



California Environmental Protection Agency
DEPARTMENT OF TOXIC SUBSTANCES CONTROL

PRIORITY PRODUCT PROFILE

PAINT STRIPPERS CONTAINING METHYLENE CHLORIDE

MARCH 2014

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

The mission of DTSC is to protect California's people and environment from harmful effects of toxic substances through the restoration of contaminated resources, enforcement, regulation and pollution prevention.



INTRODUCTION

Under the Department of Toxic Substances Control's (DTSC) Safer Consumer Products regulations, DTSC must publish a proposed initial Priority Products list by March 28, 2014. This draft list imposes no new regulatory requirements on product manufacturers until DTSC finalizes it by adopting regulations. This profile provides DTSC's rationale for proposing this Priority Product. To the extent practical, it follows the organization of the regulations. The section titled "Hazard Trait of the Chemical of Concern" identifies the authoritative lists¹ of chemicals on which methylene chloride appears and provides additional information on the chemical's hazard traits. The "Exposures" section identifies the chemical types specified in the regulations² into which [methylene chloride] falls.

PRIORITY PRODUCT IDENTIFICATION

DTSC has identified as a Priority Product all paint and varnish removers and paint and varnish strippers that contain methylene chloride.

PROBLEM IDENTIFIED

Methylene chloride is a well-known and widely used component in paint strippers. Due to its high volatility, the major route of exposure to methylene chloride is through inhalation. Exposure may also occur through ingestion or dermal absorption.

There have been numerous worker deaths related to the use of methylene chloride stripping agents. Consumer deaths related to the use of methylene chloride paint strippers have also been documented. The European Parliament banned the marketing of methylene chloride-based paint strippers in the European Union effective June 2012, citing numerous deaths from acute methylene chloride poisoning specifically related to its use in paint strippers.

Methylene chloride is recognized as a carcinogen and has been linked to cancers of the brain, liver, and biliary tract. In the body, methylene chloride is also transformed into carbon monoxide, a known poison to the brain and nervous system. The neurological effects from methylene chloride may be more severe in children. Inhalation of methylene chloride causes headaches, dizziness, nausea, memory loss, and decreased visual, auditory, and psychomotor functions. Exposure to methylene chloride vapors irritates the eyes, nose and throat, and damages blood cells. Direct contact with methylene chloride may cause intense burning and redness of the skin.

PRIORITY PRODUCT DESCRIPTION

The Department of Toxic Substances Control ("DTSC") has identified as a Priority Product all paint and varnish removers, paint and varnish strippers, and surface cleaners, that contain methylene chloride. Under the Global Product Classification ("GPC") System these products are assigned to "Brick 10002501"(1). Use of GPC Brick codes, where available, to identify

¹ Identified in subsection (a)(1) of section 69502.2 of title 22 of the California Code of Regulations.

² Identified in subsection (a)(2) of section 69502.2 of title 22 of the California Code of Regulations.

California's Priority Products may assist stakeholders in identifying such products, and is consistent with the State of Washington's use of GPC brick codes to identify products reported to contain chemicals of concern under the Washington Children's Safe Product Act (2).

Brick 11002501 is defined in the Building Products Segment of the GPC as (1):

"...any products that may be described as a chemical substance designed to break down paint or varnish to facilitate its removal from a surface. These products may be designed for indoor or outdoor use, and can be used to remove varnish or paint from any chosen surface. This product category includes products such as Paint Stripper, Cleaning Solvents and Paint Solvents. This product category excludes products such as Paints, Special Purpose Paints, and Paint Additives/Enhancers, as well as Sandpaper and other Abrasives."

This brick category also includes products with the following additional descriptive terms and attributes (number indicated in parentheses) that may be used by the product manufacturer to further assist in identifying the product:

BRICK DESCALER (30012653)

GRAFFITI REMOVER (30012654)

MONUMENT CLEANER (30012655)

PAINT BRUSH CLEANER (30012658)

PAINT STRIPPER/REMOVER (30012656)

PAINT/CLEANING SOLVENT (30012652)

TURPENOID (30012694)

TURPENTINE (30012695)

UNCLASSIFIED (30002515)

UNIDENTIFIED (30002518)

VARNISH REMOVER (30012659)

Any consumer product placed into the stream of commerce in California for use as a paint or varnish remover or stripper, and that contains methylene chloride, is a Priority Product. This includes, but is not limited to, products in Brick 10002501 of the GPC, and products with any of the attribute values described above. Collectively, these priority products are referred to hereafter as "paint strippers."

