep products (IHS 2021).
- **Authoritative basis for Candidate Chemical listing:** ATSDR Toxic Substances Portal, Health Effects of Toxic Substances and Nervous System; OEHHA RELs; CA TACs.
- **Known hazard traits:** MEK is identified as a toxic air contaminant by the California Air Resources Board (CARB)(CARB 2022) due to its developmental toxicity, neurotoxicity, ocular toxicity, and respiratory toxicity (CARB 1997; ATSDR 2020). Occupational exposure to MEK in nail salons occurs via inhalation, dermal, ocular, and incidental ingestion exposure as the result of direct volatilization from open nail products that contain MEK (Gjølstad et al. 2006; Nguyen 2016). However, many occupational exposures to MEK have been conducted with exposure to a mixture of other solvents (U.S. EPA 2003), so additional research is warranted to determine its safety.
- **Example products:** The Mintel database reports MEK as an ingredient in 10 products, including Orly Shining Armor topcoat, Sally Hansen color and topcoat Friends kit, Sally Hansen Cruella nail color and topcoat, Sally Hansen Miracle Gel TopCoat, Sally Hansen Miracle gel color and topcoat, Butter London Glazen Peel-Off Glitter! Nail Lacquer, Sally Hansen Salon Chrome gel topcoat and Sally Hansen Festival Floral Collection Gift Pack (Mintel 2022e).

Hexane

- **Description:** Hexane (CAS RN 110-54-3) is an unbranched alkane, made up of six carbons. It's a non-polar solvent that does not seem to be commonly used in nail products, as indicated in

Mintel's GNPD (Mintel 2022f). Hexane vapors are heavier than air, which may cause them to accumulate in confined spaces (PubChem 2022e). Hexane can be dermally absorbed, but that may happen slowly (PubChem 2022e).

- **Authoritative basis for Candidate Chemical listing:** ATSDR Toxic Substances Portal, Health Effects of Toxic Substances and Nervous System; IRIS Neurotoxicant; OEHHA RELs, CA TACs, Proposition 65.
- **Known hazard traits:** Hexane is highly flammable, and its vapors can be explosive (PubChem 2022e). U.S. EPA's Integrated Risk Information System designates hexane as a neurotoxicant (U.S. EPA 2005), as does the Agency for Toxic Substances and Disease Registry (ATSDR 1999). California's Proposition 65 lists hexane as a reproductive toxicant (OEHHA 2017). It has toxic effects on both male and female reproduction (Joshi and Adhikari 2019; PubChem 2022e). Hexane is listed as a skin irritant by the European Chemicals Agency (ECHA 2021). The National Institute of Occupational Safety and Health lists the respiratory system as a target of hexane toxicity (NIOSH 2019). The American Conference of Governmental Industrial Hygienists states that it is a suspected developmental toxicant (PubChem 2022e). It is toxic to aquatic life with long lasting effects (PubChem 2022e) and thus is listed as a Clean Water Act priority pollutant (CWA 303d). In addition, hexane can be transferred through the placenta and breast milk (PubChem 2022e). It has an estimated BCF of 170, which suggests that it has a high potential for bioaccumulation, if it is not metabolized (PubChem 2022e). Hexane is banned from use in any cosmetic products in the European Union (ECHA 2022c).
- **Example products:** There was only one nail product containing hexane identified in the Mintel GNPD: Lisa Frank Nail Sticks, which appear to be marketed to children (Mintel 2022f). These do not seem to be available on Amazon nor through 8 pages of Google results. They may be discontinued.

n-Heptane

- **Description:** n-Heptane (CAS RN: 142-82-5) is a seven-carbon alkane, colorless and liquid under standard temperature and pressure conditions with a petroleum-like odor (PubChem 2022f). n-Heptane is highly volatile and flammable, and can be naturally occurring in gas, crude oil, and in

raw or cooked meat, seafood, and certain plants (ToxServices LLC 2019). Heptane is a common solvent that has been proposed as an alternative to other solvents deemed as problematic such as dichloromethane and hexane (Joshi et al. 2019).

- **Authoritative basis for Candidate Chemical listing:** CDC 4th National Report on Human Exposure to Environmental Chemicals.
- **Known hazard traits:** n-Heptane was assigned a GreenScreen Benchmark Score of 2 ("Use but Search for Safer Substitutes") by the company ToxServices (ToxServices LLC 2019). This score is based on the following hazard score combinations: Moderate Score for Group I Human Health Hazard (developmental toxicity - D), Very High Score for Benchmark 2f Ecotoxicity (acute aquatic toxicity - AA and chronic aquatic toxicity - CA), and High Score for Benchmark 2g Flammability - F (ToxServices LLC 2019).
- **Example products:** EWG reports the following products containing heptane: Nail Strengthener European Secrets Rock Hard, Beauty Secrets Rock Hard Hardener & Basecoat, and Orly Basecoat for Longer lasting manicure and pedicure (EWG 2022g). Mintel reports 63 products formulated with heptane, examples include, Orly 1 step manicure, Orly get the look bundle, essie first base coat and Sephora by OPI 3-in-1 Base, Top and Strengthener, among others (Mintel 2022g).

N-Methyl-2-pyrrolidone

- **Description:** N-methylpyrrolidone (NMP; CASRN: 872-50-4) appears on two of the authoritative lists recognized by the Safer Consumer Products program. It appears on these authoritative lists for both Developmental Toxicity (Prop 65) and Reproductive Toxicity (EC Annex VI CMRs - Cat.1B). Additionally, NMP has been identified as an eye, skin, and respiratory irritant. The main exposure route is absorption through the skin but can also be absorbed into the body via inhalation and ingestion. Recommended personal protective equipment (PPE) for handling NMP include rubber gloves and goggles/face shield. The easy routes of exposure during nail care work, coupled with the hazard traits of NMP make this chemical more likely to cause exacerbated health effects.
- **Authoritative basis for Candidate Chemical listing:** Proposition 65; European Commission (EC) Annex VI carcinogen, mutagen, and or reproductive toxicants Category 1B.

- **Known hazard traits:** According to the GHS classification, NMP causes skin, eye, and respiratory irritation (H315, H319 and H335 correspondingly), it may also elicit reproductive toxicity (H360D).
- **Example products:** The Mintel GNPD reports 3 products containing NMP: SEP liquid sticker nail, Shellac UV Color Coat Nail Color and Kiss Custom Fit Nail kit (Mintel 2022h).

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