

# Investigation of the Potential for Microbial Contamination in Nail Polish (2008)



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The Nail Manufacturers Council (NMC) commissioned a scientific study designed to determine if nail polish products present a significant risk of cross-contamination by microorganisms. The NMC solicited input from several accredited microbiological testing facilities to gain an understanding about which accredited microbiological test protocol was most appropriate to determine if microbes are able to survive in widely used salon nail polish products.

### **Summary of Nail Polish Contamination Studies**

Bottles of nail polish that had been used on multiple clients in salons were tested for contamination at an independent laboratory, along with unused controls. Standard microbiological tests were performed on all bottles to determine if microbes could survive in the nail polish, whether introduced in salon use or as part of the follow-up challenge test protocol. Results show that microbes do not survive in nail polish and are quickly killed when introduced into the product. Solvent-based nail polish products (e.g., nail polish, lacquers, enamels, varnish, base coats, top coats), do not provide suitable conditions for either microbial growth or reproduction and, indeed, are extremely hostile to the survival of microbes.

### **Protocol #1: Challenge Study**

Nail polish samples of two popular brands (OPI Products Inc. and Creative Nail Design a.k.a. CND) were furnished to California-licensed nail technicians for use in their salons. Samples were furnished in 0.5 fl. oz. glass bottles with application brushes integral to the cap, as is the universal industry design. No attempt was made to conceal the brand names of the polishes; the samples and control were taken from standard production runs. The nail polish colors were chosen in the bright-pink range (currently in fashion) to ensure that a sufficient number of clients would be willing to wear these colors. Only a single color per company was used. It is important to note, however, that OPI, CND, and most other nail polish brands have very similar resin/solvent base combinations for each of their various shades, and, therefore, a single shade is representative of the entire product line. It is important to note that the same set of solvents is used by nearly all nail polish manufacturers, with the exception of toluene which is being phased out of the industry. Solvents represent approximately 60-70% of nail polish product formulas. The OPI sample was toluene-free; the CND sample contained toluene. These two

formulas, therefore, are considered to fairly represent the range of solvent-based nail polish formulas on the market, as well as some of the most widely sold.

Each nail technician was instructed to use the nail polish provided on a minimum of five clients over the course of three days, and to keep a log sheet showing the number/ types of usages; i.e. over natural fingernails, toenails, or artificial nail enhancements. Nail technicians were instructed not to use a basecoat, which could interfere with the test by preventing the polish brush from coming into contact with the natural or artificial nail. The exact purpose of the test was not disclosed to the nail technician to minimize either conscious or unconscious changes in work habits that might interfere with the test, although the knowledge that they were participating in an “NMC Scientific Study” could not be avoided. Table 1 contains a summary of the test response forms.

**Table 1**  
**Summary of Salon Testing Applications**

Sample bottle Designation	Total salon services	# of natural fingernail polish services	# of acrylic fingernail polish services	# of toenail polish services	Total salon clients
OPI-A	7	-	4	3	6*
OPI-B	5	2	2	1	5
OPI-C	0 (control)	-	-	-	-
CND-A	5	2	1	2	5
CND-B	7	5	2	-	7
CND-C	0 (control)	-	-	-	-

\*One client had both acrylic fingernail and pedicure services.

The OPI nail polish samples A, B, and C were the color designated “Hawaiian Orchid”, lot number B104993WU. The CND polish samples A, B, and C were of the color designated “Tutti Frutti”, lot number A6001.

After three days, the samples and log sheets were retrieved, then sent, along with the controls, to an independent, accredited testing laboratory, BioScreen Testing Services. Bioscreen used the protocol, "Anti-microbial Effectiveness", M404.R02, Cosmetics, Toiletry & Fragrance Association (CTFA) November, 2001, which utilizes plating media that test for full range of known pathogens, including bacteria, yeasts and molds.

Each used sample and unused control sample was identically inoculated with a solution of live microorganisms. The samples were evaluated for microbial contamination at 0 and 48 hours, 7, 14, 21, 28 days. Three of the samples were usable for the full 28 days. Unfortunately three samples dried out and eventually became unusable; two were unusable after the 15<sup>th</sup> day of sampling and another after the 21<sup>st</sup> day. Nevertheless, in no case was less than two weeks worth of data collected.

**Results – Protocol #1**

All six samples tested exhibited an extremely rapid reduction in the number of microbes after inoculation; most samples yielded more than 99.9% reduction in microbes and maintained these levels for as long as the test was in progress. Illustrative excerpts of

these results are shown in Table 2. Full details on the studies can be found in the reports from Bioscreen Testing Services (available from NMC).

