State of California
AIR RESOURCES BOARD

Initial Statement of Reasons for Proposed Amendments to the California Consumer Products Regulation

Volume II
Technical Support Document

Initial Statement of Reasons
for
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California Consumer Products Regulation

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I.

INTRODUCTION

A. OVERVIEW

In Volume II of the Initial Statement of Reasons (ISOR) for Proposed Amendments to the California Consumer Products Regulation, we present our technical justification and analysis of the Mid-term Measures proposed amendments to the consumer products regulation. Included in this TSD is the following information:

- a discussion of the process used to develop the proposed amendments;
- a discussion of the technical basis for the proposed amendments;
- a review of the emissions from the proposed categories for regulation and the overall need for the emission reductions;
- a description of the proposed amendments and the consumer product categories proposed for regulation;
- an analysis of the environmental and expected economic impacts from the proposed amendments; and
- a discussion of future activities related to the mid-term measures.

B. ENABLING LEGISLATION

In 1988, the Legislature enacted the California Clean Air Act (CCAA or "the Act"), which declared that attainment of the California state ambient air quality standards is necessary to promote and protect public health, particularly the health of children, older people, and those with respiratory diseases. The Legislature also directed that these standards be attained by the earliest practicable date.

This landmark legislation made consumer products part of the clean air challenge by adding section 41712 to the California Health and Safety Code (HSC) which, along with subsequent amendments, requires the Air Resources Board (ARB/Board) to adopt regulations to achieve the maximum feasible reduction in volatile organic compounds (VOCs) emitted by consumer products. In addition, the ARB must: 1) determine that adequate data exist to adopt the regulations; 2) adopt regulations that are technologically and commercially feasible; 3) adopt regulations that are necessary; 4) adopt regulations that do not eliminate of any product form; and 5) require specific consultation with health professionals to ensure any

VOC reductions from health benefit products do not compromise the health benefits of the products. In enacting section 41712, the Legislature gave the ARB new authority to control emissions from consumer products, an area that had previously been subject to very few air pollution control regulations.

C. BACKGROUND

1. Consumer Product Regulations Adopted to Date

To date, the Board has taken several actions to fulfill the legislative mandate. Four regulations have been adopted regulating a total of 28 consumer product categories and 35 categories of aerosol paints. (A complete summary of the regulations adopted and dates of regulatory amendments is provided in Appendix D.)

On November 8, 1989, the ARB adopted a regulation for reducing VOC emissions from antiperspirants and deodorants (the "antiperspirant and deodorant regulation;" sections 94500-94506.5, Title 17, California Code of Regulations (CCR)) (ARB, 1989a-b). The ARB then adopted a more comprehensive regulation for reducing VOC emissions from 26 additional categories of consumer products, which was adopted by the Board in two phases (the "Consumer Products Regulation;" sections 94507-95417, Title 17, CCR)(ARB, 1990a-c; ARB, 1991 a-c). Phase I was adopted on October 11, 1990, and Phase II was adopted on January 9, 1992. These regulations reduce VOC emissions primarily through specification of maximum allowable VOC content limits (by weight percent) for individual product categories.

On September 22, 1994, the Board adopted the third regulation, the "Alternative Control Plan Regulation for Consumer Products" (the "ACP") (ARB, 1994a-b). The ACP is a voluntary, market-based regulation that employs the well-established concept of an aggregate emissions cap or "bubble." This program supplements existing regulations by providing consumer products and aerosol coatings manufacturers additional flexibility when formulating consumer products. This regulation is contained in Title 17, CCR sections 94540-94555.

The Board adopted a fourth regulation on March 23, 1995, the "Regulation to Reduce Volatile Organic Compound Emissions from Aerosol Coating Products" (the "aerosol coating regulation") (ARB, 1995 a-b). This regulation limits the VOC content of 35 categories of aerosol coatings. At the same time, the ACP was amended to make it possible to "bubble" aerosol coatings emissions. The aerosol coatings regulation is contained in Title 17, CCR, sections 94520-94528.

2. The State Implementation Plan

On November 15, 1994, the ARB adopted the State Implementation Plan (SIP) for ozone (ARB, 1994c). The SIP serves as California's overall long-term plan for attainment of the federal ambient air quality standard for ozone. Together with significant reductions from stationary industrial facilities, mobile sources (e.g. cars, trains, boats), and other area sources (e.g. architectural and industrial maintenance coatings), the reductions in the consumer products element of the SIP are an essential part of California's effort to attain the air quality standards for ozone. The VOC reductions from consumer products are also needed to help several local air pollution control districts meet rate-of-progress requirements in the federal Clean Air Act (CAA).

The consumer products component of the SIP is a multi-faceted program comprised of "near-term", "mid-term", and "long-term" control measures. The near-term SIP measures are our existing consumer products regulations. The mid-term measures consist of regulations to cover additional product categories not currently subject to the existing regulations. The long-term measures rely on new technologies with components of market incentives and consumer education.

In the SIP, the ARB has committed to an overall 85 percent reduction in consumer product emissions by the year 2010 (including the adopted regulations). This reduction is necessary for the South Coast Air Basin, among others, to attain the federal ozone standard and meet the rate-of-progress requirements under the CAA. Under the SIP, the various control measures will contribute the following emission reductions:

30 percent will come from the near-term measures,
25 percent will come from the mid-term measures,
30 percent will come from the long-term measures.

The mid-term measures component is important both to the consumer products SIP element and our effort to achieve the maximum feasible reduction in the VOC emissions from consumer products as required by HSC section 41712. As indicated above, our commitment is to achieve an additional 25 percent reduction relative to the uncontrolled 1990 consumer product emissions by the year 2005. This translates to a 60 tons per day emission reduction goal or about a 50 percent reduction in emissions. In the SIP, we indicated these reductions would come from consumer product categories not regulated under the near-term measures. We also committed to adopting these measures by July 1, 1997, and to obtain the reductions by the year 2005. These mid-term measures emission reductions are necessary for the Sacramento Metropolitan Area and Ventura County Air Pollution Control District to demonstrate ozone attainment by 2005. They are also necessary for other districts to show continuing rate-of-progress.

As part of the mid-term measures component, we also committed to establishing a "Consumer Products Working Group" (CPWG) to help facilitate the development and implementation of future consumer products control measures. This working group would be advisory in nature and comprised of representatives from the ARB, industry, environmental groups, the local districts, and the United States Environmental Protection Agency (U.S.

EPA). Its role would be to provide a forum for ongoing communication, cooperation, and coordination in the development of consumer product control measures.

On November 15, 1994, the ARB submitted the consumer products Phase I and II regulations and the antiperspirant and deodorant regulation to the U.S. EPA for approval as a SIP revision. On January 13, 1995, the U.S. EPA found the submittal complete and approved the regulations on February 14, 1995. The U. S. EPA's approval of the consumer products regulations was published in the Federal Register on August 21, 1995. The ACP was submitted to the U.S. EPA on August 27, 1996.

3. Comparable Federal Regulations

The U.S. EPA recently published a proposed rule, National Volatile Organic Compound Emissions Standards for Consumer Products, which appeared in the April 2, 1996, Federal Register (Vol. 61, No. 64, pages 14531-14543). This regulation is similar to the ARB's consumer products regulation, although some differences do exist. The proposed rule specifies VOC standards for consumer products. The U.S. EPA's proposed rule applies nationwide to consumer product manufacturers, importers, and distributors (but not retailers), while the ARB regulation applies to any person (including retailers) who "sells, supplies, offers for sale, or manufactures consumer products for use in the State of California". The U.S. EPA's rule does not regulate several product categories which are regulated under the ARB regulation and does not regulate any of the categories under consideration in the mid-term measures amendments. All of the VOC standards in the U.S. EPA's proposed rule have a standard effective date of September 1, 1996, whereas the VOC standards in the existing ARB regulation and the proposed mid-term measures amendments to this regulation are phased in at various dates from 1993 to 2005. Unlike the ARB regulation, the U.S. EPA's proposed rule does not have a second tier of "future effective" VOC standards for any product category. Finally, the U.S. EPA's proposed rule has an unlimited "sell-through" period for noncomplying products manufactured before the effective date of the standards, whereas California law allows a three year sell-through period.

Whenever possible, the ARB strives to harmonize its rules with federal regulations addressing the same issues. However, Phase I of the ARB consumer products regulation has been in existence since 1990, and Phase II was adopted by the Board in 1992. Both phases, therefore, predate the proposed U.S. EPA regulation by several years. Additionally, the proposed U.S. EPA regulation is less effective in reducing emissions than is the ARB regulation in several areas because it has less stringent standards for many categories and does not set limits for any of the mid-term measures categories. Consequently, amending the California consumer products regulation to eliminate conflict with the U.S. EPA's regulation would reduce the air quality benefits of the regulation and would significantly change the rules in California after manufacturers have expended significant resources to comply with them. In summary, given the serious nature of the air pollution problem in California, the benefit to human health and the environment justifies a California consumer products regulation that results in greater emission reductions than would the proposed U.S. EPA regulation.

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Air Resources Board, “Final Statement of Reasons for Rulemaking - Public Hearing to Consider the Adoption of a Regulation to Reduce Volatile Organic Compound Emissions from Aerosol Coating Products and Amendments to the Alternative Control Plan for Consumer Products”, Scheduled for Consideration: March 23, 1995;
Agenda Item No.: 95-3-1.

United States Environmental Protection Agency, Federal Register, “National Volatile Organic Compound Emission Standards for Consumer Products”, April 2, 1996, Vol. 61, No. 64, pp. 14531-14543.

II.

DEVELOPMENT OF PROPOSED AMENDMENTS

A. PROCESS FOR DEVELOPING PROPOSED STANDARDS

Our efforts to fulfill the consumer product's Mid-term Measures State Implementation Plan commitment began with the formation of the Consumer Products Working Group (CPWG) and its first meeting on April 11-12, 1995. Based on the comments at that meeting, two technical subgroups were formed, one for the Mid-term Measures efforts ("Mid-term Measures Subgroup") and one for our reactivity/scientific activities ("Reactivity Subgroup"). Subsequent to that meeting, we conducted seven public workshops, five meetings of the CPWG, two meetings of the Mid-term Measures Subgroup and Ad Hoc Categories Committee, and six meetings of the Reactivity Subgroup. A summary of these meetings is presented in Table II-1 below. In addition to these more formal meetings, staff conducted over 17 teleconferences, three video conferences, and numerous individual meetings with interested stakeholders to gather the technical information necessary to develop the Mid-term Measures amendments to the consumer products regulation. In addition, staff reviewed all available technical literature, patents, and trade journals to obtain information upon which to base the amendments. To gather specific information on the sales and emissions from the categories selected for evaluation under the Mid-term Measures effort, the staff also conducted a comprehensive survey entitled the "ARB's 1994/1995 Mid-term Measures Survey" (Survey). To maximize Survey response, staff made 1,700 telephone calls to non-respondents. This is discussed in more detail in Chapter IV, "Emissions".

Table II-l
Summary of Mid-term Measures Public Meetings

Date	Meeting	Location
April 11-12, 1995	Consumer Products Working Group	Sacramento, CA
July 11, 1995	Reactivity Subgroup	Sacramento, CA
July 12, 1995	Mid-term Measures Subgroup	Sacramento, CA
October 17, 1995	Consumer Products Working Group Reactivity Subgroup	Sacramento, CA

Table II-l (continued)
Summary of Mid-term Measures Public Meetings

Date	Meeting	Location
October 18, 1995	Mid-term Measures Subgroup (Ad Hoc Categories Committee)	Sacramento, CA
January 18, 1996	Mid-term Measures Workshop Reactivity Subgroup	Sacramento, CA
April 16, 1996	Consumer Products Working Group Mid-term Measures Workshop	Sacramento, CA
June 19, 1996	Reactivity Subgroup	Sacramento, CA
October 29, 1996	Consumer Products Working Group Reactivity Subgroup	Sacramento, CA
October 30, 1996	Mid-term Measures Workshop	Sacramento, CA
February 4, 1997	Mid-term Measures Workshop Reactivity Subgroup	Sacramento, CA
March 12, 1997	Mid-term Measures Workshop	San Francisco, CA
April 15, 1997	Mid-term Measures Workshop	Sacramento, CA
May 20, 1997	Consumer Products Working Group	Sacramento, CA
May 21, 1997	Mid-term Measures Workshop	Sacramento, CA

B. EVALUATION OF ALTERNATIVES

The first step in developing the Mid-term Measures was to identify unregulated product categories that have the greatest potential for cost-effective emission reductions. To identify and prioritize these product categories, we reviewed the data from the United States Environmental Protection Agency's (U.S. EPA) 1990 survey of 245 consumer and commercial product categories. To assist us in reviewing the U.S. EPA's survey data, we formed an Ad Hoc Categories Committee with industry representatives from the Mid-term Measures Subgroup. This committee helped us to identify and prioritize product categories for inclusion in the Mid-term Measures survey.

After reviewing the U.S. EPA's survey results and excluding product categories that the ARB and local air districts already regulate, we identified 92 product categories that warranted further investigation for inclusion in the Mid-term Measures survey. These categories warranted further investigation because they had relatively high volatile organic compound (VOC) emissions and appeared to have a potential for emission reduction. However, after further review of the U.S. EPA's survey data we found that 34 of these 92 product categories consist primarily of industrial or agricultural products which the ARB has no authority to regulate. Therefore, we decided to include the remaining 58 product categories in the 1995 Mid-term Measures survey. After compiling the Mid-term Measures survey results, we found that 19 of the 58 categories surveyed had low emissions (less than 0.1 ton per day each) and a low potential for emission reductions. Therefore, we decided to focus our control efforts on the 39 remaining product categories. Based on comments from industry and similarities in product function, the 39 product categories were regrouped into 32 product categories.

Following further investigation of the 32 product categories and based on industry's comments, we determined that 13 of the remaining 32 categories warrant further study before we investigate the feasibility of developing proposed VOC standards. These categories are either: 1) health benefit products requiring consultation with the Department of Health Services and experts in the field of public health, as required by the Health and Safety Code; 2) soap products with VOC's that may go down-the-drain and biodegrade in the sewer system; 3) 100 percent solvent categories which require further technical study regarding potential reformulation options; or 4) multipurpose dry lubricants which also require further technical study. A further discussion of the basis for postponing consideration of these 13 product categories is contained in Chapter IX. We later decided to exclude the selective terrestrial herbicide category because data demonstrated that the majority of VOCs in these products form a salt and do not evaporate. Consequently, we are currently proposing VOC standards for the remaining 18 product categories.

The initial draft standards were proposed at the February 4, 1997, public workshop. In response to industry concerns regarding the technological and commercial feasibility of these initial standards, many of them were revised prior to making this proposal to the Board.

III.

TECHNICAL BASIS FOR THE PROPOSED AMENDMENTS

Health and Safety Code section 41712 requires all consumer product regulations adopted by the Board to be technologically and commercially feasible. During the development of the Phase I and II consumer product regulations, the ARB staff established guidelines in setting the standards to ensure that these statutory criteria were met. Also, revisions to section 41712 as of September, 1996, require that consumer product regulations not eliminate a product form. These guidelines and statutory criteria were followed in setting the proposed standards for the Mid-term Measures. A detailed discussion of the technical basis for each proposed standard is included in Chapter VI of the Technical Support Document.

The Mid-term Measures standards were targeted towards the lower volatile organic compound (VOC) content technologies within a product category. In doing this, consideration was given to preserve the various product forms within each category. In all categories proposed for regulation, with the exception of the aerosol form of hair shine, there exist products on the market which currently comply. However, the proposed 55 percent VOC standard for hair shine products (effective January 1, 2005) may be achieved for the aerosol form through the transfer of technology used to formulate hair spray (see Chapter VI). This fact creates a strong presumption that the proposed standards are both technologically and commercially feasible. Further discussion of these concepts is presented below.

A. TECHNOLOGICALLY FEASIBLE

Health and Safety Code section 41712(b) requires the Board to adopt consumer product regulations that are “technologically feasible”. Technological feasibility is a different concept than “commercial feasibility”, and does not take into account the cost of the complying product. The staff believes that a proposed standard is technologically feasible if it meets at least one of the following criteria: (1) the standard is already being met by at least one product within the same category, or (2) the standard can reasonably be expected to be met in the time frame provided through additional development efforts. With the exception of the aerosol form of “hair shine” and the hard paste wax form of “automotive wax, polish, sealant or glaze”, our survey results show that a number of products are currently marketed that comply with both the first tier and second tier standards for all of the product categories under consideration. In the case of “hair shine”, this category is closely related to the “hair spray” category from the Phase II regulation. The second tier standard for “hair spray” is

55 percent VOC, and manufacturers expect to be able to comply with this limit by June of 1999. Because of the similarities between the hair spray and hair shine categories, the technologies that allow hair spray to comply with a 55 percent VOC standard should allow hair shine to also meet a 55 percent VOC limit. In the case of the hard paste wax form of "automotive wax, polish, sealant or glaze", a complying product entered the marketplace after our survey was conducted. Appendix E shows the number of complying products and complying market share for the Phase I and Phase II consumer product categories. This shows a wide range in complying market share similar to our Mid-term Measures proposal.

In setting the proposed standards for the Mid-term Measures categories, staff made an effort wherever possible to ensure that multiple reformulation technologies exist which would allow products to comply. Proposed standards were set at VOC levels that staff determined could be met without increased use of Toxic Air Contaminants or ozone-depleting compounds. General reformulation options included addition of water with cosolvents, development of emulsion products, use of low vapor pressure volatile organic compound solvents, use of non-VOC propellants, and use of exempt solvents. Multiple reformulation options allow flexibility in the design of compliant products, ensuring that efficacious, cost-effective products will be brought to the marketplace.

B. COMMERCIALLY FEASIBLE

Health and Safety Code section 41712(b) also requires the Board to adopt consumer product regulations that are "commercially feasible". The term "commercially feasible" is not defined in State law. In interpreting this term, the staff has utilized the reasoning employed by the United States Court of Appeals for the District of Columbia in interpreting the federal Clean Air Act. In the leading case of International Harvester Company v. Ruckelshaus, (D.C. Cir. 1973) 478 F. 2d 615, the Court held that the United States Environmental Protection Agency could promulgate technology-forcing motor vehicle emission standards which might result in fewer models and a more limited choice of engine types for consumers, as long as the basic market demand for new passenger automobiles could be generally met.

Following this reasoning, the staff has concluded that a regulation is "commercially feasible" as long as the "basic market demand" for a particular consumer product can be met. "Basic market demand" is the underlying need of consumers for a product to fulfill a basic, necessary function. This must be distinguished from consumer "preference", which may be towards specific attributes of a particular product. A "preference" is the choice of consumers for a certain product or products based upon fragrance, cost, texture, etc. By way of example, a consumer may <u>need</u> a floor wax stripper to remove aged or worn polish from their floor. Consumers may choose an ammoniated stripper because they <u>prefer</u> the performance characteristics, or they may choose a non-ammoniated stripper because they dislike the smell of ammonia. This distinction is not recognized by all parties. Some commenters have expressed the view that consumers do not have a "basic market demand" for a general class of products, but that consumers instead have a number of separate and distinct "basic market demands" for many specialty products with differing characteristics. In the category of "rubber and vinyl protectant", for example, some protectants are water-based and some are solvent-based. Some commenters have suggested that it is inappropriate for the ARB to establish a single standard for rubber and vinyl protectants (based on the "basic market demand" for a product that will protect rubber or vinyl), because such a standard may not account for the separate market demand of some consumers for solvent-based "rubber or vinyl protectants".

The ARB staff believes this interpretation of "basic market demand" is inconsistent with the reasoning from the International Harvester case. To adopt such a narrow interpretation would be inconsistent with the clearly expressed legislative intent that "...the state board shall adopt regulations to achieve the maximum feasible reduction in reactive organic compounds emitted by consumer products..." (Health and Safety Code section 41712(a)). In order to achieve emission reductions, manufacturers of high VOC products which perform the same function as lower VOC counterparts must reduce the VOC's in their products. It is expected that when a product formulation changes, some attributes of the product will also change. If ARB were to establish standards which accounted for every distinct feature of every product, then each product would require a standard unto itself. Using this approach, it would be difficult to achieve the maximum feasible reduction in VOC emissions because changes in formulation would change product features.

Every currently marketed product has some unique features that differentiate it from other products. Consumers who purchase a particular product have demonstrated a preference over other competing products. This distinction between "preference" and "basic market demand" was clearly made in the International Harvester case. In the International Harvester case, the court stated that the proposed emissions standards would be feasible even though they might result in the unavailability of certain kinds of vehicles and engine types people preferred (e.g. fast "muscle" cars), as long as the basic market demand for passenger cars could be generally met. Applying this principle to consumer products, the proposed amendments allow the basic market demand to be met for each product category, even though it may no longer be possible to manufacture products with some specific attributes. The ARB staff believe that this approach complies with section 41712.

Tables III-1 and III-2 below list the proposed VOC limits for each category, the emission reductions and the number and market share of products that currently comply with the proposed limits. The total emission reductions from both the initial and future-effective standards (as shown in Table 7 and 8) is 15.3 TPD. This represents an overall emission reduction of about 50 percent from the categories proposed for the Mid-term Measures. The variation in complying market share reflects the fact that each standard is developed independently based on the available reformulation options.

Table III-1 First Tier Standards					
Product Category (Effective Date)	**Range of VOC Content**	**Proposed VOC Limit (wt%)**	**VOC Emission Reduction*** * (pounds) and Percent Reduction**	**Number of Complying Products /Total Percent Complying**	**Complying Market Share (%)**
Automotive Rubbing or Polishing Compound					
All Forms (2002)	0-55%	15%	660 32%	16/63 25%	18%
Automotive Wax, Polish, Sealant or Glaze					
All Other Forms (2005)	0-95%	15%	1,340 35%	42/146 29%	39%
Hard Paste Wax (2005)	60-80%	45%	480 36%	1*/17 6%	unknown (low)
Instant Detailers (2000)	0-10%	3%	80 10%	4/8 50%	47%
Bug and Tar Remover					
All Forms (2002)	0-100%	40%	640 39%	8/32 25%	43%
Carpet & Upholstery Cleaner					
Aerosol (2000)	4-18%	7%	80 16%	8/34 24%	44%
Dilutable Non-aerosol (2000)	0-13%	0.1%	700 60%	66 / 142 46%	45%
Ready-to-use Non-aerosol (2000)	0-11%	2.5%	50 31%	9 / 14 64%	71%
Floor Wax Stripper					
Non-aerosol (2002)	0-90%	3%	3,440 54%	55/108 51%	69%
General Purpose Degreaser					
Aerosol (2002)	10-100%	50%	540 46%	6/59 10%	5%
General Purpose Degreaser					
Non-aerosol (2000)	0-100%	10%	2,780 66%	140/193 73%	98%

Table III-1 First Tier Standards					
Product Category (Effective Date)	**Range of VOC Content**	**Proposed VOC Limit (wt%)**	**VOC Emission Reduction*** * (pounds) and Percent Reduction**	**Number of Complying Products /Total Percent Complying**	**Complying Market Share (%)**
Hair Shine					
All Forms (2005)	0-99%	55%	500 43%	5/24 63%	13%
Heavy Duty Hand Cleaner					
All Forms (2002)	0-50%	10%	3,340 56%	52/122 43%	58%
Metal Polish/Cleanser					
All Forms (2002)	5-100%	30%	280 42%	89 / 113 79%	90%
Multipurpose Lubricant					
All Forms** (2002)	0-100%	60%	2,320 20%	75/133 56%	11%
Non-selective Terrestrial Herbicide					
Non-aerosol (2002)	0-30%	3%	5,220 77%	33/42 79%	96%
Paint Remover or Stripper					
All Forms (2002)	0-100%	65%	100 2%	59/82 72%	96%
Penetrant					
All Forms (2002)	0-100%	60%	160 14%	44 / 100 44%	53%
Rubber and Vinyl Protectant					
Aerosol (2005)	0-95%	10%	460 31%	7 / 24 29%	16%
Non-aerosol (2000)	0-100%	3%	1,680 93%	40 / 75 59%	87%
Silicone-based Multipurpose Lubricant					
All Forms** (2005)	0-100%	60%	500 34%	29 / 92 32%	17%

Table III-1 First Tier Standards					
Product Category (Effective Date)	**Range of VOC Content**	**Proposed VOC Limit (wt%)**	**VOC Emission Reduction*** (pounds) and Percent Reduction**	**Number of Complying Products /Total Percent Complying**	**Complying Market Share (%)**
Spot Remover					
Aerosol (2000)	0-98%	25%	100 65%	10 / 30 65%	78%
Non-aerosol (2000)	0-100%	8%	420 67%	49 / 75 65%	80%
Undercoating					
Aerosol (2002)	30-75%	40%	120 26%	9 / 32 28%	12%
Wasp and Hornet Insecticide					
All Forms (2005)	0-97%	40%	500 40%	5/29 17%	67%
Total emission reductions for the first tier standards and the total percent reduction (13.2 tpd)			26,400 43%		

* A complying product entered the market after our survey was conducted.

** All forms except solids or semisolids (primarily greases).

Table III-2 Second Tier Standards				
Product Category (Effective Date)	**Proposed VOC Limit (Wt%)**	**VOC Emission Reduction (pounds)** and Total Percent Reduction (%)**	**Number of Complying Products /Total Percent Complying**	**Complying Market Share (%)**
Heavy Duty Hand Cleaner (2005)	5%	4,540 76%	39/122 32%	12%
Multipurpose Lubricant (2005)	45%	4,700 40%	62/133 47%	9%
Paint Remover or Stripper (2005)	50%	420 10%	38/82 46%	38%

Table III-2 (continued) Second Tier Standards				
Product Category (Effective Date)	**Proposed VOC Limit (Wt%)**	**VOC Emission Reduction (pounds)** and Total Percent Reduction (%)**	**Number of Complying Products /Total Percent Complying**	**Complying Market Share (%)**
Penetrant (2005)	**45%**	**300 27%**	**30/100 30%**	**37%**
Total emission reductions for the first tier standards (26,400 pounds) and the second tier standards (4,200 pounds) and the total percent reduction achieved (15.3 tpd)		**30,600 50%**		

*** All forms except solids or semisolids (primarily greases).**

IV.

EMISSIONS

In this chapter we provide an overview of California's air quality problems and the need for significant emission reductions from all sources of air pollution. We also describe the need for the regulation of additional categories of consumer products and provide a detailed summary of the emissions from the categories proposed for regulation.

A. AMBIENT AIR QUALITY AND THE NEED FOR EMISSIONS REDUCTIONS

Volatile organic compound (VOC) emissions contribute to the formation of both ozone and PM_{10} (particulate matter less than 10 microns equivalent aerodynamic diameter). Ozone formation in the lower atmosphere results from a series of chemical reactions between VOCs and nitrogen oxides in the presence of sunlight. PM_{10} is the result of both direct and indirect emissions. Direct sources include emissions from fuel combustion and wind erosion of soil. Indirect emissions result from the chemical reaction of VOCs, nitrogen oxides, sulfur oxides and other chemicals in the atmosphere.

Ozone

VOCs and nitrogen oxides (NOx) react in the presence of sunlight to form ozone. The rate of ozone generation is related closely to the rate of VOC (in the form of reactive organic gases, or ROG) production as well as the availability of NOx in the atmosphere (ARB, 1987a, 1987b; Seinfeld, 1989). At low ambient concentrations, ozone is a colorless, odorless gas, and the chief component of urban smog. It is by far the state's most persistent and widespread air quality problem. Air quality data have revealed that 75 percent of the nation's exposure to ozone occurs in California (ARB, 1994a). As shown in Figure IV-1, the population-weighted average exposure to ozone concentrations above the state ambient air quality standard (of 9 parts per hundred million) in the South Coast Air Basin has been declining. However, despite this decline and nearly 25 years of regulatory efforts, ozone continues to be an important environmental and health concern.

It has been well documented that ozone adversely affects the respiratory functions of humans and animals. Human health studies show that short term exposure to even very low levels of ozone injures the lung (ARB, 1997b). Ozone is a strong irritant that can cause constriction of the airways, forcing the respiratory system to work harder in order to provide oxygen to the body. Besides shortness of breath, it can aggravate or worsen existing respiratory diseases such as emphysema, bronchitis, and asthma (ARB, 1987b).

Chronic exposure to ozone can damage deep portions of the lung. ARB research has documented permanent lung damage in young adults, aged 14-25, most of whom were life-long residents of the highly polluted South Coast Air Basin. The research, which provides some of the most definitive research to date of the potential life-long health threat from poor air quality, found early signs of permanent lung disease in 104 out of 107 accident victims who were studied (ARB, 1987b). This study suggests that lung tissue does not fully restore itself, but rather reacts somewhat like sunburned skin, losing some of its restorative ability with each exposure and eventually leading to premature or permanent damage (ARB, 1987b).