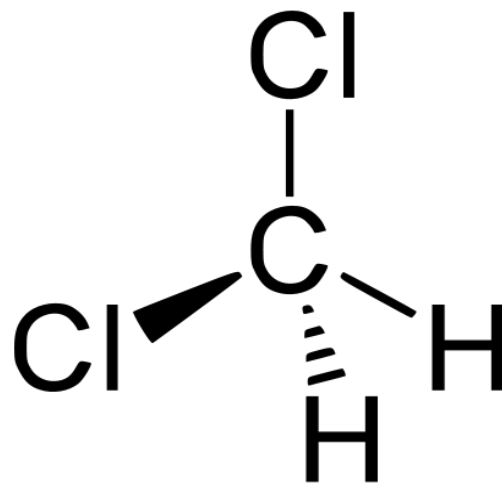
RATIONALE FOR PRIORITY PRODUCT SELECTION

EVALUATION OF ADVERSE IMPACTS AND EXPOSURES

(See California Code of Regulations, title 22, section 69503.2(b)(1) and section 69503.3)

1. Chemical of Concern: Methylene Chloride.

- Chemical abstract service (CAS) registry number 75-09-2
- Common synonyms or trade names: Dichloromethane, Methylene Dichloride
- Chemical formula: CH_2Cl_2
- Chemical structure:



Methylene chloride meets the conditions specified in California Code of Regulations, title 22, section 69503.6 (a): It appears on one or more of the authoritative lists in California Code of Regulations, title 22, section 69502.2(a)(1) and is one or more of the types of chemicals listed in California Code of Regulations, title 22, section 69502.2(a)(2). Methylene chloride is listed on four of the lists described in section 69502.2(a)(1) for carcinogenicity, and one list for neurotoxicity. It also appears on five of the lists described in section 69502.2(a)(2) for a variety of traits. Additional information about the basis of listing methylene chloride as a Candidate Chemical is available from the Department of Toxic Substances Control's (DTSC's) Candidate Chemical Database (3).

2. Physicochemical properties of the Chemical of Concern

(See California Code of Regulations, title 22, section 69503.3(a)(1)(D))

- Molecular weight 84.9 (4).
- Specific gravity 1.33 (4).
- Melting point between -95°C and -97°C (4).
- Boiling point between 39°C and 40°C (4).
- Log Kow 1.25 (4).
- Water solubility 13.0 g/L @ 25°C (4).
- 400 mm Hg at 24.1°C (5).
- Vapor density relative to air 2.93 (6).
- Methylene chloride is considered highly volatile with a penetrating, ether-like odor (7).

3. Hazard traits of the chemical of concern

(See California Code of Regulations, title 22, section 69501.1(a)(36), section 69502.2(a)(1), section 69502.2(a)(2), and section 69503.3 (a)(1)(A))