**Table 2**  
**Selected Log Reduction Values of Inoculated Microbes – Salon Test Samples**

Salon Sample	Bioscreen project #	Microbe Pool*	0 hour Log Reduction	% Reduction	48 hour Log Reduction	% Reduction	14 day
OPI-A	584357	Pool 1	4.1	>99.99	4.1	>99.99	4.1
		Pool 2	4.1	>99.99	4.1	>99.99	4.1
		Pool 3	0.9	~90	2.3	>99.0	2.3
OPI-B	584358	Pool 1	4.2	>99.99	4.2	>99.99	4.2
		Pool 2	4.1	>99.99	4.1	>99.99	4.1
		Pool 3	1.3	>90	3.4	>99.9	3.4
CND-A	584360	Pool 1	4.6	>99.99	4.6	>99.99	4.6
		Pool 2	4.4	>99.99	4.4	>99.99	4.4
		Pool 3	3.9	~99.99	3.9	~99.99	3.9
CND-B	584361	Pool 1	4.6	>99.99	4.6	>99.99	4.6**
		Pool 2	4.4	>99.99	4.4	>99.99	4.4**
		Pool 3	3.9	~99.99	3.9	~99.99	3.9**

\*Microbe pools are as follows:

Pool 1 = *Escherichia coli*, *Enterobacter cloacae*, and *Staphylococcus aureus*

Pool 2 = *Pseudomonas aeruginosa* and *Burkholderia cepacia*

Pool 3 = *Aspergillus niger* and *Candida albicans*

\*\*Tested on the 15<sup>th</sup> day.

## **Protocol #2: Salon Repurchase Study**

NMC representatives visited 10 salons and purchased a total of 20 approximately half-used nail polish bottles, representing various colors and 8 different brands (see Table 3). Since a 0.5 fl oz bottle of nail polish (the standard size) contains enough material to serve 50-60 clients, it is estimated that each bottle had been used on approximately 25-30 different clients before repurchase by the NMC. No attempt was made to determine how long the bottles had been in service but experience suggests that a half-used bottle has typically been in active use in the salon for at least several weeks if not months. (An extra sample from another salon had been in service for only 2 weeks and was more than half full, but the salon owner asserted it had already been used on several clients due to its popularity.)

Standard aerobic plate count and yeast/mold plate count were performed on all of the samples by Bioscreen Testing Services, in order to determine if microbes had colonized the nail polish during salon use. Unlike the first protocol, there was no deliberate challenge-contamination of the samples with aqueous microbial nutrient-rich broth. Since microbes require water for growth, the injection of the nutrient-rich broth into the samples creates an unrealistic opportunity for microbes to exist for longer than would be expected under real-world salon conditions.

Also, in contrast to the first protocol, simply purchasing previously-used polish bottles eliminates the possibility that the nail techs would change their techniques in response to the knowledge that they were participating in a scientific study. Contamination, if any,

would be the result of normal application methods that took place before the NMC’s visit. It was, therefore, as close to a “blind” study as circumstances permitted.

## **Results – Protocol #2**

Aerobic plate count and yeast/mold plate count revealed that less than 10 colony forming units (CFU) per gram existed in any samples (Table 3). According to Bioscreen, 10 CFU/gram is the detection limit of the test, therefore the term "<10 CFU" is equivalent to saying that no microbes were observed. Full details may be found in Bioscreen’s report.

**Table 3**  
**Salon Repurchase Study**

<b>Manufacturer/Color – Salon/Location</b>	<b>#</b>	<b>Volume (est.)*</b>	<b>Aerobic Plate Count**</b>	<b>Yeast &amp; Mold Plate Count**</b>
CND/Demure - Perfect 10/San Clemente	1-1	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
CND/Bare Necessities - Perfect 10/San Clemente	1-2	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
OPI/Up the Amazon Without a Paddle - Raffles/ San Clemente	1-3	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
OPI/Tijuana Dancer - Raffles/San Clemente	1-4	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
Essie/Mademoiselle - Norma Jeans/Mission Viejo	1-5	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
CND/Moonlight & Roses Norma Jeans/Mission Viejo	1-6	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
Color Me/Whisper - Happy Nails/San Juan Capistrano	1-7	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
Color Me/Worth a Million - Happy Nails/San Juan Capistrano	1-8	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
China Glaze/Scarlet - ProNails/Laguna Hills	1-9	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
Bon Colour/Pink Pearl - ProNails/Laguna Hills	1-10	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
Orly/Raspberry Ice - June & Co./Woodland Hills	2-1	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
Sally Hansen/Nude Shimmer – June & Co./Woodland Hills	2-2	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
Orly/Garnet Truth – Claudio Marino Salon/Woodland Hills	2-3	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
Essie/Blanc - Claudio Marino Salon/Woodland Hills	2-4	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
CND/Heiress – Simbotica/Woodland Hills	2-5	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
Essie/Aruba Blue – Simbotica/Woodland Hills	2-6	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
OPI/Kiss on the Chic – Miabella Nail Salon/Studio City	2-7	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
Essie/Pinking Up the Pieces - Miabella Nail Salon/Studio City	2-8	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
China Glaze/Pin Prick – Nail Time/Studio City	2-9	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
Essie/The Closer Crimson – Nail Time/Studio City	2-10	~ ¼ fl oz	<10 CFU/gram	<10 CFU/gram
OPI/Passion – Robb Salon/Studio City (extra sample)	2-11	Slightly under ½ oz	<10 CFU/gram	<10 CFU/gram

\*Standard 0.5 fluid ounce bottles, partially used; remaining volume determined by visual estimate.

\*\*10 Colony Forming Units (CFU) per gram is the detection limit of the test.

## **Conclusion**

The results of the challenge study show that in each of the four salon-tested samples the level of test microbes introduced into the nail polish were quickly reduced by 99.0-99.99% and these levels were maintained throughout the test period

The results of salon repurchase study indicate that in actual salon usage, bottles that are used on numerous clients in the salon over a period of weeks or months do not experience any microbial colonization at all.

Both results support the conclusion that solvent-based nail polish products do not harbor or promote growth and quickly kill pathogenic organisms.