Figure IV-1
Population-Weighted Exposure to Ozone Concentrations
Above the State Ambient Air Quality Standard

(See graphics file)

Not only does ozone adversely affect human and animal health, but it also affects vegetation throughout most of California resulting in reduced yield and quality in agricultural crops and disfiguration or unsatisfactory growth in ornamental vegetation. During the summer, ozone levels are often highest in the urban centers in Southern California, the San Joaquin Valley, and Sacramento Valley, which are adjacent to the principal production areas in the state's multibillion dollar agricultural industry. ARB studies indicate that ozone pollution damage to crops is estimated to cost agriculture over 300 million dollars annually (ARB, 1987a).

$\underline{PM_{10}}$

Airborne particulate matter (PM_{10}) is a solid or liquid substance with less than (<) 10 microns determined as the equivalent aerodynamic diameter. PM_{10} can be directly emitted into the atmosphere as the result of anthropogenic actions such as fuel combustion or natural causes such as wind erosion. Indirect PM_{10} is formed via a complex reaction involving a gas-to-particulate matter conversion process in which VOCs can participate. The focus of this discussion will be on the indirect aerosol formation of PM_{10}.

PM_{10} is composed of up to 35 percent aerosols which may be the result of atmospheric chemical reactions of sulfate, nitrates, ammonium, trace metals, carbonaceous material (VOCs), and water. The products of the gas-phase reactions may combine to form new particles (either single or two or more vapor phase species) or increase existing particle growth by condensation of VOCs. Furthermore, although the contribution from VOCs is not known, carbonaceous aerosols generally account for a significant fraction of the fine (<2 micron equivalent aerodynamic diameter) urban particulate matter. In Los Angeles, for example, aerosol carbon alone accounts for about 40 percent of the total fine particulate mass (Seinfeld, 1989).

PM_{10} has the greatest impact on the respiratory system because it can reach deep into the lungs. The elderly, persons suffering from lung or cardiovascular disease, infants and children, and asthma sufferers have been identified as being at greater risk from exposure to particulate matter. PM_{10} causes irritation of the respiratory tract and may contain toxic compounds which adhere to the particle surfaces and can enter the lungs. New information from studies conducted over the past 10 years consistently demonstrates that exposure to ambient levels of PM_{10} adversely impacts human health. These adverse effects include increased respiratory illness, hospitalizations, and mortality rates (ARB, 1997b). Because it is visible in the atmosphere, PM_{10} also contributes to reduced visibility.

To protect California's population from the harmful effects of ozone and PM_{10}, federal and state air quality standards for these contaminants have been established. These standards are shown in Table IV-1. The state hourly ozone standard is 9 parts per hundred million (pphm) and the national hourly ozone standard is 12 pphm. The state PM_{10} standard for a 24 hour period is 50 micrograms per cubic meter ($\mu g/m^3$), and the national standard is 150 $\mu g/m^3$ over a 24 hour period.

Table IV-1
Ambient Air Quality Standards for Ozone and PM_{10}

Pollutant	Averaging Time	State Standard	National Standard
Ozone	**1 hour**	**9 pphm ($180\ \mu g/m^3$)**	**12 pphm ($235\ \mu g/m^3$)**
PM_{10}	**Annual Geometric Mean** **24 hour** **Annual Arithmetic Mean**	**$30\ \mu g/m^3$** **$50\ \mu g/m^3$** **-------**	**--------** **$150\ \mu g/m^3$** **$50\ \mu g/m^3$**

The vast majority of California's population who live in urban areas breathe unhealthy air for much of the year, as clearly shown in Figure IV-2. Lastly, Figures IV-3 and IV-4 show that ozone and PM_{10}, respectively, are not limited to just urban areas, but can be found in nearly every county in California. As shown in these maps, 44 counties are currently designated as nonattainment for the state ozone standard, while 53 counties are designated as nonattainment for the state PM_{10} standard (ARB, 1997a). These counties contain over 97 and 99 percent, respectively, of California's population, a clear indication of the extent and magnitude of the ozone and PM_{10} problems in California.

Figure IV-2
California Ambient Air Quality Exceedences During 1995

(See graphics file)

Figure IV-3
Area Designations for State Ambient Air Quality Standard for Ozone

Figure IV-4
Area Designations for State Ambient Air Quality Standard for PM_{10}

(See graphics file)

B. WHY REGULATE CONSUMER PRODUCTS?

Over the past 25 years, air pollution agencies in California have been working diligently to improve air quality. Much of the effort was directed to the more traditional sources of air pollution such as mobile sources (e.g., cars, trucks, etc.) and stationary sources (e.g., factories, power plants, etc.). There have been dramatic gains in reducing emissions from these traditional sources. However, to continue to make progress toward meeting the state and federal ambient air quality standards and protecting the public health of California citizens, there is a need for further reductions from all other sources of emissions such as consumer products. Also, as emissions from the traditional sources are further reduced, emissions from all other unregulated sources, including consumer products, have become more significant. Therefore, the emissions from these sources must be evaluated for possible reductions.

Consumer products comprise an important source of emissions in California because they are widely distributed, emit VOCs when used, and contribute to the air pollution problem in California. Although each consumer product may seem to be a small source of emissions, when the total number of users (e.g., about 32 million people) in California is aggregated, the total VOC emissions become significant. As the population in California continues to grow, the VOC emissions from consumer products will also grow.

Recognizing the importance of the potential impact of VOC emissions from consumer products, the California Legislature enacted the California Clean Air Act of 1988 (the Act). The Act declared that attainment of the California state ambient air quality standards is necessary to promote and protect public health, particularly the health of children, older people, and those with respiratory diseases. The Act added section 41712 to the California Health and Safety Code (HSC), which requires the ARB to adopt regulations to achieve the maximum feasible reduction in VOCs emitted by consumer products. As part of the regulatory process, the ARB must determine that adequate data exist to adopt the regulations. The ARB must also determine that the regulations are technologically and commercially feasible, necessary, and do not eliminate any product form. To date, VOC standards for 28 categories of consumer products (including antiperspirants and deodorants and aerosol coatings (35 subcategories)) have been established to meet the requirements of the Act.

The State Implementation Plan (SIP) projects that an 85 percent reduction in consumer products emissions (from the 1990 baseline year) is necessary to attain the federal ozone standard in the South Coast Air Basin. The consumer products regulations as a whole have not achieved emission reductions even remotely close to this 85 percent goal. The current regulations will only achieve a 30 percent reduction in VOC emissions from consumer products by the year 2000. Since much greater additional reductions are necessary to attain the federal ozone standard, the reductions from the Mid-term Measures are therefore “necessary” within the meaning of section 41712 of the HSC. In addition, section 41712(b)(1) of the HSC provides that a regulation’s “necessity” is to be evaluated in terms of both the state and federal standards. The SIP only addresses the ARB's commitments to achieve the federal air quality standard for ozone. The state air quality standard for ozone is more stringent than the federal standard, and will require even greater emission reductions to achieve attainment.

The applicable state and federal law show that both the U.S. Congress and the California Legislature intended progress toward clean air to be made as quickly as possible. The Act specifically declares that it is the intent of the Legislature that the state air quality standards be achieved "...by the earliest practicable date..." (see HSC, sections 40910 and 40913(a); see also the uncodified section 1(b)(2) of the Act (Stats. 1988, Chapter 1568)). A similar intent is expressed in the federal Clean Air Act, which declares that the federal air quality standards are to be achieved "...as expeditiously as practicable..." (see sections 172(a)(2), 181(a), and 188(c) of the federal Clean Air Act). For all of the reasons described above, the proposed amendments are "necessary" within the meaning of HSC section 41712.

Achieving significant VOC reductions from consumer products is a key element of the SIP (ARB, 1994b, 1994c, 1994d, 1994e). The SIP was adopted by the ARB on November 15, 1994, and serves as California's overall long-term plan for the attainment of the federal ambient air quality standard for ozone by early next century. Together with significant reductions from stationary industrial facilities, mobile sources (e.g., cars, trains, boats), and other area sources (e.g., architectural and industrial maintenance coatings), the reductions in the consumer products element of the SIP are an essential part of California's effort to attain the air quality standards for ozone. The 28 product categories currently being regulated represent our near-term commitment in the SIP and the 18 product categories with proposed VOC limits are our Mid-term Measures commitment in the SIP. Through the implementation of these measures, we will continue to make progress toward meeting California's SIP commitment for ozone attainment.

The VOC reductions from consumer products are also needed to help several local air pollution control districts attain the federal ozone standard and meet the rate-of-progress requirements under the federal Clean Air Act. For example, in the South Coast Air Basin where a large portion of the California population resides, the VOC emissions are enormous, reflecting the size of the regional pollution problem there. The 1990 baseline inventory of VOCs for the South Coast Air Basin was 1,517 tons per day (ARB, 1994b). In order to reach attainment of the federal ozone standard in the South Coast Air Basin by 2010, the VOC emissions must be reduced by 1,194 tons per day, or about 75 percent of the 1990 baseline inventory. In Ventura County and the Sacramento Metropolitan Area, the 1990 baseline VOC inventory was 87 and 222 tons per day, respectively (ARB, 1994b). To reach attainment of the federal ozone standard in both areas by 2005, the VOC emissions must be reduced by 42 (about 50 percent) and 85 (about 40 percent) tons per day, respectively.

C. ESTIMATED EMISSIONS FROM CONSUMER PRODUCTS AND MID-TERM MEASURES CATEGORIES

Emission Estimates for Consumer Products

The VOC emissions from consumer products statewide in 1990 are estimated to be about 265 tons per day, or 15 percent of the total stationary source emissions. These data are shown in Figure IV-5. As previously stated, consumer products are an important source of VOC emissions and, if left uncontrolled, the percentage contribution to the total smog-forming emissions will increase as California's population continues to grow and the emissions from mobile and stationary sources are increasingly regulated.

Figure IV-5
Stationary Source VOC Emissions,
1,800 Tons Per Day (TPD) in 1990

(See graphics file)

California Air Resources Board 1994/1995 Consumer Products Survey

In order to determine the current inventory of consumer products categories under consideration for regulation, the ARB conducted a comprehensive survey of 58 previously unregulated consumer product categories for the 1994/1995 years. This survey was developed with extensive input from members of the consumer products industry and industry associations. Utilizing the comprehensive 1990 United States Environmental Protection Agency (U.S. EPA) consumer products survey, staff prioritized categories based upon VOC emissions and reformulation alternatives. Based upon the U.S. EPA 1990 survey, we predicted that the 58 categories surveyed represented about 57 tons per day. Staff conducted the survey because the data from previous surveys performed by U.S. EPA for 1990 and by ARB for 1990 and 1991 were inadequate in certain respects, and staff wanted to use the best possible data in developing the Mid-term Measures. Areas of inadequacy included incomplete speciation of VOCs and Toxic Air Contaminants, exemption from reporting for products containing no VOCs, outdated sales data, and no speciation of exempt compounds such as alternative propellants. Speciation data are imperative in determining the formulation technologies within product categories, as well as being required to assist staff in developing reactivity-based control strategies in the future.

In March 1996, ARB staff mailed approximately 3,000 surveys to all manufacturers of consumer products on current ARB mailing lists. The survey was made available over the Internet, and manufacturers had options of submitting electronically or by hard copy. Staff maintained a current Internet website with answers to commonly asked questions, responded to numerous e-mail questions and telephone calls regarding questions on the survey process, and performed demonstrations on the use of the electronic survey software. Staff also mailed the manufacturers' associations copies of the survey, and asked that these be distributed to their members. These associations were asked to encourage their members to submit surveys, and to offer assistance in the survey process. After the due date of the survey, staff began contacting manufacturers that had not responded to the survey. Over 1,700 companies were contacted. Although many companies were not manufacturing products covered by the survey, other companies eventually submitted completed surveys. In short, staff made an extensive effort to survey the entirety of the consumer products industry.

All incoming surveys were extensively reviewed by staff. When inconsistencies were found, staff contacted the companies and made necessary corrections. Many corrections were made to formulation data, where some confusion seemed to occur as to what compounds are low vapor pressure volatile organic compounds (LVP-VOCs), exempt compounds, inorganic compounds or VOCs. Prior to entry into the consumer products database, staff made every effort to correct the survey data.

To further ensure the accuracy of the survey data, staff provided extensive summaries to industry detailing the aggregate sales, speciation, VOC tonnage, and other key factors. Product by product summary tables were provided (scrambled to protect confidentiality) detailing product use, VOC content, product form, LVP-VOC content, exempt compound content and other information. Comments from industry on these data summaries were used to check, and in some cases, correct inaccuracies in the data.

Software was developed by staff to automate calculations of emissions, reductions, market coverage and other frequently performed calculations. This software underwent extensive testing, and after validation, has been used to perform all calculations. This effort was undertaken both to facilitate the calculations process, and also to prevent mistakes which might occur in the performance of numerous hand calculations.

By March, 1997, approximately 300 companies had submitted surveys representing approximately 5,000 products in the 58 consumer products categories. Reported emissions from these products account for nearly 50 tons of VOCs per day.

Market Coverage Adjustments to the Survey

Despite the extensive outreach by the ARB staff, the survey did not result in complete market coverage. Many companies which were mailed surveys and even subsequently contacted by telephone were slow to respond to the survey or did not respond at all. Also, some companies are not represented on consumer products mailing lists, and therefore did not receive a survey.

In order to adjust the VOC emissions from the Mid-term Measures survey to reflect complete market coverage, an estimate of the survey coverage was developed using ARB's 1990 and 1991 consumer products surveys, the U.S. EPA 1990 consumer products survey, and the shelf surveys staff performed during the summer of 1995.

Methodology

The survey market coverage estimate was developed by comparing lists of responding companies in each product category from the various surveys. First, the U.S. EPA 1990 survey respondents were compared to Mid-term Measures survey respondents. All products from companies that responded to the U.S. EPA 1990 survey but not the Mid-term Measures survey were included as unreported products. Next, the ARB 1990 and 1991 survey respondents were compared with both the Mid-term Measures respondents and the U.S. EPA respondents. All products from companies that responded to the ARB 1990 and 1991 surveys but not the U.S. EPA or Mid-term Measures surveys were also included as unreported products.

Adjustments

Prior to adjusting the emissions, the unreported products for each category were checked to make sure they were both appropriately categorized and that they were not strictly for industrial use. In product categories where the U.S. EPA 1990 survey included industrial or agricultural products, large product sizes were removed from the list, so credit was taken only for products with household and institutional uses. All products which came in container sizes greater than five gallons were deleted. For products which were designated as being for household, commercial and industrial usage, factors were assigned based upon the range of reported product sizes. Products which were miscategorized were also removed from the list. Miscategorizations were determined based upon the product name.

The U.S. EPA 1990 survey had categories for lubricants, herbicides and automotive rubbing compounds and polishes, whereas the Mid-term Measures survey split these categories into subcategories. For these categories, adjustments to market coverage were made by recombining the ARB categories to make them consistent with the U.S. EPA categories. The ARB combined categories were then compared to the U.S. EPA categories, and unreported products were identified. A percentage increase in emissions was determined for the ARB combined categories, and this percentage was then applied to the subcategories.

The general purpose degreaser category and the floor wax stripper category were not surveyed by the U.S. EPA. However, some of these products were reported in miscellaneous categories, and these products were combined and used to adjust the ARB inventory in these categories. Once again, manufacturers of these products were compared against those that responded to the Mid-term Measures survey, and products from non-responding companies were included as unreported products.

Justification

Inclusion of products from the U.S. EPA 1990 and the ARB 1990 and 1991 surveys could overestimate emissions by counting emissions from products which are either no longer manufactured or were never sold in California. However, in reviewing the lists of unreported products, we found many popular brands and products which are currently sold in California and were also sold during the time frame of the Mid-term Measures survey. Lists of the unreported products were provided to industry representatives and the trade associations in the hopes that products which should not have been included would be identified. Very few companies responded to the unreported products lists. Additionally, our shelf survey of retail outlets identified a large number of products which did not show up in any of the surveys. It is expected that the inclusion of emissions from products not sold in California or no longer manufactured would be offset by emissions from products which were not reported in any of the surveys.

During the compilation of the unreported products, it was assumed that if a company responded to both surveys, then all relevant products for that particular category were reported. This assumption is conservative. One of the problems we encountered during the Mid-term Measures survey was confusion by companies as to whether a particular product was "institutional" versus "industrial". It appears that some companies did not report institutional products because they believed they were for "industrial" use only.

Precedent

Adjustments to the inventory to account for the incomplete market coverage inherent in the survey process is not without precedent. The U.S. EPA , in compiling their emissions estimates for their 1990 survey, increased the sales in most categories to account for incomplete market coverage. In fact, members of industry encouraged staff to use the U.S. EPA 1990 survey, both the speciation data and the emissions estimates, for development of the Mid-term Measures rather than resurveying. In addition, during the development of the Aerosol Coatings Regulation, the ARB 1992 Aerosol Paint Survey yielded 20 tons of VOC per day from the combined paint categories. This estimate was inconsistent with previous estimates from the U.S. EPA 1990 survey and the Chemical Specialties Manufacturers

Association's Pressurized Product Survey, which predicted the emissions from aerosol coatings to be approximately 31 tons per day. Staff felt that despite the discrepancies between the predicted emissions, that the Aerosol Paint Survey had excellent representation of the aerosol paint technologies. Staff utilized the data provided by the Aerosol Paint Survey in developing standards, but retained the 31 tons VOC per day as the inventory estimate (ARB, 1995).

Emission Estimates for Mid-term Measures Categories

The adjusted emissions from the 18 categories under consideration for the Mid-term Measures is now estimated to be 31 tons per day, which approximates our estimates for these categories based on previous ARB and U.S. EPA surveys. Due to underreporting, the Mid-term Measures survey predicts 17.8 tons per day from these categories. This yields an average market coverage of approximately 60 percent, although this varies by category.

Some categories had market coverage of only 20 to 30 percent. The reasons for this include:

- Few respondents among the retail store chains with “house” brands (supermarkets, drugstores, auto parts stores, etc.),

- Large companies that have not responded or are in the process of responding, and

- Difficulty distinguishing between “institutional” and “industrial” products.

The ARB is still receiving many surveys and compiling sales and formulation data from private label marketers and manufacturers. We are continuing to send out surveys to companies. As more responding companies are added to our survey, emissions from their products will replace those emissions which were added for unreported products. However, within the regulatory time frame of the Mid-term Measures, it is not likely that all of the non-responding companies will have submitted surveys. Additional updates to the Mid-term Measures inventory, as more companies respond, will be performed by the ARB Technical Support Division when it develops updates to the entire consumer products inventory for Board approval in November 1997.

The emissions from the Mid-term Measures categories are summarized in Table IV-2. The emissions from these product categories account for approximately 9 percent of the total consumer product emissions.

Table IV-2
VOC Emissions by Product Category

Product Category	VOC Emissions ARB 1995 Survey (Pounds/Day)	VOC Emissions Adjusted (Pounds/Day)
Automotive Rubbing or Polishing Compound		
All Forms	1,420	2,020
Automotive Wax, Polish, Sealant or Glaze		
All Other Forms	2,820	3,800
Hard Paste Wax	1,280	1,320
Instant Detailers	180	To be determined
Bug and Tar Remover	460	1,620
Carpet and Upholstery Cleaner		
Aerosols	380	560
Non-Aerosols - Dilutables	400	1,180
Non-Aerosols - Ready to Use	260	300
Floor Wax Stripper		
Non-Aerosols	2,600	6,400
General Purpose Degreaser		
Aerosols	1,040	1,180
Non-Aerosols	1,900	4,200
Hair Shine	800	1,180
Heavy-duty Hand Cleaner or Soap	2,880	6,000
Metal Polish / Cleanser	480	680
Multi-purpose Lubricant		
Excluding Solids / Semisolids	10,200	11,800
Nonselective Terrestrial Herbicide		
Non-Aerosols	860	6,800
Paint Remover or Stripper	1,720	4,000
Penetrant		
Excluding Solids / Semisolids	1,020	1,100
Rubber and Vinyl Protectant		
Aerosols	700	1,480
Non-Aerosols	1,160	1,800
Silicone-based Multi-purpose Lubricant		
Excluding Solids / Semisolids	1,280	1,480
Spot Removers		
Aerosols	160	380
Non-Aerosols	180	620

Table IV-2 (Continued)
VOC Emissions by Product Category

Product Category	VOC Emissions ARB 1995 Survey (Pounds/Day)	VOC Emissions Adjusted (Pounds/Day)
Undercoating **Aerosols**	**380**	**480**
Wasp and Hornet Insecticide	**1,060**	**1,280**
Total Emissions	**35,600**	**61,600**

Adequate Data

With our estimate of 60 percent market coverage in the survey, we consulted with industry representatives to ensure that the survey had full representation of the available technologies in the market place. Based upon these discussions and the wide range of VOC content in these categories, ARB staff feels confident that all available technologies are represented. In general, the market sector representing the lowest coverage was the "private label" sector. This market sector does not manufacture products. They purchase products from manufacturers, then put their own brand name on them. Those products generally use the same technology as other products made by the manufacturer, and the ARB survey had good coverage of manufacturers.

Staff has worked extensively with industry on all categories proposed for regulation. In dealing with members of industry, extensive discussions on the types of technologies used in each category have occurred. Numerous labels of products in each category were gathered, as well as product literature. Category information was obtained from trade journals, Internet sites, textbooks, and directly from manufacturers. If any of these technologies were not represented by products in the survey, staff would have become aware of this inadequacy and taken steps to gain information on the missing technologies.

In summary, staff believes that the 60 percent market coverage achieved by the survey covered essentially all types of formulations within each product category.

Formulation Data vs. Inventory

It is worth emphasizing that all formulation data used to develop the proposed standards was derived from the Mid-term Measures survey, industry representatives and product literature. The U.S. EPA 1990 survey and the ARB 1990 and 1991 surveys were simply used to adjust the inventory and predict the cost of the regulation. Staff emphasizes that a tremendous effort was made to obtain the most current and accurate formulation data for use in developing the standards, and that the technological feasibility of these standards was determined based upon the current data. Adjustments to the inventory for these categories is a separate exercise, having no bearing upon the technical feasibility of the standards.

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V.

PROPOSED AMENDMENTS TO THE CONSUMER PRODUCTS REGULATIONS

In this chapter, we provide a plain English discussion of the proposed amendments to the consumer products regulation and the Alternative Control Plan, and explain the rationale for the amendments. Where applicable, key terms or concepts involved in each amendment are described. The discussion in this chapter is intended to satisfy the requirements of Government Code section 11343.2, which requires that a noncontrolling “plain English” summary of the regulation be made available to the public.

Amendments are being proposed to three sections in the regulation, section 94508, “Definitions”, section 94509, “Standards and Requirements”, and section 94513, “Reporting Requirements”. These are discussed below in some detail. No other amendments to the existing regulations are being proposed and the existing regulatory provisions such as exemptions and test methods will apply to the Mid-term Measures categories as they apply to the Phase I and Phase II product categories. In addition, no amendments to the Alternative Control Plan are required to enable manufacturers subject to the Mid-term Measures to participate in this program. A few of the more significant existing regulatory provisions that will apply to the Mid-term Measures categories are described briefly. However, for a more detailed discussion of the existing regulatory requirements, the reader is directed to the Phase I and Phase II Technical Support Documents (ARB, 1990 and ARB, 1991).

A. DEFINITIONS (SECTION 94508)

Section 94508, “Definitions”, provides all the terms used in the regulation which are not self-explanatory. The proposed Mid-term Measures amendments include 37 new or revised definitions to help clarify and enforce the regulation. In Table V-1, we list the new definitions proposed for addition. These include 18 definitions for new categories proposed for regulation, and 16 definitions needed to clarify terminology referenced in the regulation. Three of the existing definitions are proposed for modification, wasp and hornet insecticide, paint remover or stripper, and existing product. These are listed in Table V-2.

Table V-1. Definitions Proposed for Addition

Adhesive Remover	Herbicide
Antimicrobial Hand or Body Cleaner or Soap	Lubricant
Astringent/Toner	Medicated Astringent/Medicated Toner
Automotive Hard Paste or Wax	Metallic Parts Cleaner
Automotive Instant Detailer	Metal Polish/Cleanser
Automotive Rubbing or Polishing Compound	Multi-purpose Dry Lubricant
Automotive Wax, Polish, Sealant, or Glaze	Multi-purpose Lubricant
Bug and Tar Remover	Multi-purpose Solvent
Carpet and Upholstery Cleaner	Non-Selective Terrestrial Herbicide
Dry Cleaning Fluid	Penetrant
Electronic Cleaner	Rubber and Vinyl Protectant
Facial Cleaner or Soap	Rubbing Alcohol
Floor Wax Stripper	Semisolid
General Purpose Degreaser	Silicone-based Multi-purpose Lubricant
General-use Hand or Body Cleaner or Soap	Spot Remover
Hair Shine	Terrestrial
Heavy-Duty Hand Cleaner or Soap	Undercoating

Table V-2. Definitions Proposed for Modification

Existing Product	Paint Remover or Stripper
	Wasp and Hornet Insecticide

B. STANDARDS AND REQUIREMENTS (SECTION 94509)

The proposed Mid-term Measures amendments would establish volatile organic compound (VOC) content standards for an additional 18 consumer product categories. Some of these categories are split into subcategories for a total of 29 VOC standards (including four tier two standards). For example, the "General Purpose Degreaser" category is subcategorized into "Aerosols" and "Non-aerosols". The definition of VOC is contained in section 94508(124) of the regulation, and includes most solvents and propellants used in consumer products. The VOC definition does not include, for example, inorganic solids, water, methylene chloride, perchloroethylene, 1,1,1-trichloroethane, and the propellant HFC-152a. There are three proposed effective dates for the Mid-term Measures categories to meet specified VOC content limits: January 1, 2000; January 1, 2002; and January 1, 2005. Eight standards would have an effective date of January 1, 2000. Eleven standards would have an effective date of January 1, 2002, and six standards would have an effective date of January 1, 2005. In addition, four product categories would have tier two standards effective January 1, 2005, which would replace the initial standards. Heavy-duty Hand Cleaner or Soap, Multipurpose Lubricant, Paint Remover or Stripper, and Penetrant have initial standards effective on January 1, 2002, which would be replaced by tier two standards on

January 1, 2005. The categories proposed for regulation along with their standards and effective dates are shown in Table V-3.

Table V-3
Phase III
Table of Standards for Mid-term Measures Categories
in the Consumer Products Regulation

Category	*Effective Dates*		
	1/1/2000	1/1/2002	1/1/2005
Automotive Rubbing or Polishing Compound		15	
Automotive Wax, Polish, Sealant, or Glaze			
All Other Forms			15
Hard Paste Waxes			45
Instant Detailers	3		
Bug and Tar Remover		40	
Carpet and Upholstery Cleaner			
Aerosol	7		
Non-Aerosol (dilutable)	0.1		
Non-Aerosol (ready-to-use)	2.5		
Floor Wax Stripper, Non-Aerosol		3 (See 94509(j))	
General Purpose Degreaser			
Aerosol		50	
Non-Aerosol	10		
Hair Shine			55
Heavy-duty Hand Cleaner or Soap		10	5
Metal Polish/Cleanser		30	
Multi-purpose Lubricant (excluding solid or semisolid products)		60	45
Non-selective Terrestrial Herbicide, Non-Aerosol		3	
Paint Remover or Stripper		65	50
Penetrant (excluding solid or semisolid products)		60	45
Rubber and Vinyl Protectant			
Aerosol			10
Non-Aerosol	3		
Silicone-based Multi-purpose Lubricant (excluding solid or semisolid products)			60
Spot Remover			
Aerosol	25		
Non-Aerosol	8		
Undercoating, Aerosol		40	
Wasp and Hornet Insecticide			40

The only other modifications being proposed to section 94509, "Standards and Requirements" are to modify subsection (f) to include products in the Mid-term Measures categories that contain ozone-depleting compounds and to add subsection (j) which pertains to non-aerosol floor wax strippers. Manufacturers of products in the proposed Mid-term Measures categories will be subject to the existing regulatory requirements. Some examples of these requirements are listed below:

- *Concentrated Products.* The proposed standards are set on the basis of percent VOC by weight and apply to products diluted with water or non-VOC solvents only after the "minimum recommended dilution" has taken place. Spot or incidental use of products in a concentrated form is allowed so products such as general purpose cleaners can occasionally be used full strength in small amounts to treat hard-to-remove soils. Section 94509(b)(2) applies to products that are diluted with VOC solvents and states that the proposed limits specified in subsection (a) shall apply to the product after the maximum recommended dilution has taken place.

- *Manufacturers sell-through.* A three year period is provided for retailers and suppliers to "sell through" products manufactured prior to each of the effective dates of the standards. In order to ensure that the sell-through provision can be effectively enforced, the sell-through provision is not available for products that do not display the manufacture date of the product, or a code indicating such a date.

- *FIFRA products.* The effective date for products that are registered under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) is one year after the date listed in the table of standards. FIFRA and California state law require that pesticide products be registered with the U.S. EPA and the California Department of Pesticide Regulation before being sold in the marketplace. The registration process requires companies to provide test results that demonstrate the safety and efficacy of new or reformulated products. This provision allows additional time for companies to register products that must be reformulated for compliance. With this additional year for compliance, products in the Mid-term Measures categories that are subject to FIFRA requirements (non-selective terrestrial herbicides and wasp and hornet insecticides), will have six to nine years to come into compliance.