- Carcinogenicity
 - Methylene chloride is known to the State of California to cause cancer pursuant to the Safe Drinking Water and Toxic Enforcement Act of 1986 (8).
 - Methylene chloride is classified as “likely to be carcinogenic in humans” in the U.S. Environmental Protection Agency’s (EPA’s) Integrated Risk Information System (9). Epidemiological data has linked methylene chloride to cancers of the brain, liver, and the biliary tract (bile system) (9).
 - Methylene chloride is classified as “possibly carcinogenic to humans” (i.e., a group 2B carcinogen) by the International Agency for Research on Cancer (10).
 - In the Twelfth Edition of the Report on Carcinogens published by the U.S. Department of Health and Human Services, National Toxicology Program, methylene chloride is classified as “reasonably anticipated to be a human carcinogen” (11).
 - Methylene Chloride is considered to be a “Potential Occupational Carcinogen” by the National Institute of Occupational Safety and Health (NIOSH) (12).
 - Methylene Chloride is classified as a “Potential Occupational Carcinogen” by the Federal Occupational Safety and Health Administration (OSHA) (13).
 - Methylene Chloride is classified as a “Regulated Carcinogen” by the California Department of Industrial Relations, Occupational Health and Safety Administration (Cal-OSHA) (14).
- Neurotoxicity
 - According to the Agency for Toxic Substances and Disease Registry (ATSDR), “A number of human studies reveal that the nervous system is perhaps the most important target of acute methylene chloride toxicity,” and methylene chloride is recognized as a neurotoxicant (15).
- Dermatotoxicity
 - In humans, direct skin contact with large amounts of methylene chloride causes intense burning and mild redness of the skin (15).
- Ocular toxicity
 - Exposure to high levels of methylene chloride vapors may irritate the eyes and adversely affect the cornea (15,16).
 - There is a reported case of optic neuropathy in a 65 year old man that resulted from methylene chloride inhalation (17).
- Acute toxicity
 - Methylene chloride is metabolized to carbon monoxide in the body, and there have been severe cases of carbon monoxide intoxication caused by inhaling methylene chloride from paint strippers (18-21). The California Office of Environmental Health Hazard Assessment (OEHHA)

previously evaluated methylene chloride and noted that, while there are no studies suggesting that methylene chloride exposure per se differentially affects children, the effects of carbon monoxide produced metabolically following methylene chloride exposure may be exacerbated in fetuses and infants because fetal hemoglobin has a higher affinity for carbon monoxide than adult hemoglobin (22).

- Acute exposure to methylene chloride by inhalation causes gastrointestinal effects including nausea and vomiting, and respiratory effects, such as cough, loss of breath, chest tightness and asphyxiation (15). Acute exposure may also result in depression, dizziness, confusion, intoxication, loss of coordination, memory loss, personality changes, and unconsciousness (15). The California Department of Public Health (CDPH) identifies short-term exposure to methylene chloride as causing headaches, dizziness, eye, nose and throat irritation, chest pain, and trouble breathing, whereas long term exposure increases the risk of liver damage (6,16).
- The U.S. EPA has found that methylene chloride has the potential to cause adverse neurological effects and blood cell damage from acute exposures (5).
- Other hazard traits
 - The U.S. Department of Labor has warned that the use of methylene chloride paint stripping products in small or enclosed spaces represents an extreme danger (23).
 - Methylene chloride is classified as a toxic air contaminant in California, and no safe “threshold” concentration has been determined (24).
- Fatalities associated with acute methylene chloride exposure
 - Exposure to methylene chloride vapor can be fatal (15). There have been numerous worker deaths associated with the use of methylene chloride stripping agents (6,23,25).
 - Consumer deaths related to the use of methylene chloride-based paint strippers have been documented (27,28).

4. Environmental Fate

(See California Code of Regulations, title 22, section 69503.3(a)(1)(E))

- Atmosphere
 - Because of its high volatility, most methylene chloride will find its way into the atmosphere (5). Of the total methylene chloride released to the environment, ~90% is released to the atmosphere, while smaller amounts may be released to land or water. Releases occur from both industrial and consumer uses (29). The average atmospheric lifetime for methylene chloride is 130 days (15).
- Water
 - Releases of methylene chloride to water will be removed primarily by evaporation. The half-life of methylene chloride volatilization from water has been found to be 21 minutes under experimental conditions, but the actual rate of volatilization from natural waters may vary, as it will depend on a variety of environmental factors such as temperature and pH (15). Biodegradation is possible in natural waters but is likely to be very slow compared with evaporation (5).

- Although experimental data are lacking, methylene chloride is not expected to bioconcentrate due to its low octanol/water partition coefficient (log Kow is 1.25), from which a bioconcentration factor of 5 can be estimated (5).
- Land
 - The principal releases of methylene chloride to land are via the disposal of methylene chloride products and containers to landfills (29).