- *Ozone-depleting compounds*. Consumer product categories specified under section 94509(a) may not contain the following ozone depleting compounds: CFC-11, CFC-12, CFC-13, CFC-114, CFC-115, halon 1211, halon 1301, halon 2402, HCFC-22, HCFC-123, HCFC-124, HCFC-141b, HCFC-142b, 1,1,1-trichloroethane, and carbon tetrachloride. This provision does not apply to any existing product formulation that complies with the table of standards which was sold, supplied or offered for sale in California prior to the effective date of the article, or any existing product that was sold in California prior to the effective date of the article that is reformulated to meet the table of standards, provided the ozone depleting compound content of the reformulated product does not increase, or to any ozone depleting compounds that may be present as impurities in an amount equal to or less than 0.01 percent by weight of the product. An amendment is proposed for this provision in section 94509(f) to specify an effective date for products subject to the Mid-term Measures table of standards.

We are also proposing to add subsection 94509(j) which would apply to the floor wax stripper category. Subsection 94509(j) would require the responsible party for any non-aerosol floor wax stripper to specify on the product label that a minimum dilution with water up to three weight percent VOC is recommended for light or medium build-up of polish, and a dilution up to 12 weight percent VOC is recommended for stripping heavy build-up of polish. This provision would allow non-aerosol floor wax strippers to be occasionally used at concentrations up to 12 weight percent VOC, when needed for hard-to-remove floor waxes.

C. OTHER SECTIONS (SECTIONS 94510-94517)

Although we are only proposing a modification to section 94513, "Reporting Requirements", all of the provisions in sections 94510 through 94517 of the regulation apply to manufacturers of products in the Mid-term Measures categories. These provisions include: exemptions, innovative product provision, administrative requirements, registration, variance provision, test methods, severability, and federal enforceability. We have provided a brief discussion highlighting some of the exemptions, innovative product provision, administrative requirements, and the variance provisions. For a more comprehensive discussion on these sections and for information on sections not discussed here, please see the Phase I and Phase II Technical Support Documents and the Consumer Products Regulation (ARB, 1990; ARB, 1991; and ARB, 1997).

Exemptions

There are five exemptions in section 94510 which will be of interest to manufacturers, distributors, and retailers of products in the Mid-term Measures categories. These include: the manufacturer's exemption, the distributor's exemption, the fragrance exemption, and the low vapor pressure volatile organic compound (LVP-VOC) exemption.

- *Manufacturer's Exemption.* The manufacturer's exemption excludes from the consumer products regulation those products that are manufactured in California for shipment and use outside of California.

- *Products intended for use outside of California.* This exemption allows distributors or manufacturers to sell, supply or offer for sale a non-complying product if the product is to be shipped, sold, and used outside of California.

- *Fragrance Exemption.* This exemption allows up to 2 weight percent fragrance in a consumer product to be exempt from the VOC limits specified in section 94509(a).

- *LVP-VOC Exemption.* This exemption specifies that the limits specified in section 94509(a) do not apply to LVP-VOCs. A LVP-VOC is a volatile organic compound which contains at least one carbon atom and meets one of the following criteria: has a vapor pressure less than 0.1 millimeter of Mercury at 20 ^{o}C; or more than 12 carbon atoms, if the vapor pressure is unknown.

Innovative Product Provision

The innovative product provision (section 94511) exempts a consumer product from the VOC limits specified in section 94509(a) if a manufacturer demonstrates by clear and convincing evidence that, due to some characteristic of the product formulation, design, delivery systems or other factors, the use of the product will result in less VOC emissions than a representative consumer product that complies with the VOC limit, or the calculated VOC emissions from a noncomplying representative product, if the product has been reformulated to comply with the VOC limit.

Administrative Requirements

The Administrative Requirements Section, section 94512, discusses the most restrictive limit provision and the code-dating requirements.

- *Most Restrictive Limit.* If a product could be classified in two separate categories, then the product must comply with the category with the most restrictive VOC limit.

- *Code-dating.* Each manufacturer of a consumer product subject to section 94509(a) must display on each consumer product container or package the day, month, and year on which the product was manufactured, or a code indicating such date. This date or code shall be displayed on each consumer product container or package no later than 12 months prior to the effective date of the applicable standard specified in section 94509(a) in the consumer products regulation.

Reporting Requirements

Several revisions are proposed for section 94513, "Reporting Requirements." We are proposing to: (1) add subsection (g), "Special Reporting Requirements for Consumer Products that Contain Methylene Chloride or Perchloroethylene, and are Subject to the Phase III VOC Standards;" (2) add subsection (h), "Special Reporting Requirements for Phase III Product Categories with Second-Tier VOC Limits (i.e., Heavy Duty Hand Cleaners, Multipurpose Lubricants, Paint Removers or Strippers, and Penetrants);" and (3) modify subsection (e), "Special Reporting Requirements for Perchloroethylene-Containing Consumer Products."

Subsection (g) would require the responsible party for any product subject to the Phase III (Mid-term Measures) table of standards that contains methylene chloride or perchloroethylene to submit annual reports to the ARB beginning two years prior to the effective date of the VOC standard, until the year 2006. The annual reports would include information on the sales and product formulations of products containing methylene chloride or perchloroethylene, and will allow ARB staff to track the use of these compounds.

Subsection (h) only applies to the Phase III product categories with second-tier VOC limits (i.e., Heavy Duty Hand Cleaners, Multipurpose Lubricants, Paint Removers or Strippers and Penetrants). This subsection would require the responsible party for any product subject to the second tier standards in the Phase III (Mid-term Measures) table of standards to submit annual sales and formulation information, and a compliance plan and annual updates to the ARB beginning three years prior to the effective date of the VOC standard, until 2006. The compliance plan and annual updates to the plan would include the projected sequence and dates of all key events pertaining to the development of a complying product. The compliance plans would no longer be required when a product achieves compliance with the 2005 second-tier VOC standard.

We are also proposing some minor revisions to subsection (e) to clarify that this subsection only applies to products subject to the Phase I or II VOC standards (and not to products subject to the Phase III standards).

Variances

If a manufacturer cannot comply with the requirements set forth in section 94509, because of reasons beyond their reasonable control, they may apply for additional time to reformulate under the variance provision in section 94514. A variance will only be granted if all of the following three criteria are met: (1) because of reasons beyond the reasonable control of the applicant, requiring compliance with section 94509 would result in extraordinary economic hardship; (2) the public interest in mitigating the extraordinary hardship to the applicant by issuing the variance outweighs the public interest in avoiding any increased emissions of air contaminants which would result from issuing the variance; and (3) the compliance report proposed by the applicant can reasonably be implemented, and will achieve compliance as expeditiously as possible.

REFERENCES

State of California Air Resources Board Stationary Source Division, “Proposed Regulation to Reduce Volatile Organic Compound Emissions from Consumer Products, Technical Support Document”, August 1990. (ARB, 1990).

State of California Air Resources Board Stationary Source Division, “Proposed Amendments to the Statewide Regulation to Reduce Volatile Organic Compound Emissions form Consumer Products - Phase II”, October 1991. (ARB, 1991).

The California Consumer Products Regulation (Title 17, California Code of Regulations, Division 3, Chapter 1, Subchapter 8.5, Article 2, Sections 94507-04517. Amended March 1997.

VI.

DESCRIPTION OF PRODUCT CATEGORIES

In this chapter, we provide for each of the mid-term measures product categories: 1) a product category description; 2) information on product use and marketing; 3) information on the product formulations; 4) a discussion of the proposed volatile organic compound (VOC) standard, our rationale for the proposed standard, and the options for compliance; and 5) a discussion of the issues associated with the proposed VOC standard, as raised by some of the affected industry. The product categories are in alphabetical order.

A. Automotive Rubbing or Polishing Compounds

Product Category Description:

Automotive rubbing or polishing compounds are products designed primarily to remove surface imperfections from the painted surfaces of automobiles. These surface imperfections may include: scratches induced by environmental hazards or through the use of mechanical buffers or sandpaper; the discoloration or disfigurement of a painted surface due to chemical contaminants, referred to as chemical spotting or etching (Pfanstiehl); water spots; road film; dust nips; paint runs or sags; minor, curved scratches introduced to the painted surface through mechanical abrasion, generally known as “swirl marks;” oxidation, which is the chemical weathering of a car’s finish due to exposure to sunlight, atmospheric pollutants, and air; and “orange peel,” a term used to indicate the texture of a painted surface containing ridges or bumps similar to the skin of an orange peel resulting from poor coalescence of atomized paint droplets (Pfanstiehl). The action of using an abrasive material to smooth out automotive paint may be called compounding, polishing, or finessing (Pfanstiehl).

While there may be some overlap in the functions provided by products found in the automotive rubbing or polishing compound category and the automotive wax, polish, sealant or glaze category, the products can be distinguished from each other. The function of automotive rubbing or polishing compounds is to decrease imperfections in the surface paint of automobiles by removing the deteriorated top layer of paint and creating a smoother surface. By themselves, automotive rubbing or polishing compounds add no degree of protection other than the benefits derived from a thorough cleaning (Pfanstiehl). Automotive wax, polish, sealant or glaze products protect the paint surface to which they are applied.

Automotive rubbing or polishing compounds may be sold under various names, including, but not limited to: scratch remover, cutter, cutting creme, cutting compound, compounder, compounding paste or liquid, swirl remover, restorer, reconditioner, scrub, finishing material, glaze, lusterizer, cleaner, and polish. For the purposes of this discussion, the term automotive rubbing or polishing compound will be used to refer to all products covered under the automotive rubbing or polishing compound category definition.

As shown in Table VI-1, 63 products were reported in the Air Resources Board (ARB) Mid-term Measures 1994/1995 Consumer Products Survey (Survey) by 18 companies; 48 of the products are liquids, 13 are semisolids, one is reported as solid, and one is reported in the "other" product category. Due to confidentiality concerns and the extremely low market share attributable to the solid and "other" product forms, for purposes of our discussion it is assumed that the products reported as solid and "other" are semisolids. According to the Survey, 7,440 pounds of automotive rubbing or polishing compound are sold daily in California and account for 1,420 pounds of volatile organic compound (VOC) emissions per day. The Survey shows that the vast majority of the products in this category are liquids and semisolids, which represent approximately 84 percent and 16 percent, respectively, of the market.

Table VI-1
Automotive Rubbing or Polishing Compound*

Product Form	**Number of Products**	**Category Sales (lbs./day)**	**VOC Emissions (lbs./day)**	**Adjusted VOC Emissions (lbs./day)****
Liquid	48	6,240	1,300	1,849
Semisolid	15	1,200	120	171
Total	63	7,440	1,420	2,020

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Survey emissions adjusted for complete market coverage (see Chapter IV).

<u>Product Use and Marketing</u>:

Automotive rubbing or polishing compounds are used by professionals who work in automotive body repair and automotive refinishing and detailing shops, as well as by home enthusiasts who restore, repair, repaint or detail motor vehicles. Of those companies who opted to report product sizes in the Survey, the majority of the liquid automotive rubbing and polishing compound product sizes fell within the 16 to 128 fluid ounce range, while the majority of the semisolid automotive rubbing and polishing compound product sizes were reported to be between 10.5 and 20 ounces by weight.

Automotive rubbing or polishing compounds are used in the preparation, maintenance, and enhancement of automotive paint surfaces. Surface preparation may include removal of scratches introduced by sanding of the autobody surface and polishing of the surface in preparation for coating application as well as removal or reduction of over spray. Surface maintenance includes the removal of oxidized paint and hydrocarbon based road film, and surface enhancement may include removal of fine scratches and imperfections caused by abrasion or environmental factors.

Automotive rubbing or polishing compounds work by flattening the paint surface. Imperfections in the painted surface cause light to be reflected at various angles and diffuse the reflectivity of the surface (Storer, et al.; Pfanstiehl). Use of an automotive rubbing or polishing compound will remove the deteriorated upper surface of the paint, decreasing the depth of the remaining defects (Pfanstiehl). Through minimization of surface imperfections, automotive rubbing or polishing compounds cause the painted surface to be more highly reflective, creating a shine. Important factors to consider when choosing an automotive rubbing or polishing compound product include the type of paint the product is being applied to, the amount and types of imperfections present in the surface of the automotive paint, and the technique that will be used to apply the automotive rubbing or polishing compound (3M, April 8). It is generally recommended that a less abrasive product be used prior to graduating to a more aggressive product that will remove a thicker layer of paint (Storer, et al.; Jacobs Jr.; Pfanstiehl). Depending upon the product used and the method of application, the typical thickness of paint removed ranges from less than 0.001 millimeters to 0.3 millimeters (3M, March 12). In general, rubbing compounds are the most abrasive, and polishing compounds are less abrasive. However, due to differences in labeling there is much overlap among manufacturer’s claims, and one company’s polishing compound might be as abrasive as another company’s rubbing compound.

Rubbing or polishing compounds may be applied by hand or with the use of a machine after the automobile paint has been washed to remove dust and dirt. While some products are indicated for hand application or machine application only, many products provide the consumer with application directions for both hand and machine application. When these products are applied by hand, it is typically recommended that they be applied to a small section of the vehicle at a time using a soft damp cloth. Some product labels direct the consumer to remove excess rubbing or polishing compound before it dries (Turtle Wax), while others instruct the user to let the product dry before removing the excess with a clean, dry cloth.

Machine application is accomplished through the use of a mechanical buffing machine, and unlike hand application, it is generally recommended that the product be applied directly to the painted surface of the automobile (Nast). Typically, those products formulated for machine application are in liquid form (Joseph). Often referred to as “buffers,” machine applicators are used in conjunction with polishing or buffing pads (or “bonnets”) made of wool, synthetic wool, terry cloth, or foam (Joseph).

Automotive rubbing or polishing compounds are sold by mass merchandisers, food and drug stores and automotive retail outlets, direct merchandisers, new and used car dealerships, automotive paint and supply stores, recreational and utility trailer dealers, motorcycle dealers, home supply stores, and mail order catalogs.

Product Formulation:

Minute particles of inorganic material provide the cutting action in automotive rubbing and polishing compounds; abrasive materials used for cutting include diatomaceous earth (Mequir's), talc (Pfanstiehl), aluminum silicate (3M, MSDS) and aluminum oxide (First Brands). Like sandpaper, automotive rubbing or polishing compounds are available in formulations with varying degrees of abrasiveness and range from more abrasive products suitable for buffing a new, wet-sanded paint, to those used for removal of spots and oxidized paint, to fine polishes and paint “cleaners,” with very fine abrasives (Storer, et al.). As previously mentioned, there is no grading system commonly used in the industry for the abrasiveness of automotive rubbing and polishing compounds (Pfanstiehl). However, a polish is typically a minimally abrasive cleaner and lusterizer, while the term rubbing compound usually indicates a more abrasive product (Joseph).

The abrasive or cutting medium is carried in water, low vapor pressure volatile organic compound (LVP-VOC) solvent or VOC solvent, or a combination of these, present in varying amounts, depending upon the product form. Our Survey indicates that in liquid automotive rubbing or polishing compounds the range of water content is 20 percent to 70 percent, the LVP-VOC content is from zero to 26 percent, the VOC content is from zero to 51 percent and inorganics are present in quantities ranging from one to 49 percent. In the semisolid automotive rubbing or polishing compounds, the water content ranges from 25 to 66 percent, the LVP-VOC content ranges from zero to 12 percent, the VOC content ranges from zero to 53 percent, and the inorganics are present in quantities ranging from six to 52 percent. Antifungal, wetting, and stabilizing agents and fragrance may also be present in small amounts.

The combined sales weighted average VOC content for all product forms of automotive rubbing or polishing compounds reported in the Survey is 20 percent; with the sales weighted average VOC content at ten percent for semisolids and 21 percent for liquids.

Proposed VOC Standard and Compliance:

The proposed VOC limit for all forms of automotive rubbing or polishing compounds is 15 percent by weight, effective 2002. We believe this standard is both technically and commercially feasible as evidenced by the Survey. The Survey indicates there are 16 automotive rubbing or polishing compound products at or below the 15 percent proposed standard, representing an estimated 18 percent of the sales in California in 1995. Of the liquid products reported, 12 of the products with a market share of approximately 11 percent have a VOC content at or below the proposed standard, and four semisolid products, with a market share of 58 percent, presently comply with the proposed standard (see Table VI-2). There are currently complying products of both the semisolid and liquid form designated in the Survey as being used by institutional customers.

Table VI-2
Automotive Rubbing or Polishing Compounds*

Product Form	Proposed VOC Standard (wt. %)	Complying Products	Complying Market Share (%)	Emissions Reductions (lbs./day)	Adjusted Emission Reductions (lbs./day)**
Liquid	15	12	11	420	603
Semisolid	15	4	58	40	57
Total	15	16	18	460	660

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Emission reductions adjusted for complete market coverage (see Chapter IV).

Per our Survey, currently complying automotive rubbing or polishing compounds range from approximately 33 to 82 percent water and contain between zero and 15 percent VOC. The inorganic content ranges from five to 45 percent, and LVP-VOCs are present in amounts ranging from four to 25 percent.

Automotive rubbing or polishing compounds can be reformulated to meet the proposed VOC standard of 15 percent by weight by replacing VOC solvents with water or LVP-VOCs. A product with a higher amount of water or LVP-VOC such as mineral oil keeps the product "wet" so it dries slower when used with a high speed buffer, thus helping to prevent burning. It may also reduce the amount of product needed to buff the surface (Pfanstiehl). As previously stated, the use of water and/or LVP-VOC solvents instead of VOC solvents may result in an automotive rubbing or polishing compound with a longer dry-time, necessitating the need for modification of directions for use of the product.

Issues:

1. Issue: Formulation of lower VOC automotive rubbing or polishing compounds will result in an unacceptable product for consumers due to the longer dry-time.

Response: The large complying market share for the low VOC products in this product category indicates we believe that consumers use and accept low VOC products. It should be noted that not all automotive rubbing or polishing compounds are allowed to dry prior to removal; some of the complying products bear instructions which direct the user to remove the product from the paint surface prior to the product drying. In this situation the length of dry-time would not be an issue.

2. Issue: Formulation constraints for this product category are dictated to a degree by the method in which the product is applied, so this product category could better be defined if broken down by application method (hand vs. machine applied).

Response: Industry chose not to pursue the subcategorization of the automotive rubbing or polishing compound category based on the recommended application technique. This may be the case because many products are designed for either hand or machine application causing difficulty in product differentiation.

3. Issue: Setting a separate standard for semisolid automotive rubbing or polishing compounds vs. all other forms would result in manufacturers opting to produce the product form with the higher proposed VOC standard.

Response: We agree that setting separate standards could cause a shift to the product form with the higher VOC standard. That is one of the reasons why we are proposing one standard for the entire product category that is achievable by all product forms.

4. Issue: A separate, higher VOC standard is necessary to formulate a liquid product which will be acceptable for use by professionals who use mechanical buffers to apply the product.

Response: In the Survey, information regarding the type of customer using the product was gathered so that we could evaluate differences in use patterns among product forms and better assess the needs of the consumer. Our Survey indicates that while the liquid form of automotive rubbing or polishing compounds is reported to be used institutionally to a greater extent than the semisolid product form, both liquid and semisolid automotive rubbing and polishing compounds are reported to be sold for institutional use. The proposed VOC standard allows for currently complying products of both the semisolid and liquid product form designated for institutional use.

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B. Automotive Wax, Polish, Sealant or Glaze

Product Category Description:

Automotive wax, polish, sealant or glaze products are designed primarily to seal out moisture, increase gloss, or otherwise enhance a motor vehicle's painted surfaces. In addition to enhancing appearance, these products may deposit a coating which provides a barrier on the automotive paint surface, repelling contamination and slowing oxidation (Meguiar's). When applied to painted automotive surfaces, the coating provided by automotive wax, polish, sealant or glaze products serves as a "wear layer" as it is eroded (Amway). The Automotive Wax, Polish, Sealant or Glaze category has been subcategorized into Automotive Instant Detailer, Automotive Hard Paste Wax, and "All Other Forms." The degree and duration of the protection provided varies within and between these subcategories. In general, the subcategory of Automotive Instant Detailer provides the least amount of protection to automotive painted surfaces and may or may not leave a residual protective coating. The Automotive Hard Paste Wax subcategory contains products which leave a protective coating on the automotive paint surface, providing a more durable, long-lasting protection. Products found in the "All Other Forms" subcategory leave a protective coating on the automotive paint surface which provides a degree of protection that is intermediate between that of Automotive Instant Detailer and Automotive Hard Paste Wax.

Automotive Instant Detailer: These automotive wax, polish, sealant or glaze products are primarily intended for quick cleaning and removal of light contaminants in between regular washings. These products also enhance gloss and protection in between uses of products in the Automotive Hard Paste Wax and "All Other Forms" product categories.

Automotive Hard Paste Wax: This is a unique product form that contains no water and is a solid at room temperature. This subcategory consists of products that typically contain a large amount of actives, so a relatively small amount of product is required for each application. Many Automotive Hard Paste Wax products provide a cleaning function in addition to their primary purpose of protecting the automotive surface.

All Other Forms: This subcategory consists of all automotive wax, polish, sealant or glaze products that do not fit the definition of either Automotive Instant Detailer or Automotive Hard Paste Wax. This includes, but is not limited to semisolid, liquid, and aerosol waxes, and sealants and glazes. As with the Automotive Hard Paste Wax subcategory, these products may provide the additional function of cleaning the painted automotive surface. Products in this subcategory may be used to provide a final coating on the painted automobile surface or may provide a coating of a transitory nature, which is to be followed up by the application of another product in this subcategory or by a product from the Automotive Hard Paste Wax subcategory.

While there may be some overlap in the functions provided by products found in the Automotive Wax, Polish, Sealant or Glaze category and the Automotive Rubbing or Polishing Compound category, the products can be distinguished from each other. Automotive wax, polish, sealant or glaze products may decrease paint imperfections, but their primary function is to protect the paint surface to which they are applied (Pfanstiehl). Automotive rubbing or polishing compounds are used primarily to decrease imperfections in the surface paint of automobiles but provide no protection to the surface to which they are applied. It should be noted that the problems presented by a lack of consistent terminology on product labels is evidenced in the Automotive Rubbing or Polishing Compound category as well as the Automotive Wax, Polish, Sealant or Glaze category. For example, a product labeled as a glaze may be either a rubbing or polishing compound, a product that provides the painted automotive surface with a light, nondurable coating, or a product intended to provide a durable protective coating. Similarly, a product labeled as a polish may be a rubbing or polishing compound or a product that leaves a durable coating.

Automotive wax, polish, sealant or glaze products may be sold under various names including, but not limited to: protectant, treatment, seal, sealer, renewer, detailer, finish, and shield. Automotive Wax, Polish, Sealant or Glaze products may remove surface imperfections as well as provide protection for painted automobile surfaces. Dual function products include, but are not limited to, those labeled as cleaner/wax, sealer/wax, and polish/wax (Joseph). For the purposes of this discussion, the term automotive wax, polish, sealant or glaze will be used to refer to all products covered under the Automotive Wax, Polish, Sealant or Glaze category definition.

As shown in Table VI-3, 171 products were reported in the Air Resources Board (ARB) Mid-term Measures 1994/1995 Consumer Products Survey (Survey) by 24 companies. According to the Survey, 15,500 pounds of Automotive Wax, Polish, Sealant or Glaze are sold daily in California and account for 4,280 pounds of volatile organic compound (VOC) emissions daily. The average VOC content for all Automotive Wax, Polish, Sealant or Glaze products is 27 weight percent and ranges from a low of three percent for the Automotive Instant Detailer subcategory to a high of 70 percent for the Automotive Hard Paste Wax subcategory.

Table VI-3
Automotive Wax, Polish, Sealant or Glaze*

Product Form	Number of Products	Category Sales (lbs./day)	VOC Emissions (lbs./day)	Adjusted VOC Emissions (lbs./day)**
Instant Detailers	8	180	180***	To Be Determined***
Hard Paste Wax	17	1,840	1,280	1,320
All Other Forms	146	13,480	2,820	3,800
Total	171	15,500	4,280	5,120

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Emissions adjusted for complete market coverage (see Chapter IV).
*** See text for additional information regarding instant detailers and survey reporting.

Product Use and Marketing:

Automotive wax, polish, sealant or glaze products are used in the maintenance and enhancement of automotive paint surfaces by professionals who work in automotive body repair, automotive refinishing and detailing shops, and by consumers who use it in the home environment.

Automotive wax, polish, sealant or glaze products may be applied either by hand or machine to the automobile paint after it has been washed to remove dust and dirt. Products found in one subcategory may be recommended for use in conjunction with products from another subcategory (Mother's). For example, the consumer may be instructed to use a sealer or glaze product from the “All Other Forms” subcategory prior to the application of a product from the Automotive Hard Paste Wax subcategory. Some products are indicated for hand application or machine application only, while others may be applied by either method. When these products are applied by hand, it is typically recommended that they be applied to a small section of the vehicle at a time using a soft damp cloth. Some products, particularly semisolid products from the “All Other Forms” and the Automotive Hard Paste Wax subcategories, are packaged with a pad to be used for product application.

Claims of protection are made on products found in every subcategory of automotive wax, polish or glaze products. The duration of the protection provided by automotive wax, polish, sealant or glaze products depends not only upon the formulation of the product being applied, but upon other variables such as the type, color, and condition of the automotive paint surface, the amount of exposure to outdoor elements, the frequency with which the automotive surface is washed, and the products used to wash the vehicle (Jacobs Jr.).

Automotive Instant Detailer: This subcategory contains non-aerosol products that are sprayed on the automotive paint surface and/or a towel, and wiped off prior to the product drying (Meguiar's). These products are often referred to as “spray on/wipe off” products. Their application differs from other automotive wax, polish, sealant or glaze products which typically instruct the user to apply the product and allow it to dry to a haze before buffing.

Most Automotive Instant Detailer products direct the consumer to apply the product to cool, clean, and dry painted automotive surfaces. However, some Automotive Instant Detailer products indicate they can be sprayed on the vehicle while still wet from washing to “revitalize” the vehicle’s waxed surfaces while wiping dry (3M, “Perfect-It Gloss Enhancer”).

Automotive Hard Paste Wax: Automotive Wax, Polish, Sealant or Glaze products in the Automotive Hard Paste Wax subcategory are characterized by the absence of water in their formulation and their solid form at room temperature. It should be noted that there are products on the market labeled as paste wax that are actually semisolid; these products are correctly classified under the Automotive Wax, Polish, Sealant or Glaze “All Other Forms” subcategory. These products are typically offered for sale in tightly closing metal cans which help to slow down product deterioration.

All Other Forms: This product category includes all Automotive Wax, Polish, Sealant or Glaze products not covered under the definitions of Automotive Instant Detailer or Automotive Hard Paste Wax. The products may be of liquid or semisolid form including, but not limited to, spray waxes, semisolid waxes, sealants and glazes.

The spray waxes found in this subcategory can be distinguished from products in the Automotive Instant Detailer subcategory by their method of application. While Automotive Instant Detailer products instruct the consumer to wipe the product while drying the painted automotive surface, spray waxes are allowed to dry and will form a haze. Once the product is dry, the haze is removed by buffing.

The semisolid products found in this subcategory differ from those in the Automotive Hard Paste Wax subcategory in that they may contain water and are not a solid at room temperature (Survey).

This subcategory also contains products labeled as sealers and glazes. While these terms are often applied to very different product types, most of the automotive wax, polish, sealant or glaze products labeled as sealers or glazes have two primary functions; to fill in very small surface imperfections and produce a shine (Joseph). Most glazes and sealers do not offer extended protection and will loose their effectiveness unless protected by a product providing a more durable coating (Joseph). Sealer and glaze products may be allowed to dry to a haze before being buffed to a shine, but some users advocate buffing when semi-wet to facilitate the buffing process and produce a shinier surface (Joseph; Storer, et al.).

As stated previously, the durability of the coating imparted to the automotive paint surface by the use of automotive wax, polish, sealant or glaze products varies widely and is dependent upon external factors. In general, products in this subcategory provide a protection which is intermediate between products found in the Automotive Instant Detailer and Automotive Hard Paste Wax subcategories.

Automotive wax, polish, sealant or glaze products are sold by mass merchandisers, direct merchandisers, food and drug stores, automotive retail outlets, new and used car dealerships, automotive paint and supply stores, recreational and utility trailer dealers, motorcycle dealers, home supply stores, and mail order catalogs.

Product Formulation:

Automotive wax, polish, sealant or glaze products typically contain a wax or other polymer, solvent such as mineral spirits or water, and smaller amounts of other agents such as emulsifiers and fragrance.

The wax or polymer functions as an active ingredient and may include polydimethylsiloxane, silicone polymers, acrylate copolymers, and natural waxes including carnauba and montan. For those products making claims of cleaning or polishing, an abrasive may also be included as an active ingredient. Typically, the abrasives found in automotive wax, polish, sealant or glaze products are less aggressive than those used in automotive rubbing or polishing compounds (Pfanstiehl).

The solvents or “carriers” used in automotive wax, polish, sealant or glaze products include hydrocarbon (VOC) solvents and water. These carriers may also act as cleaning agents. In addition to the active ingredient(s) and solvent, automotive wax, polish, sealant or glaze products may contain surfactants, thickening agents, dyes and fragrance (Halpern).

Automotive Instant Detailer: Automotive Instant Detailer products are characterized by an extremely low level of actives present in the product, resulting in a lack of haze after the product has dried. The haze that is produced after drying of many of the products in the semisolid, hard paste wax, and all other forms category is left by excess wax or active that must be removed in order to achieve a glossy surface on the automotive paint. Of the Automotive Instant Detailers reported in our Survey, low vapor pressure volatile organic compounds (LVP-VOCs) are present in amounts ranging from 0.3 percent to four percent. The products are comprised primarily of water and may contain a small amount of isopropyl alcohol. Automotive Instant Detailer products may contain volatile methyl siloxanes in varying amounts, and typically do not contain abrasives.

Automotive Hard Paste Wax: These solvent based products contain waxes or other significant quantities of polymers, with the majority of the balance of the product consisting of solvents such as mineral spirits.

All Other Forms: The formulation of a product thin enough to be packaged as a spray or liquid typically involves the use of less actives. While the liquids and sprays are easier to apply, they generally offer less protection than the hard paste wax and the semisolid product forms.

Proposed VOC Standard and Compliance:

The proposed volatile organic compound (VOC) limit for the Automotive Instant Detailer subcategory is three percent by weight effective 2002. We believe this standard is both technically and commercially feasible as evidenced by the Survey. The Survey indicates there are four Automotive Instant Detailer products at or below the three percent proposed standard, representing an estimated 47 percent of the sales in California in 1995. Our Survey indicates that for currently complying products that are water-based, the water content ranged from 93 percent to over 98 percent, the LVP-VOC content was between 0.3 and two percent, and the VOC content ranged from zero to 0.6 percent. It should be noted that due to varying interpretations of the Automotive Wax, Polish, Sealant or Glaze product category definition in the Survey, many manufacturers did not report their Automotive Instant Detailer products. We would like to acknowledge industry's swift response to the request for additional information that helped us to better characterize the Automotive Instant Detailer subcategory.

The Automotive Instant Detailer subcategory consists of products that contain relatively low amounts of VOCs, and according to our Survey constitute a very small portion of the total product sales in the Automotive Wax, Polish, Sealant or Glaze category. However, information provided to us after compilation of the Survey data indicates that this is a much larger product subcategory than is reflected by our Survey results. The Automotive Instant Detailer market constitutes a relatively new and fast growing segment of automotive appearance products and is therefore addressed by this proposed regulation. By setting the proposed VOC standard at the sales weighted average VOC content, we are acknowledging that the products currently on the market contain low levels of VOCs. However, we recognize the need to ensure that emissions from the Automotive Instant Detailer subcategory do not remain unchecked as new products enter the market and new and existing products gain consumer acceptance and market share. While our Survey indicates there are no currently complying Automotive Instant Detailer products listed for use institutionally, information provided by industry after the Survey was compiled indicates there are complying products for institutional as well as household use.

The proposed VOC limit for the Automotive Hard Paste Wax subcategory is 45 percent by weight. While there are no products reported in the Survey that comply with the proposed standard of 45 percent by weight, ARB staff has been made aware of a product, manufactured by 3M Corporation and released after the time frame covered by the Survey, which contains 34 percent by weight VOC (3M, "Perfect-It Show Car Paste Wax"). In order to allow manufacturers sufficient time to reformulate, it is proposed that the 45 percent by weight VOC standard be effective in 2005.

The proposed VOC limit for the "All Other Forms" subcategory is 15 percent by weight effective 2005. This standard is both technically and commercially feasible as evidenced by the Survey. The Survey indicates there are 43 "All Other Forms" products at or below the
15 percent proposed standard, representing an estimated 39 percent of the sales in California in 1995 (see Table VI-4).

Our Survey indicates that for the "All Other Forms" subcategory, the range of water content is zero to 99 percent, the LVP-VOC content ranged from zero to 49 percent, the VOC content was between 0 to 95 percent, and inorganics were present in quantities ranging from zero to 53 percent. There are currently complying products designated in the Survey as being used by institutional and household customers.

Table VI-4
Automotive Wax, Polish, Sealant or Glaze*

Product Form	**Proposed VOC Standard (wt. %)**	**Complying Products**	**Complying Market Share (%)**	**Emissions Reductions (lbs./day)**	**Adjusted Emissions Reductions (lbs./day)****
Instant Detailer	3	4	47	18	To Be Determined
Hard Paste Wax	45	0***	0***	460	480
All Other Forms	15	43	39	1,000	1,340
Total	----	47		<1,478	<1,820

*   Based on Mid-term Measures 1994/1995 Consumer Products Survey.
**   Survey emissions adjusted for complete market coverage (see Chapter IV).
***   See text for additional information about currently complying products.

Automotive wax, polish, sealant or glaze products, with the exception of those products in the Automotive Hard Paste Wax subcategory, can meet the proposed standards through replacement of a portion of their VOC solvent with water, and increasing the emulsifying agents, if necessary. Due to formulation constraints, using water to reformulate to comply with the standard is not an option for products in the Automotive Hard Paste Wax category and manufacturers will need to employ the use of LVP-VOCs.

<u>Issues</u>:

1. <u>Issue</u>: Due to the wide variety of products in the "All Other Forms" subcategory, it should be subcategorized further to separate those products which provide a durable protective coating from those that provide a less durable coating. Those products providing a durable coating should be allowed a higher standard than those providing a less durable coating.

<u>Response</u>: To subcategorize products based on whether they provide a durable or nondurable protective coating is subjective, and use of the term "durable" to describe a product which provides a protective coating would result in the product being placed in a category with a less stringent VOC limit. In addition to durability being of an undefined duration, the term is not used uniformly throughout the industry and compliance with the standard would be difficult to enforce as there are no standard test methods in place to ensure durability.

2. <u>Issue</u>: Due to formulation constraints, it is not possible to formulate a hard paste wax with a VOC content lower than what is reported in the Survey.

<u>Response</u>: 3M has developed and is marketing a hard paste wax with a VOC content of 34 percent (3M, "Perfect-It Show Car Paste Wax"). In order to allow manufacturers the maximum amount of time possible to overcome formulation challenges, we are proposing an effective date of 2005 for the Automotive Hard Paste Wax subcategory. Also, the proposed VOC limit for these products is 11 percent above the VOC content of this complying product which gives manufacturers flexibility to reformulate their products to meet the proposed limit.

3. <u>Issue</u>: Due to overlapping function found in products categorized as "Automotive Rubbing or Polishing Compound" and "Automotive Wax, Polish, Sealant or Glaze," these product categories should be combined.

<u>Response</u>: While these product categories have not been combined, a proposed standard of 15 percent is feasible for both product categories. This will help to eliminate industry

concerns regarding products being miscategorized and subject to a more stringent standard than appropriate.

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C. Bug and Tar Remover

Product Category Description:

Bug and tar removers are products designed to remove a variety of road grime and insect residues from painted motor vehicle surfaces without causing damage to the finish. These products remove biological-type residues such as insect carcasses and tree sap, and also remove road grime, such as tar, roadway paint markings, and asphalt. Depending on formulation, products may be marketed for bug removal only, for both bug and tar removal, or for tar removal only.

As shown in Table VI-5, according to our survey, 33 products were sold in California in 1995 by 21companies. Also, based on the Survey, approximately 850 pounds of bug and tar removers were sold daily in California during 1995. According to the Survey, these products emitted about 460 pounds of VOCs per day. The VOC content of products reported in the Survey ranges from 0 to 100 percent by weight with the sales weighted average VOC content being 54 percent by weight.

Due to underreporting in the Survey, Table VI-5 also shows the adjusted VOC emissions. Using data from the U.S. EPA 1990 Consumer Products Survey and ARB's 1990 and 1991 Consumer Product Surveys, VOC emissions were raised to 1,620 pounds per day (see Chapter IV).

Table VI-5
Bug and Tar Remover*

Product Form	Number of Products	Category Sales (lbs/day)	VOC Emissions (lbs/day)	Adjusted VOC Emissions (lbs/day)**
Aerosol	6	269	120	423
Non-Aerosol	27	581	340	1,197
Total	33	850	460	1,620

* Based on Mid-term Measures 1994/1995 Consumer Products Survey
** Survey emissions adjusted for complete market coverage (see Chapter IV).

Product Use and Marketing:

Table VI-5 also shows that of the 33 products reported in the Survey, 6 were aerosols and 27 were non-aerosols. Twenty-one companies reported that they sold bug and tar removers in California during 1995. Four of these companies are located in California. Bug and tar removers are sold at auto supply stores, auto dealerships, supermarkets, and discount stores.

Bug and tar removers are used to remove road tar, roadway paint markings, asphalt, insect carcasses and tree saps from painted motor vehicle surfaces. They are applied directly to the surface to be cleaned and allowed to remain for 30 seconds or longer, depending on the product used and the difficulty of removal. After allowing the product to set, dissolved residues are removed by gently rubbing the surface with a soft cloth or scrubber.

Product Formulation:

Depending on their intended use, bug and tar removers are formulated to remove residues of varying chemical composition. Survey data indicate that bug and tar removers are solvent based and water based. Products that make claims to remove both bugs and tar are water based emulsions (Guardsman). Bug and tar formulations may use oil-out or water-out emulsions, depending on the types of residues the product is formulated to remove. Oil-out refers to emulsions with the water phase contained inside of the hydrocarbon phase. Such emulsions remove organic material more efficiently from the finish, since the material is first contacted by the outer hydrocarbon phase in which it is soluble (Cyclo). Hydrocarbon compounds emulsified with water are efficient for the removal of most types of residues. To solubilize difficult organic residues, typical active ingredients found in bug and tar removers include petroleum distillates, turpentine, kerosene, naphtha, xylene, toluene, and orthodichlorobenzene (Survey).

A primary concern of formulators is to completely remove difficult organic residues without damaging the painted finish. Aliphatic compounds are typically used because they have the least impact on the finish. Aromatics are used less because of an increased impact on the finish. Oxygenated compounds are rarely used because they have the greatest impact on the finish. However, highly acidic or alkaline compounds can also damage the paint finish (Hydrosol).

Some insect residues are slightly acidic and water soluble. Insect exoskeletons consist of protein material which is not soluble in water. Therefore, efficient removal of all of the insect remains requires the addition of organic compounds emulsified in water under alkaline conditions (Turtle Wax). Nonionic, low vapor pressure volatile organic compounds (LVP-VOC) can be added to water to solubilize insect remains. LVP-VOC compounds also are used to assist in the removal of other compounds such as some forms of tree sap (Hydrosol).

Tree sap is a generic term for a variety of compounds exuded by trees and deposited on the painted surfaces of vehicles. This material may consist of waxes and various compounds classified as terpenes. The terpenes are a mixture of organic acids, esters, sterols, alcohols and waxes (Kramer). These compounds are not soluble in water and have limited solubility in aliphatic compounds. Therefore, to efficiently remove these types of residues, aromatic compounds such as xylenes or oxygenated solvents such as high boiling point glycol ethers and dibasic esters are often added to formulations (Hydrosol). To enhance the solubility of waxes, oil-out water emulsions are used. Sorbitan monooleate and similar polyglyceride species are examples of LVP-VOCs which may be used as oil-out emulsifiers (Hydrosol).

Aerosol forms of bug and tar removers typically use hydrocarbon propellant blends of propane, n-butane, or iso-butane, to expel product from the can. However, Survey data also indicate that nitrogen gas is an effective propellant for bug and tar removers.

Small amounts of inorganic compounds may be added to some formulations. These additives can be used as corrosion inhibitors or polishers. Because of potential damage to the paint finish, the concentrations of these compounds is small, usually less than one weight percent. Typical polishing agents added are talc and silica (Turtle Wax).

To inhibit corrosion in formulations containing water, chemical salts may be added to reduce the rate at which metal cans are corroded by acidic ingredients. Some inorganic inhibitors are sodium nitrite and ammonium hydroxide. Morpholine is an organic salt which is used as a corrosion inhibitor in both the liquid and vapor phase (Petro Chemical). Sodium benzoate is another organic corrosion inhibitor which might be used in the liquid phase (Hydrosol).

<u>Proposed VOC Standard and Compliance</u>:

The proposed VOC limit for the bug and tar remover category is 40 percent by weight. This standard would be effective in 2002. We believe this standard is technologically and commercially feasible as evidenced by Survey data. As shown below in Table VI-6, based on Survey results, nine products comply with this proposed standard. The complying aerosol and non-aerosol products constitute significant percentages of their respective market shares. The proposed standard would result in emission reductions totaling 180 pounds per day. Of this amount, 20 pounds are from aerosol products and 160 pounds are from non-aerosol products. The adjusted emission reductions total 633 pounds per day, 70 pounds coming from aerosol products and 563 pounds from non-aerosol products.

Table VI-6
Bug and Tar Remover*

Product Form	**VOC Standard (wt %)**	**Complying Products**	**Complying Market Share (%)**	**Emissions Reductions (lbs./day)**	**Adjusted Emission Reductions (lbs./day)****
All Forms	40	9	78	180	633

* Based on Mid-term Measures 1994/1995 Consumer Products Survey
** Emission reductions adjusted for complete market coverage (see Chapter IV).

Complying bug and tar removers for both household and institutional markets already exist in the market place. The complying products are aerosol and non-aerosol water-based formulations.

There are no distinctive differences in the formulations of products designed for both bug and tar removal. Both household and institutional markets offer products with high and low VOC and water content. For bug and tar formulations containing water, the water content ranges from about 9 to 75 weight percent and the VOC content ranges from about 20 to 70 weight percent. Based on our Survey data, there are no products designed for tar removal only that are designated for household use. All of the “tar removers” are designated as institutional products or institutional/industrial products.

Some formulations (“bug removers”) are made only for removal of insect carcasses and tree sap, not grime removal. Such formulations are efficient without significant amounts of VOCs and already meet the proposed 40 percent standard using LVP-VOCs. The products marketed as “bug removers” contain LVP-VOCs ranging from 11 to 21 weight percent (Survey).

According to information provided in the Survey, complying formulations for the removal of both bug and tar are currently marketed in both aerosol and non-aerosol forms. Compliance is achieved using water-based formulations in all cases. However, the use of LVP-VOCs is not necessary to achieve compliance. As evidence of this, if all of the LVP-VOCs in these complying formulations were considered as VOCs, all would still comply with the proposed 40 percent by weight standard.

Examples of non-VOC propellants available in the marketplace are carbon dioxide, nitrogen and hydrofluorocarbon 152a (HFC-152a). We are not aware of any insurmountable technical problems associated with using these compounds as propellants for aerosol sprays. Nitrogen has been used successfully as a bug and tar remover propellant for many years. The use of HFC-152a as a propellant is technically feasible but would increase the cost of these products. Some manufacturers have indicated that carbon dioxide can not be used as a propellant with formulations containing water because of acid formation and the possibility of corrosion. However, the use of inverse emulsions permits the use of carbon dioxide with water-based formulations in some instances by minimizing the contact between the inside surface of the can and the water phase (Dow). Also, corrosion effects are significant only at the can seams (Clorox). The substitution of aluminum cans which are seamless or the use of corrosion inhibitors can eliminate corrosion concerns for many formulations (Peerless).

Based on the responses to the Survey, tar removal formulations contain no water. It has been suggested that tar is 100 percent hydrocarbon and that the most effective tar removers are high VOC products. However, recent advances in inverse emulsion technology have demonstrated that significant amounts of water (up to 50 percent in some cases) can be added to aerosol formulations without adversely affecting chemical reactions or product efficacy (Petro Chemical).

Issues:

1. Issue: Applying the same VOC limit for bug removers (water-based formulations) and tar removers (hydrocarbon based formulations) is inappropriate.

Response: The VOC limit was determined using bug and tar formulations, not bug only formulations. All bug only formulations contain much less VOC than any of the bug and tar formulations. However, the Survey data demonstrate that tar removal products (in the combined bug and tar forms) comply and are widely used and accepted by consumers based on the overall
78 percent complying market share.

2. Issue: Tar removal products should be 100 percent VOC to be most efficient.

Response: Our Survey data demonstrate that existing complying products have consumer acceptance as tar removers.

3. Issue: The addition of water to hydrocarbon products used for the removal of tar will not result in a reduction of VOC emissions. Because the water causes the hydrocarbon material to be less concentrated, additional product will be used to compensate for the reduction in VOCs. Therefore, the total amount of VOCs emitted may not be reduced.

Response: The ARB staff is not aware of any label directions that require repeated applications of water-based products to remove tar. However, depending on the contact time between the tar and the formulation, a reduced VOC formulation may require additional rubbing to perform the same function.

4. Issue: A carbon dioxide propellant cannot be used with water-based products. The carbon dioxide will react with the water phase to form acidic compounds which can corrode the metal can.

Response: The use of inverted emulsions hinders contact between carbon dioxide and the metal surface of the can. Some formulators indicate that this technology is sufficiently advanced to permit the use of carbon dioxide in metal cans containing water with negligible corrosion. Also, corrosion is significant only at the seam. Aluminum cans which are seamless and the addition of corrosion inhibitors could be used with carbon dioxide and water with negligible corrosion effects (Clorox). In addition, there are other propellants that can be used in these products, such as nitrogen. Nitrogen is currently being used in some bug and tar removers and it does not present a corrosion problem when used with water.

5. Issue: Non-VOC propellants are too expensive to use. Because of increased cost, consumers would not buy the products using such propellants.

Response: Presently, nitrogen is being used as a propellant in bug and tar removal products at a cost less than $0.01 per pound (Nellcor-Puritan-Bennet). This cost is significantly lower than typical VOC propellants such as A-46 and propane which cost $0.25 per pound (See cost section of Chapter VI). These nitrogen propellant products also have consumer acceptance based on Survey data.

6. Issue: Non-VOC propellants result in products that inherently have higher package pressures. To meet the transportation requirements of the United States Department of Transportation, higher strength cans would be required. These are available at higher costs to the producers and ultimately to the consumers.

Response: It is not necessary to use non-VOC propellants to meet the proposed limit. There are complying products using VOC propellants. However, non-VOC propellants can be blended with hydrocarbon propellants to reduce the pressure in the container.

7. Issue: If the required amount of VOC material is not present, soil removal is compromised. Because the soil is not easily solvated, excessive rubbing will be required. This can lead to paint damage to the areas immediately surrounding the soiled area particularly if the product contains any abrasive inorganic materials. Also, LVP-VOCs may leave a residual oil on the paint surface.

Response: Survey data demonstrate that lower VOC products and products containing LVP-VOCs are successfully marketed for soil removal and are accepted by consumers. If these products really damaged the paint surface, they would not be accepted by the consumer.

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D. Carpet and Upholstery Cleaner

Product Category Description:

Carpet and upholstery cleaners are products designed to remove dirt and stains from rugs, carpeting, and the interior of motor vehicles, as well as from cotton, nylon, or other synthetic fabrics used to upholster furniture. This category includes carpet and upholstery cleaners that make fabric protectant claims, but does not include spot remover, general purpose cleaner, dry cleaning fluids, vinyl and leather cleaner, or products designed exclusively for use at facilities engaged in furniture or carpet manufacturing.

Most carpet and upholstery cleaners can be used to clean entire carpeted areas, but some can also be used to clean heavy traffic areas, spills, or other small isolated areas. This category does not include products used to only treat small isolated areas which fall under the spot remover category.

As shown in Table VI-7, according to our survey, 190 products were sold in California in 1995. Also, based on the Survey, approximately 253,420 pounds of carpet and upholstery cleaners were sold daily in California during 1995. Of that total, 5,120 pounds are aerosol products, 239,820 pounds are non-aerosol dilutable products, while the remaining 8,480 pounds are non-aerosol ready-to-use products. According to the Survey, these products emitted about 1,040 pounds of VOCs per day. The VOC content of aerosol products reported in the Survey ranges from 4 to 18 percent by weight with the sales weighted average VOC content being 7 percent by weight. The non-aerosol dilutable products reported in the survey have a range of VOC content of 0 to 13 percent by weight and a sales weighted average VOC content of .16 percent by weight. The VOC content of the non-aerosol ready-to-use products ranges from 0 to 11 percent by weight with the sales weighted average of 3 percent by weight.

Due to underreporting in the Survey, Table VI-7 also shows the adjusted VOC emissions. Using data from the U.S. EPA 1990 Consumer Products Survey and ARB's 1990 and 1991 Consumer Products Surveys, VOC emissions for aerosol carpet and upolstery cleaners were raised to 560 pounds per day. In addition, non-aerosol dilutable VOC emissions were raised to 1,180 pounds per day, and the non-aerosol ready-to-use VOC emissions were raised to 300 pounds per day (See Chapter IV).

Table VI-7
Carpet and Upholstery Cleaner*

Product Form	Number of Products	Category Sales (lbs./day)	VOC Emissions (lbs./day)	Adjusted VOC Emissions (lbs./day)**
Aerosol	34	5,118	380	560
Non-aerosol Dilutables	142	239,824	400	1,180
Non-aerosol Ready-to-Use	14	8,489	260	300
Total	190	253,431	1,040	2,040

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Emissions adjusted for complete market coverage (see Chapter IV).

Product Use and Marketing:

Carpet and upholstery cleaners are used in both household and institutional settings to clean unwanted soils and dirt from carpeting, rugs, and the interior of motor vehicles. They are also used to clean household objects or furniture upholstered with cloth fabrics such as cotton, wool, nylon, or other synthetic fabrics.

Products are sold in a variety of retail outlets including auto supply stores, janitorial supply stores, grocery stores, drug stores, and retail warehouse outlets. They are also sold on the Internet.

Most carpet and upholstery cleaners work in the same way and make similar claims. They are applied directly to the carpet or upholstery to break up the grease or soil and suspend it.   Once dry, the treated area is vacuumed. Many of these cleaners also contain compounds designed to repel future soiling (Clorox).

Many of the aerosol carpet and upholstery cleaners have foaming characteristics and on their labels include directions, both for self-cleaning and deep-cleaning (Amway; Reckitt & Coleman, “Resolve Foam Carpet Cleaner;” S.C. Johnson & Son). For self-cleaning, the cleaner is sprayed on and given approximately 15 minutes to dissolve the soil and dry. During the 15 minute contact time, the foam applied to the carpet drys to a powder and is removed with a vacuum. For deep-cleaning, the cleaner is sprayed on the area, mopped or sponged into the carpet or upholstery, allowed to dry, and then vacuumed up. Some carpet and upholstery cleaners only include deep-cleaning directions (Bissell Inc., Playtex Products). When using a carpet and upholstery cleaner, the objective is to clean the desired area and to leave as little residue as possible (Clorox).

Most of the non-aerosol products in this category are concentrates. Once diluted, they are administered to the freshly vacuumed area to be cleaned, scrubbed into the area, and left to dry (The Brulin Corp. “Carpetcare Shampoo;” Cotter & Company). Some of the products in non-aerosol form can also be used with steam cleaning machines (The Brulin Corp., “Carpetcare Extraction Concentrate;” Maintex). There are also a few ready-to-use (non-dilutable) carpet and upholstery cleaners. Most of these are liquids or pumps that are administered to an area and left to dry to a powder and vacuumed (Blue Coral), or are applied and blotted with a clean damp sponge or cloth until the soiled area is clean (Reckitt & Coleman, “Resolve Fabric & Upholstery Cleaner”). The solid carpet and upholstery cleaners are available in dilutable, or ready-to-use forms (Survey).   They are used in much the same way as the other non-aerosol dilutable and ready-to-use products although there is more scrubbing needed when using the ready-to-use powders.

Although there are carpet and upholstery cleaners manufactured for use in automobiles, most auto upholstery requires no special shampoo. Any carpet and upholstery shampoo found at a supermarket will do the job (Jacobs Jr.). A mixture of any household wash product, such as liquid hand soap, soap for handwashing delicate fabrics, or fabric and rug shampoos shelved in supermarkets, and water will also clean an automobile interior (Joseph).

Product Formulation:

Typical carpet and upholstery cleaners contain zero to three percent alkaline material, zero to five percent surfactants and various amounts of organic solvents. Alkaline materials such as alkaline salts or builders perform many functions in cleaning formulations. They increase the efficiency of surfactants, prevent water hardness from soils, maintain a desirable alkalinity, and aid in the removal of both fatty and particulate soils by suspending them and minimizing resoiling. Solvents such as glycol ether are often included in formulations to dissolve greasy or oily matter, mobilize other cleaning ingredients, and assist in the evaporation of the solution (Reckitt & Colman, April 15). Water is the most widely used solvent.

It is essential that the propellant used in a carpet and upholstery cleaner uniformly disperse the product with a dry light foam. There are no aerosol carpet and upholstery cleaners using CO_2 or non-VOC propellants according to the Survey. Aerosol forms are similarly formulated but contain between 4 and 15 percent propellant. Survey data indicates that typical hydrocarbon propellant blends are used.

Some of the products also contain a protective polymer to aid in fabric protection. These protective compounds are designed, due to their low surface energy values, to wet and surround fabric fibers, thereby providing protection.

Proposed VOC Standard and Compliance:

The proposed standards for carpet and upholstery cleaners are as follows: seven weight percent for aerosol forms, 0.1 weight percent for non-aerosol, dilutable forms, and 2.5 weight percent for non-aerosol, ready-to-use forms. All of these proposed standards are effective in 2000.

As shown in Table VI-8, which is based on our Survey, eight products in the aerosol category currently comply with the seven percent standard. The complying market share for aerosols is 44 percent with all of the non-complying products being within eight percent of the proposed standard.

Table VI-8 also shows that 66 non-aerosol dilutable products currently comply with the proposed 0.1 percent standard. These products represent an estimated 45 percent of the market. Approximately 99 percent of the entire market share for non-aerosol dilutable carpet and upholstery cleaners contain zero to five percent VOC by weight.

Also shown in Table VI-8 are nine non-aerosol ready-to-use products currently complying with the proposed 2.5 weight percent standard. Survey data indicate that these products are used and accepted by consumers based on a complying marketshare for these complying products of 71 percent. All of the non-complying products reported in the survey are within nine percent of the complying with the proposed standard.

As shown in Table VI-8, using adjusted emissions, the proposed standard will result in VOC emission reductions of approximately 880 pounds per day.

Table VI-8
Carpet and Upholstery Cleaner*

Product Form	Proposed VOC Standard (wt. %)	Complying Products	Emissions Reductions (lbs./day)	Adjusted Emission Reductions (lbs./day)**
Aerosol	7	8	60	80
Non-aerosol Dilutables	0.1	66	240	700
Non-aerosol Ready-to-Use	2.5	9	80	100
Total	---	83	380	880

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Emissions adjusted for complete market coverage (see Chapter IV).

The aerosol carpet and upholstery cleaners are in compliance primarily because their use of propellant is so low. Generally speaking, these are water-based products with zero to five percent surfactants, zero to three percent emulsifiers, zero to five percent non-VOC cleaning solvents, and zero to five percent protective polymers.

The non-aerosol, dilutable carpet and upholstery cleaners in compliance with the proposed limit are water-based with small amounts of surfactants, emulsifiers, non-VOC cleaning solvents, and protective polymers. The complying non-aerosol, dilutable formulations share a higher water content and less of the above mentioned compounds.

Complying non-aerosol, ready-to-use carpet and upholstery cleaners have a slightly higher water content than the non-complying products. In addition, the complying non-aerosol, ready-to-use products use slightly more low vapor pressure volatile organic compounds (LVP-VOCs). For instance, a typical complying formulation may have zero to three percent non-VOC cleaning solvents and surfactants, while a typical non-complying formulation may have zero to two percent of the same or similar non-VOC cleaning solvents and surfactants.

<u>Issues</u>:

1. <u>Issue</u>: The carpet and upholstery category should not include products specifically designed for automotive use, because a higher VOC content is needed for product efficacy.

<u>Response</u>: Because of the overlap of product advertising and function (e.g. the product label mentions that it is for home or automotive use), it is appropriate to retain automotive products in this category. Also, because most cloth interiors within automobiles consist of the same basic material used on most household furnishings, any upholstery shampoo available in

supermarkets should be capable of doing a good cleaning job in an automobile. Carpet cleaners available at supermarkets are also recommended for use in the automobile (Jacobs Jr.). In addition, there are automotive carpet and upholstery cleaners in all product forms that currently comply with the proposed standards.

2. Issue: Several manufactures have requested that dilutable and non-dilutable products be split due to a difference in VOC content.

Response: The ARB staff agrees with these comments and are proposing separate standards for the non-aerosols in dilutable and ready-to-use forms.

3. Issue: How can a proposed standard of 0.1 weight percent be enforced when the limit of detection of Method 310 is three weight percent?

Response: A 0.1 weight percent standard is proposed for non-aerosol, dilutable products at the minimum dilution ratio. A concentrate, typically above three weight percent VOC could be directly tested and a dilution ratio would be used to determine the products VOC content after proper dilution. If, after testing, the VOC limit of a product is not clear, the formulation data for that product would be requested for evaluation, as has been done historically. Method 310 has a range of error of three percent. Therefore, a product is out of compliance only if the VOC content is more than three percent above the standard.