5. Human populations and sensitive subpopulations for which the Candidate Chemical has the potential to contribute to or cause adverse impacts

(See California Code of Regulations, title 22, section 69503.3(a)(1)(F) and section 69503.3(a)(2))

- Methylene chloride is recognized as a carcinogen and neurotoxin. Methylene chloride is also recognized as an acute toxicant that may adversely affect a number of organ systems. All segments of the human population may be adversely impacted by exposure.

Sensitive subpopulations

- Infants and Children
 - When methylene chloride is metabolized by the human body, reactive compounds are produced that may cause DNA damage and lead to cancer (9). According to the U.S. EPA, although there are no direct studies on whether methylene chloride affects children differently than adults, children exposed to cancer-causing agents that act by damaging DNA are assumed to have increased early-life susceptibility (30).
 - Methylene chloride vapors are heavier than air and tend to concentrate near the ground. Vapors may concentrate in the breathing zone (18). OEHHA has concluded that because of their shorter stature, children may be more at risk of exposure than adults during accidental spills or through the use of methylene chloride in unventilated areas (22). Moreover, the higher breathing rates in children compared to adults mean that children are likely to receive a higher dose of methylene chloride than adults during inhalation exposures (22).
 - According to OEHHA the neurotoxic and cardiovascular effects of methylene chloride may be exacerbated in fetuses and infants (22).
- Pregnant women
 - Studies of female pharmaceutical workers exposed to a variety of organic solvents suggested that methylene chloride exposure resulted in an increased rate of spontaneous abortions and may have adverse effects on pregnancy (22,31).
- Workers
 - Methylene chloride is acutely toxic, and a number of worker deaths have occurred during use of methylene chloride paint strippers (23,25,26).
- Other sensitive subpopulations
 - Environmental justice (EJ) communities are those where residents are predominantly minorities or low-income, and tend to be (but in California, are not always) located in

industrialized urban areas (32). Because EJ communities are typically located in industrialized areas, they tend to be more heavily impacted by industrial emissions and pollution. In 2001 OEHHA noted that there are significant emissions of methylene chloride in California from facilities in the Air Toxics Hot Spots program, and that local concentrations may be higher than statewide averages (22). This suggests the potential for environmental justice communities in industrialized areas to be disproportionately impacted by releases of methylene chloride.

- According to CDPH, methylene chloride can cause chest pains (angina) and other symptoms in people with heart disease (33).
- Because methylene chloride can have a number of adverse effects on different organ systems, it is possible that some deaths that have been attributed to other causes may actually be due to methylene chloride exposure. Although consumer deaths related to the use of methylene chloride have been documented (27,28), the actual number of injuries or deaths among home “do-it-yourselfers” caused by the use of methylene chloride paint strippers is not known.

6. Exposures

(See California Code of Regulations, title 22, section 69503.3(b))

- Methylene chloride appears on several lists included in California Code of Regulations, title 22, section 69502.2(a)(2):
 - Methylene chloride is a chemical for which primary Maximum Contaminant Levels have been established and adopted under section 64431 or section 64444 of chapter 15 of title 22 of the California Code of Regulations.
 - Methylene chloride has been identified as a Toxic Air Contaminant under sections 93000 and 93001 of title 17 of the California Code of Regulations.
 - Methylene chloride has been identified as a priority pollutant in California Water Quality Control Plans under section 303(c) of the federal Clean Water Act and in section 131.38 of title 40 of the Code of Federal Regulations, or identified as pollutants by California or the United States Environmental Protection Agency for one or more water bodies in California pursuant to section 303(d) of the federal Clean Water Act and section 130.7 of title 40 of the Code of Federal Regulations.
 - Methylene chloride has been identified with non-cancer endpoints and listed with an inhalation or oral Reference Exposure Level by OEHHA under Health and Safety Code section 44360(b)(2).
 - Methylene chloride has been identified on the Centers for Disease Control and Prevention’s Fourth National Report on Human Exposure to Environmental Chemicals and Updated Tables.
- Market presence
 - Methylene chloride is widely used in paint and varnish strippers and surface cleaners (5,22,26). As of 2006 the most widely used stripping formulations sold in California contained methylene chloride (34).
 - In 2013 CDPH published a survey of retail stores in the San Francisco Bay Area showing that methylene chloride-based paint strippers are widely available for purchase by consumers, which demonstrates considerable market demand (26). Further, CDPH reported that

methylene chloride-based strippers are more widely available in the retail stores that were surveyed than any alternative paint stripping formulations, even though safer alternatives are available.