4. Issue: One manufacturer expressed the necessity of at least five to seven percent VOC propellent in the aerosol carpet and upholstery cleaners for product efficacy (Clorox).

Response: The proposed standard for aerosol carpet and upholstery cleaners is seven weight percent which allow for sufficient propellant.

5. Issue: One manufacturer expressed the need for a higher standard for the non-aerosol ready-to-use carpet and upholstery cleaners based on the uniqueness of their products form and usage (Reckitt & Coleman, May 19, 1997).

Response: There are non-aerosol ready-to-use carpet and upholstery cleaners with the same product form that contain the same usage directions that comply with the proposed standard.

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The Brulin Corporation. Product label. “Carpetcare Shampoo.” (The Brulin Corp., “Carpetcare Shampoo”).

The Brulin Corporation. Product label. “Carpetcare Extraction Concentrate” (The Brulin Corp., “Carpetcare Extraction Concentrate”).

The Clorox Company. Meeting between Clorox representatives and ARB staff. March 13, 1997. (Clorox).

E. Floor Wax Stripper

Product Category Description:

Floor wax strippers are products intended to remove natural or synthetic floor waxes/polishes through breakdown of the wax polymers or by dissolving or emulsifying the wax. This category does not include aerosol products or those products designed to remove floor wax solely through abrasion.

The floor wax stripper category encompasses a variety of forms for both household and institutional use, including ammoniated products, no-rinse products, as well as those products for removing metal and non-metal crosslinked or durable floor finishes. Table VI-9 summarizes our Air Resources Board (ARB) Mid-term Measures 1994/1995 Consumer Products Survey (survey) results for the floor wax stripper category.

Table VI-9
Floor Wax Stripper*

Product Form	Number of Products	Category Sales** (lbs./day)	VOC Emissions (lbs./day)	Adjusted VOC Emissions*** (lbs./day)
Liquids	108	75,680	2,600	6,400

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Sales include water added to dilute to minimum recommended dilution ratios.
*** Survey emissions adjusted for complete market coverage (see Chapter IV).

Product Use and Marketing:

Floor wax strippers are used to remove old or worn floor polishes from tile, linoleum, wood, concrete and many other types of flooring. Strippers are nearly all sold as concentrates, so the first step in using the product is to dilute the solution to the concentration whereby the wax can be removed in a single stripping operation. (The term *wax* and *polish* are synonymous in the following discussions). Next, the floor area to be stripped is roped off, and a thin layer of stripper solution is applied by mopping. Due to the extremely slippery and caustic nature of the solution, it is imperative that the stripping area be closed to pedestrian traffic. The stripper is typically allowed to sit for five to ten minutes. After the contact period, the wetted area is agitated using a floor machine with a stripping pad. The combination of abrasion and chemical attack breaks down the wax and emulsifies it. The dirty solution is then mopped up, and the floor is rinsed with clean water. After drying, a fresh coat of polish may be applied (Buckeye, Clarity).

This service is frequently performed in commercial, industrial or institutional settings by janitors or contractors. However, a substantial do-it-yourself residential market also exists. A typical floor care regimen in high traffic areas is as follows: 1) initial application of eight to ten layers of burnished wax, 2) daily washing and scrubbing of the floor, 3) frequent burnishing of scrubbed floors to remove scuff marks and restore gloss, and 4) stripping of the polish every three months or so (Buckeye, Clarity). Stripping is necessitated by the build-up of dirt between the layers of polish. The polish becomes discolored, and although burnishing will restore the gloss, the discoloration is still present. This discoloration is unattractive to consumers, and therefore stripping is required.

In areas with less traffic, floor waxes may only be applied in several layers, and may not be burnished. This situation would be considered the most typical. The floor may be mopped regularly for dirt removal, and when the gloss has faded, either the wax is stripped or a new layer is applied over the old layer (Rohm and Haas).

Floor wax strippers are sold in janitorial supply stores, as well as in many retail stores for general consumer use.

Product Formulation:

Based on our Survey results, floor wax strippers are nearly all water-based liquids, and range in volatile organic compound (VOC) content from zero to 20 percent in their diluted form. Most floor finishes used today are metal cross linked polymers, and the majority of floor wax strippers are designed to remove this type of finish. A typical formulation would include water, a glycol ether solvent, ethanolamine and caustic soda, as well as inorganic salts. The ethanolamine binds and removes the metal which cross links the polymer chains, thereby weakening the polymer. The glycol ether acts as the solvent/emulsifier, softening and dissolving the floor wax, which has been weakened by removal of the cross link. The caustic soda chemically attacks and breaks down the polymer. Inorganic salts provide an alkaline pH which is optimal for both the wax stripping and also subsequent cleaning. Including the glycol ether and ethanolamine, the average VOC content is 3.5 weight percent after dilution.

Some floor finishes have no metal cross links, and these typically are softer in nature and less durable than the metal cross linked finishes. Removal of these polishes does not require ethanolamine or ammonia. A typical formulation might include glycol ether, caustic soda and inorganic salts. These compounds perform the same function as in the metal cross linked strippers.

No rinse strippers are a subcategory of floor wax strippers, and these products generally do not contain caustic soda. Caustic soda is a very aggressive reagent in strippers, attacking the esters and other functional groups in the polymer cross links. After a stripping operation has been performed, extensive rinsing is required to ensure that all of the caustic soda has been removed prior to application of the new polish. A no rinse stripper, not having the assistance of caustic soda, requires higher levels of glycol ether or other co-solvents to perform well. Since floor polishes frequently contain glycol ethers, extensive rinsing after the first mopping is not required. Because the no rinse strippers require additional glycol ethers, they are slightly higher in VOC content than other forms of strippers.

When a floor polish is applied, the emulsion contains solvents such as glycol ethers which emulsify the polish. When the polish cures, a portion of these solvents are trapped within the polish layers. These trapped solvents tend to make the polish more pliable. Over time, with subsequent washings and general wear and tear, these residual solvents are leached from the polish, and the polish becomes harder. Also, new layers of polish may be added over older, harder layers. These thick, aged polishes become difficult to remove, and may require more concentrated floor wax stripper to lift the polish in a single application (S. C. Johnson, 3/24/97) (Meeting Notes, 4/15/97).

Proposed VOC Standard and Compliance:

The proposed VOC standard for this category is three weight percent VOC for liquid products. Aerosols represent only 0.2 percent of the market, and these products are used mainly for spot removal of waxes or removal in small areas. Due to the differences in use of the aerosol and liquid products, aerosols are excluded from the proposed regulation. An exception to the three percent standard is made for situations where an aged, thick floor wax is to be removed, in which case the floor wax stripper may be used at a dilution ratio yielding no more than 12 percent VOC.   The label should recommend a dilution ratio that yields a maximum of three percent VOC for most applications, and a maximum of 12 percent VOC for removal of hard, durable polishes. This labeling requirement is contained in the proposed regulation (section 94509(j)).

Based on the Survey and industry contacts, a three weight percent standard is commercially and technologically feasible. The Chemical Specialty Manufacturers Association (CSMA) officially endores this standard (S. C. Johnson, 5/23/97). There are at least 55 floor wax strippers currently available in California that, when diluted at the recommended minimum dilution ratio, have VOC contents at or below three percent. These products represent almost 70 percent of the market for floor wax strippers, and serve both the household, institutional and industrial sectors.

Table VI-10
Floor Wax Stripper*

Product Form	Proposed VOC Standard (wt. %)	Complying Products	Complying Market Share (%)	Emissions Reductions (lbs./day)	Adjusted Emission Reductions (lbs./day)**
Liquids	3	55	69	1,400	3,440

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Emission reductions adjusted for complete market coverage (see Chapter IV).

Most products currently marketed comply with the proposed standard. These products typically contain ethanolamine or ammonia, glycol ethers, caustic soda, salts and water. Manufacturers are expected to reformulate noncomplying products by increasing the amount of caustic soda in their products, switching some ethanolamine for ammonia, or switching to low vapor pressure volatile organic compound (LVP-VOC) glycol ether solvents. Since ammonia performs the same function as ethanolamine but is inorganic, switching some or all of the ethanolamine to ammonia will lower the VOC content. Caustic soda is effective in removal of floor waxes, and it is inorganic. Additionally, switching some or all of the VOC glycol ether to LVP glycol ethers is a compliance option.

<u>Issues</u>:

1. <u>Issue</u>: A substantial amount of the glycol ether and ethanolamine goes down the drain. Therefore, these emissions should not be counted from this category (Amway, 1997).

<u>Response</u>: Sufficient data have not been provided to substantiate these claims. Rough data were presented, but there data were compiled in an experiment where the intention was to determine the maximum exposure to 2-butoxyethanol of a person performing a stripping operation. The air changes were minimized to 0.16 air changes per hour, which is only a fraction of what would occur in a typical supermarket. The study did not address actual evaporation rates, but simply looked at what could be approximated as the equilibrium concentrations of 2-butoxyethanol in the air space above the stripping solution. To properly address the down-the-drain issue, data must be presented which addresses evaporation rate for 2-butoxyethanol and ethanolamine at liquid-to-air surface ratios and air change rates representative of typical stripping operations. Additionally, information must be provided on the likely fate of 2-butoxyethanol and ethanolamine once these compounds enter the sewer system.

2. <u>Issue</u>: Ammonia is odiferous and may damage surfaces other than the floor.

<u>Response</u>: Ammonia is currently used in many products today. Addition of small amounts in replacement for some of the ethanolamine should help to control the odor.

3. <u>Issue</u>: Aged or thick, burnished polishes will not be removed by three percent VOC products. Removal of these polishes requires more solvent. Multiple applications of stripper would be necessary, costing more time, money and ultimately using the same amount of VOC if not more.

<u>Response</u>: We have addressed this issue by allowing products to be diluted at 12 percent VOC when necessary. However, to ensure that products are not routinely used at higher VOC concentrations than necessary, the label must recommend a dilution ratio for removal of less durable floor finishes that yields a VOC concentration of no more than three percent.

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F. General Purpose Degreaser

Product Category Description:

General purpose degreasers are products designed to remove grease, grime, oil and other oil-based contaminants from a **variety** of substrates. General purpose degreaser does not include engine degreaser, general purpose cleaner, metallic parts cleaner, metal polish/cleanser, electronic cleaner or adhesive remover. Table VI-11 below summarizes our Air Resources Board (ARB) Mid-term Measures 1994/1995 Consumer Products Survey (survey) results for the general purpose degreaser category.

Table VI-11
General Purpose Degreaser*

Product Form	Number of Products	Category Sales (lbs./day)**	VOC Emissions (lbs./day)	Adjusted VOC Emissions (lbs./day)***
Aerosol	59	1,120	1,040	1,180
Non-aerosol	193	82,280	1,900	4,200
Total	252	83,400	2,940	5,380

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Sales include water added to dilute to minimum recommended dilution ratios.
*** Survey emissions adjusted for complete market coverage (see Chapter IV).

Product Use and Marketing:

General purpose degreasers are used to remove oils, oily grit and dirt, food greases, and other oil-based contaminants from metals, concrete, linoleum, formica, tile, and other substrates. These degreasers are applied either by pouring or spraying the degreaser on the oil, or applying it to an abrasive rag or pad and then wiping the rag or pad on the grease. These products are used to degrease floors using a mop, clean grease from barbecues, or to remove grease and oil from stoves, tools, countertops, driveways and other locations.

General purpose degreasers are used by consumers performing yard or housework, janitors, auto shops, restaurants, and other commercial or institutional establishments to perform general degreasing duties. This category has some overlap in both use and formulation with the general purpose cleaner category from the Phase I consumer products regulation in that many products are marketed as general purpose cleaners/degreasers. Emulsion cleaners use technology similar to emulsion degreasers, and therefore have some limited degreasing ability. Typically, the general purpose cleaners use less aggressive solvent/surfactant blends or are not as concentrated as the general purpose degreasers (Clorox, 1/29/97).

Product Formulation:

General purpose degreasers fall into two categories: water-based liquids, and solvent-based liquids and aerosols. The water-based liquids range in volatile organic compound (VOC) content from zero to 20 weight percent in their diluted form. These products generally contain a solvent/emulsifier such as a glycol ether, surfactants such as alkyl benzene sulfonate or alcohol ethoxylates, builders such as inorganic phosphates or silicates, and water. Greases, oils and dirt/grime are dissolved by the solvent, sequestered by the solvent and surfactant, and thus held in solution. Factors affecting the strength of the degreaser include the concentration, the solvent or solvents used, the pH of the product and the type of surfactant used. Water-based degreasers for heavy degreasing applications contain higher levels of sodium metasilicate, are of higher pH and generally contain more glycol ethers.

Solvent-based products typically contain mineral spirits, toluene, xylene or other organic solvents. Aerosol forms generally use a hydrocarbon propellant such as butane or propane. These products simply dissolve the grease or grime into the solvent. Solvents such as toluene or xylene are excellent degreasing agents, whereas the normal paraffin solvents tend to be less effective. Solvent degreasers are frequently mixes of various solvents such as mineral spirits with aromatic solvents.

Product formulations also vary depending upon the target market. Products targeted mainly towards household or restaurant use are generally water-based, whereas those that are likely to be used in or around auto shops or industrial equipment are generally solvent-based. Removal of biological oils and greases, which are primarily triglycerides, can be done effectively by water-based, highly alkaline products with surfactants and little or no organic solvent (Clorox, 1/29/97). These are the types of greases or oils normally found in the home or restaurants. These degreasers have the advantage of having little or no objectionable odors, which would be unacceptable in such an environment. Removal of heavy hydrocarbon greases generally requires at least some organic solvent. In shop environments where smell is less of a concern, solvents such as toluene or xylene may be used either in an emulsion or as a mixture with other solvents. Many water-based or water containing degreasers are also used to remove motor oils and heavy greases in shop environments (Brulin Label).

Proposed VOC Standard and Compliance:

The recommended standard for non-aerosol general purpose degreasers is ten weight percent VOC effective in 2000. Based upon the Survey and industry contacts, we believe a ten percent standard is commercially and technologically feasible. The CSMA has endorsed this standard, as has Sherwin Williams - Diversified Brands, a major manufacturer of degreasers (Lilly, 1997)(Diversified Brands, 5/23/97). There are at least 140 general purpose degreasers currently available in California that, when diluted at the recommended minimum dilution ratio, have VOC contents at or below ten percent VOC. These products represent more than 98 percent of the market for non-aerosol general purpose degreasers, and many are used in commercial or institutional settings for heavy duty degreasing. This standard is consistent with the general purpose cleaner standard now in effect due to significant overlap in these categories.

The proposed VOC standard for aerosol general purpose degreasers is 50 weight percent VOC, effective in 2002. Based upon the 1995 mid-term measures survey and industry contacts, a 50 percent standard is commercially and technologically feasible. The CSMA has also endorsed this standard, as has Sherwin Williams - Diversified Brands (Lilly, 1997)(Diversified Brands, 5/23/97). There are at least five aerosol general purpose degreasers currently available in California that have VOC contents at or below 50 weight percent VOC. Additionally, this limit is consistent with the currently effective engine degreaser standard.

Table VI-12
General Purpose Degreaser*

Product Form	Proposed VOC Standard (wt. %)	Complying Products	Complying Market Share (%)	Emissions Reductions (lbs./day)	Adjusted Emission Reductions (lbs./day)**
Aerosols	50	5	5	480	540
Non- aerosols	10	140	98	1,260	2,780
Total	-----	145	-----	1,740	3,320

* Based upon Mid-term Measures 1994/1995 Consumer Products Survey.
** Emission reductions adjusted for complete market coverage (see Chapter IV).

Products which currently comply with the proposed aerosol standard are generally water-based or water-containing with glycol ethers, mineral spirits, alcohols and surfactants/emulsifiers. Manufacturers are expected to reformulate noncomplying products using this technology, which is similar to currently marketed engine degreasers. Solvent-only products may switch to an emulsion or use exempt solvents such as low vapor pressure volatile organic compounds (LVP-VOCs). Use of a non-VOC propellant such as CO_2 is an option which many currently complying products use. The use of hydrofluorocarbon 152a (HFC-152a) is also a viable option. In this case, since the propellant represents approximately 25 to 30 percent of the product, only 20 percent of the remaining 70 percent must be non-VOC in order to comply with the proposed standard. Substitution of VOC solvent with LVP-VOC solvent would accomplish this.

Most currently marketed degreasers comply with the non-aerosol standard. These include many products used for removal of heavy greases or grimes in institutional or commercial environments. To reformulate noncomplying products to meet the non-aerosol standard, manufacturers may increase the surfactant concentration. Additionally, LVP glycol ethers may be used as solvents. Caustic soda is very effective in removal of grease and grime. Use of strong detergents such as sodium alkylbenzene sulfonates and sodium metasilicate are also possibilities. With 98 percent of the market complying, a variety of technologies are available.

Issues:

1. Issue: Many niche products that are primarily used in industrial degreasing but also make general degreasing claims are included under the current definition. Since these products are typically all or nearly all VOC solvent, compliance will be difficult.

Response: The exclusions provided in the definition exempt products which are designed for *specific* degreasing applications. If these products also make general degreasing claims on their labels, they will be subject to the proposed standard.

2. Issue: Some manufacturers believe that the supply of HFC-152a may not be large enough to meet the increased market demand.

Response: At the end of 1996, Du Pont was scheduled to expand its Corpus Christi facility to obtain over 70 million pounds of HFC-152a capacity. A second expansion of the Corpus Christi facility is possible if the demand increases beyond the current limit. Therefore, sufficient quantities of HFC-152a should be available by 2005. (Du Pont, 1996)

3. Issue: The cost of HFC-152a is higher than the current propellants used. This cost increase may have to be passed on to the consumer and may make products which use it undesirable.

Response: According to Du Pont, the expected increase of competition in the market, the start-up of Du Pont's new HFC-152a manufacturing facility in Corpus Christi, Texas, and the propellant mixtures that can be used will all likely lead to the use of HFC-152a as being a more viable and cost-effective option for manufacturers. As recently as November, 1996, Du Pont decreased the cost of the HFC-152a product from $1.95 per pound to $1.85 per pound. By comparison, the cost of hydrocarbon propellants is approximately $0.20 per pound. Despite this seemingly large disparity, a typical aerosol only uses several ounces of propellant, and as stated above, only a portion of the propellant may be HFC-152a.

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G. Hair Shines

Product Category Description:

A hair shine is a hair care product which is sprayed onto wet or dry hair for the primary purpose of creating a shine. These products coat the hair strands, smoothing the hair cuticle, to provide maximum light reflecting potential. Hair shines are available in a variety of forms which include liquids, pump sprays, and aerosols. Other forms available may include gels which are applied by hand, although none were reported in the Air Resources Board's (ARB) Mid-term Measures 1994/1995 Consumer Products Survey (Survey). There are also two distinct formulations to accommodate many different hair types. The aerosol formulation has been designed for the unique requirements of extremely curly hair. These products hold a major part of the market share and are responsible for the majority of the emissions from this category. Non-aerosol formulations are designed for a very broad consumer market and, according to the Survey, are primarily pump sprays.

Many hair shines have secondary purposes which range from sun protection to conditioning. Those products with dual-uses are included in this category definition only if their primary purpose is to add a shine to the hair. This category does not include hairsprays, hair mousses, hair styling gels, or spray gels which are currently subject to the consumer products regulation.

Table VI-13
Hair Shine*

Product Form	Number of Products	Category Sales (lbs./day)	VOC Emissions (lbs./day)	Adjusted VOC Emissions (lbs./day)**
Aerosol	5	825	781	1,152
Pump	12	50	8	12
Liquid	7	80	11	16
Total	24	955	800	1,180

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Survey emissions adjusted for complete market coverage (see Chapter IV).

As shown in Table VI-13, according to our survey, 24 products were sold in California in 1995 by 11 companies. Also, based on the Survey, approximately 1000 pounds of hair shine were sold daily in California during 1995. According to the Survey, these products emitted about 800 pounds of VOCs per day. The VOC content of non-aerosol products reported in the Survey ranges from 0 to 90 percent by weight with the sales weighted average VOC content being 33 percent by weight. The VOC content of aerosol products reported in the Survey ranges from 90 to 100 percent by weight with the sales weighted average VOC content being 96 percent by weight.

Due to underreporting in the Survey, Table VI-13 also shows the adjusted VOC emissions. Using data from the U.S. EPA 1990 Consumer Products Survey and ARB's 1990 and 1991 Consumer Product Surveys, VOC emissions were raised to 1000 pounds per day (see Chapter IV).

Market coverage due to underreporting in the Survey was adjusted using data from the United States Environmental Protection Agency 1990 Consumer Product Survey and the ARB 1990 and 1991 Consumer Product Surveys. Based on these additional data, VOC emissions from this category were estimated to be 1,180 pounds per day (see Chapter IV).

Product Use and Marketing:

Hair shines are for personal use in the home, although they are also used in commercial establishments such as hair styling salons. Hair shines are sold in discount, department, drug, and grocery stores. They are also sold at beauty salons and beauty supply stores. The primary purpose of hair shines is to add the appearance of a shine to the hair. The product can be applied directly to wet or dry hair, before or after styling. Two different formulations, aerosol and non-aerosol, are available to meet the needs of the hair shine user.

Aerosol hair shines are designed and marketed for consumers in the ethnic market who have extremely curly hair. In the United States, the ethnic hair care industry focuses predominately on the African-American segment of the population. Worldwide, this same industry is devoted to African, African-Caribbean, and portions of the South American populations who have similar hair types (Syed).

Extremely curly hair “grows from the scalp into small twisted spirals due to the configuration of the hair follicles” (Syed). Research has shown that when compared with straight hair, extremely curly hair has less tensile strength and breaks more easily than straight hair, requires more work to comb due to its extremely curly configuration and consequential entanglement, develops higher electrostatic charge, and contains less moisture (Syed, et al.).

Many of these natural conditions are aggravated by chemical and hot-iron straightening processes. Hot-iron straightening, or pressing, uses heat, oils and metal implements to provide a temporary effect. Chemical straightening, or lanthionization, changes the hair chemistry to permanently straighten the hair (Urbano). Hair shine products have been specifically designed to combat the negative effects of these straightening processes and to prolong the desired style after straightening (CTFA).

Aerosol hair shines have been developed for consumers who desire a high degree of hair sheen. They are generally applied after the hair has been styled. Many of these products also contain sunscreen and special conditioners to repair the damage caused from the straightening process and to enhance the manageability of the hair. Aerosol hair shines are also applied to the scalp to alleviate burning caused by chemical straightening and, dry and itchy scalp conditions (CTFA).

Non-aerosol formulations are available for those consumers who do not want the heavy oils in the aerosol formulations. These products are marketed for both extremely curly and straight hair types. They are available in pump spray and liquid forms and may be applied to the hair before or after styling. Many of these products also contain sunscreen and special conditioners to moisturize, prevent hair frizzing caused by electrostatic charge, and alleviate dry and itchy scalp conditions.

Product Formulation:

Aerosol hair shine formulations are very similar to aerosol hairspray formulations. Both contain propellants, solvents, and other additives. However, hair shines contain mineral or plant oils to add a sheen rather than the resins found in hairsprays. The key ingredients for the non-aerosol formulations are volatile methyl siloxanes (VMS), solvents, and other additives.

Solvents are used to carry the active ingredients onto the hair strands and then evaporate to leave behind a thin coating of oil or VMS. Petroleum distillates and ethanol are some examples of solvents used in hair shine formulations. According the the Survey, the solvent content in the non-aerosol hair shines ranges from zero to 90 percent of the formulation by weight and 50 to 70 percent by weight for the aerosol formulations.

Aerosol hair shines contain propellant. The purpose of the propellant is to deliver the active ingredients to the hair. The propellant in these products is generally a blend of butane and propane. According the the Survey, the propellant content in the aerosol hair shines ranges from 25 to 40 percent of the formulation by weight.

The active ingredient for the aerosol hair shines is a high molecular weight oil. This may be mineral oil, plant oils (such as jojoba oil or wheat germ oil), or animal oils (such as lanolin or mink oil). The non-aerosol hair shines use VMS as the active ingredient. Dimethicone and cyclomethicone are the most common VMSs. These VMSs have a lower molecular weight than the oils used in the aerosol products, and therefore, do not weigh down the hair strands. When applied, the oils and VMS coat the hair strands, smoothing the hair cuticles and enhancing the hair's refractive potential. According the the Survey, the VMS content in the non-aerosol hair shines ranges from ten to 90 percent of the formulation by weight, and one to five percent by weight for the aerosol formulations.

According to the Survey, aerosol hair shine products make up approximately 86 percent of the market and contribute approximately 98 percent of the emissions from the category. The pump sprays and lotions make up 14 percent of the market and about two percent of the emissions. Although gel forms were not reported in the Survey, there are currently some products in the marketplace.

Proposed VOC Standard and Compliance:

The proposed VOC limit for all forms in the hair shine category is 55 weight percent, effective in 2005. This effective date gives the hair shine formulators a similar amount of research and development time as that given to the hairspray formulators to meet the 55 percent hairspray standard. The ARB will be conducting a technology assessment and is proposing an annual reporting requirement to monitor industry's progress in meeting the 55 percent standard.

Based on the ARB's Survey results, industry contacts, and information gained from developing the 55 percent hairspray standard, staff has determined that a 55 percent VOC content for hair shine is commercially and technologically feasible. Hair shines are a fairly simple mix of propellant, alcohol and actives in the form of high molecular weight oils. Whereas, hairsprays tend to be much more complicated, in that a resin must be designed which is compatible with each specific delivery system and formulation.As shown in Table VI-14, using adjusted emissions, the proposed standard will result in VOC emission reductions of approximately 500 pounds per day.

Currently, there are no aerosol hair shines on the market that meet the 55 percent limit. In order to meet the proposed limit, the VOC content of the aerosol formulations will need to be reduced by approximately 40 percent. Reformulation options may include replacing the hydrocarbon propellant with HFC-152a, or with a mixture of hydrocarbon propellant and HFC-152a which will aid in regulating the pressure in the aerosol can. Another option may be an increase in the use of VMS.

As shown in Table VI-14, there are 15 non-aerosol hair shine products reported in the Survey that have VOC contents below the proposed limit. The non-aerosol products that meet the limit contain 10 to 90 percent VMS. Reformulation options to comply with the proposed limit might include an increase in the use of VMS.

Table VI-14
Hair Shine*

Product Form	Proposed VOC Standard (wt. %)	Complying Products	Complying Market Share (%)	Emissions Reductions (lbs./day)	Adjusted Emission Reductions (lbs./day)**
Aerosol	55	0	0	292	431
Pump	55	9	38	17	25
Liquid	55	6	25	31	46

Total	55	15	63	340	502

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Emission reductions adjusted for complete market coverage (see Chapter IV).

Issues:

1. Issue: There is a concern that using HFC-152a as a propellant in the aerosol hair shines will introduce a small amount of moisture into the can. This moisture would cause can corrosion.

Response: According to studies performed by Du Pont, the manufacturer of HFC-152a, HFC-152a is hydrolytically stable and does not contribute to can corrosion (Du Pont). Corrosion inhibitors have also been developed for water-based hairspray formulations which could be used in hair shine formulations, if necessary. However, the staff believes that manufacturers can achieve the standard without reformulation to water-based products (ARB).

2. Issue: Some manufacturers believe that the supply of HFC-152a may not be large enough to meet the increased market demand.

Response: At the end of 1996, Du Pont was scheduled to expand its Corpus Christi facility to obtain over 70 million pounds of HFC-152a capacity. It was calculated that if the 55 percent VOC content by weight hair spray formulation was sold nationally only 38 million pounds of HFC-152a would be required. The increased demand for HFC-152a from reformulation of hair shines will be well below this amount. A second expansion of the Corpus Christi facility is possible if the demand increases beyond the current limit. Therefore, sufficient quantities of HFC-152a should be available by 2005. (Du Pont).

3. Issue: The cost of HFC-152a is higher than the current propellants used. This cost increase may have to be passed onto the consumer and make the product undesirable.

Response: According to Du Pont, the expected increase of competition in the market, the start-up of Du Pont's new HFC-152a manufacturing facility in Corpus Christi, Texas, and the propellant mixtures that can be used in 55 percent VOC formulas, will all likely lead to the use of HFC-152a as being a more viable and cost-effective option for manufacturers as they develop
55 percent VOC hair shine and hairspray formulations. As recently as November 1996, Du Pont decreased the cost of their HFC-152a product from $1.95 per pound to $1.85 per pound (ARB). The cost of hydrocarbon propellants is approximately $0.20 per pound.

4. Issue: The pressure in the aerosol can may increase with the use of HFC-152a causing formulators to change the type of valves they use.

Response: Hair shine and hairspray are very similar formulations. The overall pressure of the hair shine can should be within the limits of the currently used 2N, 2P and 2Q cans because the addition of ethanol lowers the pressure of HFC-152a. Several valve manufacturers are already working with the hairspray manufacturers to develop delivery systems for low VOC formulations. This same technology should also apply to the hair shine formulations (ARB).

5. Issue: Our regulation may impact small, African-American owned businesses that make-up a small share of the market.

Response: The future effective date of this standard was chosen to allow manufacturers approximately eight years for research and development in order to reduce the impact of reformulation on small businesses. The potential cost impacts to small businesses are discussed in detail in Chapter VIII.

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H. <u>Heavy-duty Hand Cleaner or Soap</u>

<u>Product Category Description</u>:

The heavy-duty hand cleaner or soap category consists of specialized cleaning products that are designed to clean or remove difficult dirt and soils such as oil, grease, grime, tar, shellac, putty, printer's ink, paint, graphite, cement, carbon, asphalt, or adhesives from the hands. Many heavy-duty hand cleaners can be wiped off with a cloth rather than being rinsed off with water. This is advantageous since water may not be easily or quickly accessible at many job sites (i.e. factories, fields, mines, etc.) where hands get dirty and soiled. Some products can also be used on laundry stains and for other household cleaning needs. According to the Air Resources Board's (ARB) 1994/1995 Mid-term Measures Survey (Survey), the vast majority of heavy-duty hand cleaner products are in liquid or gel form.

The staff of the ARB surveyed four categories of personal care soap products: 1) "Heavy-duty hand cleaner or soap," 2) "Antimicrobial hand or body cleaner or soap," 3) "Facial cleaner or soap," and 4) "General-use hand or body cleaner or soap." Since that time, the latter three of these product categories have been delayed from consideration in this mid-term measures effort because: (1) Preliminary information supplied by industry indicates that a large percentage of the volatile organic compound (VOC) content in these products may be biodegraded after being rinsed down-the-drain, and (2) further study is needed to examine any potential negative impacts on the health benefits of antimicrobial soaps due to VOC regulation. Heavy-duty hand cleaners are included in this mid-term measures effort because most of these products are able to be used without water (do not go down-the-drain), the VOC content is significantly higher than the other three soap categories, and because the VOCs are not as likely to be biodegraded due to the differences in their chemical structure.

As shown in Table VI-15, according to our Survey, one-hundred twenty-two products were sold in California in 1995 by 37 companies. Also, based on the Survey, approximately 16,000 pounds of heavy-duty hand cleaners were sold daily in California during 1995. According to the Survey, these products emitted about 3,000 pounds of VOCs per day. The VOC content of products reported in the Survey ranges from 0 to 50 percent by weight with the sales weighted average VOC content being 18 percent by weight.

Due to underreporting in the Survey, Table VI-15 also shows the adjusted VOC emissions. Using data from the U.S. EPA 1990 Consumer Products Survey and ARB's 1990 and 1991 Consumer Product Surveys, the VOC emissions are estimated to be 6,000 pounds per day (see Chapter IV).

Table VI-15
Heavy-duty Hand Cleaner or Soap*

Product Form	Number of Products	Category Sales (lbs./day)	VOC Emissions (lbs./day)	Adjusted VOC Emissions** (lbs./day)
Liquid	71	10,260	1,240	2,580
Other	51	5,340	1,640	3,420
Total	122	15,600	2,880	6,000

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Survey emissions adjusted for complete market coverage (see Chapter IV).

Product Use and Marketing:

Heavy-duty hand cleaners are commonly used by individuals in the workplace and in the home who may encounter difficult to remove soils during activities such as automotive repair, painting, construction work, farming, and printing which attract the toughest dirt and soils that cannot be easily washed-off with general-use soaps. Typically, the hand cleaner is rubbed into dry hands until the dirt and soils are dissolved or suspended in the product. The hands may then be wiped dry with a cloth or rinsed with water. However, some products specify that the user rub and rinse off with water. In addition, many containers are made to accommodate use with a dispenser which is common in institutional and industrial settings.

Heavy-duty hand cleaners are sold in automotive supply stores, discount stores, hardware stores, home supply stores, paint stores, department stores, hobby and craft stores, and by catalogue.

Product Formulation:

Heavy-duty hand cleaners typically contain surface active agents, or surfactants, (i.e. soaps/detergents and emulsifiers), solvents, and abrasives, all of which help remove dirt and soils. In addition, most heavy-duty hand cleaners contain moisturizers and some may contain fragrances.

Surfactants decrease a solution’s surface tension, making the solution a better wetting agent (Snyder). Surfactants in heavy-duty hand cleaners are generally used to cleanse or to emulsify water insoluble ingredients. A variety of surfactants are used in heavy-duty hand cleaners. Soaps and detergents, both cleansing surfactants, are active ingredients that, in addition to decreasing the water’s surface tension, convert greasy and oily dirt into micelles that become dispersed or dissolved in the product as the rubbing begins. Soaps and detergents will also keep the dirty micelles in suspension, thereby preventing them from coalescing and redepositing on the clean surface (Snyder). This same mechanism also allows surfactants to solubilize water-insoluble ingredients (i.e. solvents, emollients, and fragrances) in a water-based formulation. Emulsifiers are surfactants that are used to mix certain water insoluble solvents or oils with water. Once again, the surfactant forms a micelle (with the oil) and keeps the oil dispersed in the water phase. Typically, nonionic surfactants are used for this purpose, due to their ability to couple oil and water without negatively affecting other characteristics of the formulation (Schueller).

Solvents may act as both an active ingredient by dissolving dirt and soils, and as a carrier for other ingredients. Typical solvents include water and VOCs such as petroleum distillates and the citrus terpene, d-limonene. Water is commonly included in heavy-duty hand cleaner formulations; it is a good carrier for many ingredients (Survey; Schueller). Water is also used in combination with surfactants to lower water's surface tension enabling it to successfully suspend the dirt and grease from the hand. VOC solvents such as petroleum distillates and d-limonene already have very low surface tensions in addition to being able to dissolve most dirt and grease making these solvents very effective cleaners (Exxon). Dibasic esters (DBE's) such as dimethyl gluterate and dimethyl adipate are common among heavy-duty hand cleaners that specialize in removing paint and adhesives from the hands because of their ability to dissolve the paint coatings (Survey; Monsanto).

Abrasives are active ingredients which physically remove dirt through abrasion. Fine pumice and diatomaceous earth material such as silica generally make up the more common abrasives among heavy-duty hand cleaners (The Dial Corporation).

Moisturizers and fragrances may be included in the formulation of heavy-duty hand cleaners to make the products more appealing for everyday use. Common moisturizers include aloe, jojoba oil, and lanolin. Fragrances are sometimes used in petroleum and other non-citrus-based products to promote a more pleasant odor (Survey).

According to our Survey, the amount of VOCs in heavy-duty hand cleaners range from zero to 50 percent with a sales-weighted average of approximately 18 percent (Survey). Heavy-duty hand cleaners may be generally broken into four separate sub-categories based upon their formulation type, although not all products fit neatly into one of these sub-categories. These sub-categories are petroleum-based products, citrus-based products, surfactant-based products, and paint removing hand cleaner products.

The majority of the heavy-duty hand cleaners are petroleum-based and contain mineral spirits and other petroleum distillates as their solvent. These hand cleaners tend to have a relatively high VOC content ranging from eight to 50 percent with an average of about 35 percent. Petroleum-based hand cleaners also include, on average, about 40 percent water, 20 percent low vapor pressure volatile organic compounds (LVP-VOCs) which typically include soaps/detergents, emulsifiers, and/or moisturizers, and about five percent inorganic abrasives (Survey).

Another large segment of the hand cleaner market is the citrus-based cleaner. These contain d-limonene and other citrus terpenes as their solvent. D-limonene is produced by the pressing and distillation of fruit peels such as those from oranges, lemons, mandarins, and grapefruits (Karlberg et al.). The fruit-like aroma makes the citrus products popular among household users (Gojo). D-limonene can be used in its present form as an oil but it is usually emulsified with water by adding a variety of surfactants (Spray Technology & Marketing). The VOC content of citrus-based cleaners varies from less than one percent to approximately

30 percent and averages about ten percent. Citrus hand cleaners also include, on average, about 70 to 75 percent water, ten to 15 percent LVP-VOCs, and about five percent inorganic abrasives (Survey).

Approximately 15 percent of the heavy-duty hand cleaner products that are reported in the Survey rely heavily on surfactants (soaps and detergents) to do the cleaning. These hand cleaners have an average LVP-VOC content of approximately 40 percent (the majority of which are the soaps and detergents), a water content of about 50 percent, and about ten percent inorganic abrasives, about twice as high as the other previously discussed "solvent" categories. The VOC content among these products averages less than one percent (Survey).

A small percentage (approximately five percent) of the heavy-duty hand cleaners are primarily aimed at removing paint and adhesives from the hand. Most, if not all of these hand cleaners, contain the DBE's dimethyl gluterate (DMG), dimethyl adipate (DMA), and/or dimethyl succinate (DMS) as their solvent. DMS is a VOC while DMG and DMA are LVP- VOCs. According to our Survey, the average VOC content for these products is only about one percent with a range of zero to 30 percent. The paint removing products also include, on average, 30 percent water, 60 percent LVP-VOCs (most of which are DMG and DMA but may contain other surfactants and moisturizers), and about ten percent inorganic abrasives (Survey).

<u>Proposed VOC Standard and Compliance</u>:

The proposed two-tiered VOC limit for the heavy-duty hand cleaner or soap category is ten percent by weight effective 2002 and five percent by weight effective 2005. As shown in Table VI-16, using adjusted emissions, the proposed standards will result in VOC emission reductions of approximately 1,600 and 2,200 pounds per day, respectively. The complying products with a VOC content below ten percent have an average water content of approximately 70 percent (40 percent for noncomplying products) with about one-half of them being citrus-based. All but one of the other complying products include surfactant-based and paint removing products.

Table VI-16
Heavy-duty Hand Cleaner or Soap*

Year	Product Form	Proposed VOC Standard (Wt. %)	Complying Products	Complying Market Share (%)	Emissions Reductions (lbs./day)	Adjusted Emission Reductions (lbs./day)**
2002	Liquid	10	35	79	440	919
	Other	10	17	17	1,160	2,421
	Total	10	52	58	1,600	3,340
2005	Liquid	5	26	12	780	1,620
	Other	5	13	13	1,400	2,920
	Total	5	39	12	2,180	4,540

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Survey emissions adjusted for complete market coverage (see Chapter IV).

The noncomplying products will need to decrease the amount of VOC solvent in their formulations by as much as 45 percent by the year 2005. The options available include increasing the water content, replacing (at least in part) VOC solvents with LVP-VOC solvents, increasing the amount of surfactants, and/or increasing the amount of abrasives.

ARB staff is planning on doing a technology assessment to ensure that the five percent by weight VOC standard is technically and commercially feasible by the year 2005. In addition, ARB staff is proposing an annual reporting requirement to monitor manufacturer's progress in implementing this standard.

Issues:

1. Issue: Some manufacturers have stated that citrus-based hand cleaners cause varying degrees of allergic reactions to people with sensitive skin and, therefore, VOC limits should not result in the elimination of other product formulation types.

Response: ARB staff acknowledges that certain individuals may be sensitive to *both* citrus-based and petroleum-based products. However, currently, there are products that comply with the 10 percent VOC standard among the four formulation types previously discussed: citrus-based, petroleum-based, surfactant-based, and DBE-based products. Currently, according to our Survey, the only formulation type that does not have a complying product on the market at the 5 percent VOC limit is the petroleum-based product. The lowest VOC content among petroleum distillate products is 8 percent by weight (Survey).

2. Issue: Some manufacturers have stated that citrus hand cleaners should not be included in the same category as the petroleum hand cleaning products because the citrus hand cleaners are not as effective in removing the heavy greases such as those that may come from working on the bottom of an automobile.

Response: ARB staff has accumulated a representative sample of heavy-duty hand cleaner product labels. According to these labels, citrus products claim to be able to remove the same types of dirt and soils, including heavy greases, that the petroleum-based products claim to be able to remove.

3. Issue: Some manufacturers believe that the majority of the industrial and institutional customers have a dispenser installed near a sink where the product is used and subsequently rinsed off with water. Hence, they believe a significant portion of the VOCs from heavy-duty hand cleaners go down-the-drain and are biodegraded in the sewer system.

Response: A sampling of product labels indicate that the majority of the products are formulated for use without water. In addition, due to their difference in chemical structure, the VOCs in these products (i.e. d-limonene and various grades of petroleum distillates) are not as likely to be biodegraded before volatilizing as the VOCs in the other soap categories such as ethanol in the “General Use Hand, Face, or Body Cleaner or Soap” category.

4. Issue: Some manufacturers have stated that the dibasic esters commonly used in hand cleaning products which specialize in removing paint and adhesives are not effective in removing the heavy dirt and greases that may be obtained from working on an automobile and, therefore, should not be considered part of this category when developing a VOC standard.

Response: ARB staff has looked at the sales weighted average VOC content and the complying marketshares (at the two proposed VOC standards) when these DBE products are withdrawn from the calculations. Their affect on these numbers are negligible.

5. Issue: Some manufacturers have stated that replacing hydrocarbon VOCs with LVP-VOCs will reduce the product efficacy.

Response: While replacing hydrocarbon VOCs with hydrocarbon LVP-VOCs may (or may not) result in a less efficacious product, ARB staff believes that any potential reduction in efficacy would not keep the product from fulfilling the basic, necessary function of removing heavy dirt and greases from the hand. There are currently a few zero VOC products on the market that are using LVP-VOC solvents. A combination of VOC petroleum distillates (not greater than 5 percent) and LVP-VOC petroleum distillates is another possible formulation type that may be used to comply.

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I. Metal Polish and Cleanser

Product Category Description:

Metal polish/cleanser products are designed to improve the appearance of finished metals or metallic or metallized surfaces by removing deposits and/or polishing the surface by physical or chemical action. To "improve the appearance" means to remove or reduce stains, impurities, or oxidation from surfaces or to make surfaces smooth and shiny. Some metal polish/cleansers also leave a protective coating after application.

A number of metal polish/cleansers are intended for use on specific substrates such as aluminum, brass, bronze, silver, chrome, copper, pewter, stainless steel, and other ornamental metals. However, some metal polish/cleansers are designed for use on a variety of substrates and are labeled as multipurpose metal polish/cleansers. The metal polish/cleanser category does not include automotive wax, polish, sealant, or glaze, wheel cleaner, paint remover or stripper, products designed and labeled exclusively for automotive and marine detailing, or products designed for use in degreasing tanks.

As shown in Table VI-17, according to the Air Resources Board's (ARB) Mid-term Measures 1994/1995 Consumer Products Survey (Survey) our survey, 113 products were sold in California in 1995 by 39 companies. Also, based on the Survy, approximately 6,000 pounds of metal/polish cleansers were sold daily in California during 1995. According to the Survey, these products emitted about 500 pounds of volatile organic compounds (VOCs) per day. The VOC content of products reported in the Survey ranges from zero to 100 percent by weight with the sales weighted average VOC content being eight percent by weight.

Due to underreporting in the Survey, Table VI-17 also shows the adjusted VOC emissions. Using data from the U.S. EPA 1990 Consumer Products Survey and ARB's 1990 and 1991 Consumer Product Surveys, VOC emissions were raised to 680 pounds per day (see Chapter IV).

Table VI-17*
Metal Polish/Cleanser

Product Form	Number of Products	Category Sales (lbs./day)	VOC Emissions (lbs./day)	Adjusted VOC Emissions** (lbs./day)
Aerosol	34	407	146	211
Liquid	44	1,907	334	469
Semisolid	25	644	0	0
Solid	6	2,964	0	0
Other	4	36	0	0
Total	113	5,957	480	680

* Based on Mid-term Measures 1994/1995 Survey.
** Emissions adjusted for complete market coverage (see Chapter IV).

Product Use and Marketing:

As mentioned earlier, metal polish/cleansers are products used to improve the appearance of finished metal, metallic or metallized surfaces by physical or chemical action. Metal polish/cleansers remove grease, dust and tarnish, produce a bright shiny surface, burnish and can provide protection from future tarnishing. Tarnish is the result of the reaction of metal surfaces with pollutants in the air. Pollutants, such as nitrogen oxides, sulfer oxides and carbon monoxide, dissolve in the moisture in the air to form acidic solutions. These acidic solutions further react with the metal surfaces to produce tarnish. Tarnish is basically a scaly or powdery layer covering on metal surfaces (Reckitt & Colman, April 15). Due to tarnishing, most metals require frequent washing and occasional cleaning with specialized products to bring back the metal's original shiny appearance (Wright's, “Shining Home”).

Each type of metal is unique in its composition. Silver and aluminum have a fairly soft surface that scratches easily. Brass, copper, bronze and pewter surfaces are considered to have intermediate hardness and stainless steel and chrome surfaces are considered hard and more durable. Because of the differences in hardness and uses for metals, polishes are specially developed to address the various needs of the users (Reckitt & Colman, April 15).

Metal polish/cleansers are used in both household and institutional settings with household use accounting for the majority of product sales. These products are available in aerosols, liquids, semisolids such as pastes, and solids with the majority of sales in the liquid form (Survey).

A household consumer will use these products for a variety of cleaning and polishing needs around the home. Examples include, cleaning and polishing jewelry, flatware, fireplace accessories, home furnaces, metal surfaced or coated items, decorative trim, appliances, kitchen or bathroom fixtures, brass doors, end plates, wall coverings and railings.

Institutional users include janitors and other employees that work in restaurants, hotels, office buildings and hospitals. Metal polish/cleansers are used in these establishments to clean metal objects such as brass railings, brass fixtures, stovetops and decorative objects. Institutional users typically require products that dry quickly and clean without a lot of effort.

Products that clean by physical action include liquids, semisolids and solids and require some physical scrubbing action to clean and shine the metallic substrate. These liquid products are usually applied using a moist cloth, allowed to sit for approximately one minute or longer, and then wiped or buffed off with a clean sponge or cloth (Amway). Semisolids are usually pastes, gels or creams that clean through abrasion. They are typically applied with a damp cloth, rubbed onto the substrate and then wiped or rinsed off with soap and water. Finally, solids and powders are hard cake products that are usually somewhat abrasive (Reckitt & Colman, April 15).

Metal polish/cleansers that clean by chemical action are typically liquids and aerosols that have a higher amount of solvent. Generally, these products are applied using a clean soft cloth, allowed to dry after slight rubbing to loosen badly discolored areas, and polished with a soft, dry cloth (Reckitt & Colman). Some liquid products can be ideal for smaller objects which can be rinsed under running water after polishing. Creams can be good for large objects such as brass beds, railings, and fireplace accessories (J.A. Wright).

Some of these products are also available as dips in which objects are placed into the container of liquid metal polish/cleanser, pulled out and wiped or rinsed off to get a clean shiny appearance. Chemical dips are instant detarnishing agents for silver that require no rubbing, however they can cause long term damage and white out the intentionally dark recessed areas on silver peices (Wright's Special Report). Finally, aerosol products are used for quick spot cleaning and can be used to get into hard to clean crevices (Chemsearch, “Glo-ss”). Aerosol products are more widely used in the institutional market than the household market (Reckitt & Colman, April 15).

Metal polish/cleansers are sold at numerous locations such as department stores, grocery stores, hardware stores, hobby shops, warehouse stores, paint stores, janitorial supply stores and automotive parts stores.

<u>Product Formulation</u>:

This category includes a wide spectrum of water-based and solvent-based product forms and formulations that can be used on a variety of metallic surfaces. The ingredients for each type of metal polish are specifically chosen to address special needs for the varying metal surfaces. For example silver is very soft, so the ingredients in silver polishes must be carefully chosen not to scratch the surface (Reckitt & Colman, April 15). Metal polish/cleansers are generally mixtures of some or all of the following: water, solvent, ammonia, fatty acids, alcohols, oleic acid, chalks, thiourea, fulfuric acid, oxalic acid, thickeners, surfactants and low vapor pressure oil that will remain on the metallic surface to provide a protective film (Reckitt & Colman, April 15).

The water in these products is used as a vehicle to suspend and facilitate cleaning. Solvents function as a cleaner to dissolve grease and grime as well as suspend solids and may also be chosen for protective properties. Fatty and oleic acids are used as cleaners. When these acids are combined with ammonia, a gel-like soap is formed to facilitate cleaning. When they are combined with a solvent, they produce an ideal viscosity to allow the polish to adhere to the surface. The clays and chalks found in these products are used as polishing agents. Alcohol is used as a wetting agent to provide better contact of the cleaner to the metal surface and acts as a vehicle to suspend solids. Thiourea, sulfuric acid and oxalic acid are chemical reactants used for cleaning. Finally, the thickeners aid in adhesion to the metal surfaces and surfactants act as detergents for cleaning.

The solvent-based products rely on active ingredients such as alcohols, xylene, mineral spirits, ethanol, petroleum distillates, and toluene to chemically dissolve organic materials on the metallic surface and to act as a carrier for any abrasive ingredients included in the product. The solvents in the polish begin to dissolve the grease and grime covering the tarnish and they act to lubricate the metal or lower the surface tension of the polish for easier cleaning. A higher solvent content enables the polish to clean quickly and allows the use of solids with larger particle sizes. As solvent-based products are rubbed on the surface, the solvent evaporates allowing clays or chalks to remove the tarnish through abrasion. The larger particles break down during rubbing into finer particles which enables the metal's molecular surface to be dragged across scratches, thereby filling them in (Reckitt & Colman, April 15).

The fatty and oleic acids and ammonia in liquid polishes react to form ammonia oleate, a soap that aids in the cleaning process. Liquid metal polish/cleanser are usually formulated with an excess of fatty acid so that not all the fatty acid reacts with the ammonia. Some of the excess fatty acid is left on the metal surface after polishing which may delay future tarnishing (Reckitt & Colman, April 15).

Thiourea is often included in solvent-based silver polish/cleansers to reduce the tarnish on silver without damaging the surface (Reckitt & Colman, April 15). However, thiourea is a known cancer-causing agent that can be absorbed through your skin (Wright's Health Alert).

The water-based products rely on abrasive materials, ammonia, water and some physical rubbing action to physically remove dirt deposits from the metallic surface. These products typically contain very little or no solvents, water, and polishing agents such as finely grained diatomaceous earth, clay, talc, or silica. The abrasives can scratch some metallic surfaces as they are used, therefore, it is recommended that these products not be used on soft, easily scratched surfaces (Wright's, “Shining Home”). Some of these products such as Wright's Anti-Tarnish Silver Poligh also leave an invisible, non-hazardous, wax-like coating that slows the formation of tarnish (J.A.Wright).

Pastes primarily rely on abrasion to remove grease, grime and tarnish as they contain less water or solvents. These products, which are generally more abrasive than liquids, use clays or silicates with finer particle sizes than the liquids in order to avoid scratching the metal (Reckitt & Colman, April 15).

The aerosol products in this category have formulations similar to the liquid products with the addition of a hydrocarbon propellant. The semisolids and solids are primarily abrasives with some water, petroleum distillates, low vapor pressure volatile organic compound (LVP-VOC) solvents and fragrance (Survey).

Our survey results show that the sales-weighted average VOC content of the products in the metal/polish cleansers category is eight percent, with 31 products containing no VOCs.

Proposed VOC Standard and Compliance:

The proposed VOC limit for metal polish/cleansers is 30 percent by weight, effective in 2002. We believe this limit is feasible using technology that is currently available. As shown in Table VI-18, using adjusted emissions, the proposed standard will result in VOC emission reductions of approximately 300 pounds per day. Also shown in Table VI-18, 85 products already meet the proposed limit and represent 90 percent of the market. In addition, there are numerous products in each product form that comply with the proposed limit and are used in both the household and institutional market (Survey). Currently, almost all of the semisolids and solids comply with the proposed limit, therefore it is primarily the solvent-based liquids and aerosols that will have to reformulate to meet the proposed 30 percent limit. Manufacturers will be able to comply with the proposed limit using water, LVP-VOC solvents, abrasives, or any combination of the three.

Also, a few aerosol products reported in 1995 used 1,1,1-Trichloroethane (TCA) in their formulation. These products will have to replace the TCA with VOCs, water or LVP-VOC solvents due to the phase-out of ozone depleting compounds.

Water-based Products

There are numerous water-based liquid and aerosol products that comply with the proposed VOC limit and are widely used in both the household and institutional market (Survey). A typical complying water-based liquid contains zero to 30 percent solvent, 50 to 98 percent water, zero to 15 percent ammonia, zero to ten percent abrasives and possibly some surfactants. A typical complying aerosol product has zero to 15 percent solvent, 15 to 20 percent hydrocarbon propellant, and 55 to 75 percent water (Survey).

LVP-VOC Solvents

Another reformulation option companies may choose to comply with the proposed limit is LVP-VOC solvents. Products that contain LVP-VOCs are also used in both the household and institutional market. LVP-VOC solvents are synthetically produced isoparaffinic solvents that often can be used in place of conventionally produced petroleum solvents (Exxon). A typical complying product that uses LVP-VOC solvents contains zero to 30 percent solvent, 80 to 95 percent LVP-VOC solvent, five to 15 percent water, ammonia and possibly some abrasives (Survey).

Table VI-18*
Metal Polish/Cleanser

Product Form	Proposed VOC Standard (wt.%)	Complying Products	Complying Market Share (%)	Emission Reductions (lbs./day)**	Adjusted Emission Reductions (lbs./day)**
Aerosol	30	12	74	60	85
Liquid	30	39	75	140	198
Semisolid	30	24	100	0	0
Solid	30	6	100	0	0
Other	30	4	100	0	0
Total	30	85	90	200	283

* Based on Air Resources Board Mid-term Measures 1994/1995 Survey.
** Emissions adjusted for complete market coverage (see Chapter IV).

Issues:

1. Issue: Industry representatives have stated that a higher level of solvent is needed in products used for institutional settings such as hotels and restaurants. The institutional market generally requires products that dry quickly and take minimal effort to use. In addition, they claim that high VOC products leave a protective oily film which may result in fewer applications.

Response: This product category includes a wide variety of products in a number of product forms. According to our Survey, there is a large complying marketshare for each product form with these products being used by both household and institutional users. For example, many complying products claim to work quickly and leave a protective coating such as J.A. Wright's Anti-Tarnish Silver Cleaner, and the labels for water-based products do not recommend repeated applications (J.A. Wright).

2. Issue: Some industry representatives would like to add a statement into the definition that would exclude products from this category that provide a protective coating.

Response: There are so many products that make the claim that they provide a protective coating that adding this into the definition would exclude most of the products in this category. Also, there are complying products that claim to provide a protective coating (Amway; J.A. Wright).

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J. Multipurpose Lubricant

Product Category Description:

The multipurpose lubricant category consists of lubricant products that are designed and labeled for general purpose lubrication, or for use in a wide variety of applications. For example, this category includes products labeled simply as a lubricant, or products labeled for household use, for use by mechanics, or for use on camping and sporting equipment. This category does not include specialty products, such as products only for use on locks, or chains and cables, even if the specialty products are for use on many different types of locks, or chains and cables.

This category does not include penetrants, multipurpose dry lubricants, or silicone-based multipurpose lubricants, as defined in the proposed amendments. As with all the lubricant categories, the multipurpose lubricant category does not include: (1) products excluded from the definition of “lubricant” in the proposed amendments; and (2) industrial use products as defined in the consumer products regulation (such as products designed and labeled exclusively for use in the lubrication of manufacturing equipment).

The multipurpose lubricant category contains a variety of products, including “multifunctional” light duty aerosol lubricants, and lubricants such as aerosol spray greases, which are designed only for lubrication. The multifunctional products are typically designed to provide a light, nongreasy lubricant film that penetrates intricate surfaces, displaces water, and prevents rust and corrosion (WD-40; Sprayon; LPS Labs). Multipurpose lubricants which are designed primarily for lubrication generally leave a heavier coating of lubrication that provides superior lubricity under heavier loads. These products include aerosol spray greases such as “white grease,” and liquid or aerosol products containing heavier oils.

Table VI-19 below summarizes the sales and emissions from multipurpose lubricants, based on the results of Air Resources Board’s (ARB) Mid-term Measures 1994/1995 Consumer Products Survey (Survey). The information in Table VI-19 does not include solid or semisolid products (primarily greases) because they are not a significant source of VOC emissions, and the proposed VOC standard does not apply to these products. As shown in Table VI-19, according to our Survey, 133 multipurpose lubricants were sold in California in 1995. Also, based on the Survey, approximately 15 thousand pounds of multipurpose lubricants were sold daily in California in 1995. According to our Survey, these products emitted about ten thousand pounds of VOCs per day.

The multipurpose lubricant category is the largest source of VOC emissions among the mid-term measures categories proposed in this rulemaking. The sales and emissions, as shown below, are primarily due to aerosol products, which represent about 85 percent of the sales, and 88 percent of the VOC emissions in the multipurpose lubricants category. The sales-weighted average VOC content for multipurpose lubricants is about 69 percent by weight, with an average VOC of about 71 percent for aerosols, and 54 percent for liquids.

Due to underreporting in the Survey, Table VI-19 also shows the adjusted VOC emissions. Using data from the U.S. EPA 1990 Consumer Products Survey and ARB’s 1990 and 1991 Consumer Product Surveys, VOC emissions were raised to about 12 thousand pounds per day (see Chapter IV).