- In 1998, 44 facilities in California reported releasing more than 986,000 pounds of methylene chloride to the air (15). However, based on recent data, the sales of methylene chloride-based paint strippers declined in the past several years (35). According to 2010 California Toxics Inventory estimations, methylene chloride emissions from areawide sources were about 4.71 tons per day, with consumer products contributing significantly to the overall emissions (35). California Air Resources Board (ARB) staff estimates that the use of paint removers resulted in approximately 3 tons per day of emissions of methylene chloride (35). Thus, paint strippers appear to be a major source of methylene chloride emissions. More than 99% of the atmospheric releases of methylene chloride result from industrial and consumer use (15).
- In 1998, 44 facilities in California reported releasing more than 986,000 pounds of methylene chloride to the air (15). As of 2006 the California Air Resources Board (CARB) estimated that 9.68 tons of methylene chloride from paint strippers was released each day in California (34). More than 99% of the atmospheric releases of methylene chloride result from industrial and consumer use (15).
- In 2009, methylene chloride was produced by 26 manufacturers worldwide, including 4 in the U.S., and was available from 133 suppliers, including 58 in the U.S. (11).
- Between 1996 and 2006, annual U.S. imports of methylene chloride totaled between 100 million and 500 million pounds (11).
- In 2011, the Department of Health and Human Services reported that nearly one third of all methylene chloride manufactured worldwide is used as a solvent in paint strippers (11).
- Many furniture stripping firms that use methylene chloride-based stripping formulations in California have poor ventilation (34). OSHA and Cal-OSHA established a permissible exposure limit (PEL) of 25 parts per million and an action level of 12.5 parts per million for methylene chloride in air (34,35). According to a 2006 study, most stripping firms have not met the PEL or the action level for methylene chloride (34).
- The use of methylene chloride-based products in home settings can result in high concentrations of methylene chloride in air, often exceeding OSHA PELs (36). In a home simulation study of furniture stripping, methylene chloride concentrations in air exceeded 2000 parts per million when used indoors without local exhaust ventilation (37). Concentrations in air of 2,300 parts per million are considered “Immediately Dangerous to Life and Health” (38).
- Occurrence or potential occurrence of exposure to methylene chloride in paint stripper
 - Methylene chloride is highly volatile and has a penetrating, ether-like odor (7). However, people may become adapted to the odor. Therefore, odor alone cannot be relied upon as a robust means to detect the presence of methylene chloride in air (39). Workers and others who work frequently with methylene chloride may be at increased risk of becoming desensitized to methylene chloride odor, and therefore at increased risk of exposure to methylene chloride via inhalation.
 - CDPH has suggested that precautionary labeling on methylene chloride paint strippers is not sufficient to influence how they are used by consumers (26).