Table VI-19
Multipurpose Lubricant*

Product Form	**Number of Products**	**Category Sales (lbs/day)**	**VOC Emissions (lbs/day)**	**Adjusted VOC Emissions (lbs/day)****
Aerosol	105	12,600	9,000	10,400
Liquid	27	2,200	1,200	1,400
Total	133	14,800	10,200	11,800

* Based on Mid-Term Measures 1994/1995 Consumer Products Survey.
** Survey emissions adjusted for complete market coverage (see Chapter IV).

<u>Product Use and Marketing</u>:

Multipurpose lubricants are used by household, institutional, and industrial users. Household consumers use multipurpose lubricants on a variety of objects, including door hinges, bicycle chains, locks, pulleys, fasteners, window tracks, sporting equipment, automotive parts, and gardening tools. Institutional and industrial customers use multipurpose lubricant products on the above mentioned items, as well as on more specialized equipment such as conveyors, winches, ignitions, weapons, gears, electrical equipment, marine engines, and drive equipment.

As mentioned earlier, the multipurpose lubricants category includes multifunctional lubricants that provide light lubrication, and lubricants designed solely for lubrication. The multifunctional products are more often used for light duty lubrication, or for use as a penetrant, demoisturant, or corrosion prevention coating. Typical applications include lubrication of locks or sliding mechanisms, demoisturizing electrical equipment, and freeing frozen fasteners. The multipurpose lubricants that are solely for lubrication are more often used where heavy loads are present, or where a longer-lasting lubricant is needed. Typical applications include automobile hinges, gears, and chains.

Multipurpose lubricants are sold in supermarkets, hardware stores, automotive parts stores, by specialty retailers such as hunting and fishing shops, and by mass merchandisers. Multipurpose lubricants are also sold to industrial or institutional users through distributors that serve these customers, or directly to large customers.

Product Formulation:

Multipurpose lubricants vary widely in formulation type. However, most are aerosol products that provide lubrication through the use of various grades of petroleum oils (mineral oil) or greases. The oil or grease is typically dissolved in a hydrocarbon or chlorinated solvent, and the propellant is either a liquefied petroleum gas or carbon dioxide. After the product is sprayed, the solvent and propellant evaporate away, leaving a coating of oil or grease. Liquid (or bulk) products are either pure oils, or oils thinned in any of the solvents used in aerosol products.

The oils or greases used in aerosol multipurpose lubricants typically constitute 15 to 30 percent of the formulation by weight, although the percentage may fall outside this range (Survey). The oils typically consist of highly refined petroleum hydrocarbon mixtures. The mixtures contain primarily aliphatic or naphthionic (cyclic) hydrocarbon molecules with greater than 20 carbon atoms per molecule (Exxon). The oils are generally hydrotreated to remove aromatic hydrocarbons, and may also be treated to remove high molecular weight compounds such as waxes (Exxon; Radiator Specialty Company). The oils are generally chosen based on their viscosity (Exxon Fax). Synthetic lubricating oils are generally used only when necessary to obtain performance features that cannot be obtained in an oil refined from petroleum (Diversified Brands, January 17). Specialized extreme pressure (EP) lubricants may also be added in small amounts to multipurpose lubricants to enhance the ability of the primary lubricant to protect surfaces under high load conditions. These specialized lubricants include graphite, teflon (polytetrafluoroethylene), and “moly” (molybdenum disulfide). Multipurpose grease products contain various types of greases, which are oils thickened with a “metal soap” (such as lithium hydroxystearate) or a gelling agent (such as silica or clay). The oils used are typically mineral oils, and the thickeners are typically metal soaps based on lithium, calcium, or aluminum (Specialty Chemical Resources). The most common grease used is “lithium grease,” often referred to as “white grease.”

The solvents used in multipurpose lubricants typically constitute the majority of aerosol formulations. Various grades of petroleum distillates are the primary solvent in most multipurpose lubricants. Other solvents used in multipurpose lubricants include heptane, toluene, methylene chloride, perchloroethylene, and glycol ethers. Some products still contain 1,1,1-trichloroethane, although its use is diminishing due to the U.S. EPA's mandatory phase-out of production by 1995. In addition, some multipurpose grease products use a substantial amount of water as the carrier, along with a lesser amount of VOC solvent.

The propellants used in aerosol multipurpose lubricants are either liquefied petroleum gases (propane, isobutane, normal butane), or carbon dioxide. Liquefied petroleum gases typically constitute 20 to 30 percent of the product by weight, compared to two to three percent for carbon dioxide propellant.

Corrosion inhibitors may also be added to multipurpose lubricant formulations to prevent corrosion on the coated surfaces. These compounds are generally a small percentage of the overall formulation. Many of these compounds (for example, calcium dinonylnaphthalene sulfonate) prevent corrosion by adhering to metal surfaces and forming a barrier to water that is more effective than the lubricating oil alone (Lubrizol; Husk-Itt Corp.).

Proposed VOC Standard and Compliance:

A two-tiered VOC limit is proposed for multipurpose lubricants. An initial VOC limit of 60 percent by weight is proposed for January 1, 2002, with a future effective VOC limit of 45 percent for January 1, 2005. As shown in Table VI-20, using adjusted emissions, the proposed initial and future-effective standards will result in a total VOC reduction of approximately five thousand pounds per day. Table VI-20 also shows that about 11 percent of the multipurpose lubricant market currently meets the proposed 60 percent VOC limit, and about nine percent meets the proposed 45 percent future effective VOC limit. The complying products include multipurpose lubricants for both household and institutional (commercial) use. Although some of the complying products contain 1,1,1-trichloroethane, methylene chloride, or perchloroethylene, the proposed standards can be met without the use of these compounds. If multipurpose lubricants containing these compounds are removed from the survey data, the complying market shares remains at about 11 and nine percent for the proposed initial and future effective VOC limits, respectively.

Table VI-20
Multipurpose Lubricant*

Product Form	Proposed VOC Standard (wt. %)	Complying Products	Complying Market Share (%)	Emission Reductions (lbs./day)	Adjusted Emission Reductions (lbs./day)**
Aerosol	60 (2002)	51	8	1,900	2,200
Liquid	60 (2002)	23	28	200	200
Total	60 (2002)	74	11	2,100	2,400
Aerosol	45 (2005)	39	6.4	3,600	4,200
Liquid	45 (2005)	22	24	400	500
Total	45 (2005)	61	9.0	4,000	4,700

* Based on Mid-Term Measures 1994/1995 Consumer Products Survey. Excludes greases (but not grease-containing liquids and aerosols).

** Emission reductions adjusted for complete market coverage (see Chapter IV).

Initial 60 percent VOC Standard:

As shown in Table VI-20, 11 percent of the market currently meets the proposed 60 percent VOC limit. The complying products include products with 40 percent or more lubricating oils, water-based aerosol greases, and products using non-VOC solvents such as low vapor pressure volatile organic compound (LVP-VOC) solvents, 1,1,1-trichloroethane, or methylene chloride.

Since most noncomplying multipurpose lubricants already contain 15 to 30 percent non-VOC oil or grease, these products typically need to replace ten to 25 percent of their VOC solvents or propellants with non-VOC ingredients to reach the proposed 60 percent VOC limit. Reformulation options (excluding the use of methylene chloride, perchloroethylene, and 1,1,1-trichloroethane) include: (1) adding more lubricating oil to the formulation; (2) replacing some of the VOC solvents with LVP-VOC solvents, acetone, or water; and (3) replacing liquefied gas propellants with non-VOC propellants such as carbon dioxide or hydrofluorocarbon 152a (HFC-152a).

The first option is to use more lubricating oil. Some multipurpose lubricants comply with the proposed VOC standard solely because they have 40 percent by weight or more lubricating oils or greases (Zep; Premier Farnell; Diversified Brands, April 11). For some products (especially those with close to 40 percent oil or grease), increasing the concentration of oil or grease may be all that is necessary to achieve compliance. For other products, simply adding more of the same oil or grease already used in the formulation may result in a product that is more viscous than desirable. Adding more oil or grease to the formulation may also have a detrimental effect on the spray pattern, which may be difficult to overcome with a redesigned aerosol valve (LPS Labs, April 30). However, less viscous oils or greases may be substituted, or different solvents may be used to reduce the overall viscosity of the formulation and improve the spray pattern.

Another option is to use a moderate amount of non-VOC solvent such as an LVP-VOC solvent, acetone, or water. Some manufacturers are currently selling products that meet the future effective standard through the use of LVP-VOC solvents (LPS Labs, January 15; LPS Labs, March 25; CRC). The LVP-VOC solvents are high flash point (175 ^{o}F) hydrocarbon mixtures that have the advantage of being less flammable, and safe on sensitive plastics such as Lexan, Noryl, and polycarbonate (CRC). Disadvantages include higher cost and slower dry times. In addition, LVP solvents may not be an option for aerosol grease products which rely on fast drying solvents which allow the grease to quickly "set up" (LPS Labs, April 30). However, manufacturers of typical noncomplying formulations would only have to use about ten to 25 percent LVP-VOC solvents to comply with the proposed 60 percent VOC standard.

Acetone is a fast drying non-VOC solvent that is not currently used in multipurpose lubricants. However, acetone is used in some multipurpose dry lubricants (which are excluded from the multipurpose lubricants category), and may have the potential for use in some multipurpose lubricant products. Manufacturers have reported that they are not using it because of its flammability, potential damage to plastics and painted surfaces, strong odor, and higher cost (Petro Chemical; Specialty Chemical Resources; LPS Labs, April 18). However, for the reasons stated in the "Issues" section below, we believe that it is a viable option for use in some multipurpose lubricants.

Water is currently used as the carrier in some aerosol grease products. One manufacturer reported that their water-based white grease (which meets the proposed future effective 45 percent limit) has been sold for approximately 15 years, and is a popular product (Specialty Chemical Resources). The product is reportedly an "oil-out" emulsion, with the grease/solvent/liquefied hydrocarbon propellant as the continuous phase, and water dispersed as droplets within the continuous phase. Another option that is not currently being used by lubricants, is water with dimethylether propellant (LPS Labs, April 30). One disadvantage of water-based formulations is that they may require more development work to ensure that the formulation will not corrode the aerosol container. Water-based formulations may require the use of corrosion inhibitors, or other formulation techniques which lower the potential for corrosion (Rocafort).

Another option is to use a non-VOC propellant. Carbon dioxide is currently used in many multipurpose lubricants. However, since it is used at levels of only two to three percent by weight, the use of carbon dioxide alone will not result in a complying product unless the remainder of the product (the "concentrate") is only slightly above the proposed 60 percent VOC limit. However, the use of carbon dioxide along with other reformulation techniques can be used to formulate a complying product.

Hydroflurocarbon 152a (HFC-152a) is not currently used as a propellant in multipurpose lubricants due to its higher cost. However, it can be used to replace all or a portion of the hydrocarbon propellants in some multipurpose lubricants. The ability to use

HFC-152a in lubricants will depend, in part, on the solubility of the hydrocarbon lubricant base in HFC-152a (Du Pont; LPS, April 30).

Another option would be to use a lower percentage of a higher vapor pressure hydrocarbon propellant (such as A-85 or A-108) in place of a lower vapor pressure hydrocarbon propellant, such as A-46 (LPS, April 30). This option would achieve a modest reduction in VOC content if the difference in propellant is made up with a non-VOC solvent.

A final option is to use a combination of reformulation options to achieve compliance. For example, if a manufacturer is concerned about the cost of HFC-152a propellant, and the dry time of LVP-VOC solvents, they may combine the use of lower amounts of both HFC-152a and LVP-VOC solvents to achieve compliance.

Future Effective 45 percent VOC Limit:

As shown in Table VI-20, about nine percent of the market currently meets the proposed 45 percent VOC limit. The complying products contain non-VOC solvents such as LVP-VOC hydrocarbon solvents, water, methylene chloride, or 1,1,1-trichloroethane.

The compliance options for achieving the proposed 45 percent VOC limit are the same as those described for achieving the proposed 60 percent VOC limit, except that a greater proportion of the VOC ingredients would need to be replaced with non-VOCs. As mentioned before, most noncomplying multipurpose lubricants already contain 15 to 30 percent non-VOC oil. Therefore, to achieve the proposed 45 percent VOC level, manufacturers will need to replace 25 to 40 percent of the VOCs in multipurpose lubricants with non-VOC ingredients. The most likely reformulation options (excluding the use of methylene chloride, perchloroethylene, and 1,1,1-trichloroethane) include: (1) replacing a significant portion of VOC solvents with non-VOC solvents such as LVP-VOC hydrocarbon mixtures, acetone, or water; (2) use of HFC-152a propellant; and (3) combining more than one of the reformulation options mentioned for achieving compliance with the proposed 60 percent VOC limit. Most products will not be able to achieve compliance with the proposed 45 percent limit solely by increasing the concentration of grease or oil, or by using a carbon dioxide or higher pressure hydrocarbon propellant. We are proposing a future effective date of 2005 due to the increased challenge presented by the 45 percent VOC level. We are also proposing an annual reporting requirement to determine manufacturers' progress in achieving the proposed VOC limits.

Issues:

1. Issue: Some manufacturers may comply with the proposed standards by replacing VOC solvents with toxic air contaminants such as methylene chloride or perchloroethylene.

Response: We do not believe that there will be a large increase in the use of these compounds as a result of the proposed standards. Many manufacturers have stated that they will not use these compounds due to concerns about their toxicity, and due to the warning labels required by many states. In addition, some manufacturers have stated that they may not use methylene chloride in their products due to a new limit on the occupational exposure to methylene chloride recently adopted by the Occupational Safety and Health Administration (Federal Register). Specifically, one manufacturer expressed concerns about: (1) the cost of modifications potentially necessary to reduce worker exposure to methylene chloride at the "filling plants" where products are manufactured, and (2) the potential for industrial or institutional customers to discontinue purchasing products containing methylene chloride (Diversified Brands, May 1).

We will assess manufacturers' progress in attaining the proposed limits, as we have done for other consumer products regulated by the ARB. If our assessment determines that the use of toxic air contaminants is increasing, we will further evaluate the public health impacts as explained in Chapter VII, "Environmental Impacts."

2. Issue: Acetone is not as desirable as other solvents because: (1) it is flammable; (2) it damages some plastics, elastomeric materials, and painted surfaces; (3) it has a strong odor; and (4) it is more costly than other solvents.

Response: Before addressing each of the concerns above, it should be noted that acetone is used in many consumer products, including multipurpose dry lubricants, aerosol paints, and brake cleaners. While manufacturers have raised some concerns regarding its use, many of these concerns are less significant if acetone is not the primary solvent in the product. For example, a multipurpose lubricant formulation with 25 percent oil would typically only need 15 percent acetone to achieve the proposed 60 percent VOC limit (or 30 percent to achieve the proposed 45 percent level).

> Flammability: Although acetone is highly flammable, the petroleum-based solvents and propellants typically used in multipurpose lubricants are also highly flammable.
>
> Damage to plastics, elastomeric materials, and painted surfaces: We agree that exposure to acetone can damage some types of plastics, elastomerics, and painted surfaces, depending on the concentration of acetone and the duration of exposure. However, we do not agree that this makes acetone inappropriate for use in all multipurpose lubricants. Multipurpose lubricants currently contain many solvents that can damage the substrates mentioned (Cole-Parmer). For example, some multipurpose lubricant formulations contain methylene chloride, which is used as a paint stripper, and has a severe effect on many types of plastics and elastomeric materials (Cole-Parmer). Methylene chloride and other aggressive solvents are acceptable for use in some multipurpose lubricants because the products are not used on the materials mentioned, or because the concentrations used or duration of exposure are not sufficient to damage the materials.
>
> Odor: Acetone does have a strong odor. However, manufacturers have found it acceptable for use in a wide variety of consumer products, as mentioned above. In fact, acetone is even used in some cosmetic products, such as nail polish removers.
>
> Cost: The cost of acetone is about double the cost of some typical petroleum-based solvents used in multipurpose lubricants. However, it is not significantly more expensive than some of the other solvents currently used in multipurpose lubricants. The cost of acetone is about $0.39-$0.45 per pound, compared to $0.43 per pound for methylene chloride, about $0.32-0.39 per pound for LVP hydrocarbon solvents (depending on the type), and $0.32-$0.35 per pound for perchloroethylene (Chemical Market Reporter; Exxon, Fax).

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K. Non-Selective Terrestrial Herbicide (Non-Aerosols)

Product Category Description:

Non-selective terrestrial herbicides (non-selective herbicides) are pesticide products designed to kill all terrestrial (non-aquatic) plants in a treated area by disrupting one or more of a plant's vital metabolic processes. This category includes products used by household and institutional users. Institutional users include professional gardeners, forest workers, construction workers and professional pest control operators using these products in and around homes or institutional facilities such as hospitals and golf courses. This category does not include products designed solely for agricultural use.

All non-selective herbicides that are sold in California must be registered with the United States Environmental Protection Agency (U.S. EPA) according to the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), and the California Department of Pesticide Regulation (DPR).

As shown in Table VI-21a, according to the Air Resources Board's (ARB) Mid-term Measures 1994/1995 Consumer Products Survey (Survey), 38 products were sold in California in 1995. According to the Survey, Table VI-21b shows that 98 percent of these products were sold as emulsifiable concentrates to be diluted with water. Also, based on the Survey approximately 164,000 pounds of nonselective terrestrial herbicides were sold daily in California during 1995. According to the Survey, these products emitted about 860 pounds of volatile organic compounds (VOCs) per day. The VOC content of products reported in the Survey ranges from zero to 30 percent by weight with the sales weighted average VOC content being 0.5 percent by weight. The tables below do not include products in the solid form because there were only two solids reported in the Survey with negligible emissions.

Due to underreporting in the Survey, Table VI-21a also shows the adjusted VOC emissions. Using data from the U.S. EPA 1990 Consumer Products Survey and ARB's 1990 and 1991 Consumer Product Surveys, VOC emissions were raised to 6,800 pounds per day (see Chapter IV).

Table VI-21a
Nonselective Terrestrial Herbicides*

Product Form	Number of Products	Category Sales (lbs./day)	VOC Emissions (lbs./day)	Adjusted VOC Emissions (lbs./day)**
Liquid	31	150,401	854	6,732
Pump	7	13,595	8	68
Total	38	163,996	862	6,800

* Based on Mid-Term Measures 1994/1995 Consumer Products Survey.
** Survey emissions adjusted for complete market coverage (see Chapter IV).

Table VI-21b
Non-selective Terrestrial Herbicides *

Product Form	Number of Products	Category Sales (lbs./day)	VOC Emissions (lbs./day)	Adjusted VOC Emissions (lbs./day)**
Concentrate	26	149,524	841	6,188
Ready-to-Use	12	14,472	21	612
Total	38	163,996	862	6,800

* Based on Mid-Term Measures 1994/1995 Consumer Products Survey.
** Survey emissions adjusted for complete market coverage.

<u>Product Use and Marketing</u>:

As mentioned above, non-selective herbicides are used in both household and institutional settings to get rid of unwanted vegetation. These products can be divided into those that are applied to the leaves of existing vegetation and those that are applied to soil prior to the emergence of vegetation.

A homeowner will typically use a leaf applied nonselective herbicide to get rid of unwanted weeds around fences, driveways, walkways, trees, and flower beds around their home (Solaris, “Round-Up”). These products are sprayed directly on the unwanted weeds to kill the leaves as well as the roots. Examples of leaf applied products are Solaris RoundUp, Enforcer's Next Day and Spectracide Grass & Weed Killer. These products usually keep an area free of weeds for approximately sixty to ninety days (DPR, March 17).

These products break down quickly in the soil and do not affect untreated plants. Because these products breakdown quickly, children and pets can usually enter the sprayed area as soon as the spray has dried (Solaris, "Round-Up"). They are available in emulsifiable concentrates that are diluted with water or they can be purchased in a ready-to-use spray pump.

A homeowner will choose a soil applied product if they want total vegetation control for up to one year. These products sterilize the soil and are used when no vegetation growth of any kind is desired, such as underneath wood chip or rock ground covering.

Soil applied products are often used in institutional settings to control unwanted vegetation around hotels, golf courses, road sides and construction sites. Examples of soil applied products are Ortho TRIOX Vegetation Killer and K-GRO Vegetation Killer. These products are used to reduce maintenance costs, extend the life of pavement by preventing the breakup of pavement edges and reduce the fire potential of an area (PBI/Gordon, McEwan p.58).

Many soil applied products are emulsifiable concentrates that are diluted with water and will cover 100 to 400 square feet, depending on the dilution ratio used. These products are typically applied using a tank sprayer or a sprinkling can. The user is directed to apply the product until the ground is thoroughly saturated and follow this by wetting the ground so that the chemical will move into the root zone (Dexol).

Non-selective herbicides are found in most retail outlets including home and garden, grocery, hardware, drug stores, warehouse stores, mass merchandisers as well as certified pest control outlets.

Product Formulation:

Non-selective herbicides contain active ingredients that are toxic to plants and inert ingredients that carry the actives and are necessary to have an end-use product. The active ingredients only make up a small portion of the end-use products. Higher levels of active ingredients are usually present in concentrated products that are available in liquid and solid forms. Inert ingredients typically make up the majority of the formulation and most often depend on the solubility of the active ingredients. Liquid materials in which actives are dissolved are designed to achieve stability of the active ingredients, convenience in handling and application, and maximum killing power following application (Ross).

Active Ingredients

Plants are complex organisms with well-defined structures in which multitudes of vital processes take place in well ordered sequences. Some vital metabolic plant processes include photosynthesis, amino acid and protein synthesis, respiration, energy transfer and maintenance of membrane integrity. Other vital processes include growth, cell division, and transpiration.

Each active ingredient has a specific mode-of-action which is the overall manner in which a herbicide affects a plant at the tissue or cellular level. Herbicides with the same mode-of-action will have the same movement pattern and produce similar injury symptoms. As mentioned above, non-selective herbicides can be divided into those that are leaf applied and those that are soil applied (Ross, et al.). Below is a discussion of the product formulations for the leaf applied and the soil applied products.

<u>Leaf Applied</u>

Leaf applied products are absorbed by the foliage to kill the leaves and may move to the roots. These products are generally inactive in the soil and are typically water-based because the active ingredients are soluble in water (Survey; United Industries, April 23).

One very widely used leaf applied non-selective herbicide is glyphosate, an amino acid inhibitor. Glyphosate is absorbed by plant foliage and readily translocated in plants. Its use is limited to foliar applications because glyphosate is rapidly inactivated in the soil. These products inhibit synthesis of essential amino acids and promote destruction of photosynthetic pigments in the leaves (Ross, et al.).

Glyphosate is the active ingredient found in RoundUp (DPR Internet Site). These products come in ready-to-use and emulsifiable concentrates and they claim to eliminate any green unwanted vegetation by killing the root completely so unwanted weeds will not return. Glyphosate products are used in and around fences, trees, driveways, flower beds, walkways and shrubs. Their formula breaks down into naturally occurring materials and will not move in soil to untreated plants. Children and pets can enter a sprayed area as soon as the spray has dried (Solaris, “Round-Up”).

Another widely used active ingredient in leaf applied products is diquat dibromide. These products include Lilly Miller Knock Out and Dexol Weed & Grass Killer and claim to kill unwanted vegetation around buildings, along sidewalks, fences, patios, walkways and driveways on contact. Another active ingredient used in these products is diquat dibromide. These products have phytotoxic properties that are quickly inactivated on contact with the soil (Lilly Miller).

Finally, some leaf applied products contain potassium salts of fatty acids which do not move through the soil to injure nearby plants and include Safer Brand Superfast Weed & Grass Killer (Safer Brand).

<u>Soil Applied</u>

Soil applied nonselective herbicides are typically applied to bare soil. These products are readily absorbed by plant roots and move upward to kill the entire plant before it emerges (PBI/Gordon). Most of the soil applied products include some level of petroleum distillates in their formulation because many of the actives used in these products are not soluble in water. Sometimes specific hydrocarbons, such as toluene or xylene, are added to stabilize the solution of herbicides or make it more emulsifiable. Hydrocarbon-dissolved pesticides are usually diluted for application by adding measured amounts of water to form emulsions. Less lipophilic active ingredients are sometimes dissolved in mixtures of alcohols, glycols, ethers, or various chlorinated solvents. These could also enhance the absorbability of some herbicides (FAIRS, April 21).

One of the most widely used active ingredients in soil applied products is prometon. These products enter germinating seeds and the roots of established plants as well as tightly binding to the soil so that nothing can germinate and grow for up to a year (McEwan p.92, United Industries, April 23). Products containing prometon typically consist of petroleum distillates with a few having some low vapor pressure volatile organic compound (LVP-VOC) solvents. These products are typically used to cover 100 to 400 square feet depending on the dilution ratio used.

Other soil applied non-selective herbicides include sodium chlorate which is an effective non-selective top killer and sodium metaborates such as bromocil. These active ingredients are often included in formulations with other soil sterilant herbicides because their toxicity to soil microorganisms slows the degradation of other herbicides and extends their activity in the soil.

Inert Ingredients

As mentioned above, the primary purpose for the inert ingredients is to achieve stability of the active ingredients, convenience of handling and application and for maximum killing power. Some inert ingredients are included in the formulation at smaller amounts to improve an aspect of the herbicide's performance. These inert ingredients are called adjuvants and include surfactants and penetrants.

Some of the uses of surfactants are as emulsifying agents, wetting agents or spreaders, sticking agents, and drift control agents (FAIRS, December 13). For instance, the presence of hairs on the leaf may result in a herbicide not reaching the leaf surface but remaining suspended on the hairs. In such cases, the addition of a surfactant may be useful in reducing the surface tension of the water droplet and allowing it to spread through the hairs onto the leaf surface where it may be absorbed (Colvin).

Emulsifiers also serve to stabilize water-oil emulsions formed when water is added to four concentrated products. Chemically, they are like detergents and include long-chain alkyl sulfonate ethers of polyethylene glycol and polyoxyethylene oleate (FAIRS, April 21).

Penetrants facilitate the transfer of herbicides from the leaf surface to the interior tissues. Some are lipids while others are detergent in nature. Substances used include heavy petroleum oils and distillates, polyol fatty acid esters, polyethoxylated fatty acid esters, aryl alkyl polyoxyethylene glycols, alkyl amine acetate, alkyl aryl sulfonates, polyhydric alcohols, and alkyl phosphates (FAIRS, April 21).

Proposed VOC Standard and Compliance:

The proposed VOC limit for non-selective terrestrial herbicides is three weight percent. This limit is effective in 2003, one year after the year listed in the table of standards. The additional year is proposed to give companies additional time to complete their FIFRA and DPR registrations for reformulated products. Companies that want to sell new or reformulated products in California must register their products with both the U.S. EPA and DPR. The registration requires companies to submit results of efficacy and toxicological studies to demonstrate that the product can meet its label claims and will not present harmful effects to human health.

As shown in Table VI-22, using adjusted emissions, the proposed standard will result in VOC emission reductions of approximately 5,000 pounds per day.

Table VI-22
Non-selective Terrestrial Herbicides*

Product Form	Proposed VOC Standard (wt. %)	Complying Products**	Complying Market Share (%)	Emissions Reductions (lbs./day)	Adjusted Emissions Reductions (lbs./day)***
Non-Aerosols	3	30	96	660	5,220

* Based on Mid-Term Measures 1994/1995 Consumer Products Survey.
** Based on the minimum dilution ratio for concentrated products.
***Survey emissions adjusted for complete market coverage (see Chapter IV).

Below is a discussion of how the leaf applied and the soil applied products will comply with the proposed limit.

Leaf Applied

The leaf applied non-selective herbicides are primarily water-based products with zero VOC content and account for 94 percent of the market. The range in VOC content for the leaf applied products is zero to three percent, after dilution, with the average VOC content being zero percent (Survey). Therefore, all of these products currently comply with the proposed standard.

Soil Applied

It is primarily the prometon containing, soil applied non-selective herbicides that would have to reformulate to comply with the proposed three percent limit. These products range in VOC content from zero to thirty percent, after dilution, with an average VOC content of thirteen percent.

Products that currently comply with the proposed limit have similar formulations to the noncomplying products, however they are applied using a higher dilution ratio. Most manufacturers claim that they will use LVP-VOC solvents to meet the proposed limit (PBI/Gordon). LVP-VOC solvents are synthetically produced isoparaffinic solvents that often can be used in place of conventionally produced petroleum solvents (Exxon). There are already products on the market that contain a small amount of LVP-VOC solvents. These solvents are compatible with prometon, have low flammability and are safe on sensitive plastics. A disadvantage to using LVP-VOC solvents is their higher cost. However, manufacturers of typical non-complying formulations would only have to replace from one half to thirty percent of the petroleum distillates in their products with an LVP-VOC solvent to comply with the three percent limit.

Manufacturers could also use acetone to comply with the proposed limit because acetone is very phytotoxic. Disadvantages of using acetone include flammability, odor, potential damage to certain substrates and cost. Manufacturers have stated that most of these disadvantages can be dealt with and that acetone is a viable option for reformulation (United Industries, April 23).