- Many consumers may not be aware that the most commonly used types of gloves, such as latex, rubber, and acetonitrile, are easily penetrated by methylene chloride (26). Moreover, a survey found that sales people at retail outlets where methylene chloride paint strippers are sold in California did not recommend appropriate gloves to consumers purchasing methylene chloride stripping products (26).
- Many consumers may not be aware that cartridge-type air purifying respirators and dusts masks will not provide adequate protection against methylene chloride vapors (6).
- In May 2013, CDPH reported that the concentration of methylene chloride in paint and varnish stripping products sold to consumers typically ranges from 16% to 100%, with the majority containing more than 60% methylene chloride by volume (40).
- The annual reports of the National Poison Data System show that in 2011 there were 337 reported exposures to methylene chloride paint strippers (41). Of those, 41 occurred in individuals under the age of 5, and 45 occurred in individuals between the ages of 6 and 19. Of the reported exposures, 324 were classified as “unintentional” and 6 were classified as “intentional.” One death was reported. In 114 of the exposure cases, the affected individuals required treatment in a medical facility.
- The principal route of exposure to methylene chloride for the general population is inhalation of ambient air. Average daily intake of methylene chloride from urban air has been estimated to range from about 33 micrograms to 309 micrograms. Occupational and consumer exposure to methylene chloride in indoor air may be much higher (15).
- Methylene chloride exposure may also result from the consumption of contaminated drinking water. Methylene chloride has been found in California groundwater used as drinking water, with median concentrations ranging from 0.7 to 10 micrograms per liter (42).
- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), requires ATSDR and the U.S. EPA to prepare a priority list of hazardous substances that are most commonly found at facilities on the National Priorities List (NPL), and that are determined to pose the most significant potential threat to human health due to their known or suspected toxicity and potential for human exposure (43). The NPL is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the U.S. and its territories (44). Methylene chloride is currently on the NPL, suggesting it poses a significant potential threat due to toxicity and/or potential for human exposure (43).
- Methylene chloride is colorless and highly volatile, and its vapors are heavier than air. Inhalation of vapors during use is a primary route of exposure (15,25).
- Methylene chloride exposure may result via dermal absorption or ingestion (15,25).
- Major routes of human exposure to methylene chloride are from breathing air near sources of emissions, and from ingesting contaminated drinking water (5).

OTHER RELEVANT PRODUCT-CHEMICAL IDENTIFICATION AND PRIORITIZATION FACTORS

(See California Code of Regulations, section 69503.2(b)(1)(C))

1. Availability and reliability of information

- All toxicology and health-effects references in this profile meet the definition of “reliable information” pursuant to section 69501.1(a)(57), in that all reports and studies relied upon were either published in peer-reviewed literature, and/or published by a federal, state, or local agency that implement laws governing chemicals.
- The hazard characteristics of methylene chloride have been well-documented and are widely accepted by a number of authoritative bodies. In addition, the danger of acute poisoning during use is well established (23,26).
- A recent survey conducted by CDPH showed that paint strippers containing a high concentration of methylene chloride are widely available in California (26).

2. Other regulatory programs

(See California Code of Regulations, title 22, section 69503.2(b)(2))

- In 2009, the European Union concluded that the warning labels on methylene chloride-based products were insufficient, resulting in fatalities to workers and consumers (36). The European Union subsequently banned the sale of paint strippers containing more than 0.1% methylene chloride by weight (45).
- As of 2011, businesses using methylene chloride in paint stripping operations must notify the U.S. EPA and certify they have implemented appropriate best management practices to minimize emissions (46,47).
- Various emissions regulations of the South Coast Air Quality Management District may apply to the use of methylene chloride paint strippers containing volatile organic compounds (VOCs), but they are not specific to methylene chloride, and do not restrict sales to consumers (34).
- Both Federal OSHA and Cal-OSHA have adopted exposure limits for workers who may be exposed to methylene chloride (14,48).
- DTSC is not aware of any other regulatory restrictions or requirements related to the sale or use of paint strippers containing methylene chloride in California or in the United States.

3. Alternatives to methylene chloride paint strippers³

(See California Code of Regulations, title 22, section 69503.2(b)(3))

- In 2006, the Institute for Research and Technical Assistance (IRTA) published a report for DTSC identifying low-VOC and low-toxicity alternatives to methylene chloride in paint strippers (34). Alternatives to methylene chloride were tested in large furniture stripping companies with automated stripping equipment, by smaller furniture stripping companies who strip by hand, by contractors who strip on-site, and by consumers who strip by hand. According to the IRTA report, the best performing alternative formulations contained benzyl alcohol as the active ingredient.
- A report prepared for the European Commission Directorate General of Enterprise and Industry identified the following potential chemical and mechanical alternatives to methylene chloride for paint stripping (49):
 - Potential chemical alternatives:
 - ♦ Mixtures of acetone, toluene and methanol (ATM);
 - ♦ Dibasic esters (DBE; e.g. dibasic adipate, dibasic glutamate, or dibasic succinate); and,
 - ♦ Dimethyl sulfoxide (DMSO).
 - Mechanical alternatives:
 - ♦ Hot air strippers;
 - ♦ Blowtorches;
 - ♦ Scraping;
 - ♦ Polishing;
 - ♦ Sanding; and,
 - ♦ Sand or grit blasting.

According to the report, ATM-based strippers have rather high volatility, contribute to photochemical ozone creation, and are flammable. Paint strippers based on dibasic esters have the advantage that they evaporate slowly, resulting in a lower potential for exposure than methylene chloride or ATM. However, strippers based on dibasic esters have a rather slow stripping speed (up to 24 hours), whereas methylene chloride paint strippers can do the job in one hour or less. Exposure time thus may be longer for dibasic esters relative to methylene chloride. The report summarized the relative inhalation risk (RIR) for methylene chloride and possible alternative paint strippers (see Table 1). The RIR gives a rough indication of the relative potential risk of exposure, but does not consider differences in exposure times.

³ Under the Safer Consumer Product regulations, when deciding whether to list a product-chemical combination, the Department may also consider whether there is a readily available safer alternative that is functionally acceptable, technically feasible, and economically feasible (see California Code of Regulations, title 22, section 69503.2(b)(3)). The potential alternatives identified below are provided as examples only, and do not constitute a comprehensive list of all available alternatives applicable to every Priority Product type. Furthermore, the Department is not asserting that these potential alternatives are necessarily safer, functionally acceptable, technically feasible, or economically feasible. The Department seeks information on these and any other alternatives in the marketplace. The Department expects that responsible entities and stakeholders will identify and provide reliable information on the safety, functionality, and technical and economic feasibility of these and other alternatives.

Table 1. Relative inhalation risk of some paint stripper components.

Substance	RIR
Methylene chloride	4639
Methanol	627
N-methyl pyrrolidone	4
Dibasic Ester	2

- A report prepared in 2007 for the European Commission Directorate General of Enterprise and Industry identified various alternatives to methylene chloride in paint strippers, including physical and mechanical stripping methods, pyrolytic and thermal stripping methods, and chemical stripping methods (50). The report stated that while there is a significant variety of formulations that may be used as alternatives to methylene chloride-based paint strippers, all of the alternatives may not be suitable for every application. In addition, each of the alternatives may have its own hazard traits or pose unique risks. Therefore, the suitability and safety of each potential alternative would need to be evaluated for each intended application. The alternatives to methylene chloride-based paint strippers that were identified in the 2007 report include:
 - Physical and mechanical methods:
 - ♦ Abrasive blasting with a variety of media;
 - ♦ The use of primers before re-coating;
 - ♦ Sanding;
 - ♦ Scraping; and,
 - ♦ Milling with machines.
 - Pyrolytic and thermal methods:
 - ♦ Hot air guns and gas torches;
 - ♦ Pyrolytic stripping using open flames, high-temperature ovens, fluidized beds, molten salt baths, and laser stripping.
 - Chemical methods:
 - ♦ Alkaline strippers;
 - ♦ Acid strippers;
 - ♦ N-methyl pyrrolidone-based products;
 - ♦ Dibasic ester-based products;
 - ♦ DMSO-based products;
 - ♦ Alkalis;
 - ♦ Benzyl alcohol-based products;
 - ♦ 1,3-dioxolane-based products; and,
 - ♦ Glycol and glycol ether-based products.

- A widely used chemical alternative to methylene chloride in paint stripper is N-methyl pyrrolidone, or NMP (CAS number 872-50-4). NMP is a known reproductive and developmental toxicant and a skin and eye irritant (8,51). Moreover, NMP is on DTSC's list of Candidate Chemicals due to reproductive and developmental toxicity (3). Because NMP does not meet the condition specified in California Code of Regulations, title 22, section 69503.6(a) for the Initial Priority Products List, DTSC may not name products containing NMP as "Priority Products" until January 1, 2016. However, DTSC does not recognize NMP as a "safer alternative" to methylene chloride. Manufacturers substituting NMP for methylene chloride would be required to notify DTSC pursuant to California Code of Regulations, title 22, section 69505.2.

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