In conclusion, manufacturers can continue making both leaf applied and soil applied products that are efficacious and acceptable to both the household and institutional users with technologies that are currently available. In addition, companies have until 2003 to explore ways to improve upon the current technologies to create new products that are efficacious and meet their needs.

Issues:

1. Issue: Industry representatives have pointed out that some of the soil applied non-selective herbicides contain prometon which is not soluble in water and the proposed VOC standard must take this into consideration. Also, the proposed VOC limit is based on all of the zero VOC products included in this category. To avoid basing the limit on low VOC products, industry has suggested that separate VOC limits be established for leaf applied and soil applied products.

Response: As mentioned above, prometon products are used for long term total vegetation control in both household and institutional settings. Most of these products are emulsifiable concentrates that are diluted with water before use. They typically cover from 100 to 400 square feet depending on the dilution ratio used and the results last up to one year. The proposed
three percent limit was established taking prometon products into consideration. Currently, there are a few soil applied products including products with prometon that comply with the proposed limit. It is not our intent to eliminate the use of any active ingredients in the products, and manufacturers claim that the three percent limit is feasible for the prometon products using LVP-VOC solvents or acetone (PBI/Gordon; United Industries April 23).

2. Issue: Acetone is not as desirable as other solvents because: (1) it is flammable; (2) it damages some plastics, elastomeric materials, and painted surfaces; (3) it has a strong odor; and (4) it is more costly than other solvents.

Response: Acetone is used in many consumer products, including multipurpose dry lubricants, aerosol paints, brake cleaners, and nail polish removers. Acetone may not be used in current non-selective herbicide formulations because it is more expensive than existing solvents with the desired characteristics. However, some manufacturers have mentioned acetone as a potential means of reformulating products to attain the proposed limit (United Industries, April 23). While manufacturers have raised some concerns regarding its use, many of these concerns are less significant if acetone is not the primary solvent in the product. For example, the acetone could be diluted with an LVP-VOC solvent or petroleum distillates to meet the three percent limit.

> Flammability: Although acetone is highly flammable, many existing nonselective herbicides containing petroleum distillate solvents such as kerosene are also highly flammable.
>
> Damage to plastics, elastomeric materials, and painted surfaces: Exposure to acetone can damage some types of plastics, elastomerics, and painted surfaces, depending on the concentration of acetone and the duration of exposure. However, non-selective herbicides currently contain many solvents that can damage the substrates mentioned. The only way acetone would come into contact with these surfaces would be due to accidental contact with sensitive surfaces (from overspray). This would not likely cause damage because: (1) acetone is only part of the formulation, (2) acetone evaporates very quickly, and (3) the exposure to acetone from overspray would be minimal.
>
> Odor: Acetone does have a strong odor. However, as mentioned above, acetone is currently used in many consumer products. In fact, acetone is the primary ingredient in many nail polish removers. It should also be noted that many non-selective herbicides based on petroleum solvents currently have very strong odors.
>
> Cost: Acetone is not significantly more expensive than some of the solvents currently used in other consumer products. The cost of acetone is about $0.39-$0.45 per pound, compared to $0.32 - $0.37 per pound for LVP-VOC. solvents, $0.85 -$1.25 per pound for xylene, and $0.85-$1.85 per pound for toluene (Chemical Market Reporter).

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L. Paint Remover or Stripper

Product Category Description:

Paint removers or strippers (strippers) are products which are used to remove paint, varnish, old finishes, or related coatings (coatings) from various surfaces. Strippers are typically blends of solvents that chemically dissolve or blister the coating without damaging the surface being stripped. This category includes products that are marketed for refinishing furniture. The stripper category does not include products that are labeled exclusively to remove graffiti from various substrates, multipurpose solvents, products designed to remove coatings from skin, or paint brush cleaners. Strippers are sold in aerosol, gel, and liquid formulations, but the majority of product sales are liquids (Survey).

Chemical strippers typically can be subdivided into the following four groups based on the active ingredients they contain: 1) methylene chloride (MeCl)-based; 2) caustic-based, 3) non-MeCl solvent-based products (solvent), and 4) alternative solvent systems (alternative solvent) (Old House Journal, 1991; Flexnor, 1990). No caustic strippers were reported in the Air Resources Board's (ARB) Mid-term Measures 1994/1995 Consumer Products Survey (Survey) so they will not be discussed in this chapter.

As shown in Table VI-23, according to our Survey, 72 products were sold in California in 1995 by 17 companies. Also based on the Survey, approximately 4,000 pounds of strippers were sold daily in California during 1995. According to the Survey, these products emitted about 1,700 pounds of volatile organic compounds (VOC) per day. The VOC content of products reported in the Survey ranges from 0 to 100 percent by weight with the sales weighted average VOC content being about 40 percent.

Table VI-23
Paint Remover or Stripper*

Number of Products	Category Sales (lbs./day)	VOC Emissions (lbs./day)	Adjusted VOC Emissions (lbs./day)**
72	4,260	1,720	4,000

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Survey emissions adjusted for complete market coverage (see Chapter IV).

Due to underreporting in the Survey, Table VI-23 also shows the adjusted VOC emissions. Using data from the U.S. EPA 1990 Consumer Product Survey and the ARB's 1990 and 1991 Consumer Product Surveys VOC emissions were raised to 4,000 pounds per day (see Chapter IV).

Product Use and Marketing:

Strippers are used in both household and institutional settings to remove coatings from surfaces. Most products can be used on a variety of substrates including metal, wood, and concrete. Some products specifically indicate that they should not be used on plastic or fiberglass surfaces (3M, Product label; Quest). Among the uses listed for strippers are removal of coatings from automotive parts, wood furniture, wood trims, wrought iron, toys, shutters, tile, glass, masonry, and wicker (Sherwin-Williams; Quest; CHEMSTRIP, 1992).

Products are marketed in a variety of ways. Some products target the do-it-yourself market and are designed with the homeowner in mind (3M, Product label). Other products are marketed specifically for refinishing furniture (Formby's Refinisher) and other products are marketed for automotive uses (Sherwin-Williams). A number of products are marketed as being safer for the user. These products typically do not contain MeCl or contain lower concentrations of MeCl (3M, Product label; Sherwin-Williams; Brulin, 1993; Bix, 1997).

Strippers are sold in building material stores and warehouses, paint stores, discount department stores, and automotive parts stores. Some products are also available in hobby and craft stores.

Caution should be used when working with any stripper. Regardless of the type of stripper chosen, it is essential to read and follow all instructions and safety precautions on the label. Each formulation of product has potential hazards associated with its use (U.S. Product Safety Commission, 1995). Some products contain solvents which are flammable and most products contain chemicals that can be hazardous if inhaled (Consumer Reports, 1991). Most manufacturers and literature recommend doing stripping operations outdoors, if possible. If a stripper is used indoors, it should only be used in a well ventilated area (3M, Product label; Flexnor, 1990; Center for Emissions Control; Old House Journal, 1991; U.S. Product Safety Commission, 1995; Klean-Strip). Most directions for use also suggest wearing chemical resistant gloves, safety goggles, and protective clothing (Consumer Reports, 1991; Center for Emissions Control; U.S. Product Safety Commission, 1995; Old House Journal, 1991). Product literature also cautions do-it-yourselfers against using strippers to remove lead-based paint. Professionals should be employed for removing lead-based paint (3M, Product label).

Before applying a stripper, drop cloths or paper should be put down to catch stripper drippings or coating sludge (Center for Emissions Control). When using a liquid stripper (most are thickened), shake the product well, open carefully to allow for release of pressure, and pour a minimum amount into a can or jar (3M, Product label; Flexnor, 1990; Old House Journal, 1991). Brush a thick coat of the stripper onto the article being stripped. Thicker coats of strippers will shorten the time needed to effectively remove the coating (3M, Product label; Klean-Strip). The user should leave the worksite area while the stripper is allowed time to work. The time necessary to strip a coating depends on the type of stripper selected and the type of coating to be removed. Generally, product labels will provide guidelines on how long it will take the stripper to be effective on various coatings (Old House Journal, 1991; 3M, Product label; Center for Emissions Control; Formby's Stripper). It is important that the stripper not evaporate or dry out (Flexnor, 1990). To prevent this, some products recommend that the stripper be covered with plastic wrap (3M, "Safest Stripper;" Klean-Strip). Once the stripper is applied the coating will start to blister, peel, or crack. After the recommended stripping time for a particular coating, test a small area by scraping gently with a putty knife or similar object. If the coating is thoroughly softened, continue scraping or wiping off the coating and dispose of the sludge properly (Old House Journal, 1991; Flexnor, 1990; Center for Emissions Control; Klean-Strip).

When using an aerosol stripper, the same cautions and directions are applicable as are used for liquid strippers except that the product is sprayed onto a surface rather than brushed. Typical directions recommend shaking the product, and while holding the can in an upright position, spraying at a distance of 4 to 10 inches from the surface, using a back-and-forth motion. A thick, but even coat should be applied (Quest; CHEMSTRIP, 1992).

Product Formulation:

Paint stripper formulations vary based on the active ingredient. In this section, the three types of formulations that will be described are MeCl strippers, solvent strippers, and alternative solvent strippers. The descriptions below relate to liquid forms of strippers. Aerosol forms of each stripper type are formulated similarly and contain hydrocarbon blends of propane, butane, and isobutane as propellants (Survey).

MeCl is the most effective stripping solvent available and has been the primary active ingredient in strippers for years (Flexnor, 1990). It is able to remove a variety of finishes and does so with speed and low flammability (Flexnor, 1990; Consumer Reports, 1991). However, because of the health hazards associated with MeCl use, some manufacturers have been reformulating to strippers that use less MeCl. While marketed as safer, solvent and alternative solvent strippers may be higher in VOC content, some are flammable, and some may require longer contact time with the coating to effectively remove it (Consumer Reports, 1991; BASF, 1990). Solvent formulations typically contain mixtures of acetone, alcohols, xylene, mineral spirits and toluene. Alternative solvent systems typically are mixtures of N-methyl pyrrolidone (NMP), dibasic esters (DBE), and glycol ethers (Survey; Flexnor, 1990). Water-based strippers formulated with DBE are also available (3M, 1996).

MeCl Strippers

MeCl-based solvent strippers are fast acting, effective stripping products that are effective on a wide variety of coating types (Flexnor, 1990). Because of its small molecular size, MeCl is able to rapidly penetrate through a coating. Once the MeCl is trapped between the coating and the surface, the coating blisters and swells. It is the pressure and tension caused by the swelling that releases the coating from the surface. Because the coating is not dissolved in the MeCl, it is unlikely to readhere to the surface (Monsanto). Other advantages of these products are that they typically are low in VOC and are non-flammable (Consumer Reports, 1991). However, other solvents blended with MeCl may lead to increased flammability in these products (Flexnor, 1990). As reported in the Survey, MeCl content ranges from 6 to over 94 percent by weight.

The primary disadvantage of MeCl-based strippers is that MeCl has been identified as a toxic air contaminant (ARB, 1989). The Occupational Safety and Health Administration (OSHA) in 1970 also established a standard to limit worker exposure to MeCl. At that time, the exposure limit was set at 500 parts per million (ppm) as an 8-hour time-weighted average (TWA). On January 10, 1997, OSHA revised the MeCl standard down from 500 to 25 ppm TWA (OSHA, 1997). It is too early to tell what affect the revised OSHA standard will have on the paint stripping industry. For more information on this topic please refer to Chapter VII of this report.

Because of the potential for evaporation of the MeCl before the coating is completely lifted, a small amount of paraffin wax (1 or 2 percent by weight) is often added to these strippers. The wax floats on the surface, forming a “cover” over the applied stripper which slows the evaporation rate of the MeCl (Old House Journal, 1991). This allows for more effective stripping action. Another solvent, such as toluene, is added to keep the wax in solution until the stripper is applied (Old House Journal, 1991).

Thickening agents, such as cellulose derivatives, are added to MeCl strippers to allow the stripper to cling to vertical substrates (Old House Journal, 1991). An example of a cellulose thickener is hydroxypropyl methylcellulose, a cellulose ether (BASF, 1990; DOW, Product Literature). Methyl alcohol is typically added to keep the cellulose in solution and may also help to partially solubilize the coating to increase stripper effectiveness (Old House Journal, 1991).

Occasionally, other diluent solvents, such as mineral spirits or xylene, may be added to MeCl strippers to reduce cost or to prevent coating sludge from drying before being scraped off (Old House Journal, 1991; BASF, 1990; Ashland, 1997; Bix, 1997).

Solvent Strippers

Solvent strippers typically contain blends of acetone, toluene, and methanol (Survey; Flexnor, 1990; U.S. Product Safety Commission, 1995). This type of stripper works from the surface of the coating to the substrate by dissolving the resins of the finish to be removed. In terms of health effects, these strippers are considered to be safer to use than MeCl-based strippers. However, if not used with proper ventilation, these solvents' vapors can be harmful. The disadvantages of these strippers are that they are flammable and may require longer contact time with the substrate to effectively remove the coating (Flexnor, 1990; Consumer Reports, 1991). Although they contain acetone, because of the toluene and methanol content, these strippers are typically higher in VOC content compared to most MeCl strippers (Survey). Solvent strippers may also blend xylene or naphtha into the formulation (Survey).

Like MeCl strippers, solvent strippers are thickened with cellulose derivatives and paraffin wax is added to form a "cover" to impede evaporation (Flexnor, 1990; Consumer Reports, 1991). Solvent strippers formulated in this way work almost as well as MeCl strippers (Flexnor, 1990).

Products labeled as "Refinishers" also are solvent strippers containing blends of acetone, toluene, and methanol. However, these products do not contain paraffin wax and hence evaporate rapidly (Survey; Flexnor, 1990). They are best at removing or redistributing shellac and lacquers (Flexnor, 1990; Formby's Refinisher).

Alternative Solvent Strippers

Alternative solvent strippers are based on N-methylpyrrolidone (NMP), dibasic esters (DBE), or a combination of these two solvents (Survey; Flexnor, 1990; 3M, 1996; Consumer Reports, 1991; BASF, 1990; Brulin, 1993). Strippers formulated with these chemicals are reportedly less toxic, and therefore, safer to use. They also have the advantage of low flammability. Nevertheless, precautions should still be taken when using these strippers and it is best to use them in well-ventilated areas (Old House Journal, 1991;

3M, “Safest Stripper;” U.S. Product Safety Commission, 1995). The disadvantages of alternative solvent strippers is that they typically require a longer contact time to effectively remove the coating from a surface and they cost more (Flexnor, 1990; Old House Journal, 1991; American Homeowner, 1990; Consumer Reports, 1991; U.S. Product Safety Commission, 1995; 3M, 1996; Monsanto). Alternative solvent strippers are thickened with cellulose derivatives (BASF, 1990). Most of these products contain slower evaporating solvents so it is not necessary to add paraffin to slow the evaporation rate (BASF, 1990; Flexnor, 1990).

DBE

DBE strippers are water-based products that work by dissolving the coating (Monsanto). This, combined with the longer substrate contact time needed may cause water damage to some surfaces if the user does not remove the sludge immediately after the stripping is complete (Flexnor, 1990). Advantages of using DBE strippers is their lower toxicity profile (Consumer Reports, 1991; Flexnor, 1990) and low VOC content (Survey). These strippers are low in VOC because most DBE mixtures are, by definition, low vapor pressure volatile organic compound (LVP-VOC) solvents (Survey; Monsanto). The primary DBEs used in strippers are dimethyl succinate (DMS), dimethyl glutarate (DMG), and dimethyl adipate (DMA), or blends of the three (Monsanto). Among DMS, DMG, DMA, and the commercially available blends of the three, all are LVP-VOCs except DMS (Monsanto). DBE strippers are quite effective at removing shellac and lacquers fairly quickly. To remove other finishes, or multi-layered finishes, DBE strippers tend to take several hours, or may take overnight (Old House Journal, 1991; Flexnor, 1990; 3M, “Safest Stripper;” Consumer Reports, 1991). In these situations, to prevent the stripper from drying out, the surface may be covered with plastic wrap (3M, “Safest Stripper”). The low volatility of the DBE prevents the coating from readhering to the surface before the coating sludge is removed (Monsanto). To remove finishes completely may also require some scrubbing (Flexnor, 1990; 3M, “Safest Stripper”).

NMP

NMP has recently gained popularity as a viable stripper solvent with manufacturers looking to formulate safer strippers (Flexnor, 1990; BASF, 1990). NMP strippers perform nearly as well as MeCl or solvent strippers, but likely will take slightly longer to remove the coating and are more expensive (Flexnor, 1990). Advantages of NMP include its low flammability and its miscibility with water (BASF, Product literature). NMP works by dissolving the coating (BASF, 1990). Chemically, NMP is a cyclic, organic amine, which is a VOC (BASF, Product Literature). Therefore, strippers containing this solvent are usually higher in VOC content (Survey).

NMP is typically blended with other solvents to produce an effective stripper (Survey; BASF, 1990; Monsanto). DBEs, other esters and glycol ethers are added to aid in stripping the coating (Survey; BASF, 1990). To lower the cost of NMP strippers, diluent solvents such as naphtha or water are often added (Survey; Ashland, 1997; BASF, 1990).

<u>Proposed VOC Standard and Compliance</u>:

We are proposing a two-tiered standard for strippers. As shown in Table VI-24 below, the proposed Tier I VOC limit for strippers is 65 percent by weight, effective in 2002. This standard will ensure that all current formulations can continue to be used and is not likely to lead to increased use of MeCl. A number of products that currently comply with the standard are used by both household and institutional consumers (Survey). Fifty-six products which account for over 96 percent of the market comply with the Tier I standard. As shown in Table VI-24, using adjusted emissions, the proposed Tier I standard will result in VOC emission reductions of approximately 100 pounds per day. Twenty-six percent of the market currently complies with the 65 percent standard without using MeCl in the formulation (Survey).

The proposed Tier II VOC limit for strippers is 50 percent by weight, effective in 2005. We believe manufacturers will be able to comply with this standard using chemicals that are currently available; it does not rely on any new technologies. Currently 35 products, representing over 38 percent of the market, would be in compliance with this proposed standard. Over 15 percent of the complying market currently meets the proposed Tier II standard without using MeCl. Also shown in Table VI-24 below, using adjusted emissions, the proposed Tier II standard will result in VOC emission reductions of approximately by 400 pounds per day.

Table VI-24
Paint Remover or Stripper*

	Proposed VOC Standard (wt. %)	**Complying Products**	**Complying Market Share (%)**	**Emissions Reductions (lbs./day)**	**Adjusted Emission Reductions (lbs./day)****
Tier I	65	56	96	40	100
Tier II	50	35	38	180	420

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Emission reductions adjusted for complete market coverage (see Chapter IV).

Strippers can be reformulated to meet the Tier II 50 percent VOC standard in several ways using technologies and raw materials that are currently available. Using exempt solvents such as acetone, LVP-VOC solvents, water, microemulsion solvents, NMP, and non-VOC propellants should allow the 50 percent standard to be achieved using no or small amounts of MeCl.

<u>Microemulsion Solvents</u>

"Microemulsion solvents" are available that are solvent-continuous microemulsions with high water content and low viscosity. The microemulsion solvent is not an active stripping agent, so active stripping solvents still need to be added. However, because the system is solvent continuous, the active stripping agent penetrates the coating normally, and less active stripping agent is needed (DOW, 1995). A number of solvents, including acetone, toluene, NMP, glycol ethers, MeCl, and naphtha, are soluble with microemulsion solvents (DOW, 1995).

An effective 50 percent VOC solvent stripper can be formulated with a blend of acetone, toluene, and methanol, in combination with a microemulsion solvent. Similarly, an alternative solvent stripper can be formulated with NMP and a microemulsion solvent to produce a stripper with a VOC content of 50 percent. The Survey indicates that these solvents are not presently used in strippers (Survey).

The MeCl concentration in strippers can also be reduced by using microemulsion solvents. For example, with a microemulsion solvent, an effective stripper can be formulated using only 20 percent of an active such as MeCl (DOW, 1995). This type of formulation would reduce the amount of MeCl used by three to four times that reported in the Survey and also would significantly reduce the end user’s exposure to MeCl (DOW, 1995; Survey). A cellulose thickener and paraffin wax may be added to prevent the stripper from running and evaporating off the substrate (DOW, Product Information).

Reformulating Alternative Solvent Strippers

As stated earlier, NMP is an effective solvent for stripping coatings (BASF, 1990). NMP has a low degree of flammability, a favorable toxicity profile compared to other active stripping agents, a fairly slow evaporation rate, and is miscible with water (BASF, 1990). NMP has very high solvent activity over a broad range of resins including epoxies, polyurethanes, alkyds, acrylics, and shellac (BASF, Product literature). To achieve the Tier II proposed standard of 50 percent, NMP can be formulated with a combination of LVP-VOC solvents such as DBEs and glycol ethers, to produce a low VOC stripper that is effective at removing a variety of coatings (Monsanto; BASF, 1990). In timed experiments, equal amounts of NMP, DBE, and tripropylene glycol methyl ether removed enamels in 5 minutes and polyurethane in 25 minutes (Monsanto). Acetone can also be added to improve the rate of removal activity, but will increase the flammability of the stripper (BASF, 1990).

Strippers using DBEs as the sole active ingredient are also available (3M, 1996; 3M, “Safest Stripper;” Old House Journal, 1991; Consumer Reports, 1991). Using water as the diluent, these strippers have VOC contents at or near zero percent (Survey). In addition to being less toxic for the user, these strippers are also non-flammable, biodegradable, and are water rinseable (3M, Product Literature; Old House Journal, 1991; 3M, “Safest Stripper”). The disadvantage is that a DBE-based stripper will require a longer contact time to effectively remove coatings (Old House Journal, 1991; 3M, “Safest Stripper;” Consumer Reports; 1991).

Non-VOC Propellants

Aerosol strippers that currently do not meet the proposed 65 percent standard or the Tier II proposed 50 percent standard can be reformulated much in the same way as liquid strippers. Aerosol strippers could also meet the proposed standards by using a non-VOC propellant such as hydrofluorocarbon 152a (HFC-152a), a hydrocarbon/HFC-152a blend, or a compressed gas such as carbon dioxide. Survey data indicate that carbon dioxide is not used extensively in consumer products (Survey), therefore, ARB staff believes that if formulators elect to reduce the VOC in their products by using a non-VOC propellant, HFC-152a is most likely to be chosen as a replacement. HFC-152a is compatible with a number of chemicals typically used in aerosol formulations and has been successfully used as a propellant for a number of years (Applegate). ARB staff acknowledges that HFC-152a is considerably more expensive than commonly used hydrocarbon propellants, and, therefore has set a proposed standard that is achievable using other technologies. One way to lower the cost associated with HFC-152a and still reduce VOC content would be to blend HFC-152a with hydrocarbon propellants (Applegate).

Issues:

1. Issue: MeCl is a toxic air contaminant that is an effective stripping solvent currently used in strippers. Setting a low VOC standard could result in increased use of this compound.

Response: In determining the proposed Tier I standard, we considered the possibility of increased use of MeCl. In light of this, we set the standard at a limit that is likely to result in no increased use of MeCl. Formulations of solvent and alternative solvent strippers reported in the Survey currently comply with the proposed Tier I standard of 65 percent. As stated earlier, 26 percent of products currently comply with the proposed Tier I standard without using MeCl. These data indicate that products without MeCl as the active stripping solvent are effective in stripping coatings. However, we are proposing an annual reporting requirement to determine manufacturers' progress in meeting the proposed standards without the use of MeCl.

In general, the products that do not currently meet the proposed standard are alternative solvent strippers. However, because complying alternative solvent strippers are currently available and used and accepted by consumers, non-complying products can be similarly reformulated without using MeCl.

The proposed Tier II standard is 50 percent in 2005. Prior to the Tier II standard becoming effective, we will be analyzing products available to ensure that the standard can be achieved without an increased use in MeCl. The 50 percent standard is achievable with raw materials currently available. Over 15 percent of products currently marketed comply with the proposed Tier II standard. It is also possible that new technologies will become available prior to the effective date of the standard.

2. Issue: Furniture refinishers should not be included in the "Paint Remover or Stripper" category.

Response: Furniture refinishers meet the definition for the "Paint Remover or Stripper" category in that they remove coatings from substrates through chemical action. Products identified as furniture refinishers currently comply with the proposed Tier I standard of 65 percent. Prior to the Tier II standard becoming effective, we will be analyzing products available to ensure that the standard can be achieved without an increased use in MeCl.

3. Issue: The health profile of NMP is incomplete. Its use should not be encouraged until the entire health profile is complete.

Response: A number of products that use NMP in the formulation currently would comply with the proposed standard of 65 percent. As described earlier in the chapter, other raw materials are available as reformulation options for non-complying products. NMP is one of several options available.

NMP currently is not included on any list of toxic chemicals. A number of studies regarding the safety of NMP have already been conducted (BASF, Product literature). We are also aware of additional health effects research being conducted. NMP manufacturers, with the approval of U.S. EPA, are conducting long-term studies with the goal of determining the overall health effects profile of NMP (Waldrop, 3/20/97). We will continue to monitor data that become available on potential health effects. The Tier II standard does not become effective until 2005. At such time, additional health effects studies should be complete. Depending on the available data, and the proposed annual reporting requirement to determine manufacturers' progress in meeting the proposed standards, we will determine if the proposed 50 percent standard is feasible without increased use of toxic air contaminants.

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M. Penetrants

Product Category Description:

Penetrants are lubricant products designed and labeled primarily to loosen metal parts that have bonded together due to rusting, oxidation, or other causes. This does not include "multifunctional" multipurpose lubricants, which typically function as penetrants, as well as lubricants, demoisturants, and rust-preventives (as described in the chapter on multipurpose lubricants). The penetrants category also does not include multipurpose lubricants that claim to have penetrating qualities, but are not labeled primarily to loosen bonded parts.

Table VI-25 below summarizes the sales and emissions from penetrants, based on the results of Air Resources Board's (ARB) Mid-term Measures 1994/1995 Consumer Products Survey (Survey). As shown in Table VI-25, according to our Survey, 100 penetrant products were sold in California in 1995. Also, based on the Survey, approximately two thousand pounds of penetrants were sold daily in California in 1995. According to our Survey, these products emitted about one thousand pounds of VOCs per day.

According to the ARB mid-term measures survey, approximately 83 percent of the penetrant market, and 86 percent of the VOC emissions, are contributed by aerosols. The sales-weighted average VOC content for penetrants is about 58 percent, with about 59 percent for aerosols, and 55 percent for liquids.

Due to underreporting in the Survey, Table VI-25 also shows the adjusted VOC emissions. Using data from the U.S. EPA 1990 Consumer Products Survey and ARB's 1990 and 1991 Consumer Product Surveys, VOC emissions were raised to about 1,100 pounds per day (see Chapter IV).

Table VI-25
Penetrants*

Product Form	Number of Products	Category Sales (lbs./day)	VOC Emissions (lbs./day)	Adjusted VOC Emissions (lbs./day)**
Aerosol	84	1,500	880	950
Liquid	16	260	140	150
Total	100	1,800	1,020	1,100

* Based on Mid-Term Measures 1994/1995 Consumer Products Survey.
** Survey emissions adjusted for complete market coverage (see Chapter IV).

Product Use and Marketing:

Penetrants are used by household, institutional, and industrial users to loosen immovable parts such as rusted pipe fittings, automotive parts, and nuts and bolts. Some product labels instruct the user to tap the immovable parts to set up vibrations that assist in the penetration of the product (Radiator Specialty Company). After the product has been allowed to penetrate, the user will try to disassemble the immovable parts or mechanisms, and repeat the application of the product if necessary.

Penetrants are sold in hardware stores, automotive parts stores, by specialty retailers, and by mass merchandisers. Penetrants are also sold to industrial or institutional users through distributors that serve these customers, or directly to large customers.

Product Formulation:

Penetrant formulations are similar to “multifunctional” multipurpose lubricants (see section on multipurpose lubricants). Solvent-based penetrants typically contain light petroleum oils dissolved in a petroleum or chlorinated solvent, with a liquefied petroleum gas or carbon dioxide propellant. Unlike multifunctional multipurpose lubricants, however, some penetrants utilize water-based formulations.

Solvent-based penetrants contain a balance of solvents and oils in order to achieve both low viscosity and low surface tension. One manufacturer reported that penetrant formulations are generally “water-thin” (water has a viscosity of about 1 centipoise), and utilize solvents with surface tensions well below 30 dynes per centimeter, with the exception of water (LPS Labs, April 18). Water has a surface tension of about 73 dynes per centimeter (Weast). However, manufacturers can add wetting agents to water to reduce its surface tension (NCH; LPS Labs, April 18). According to the Survey, the solvents used in penetrants include various grades of petroleum distillates (such as kerosene), perchloroethylene, water, ethyl acetate, 2-butoxyethanol, methylene chloride, trichloroethylene, and 1,1,1-trichloroethane.

Proposed VOC Standard and Compliance:

A two-tiered VOC limit is proposed for penetrants, the same as for multipurpose lubricants. An initial VOC limit of 60 percent by weight is proposed for January 1, 2002, with a future effective VOC limit of 45 weight percent for January 1, 2005. As shown in Table VI-26, using adjusted emissions, the proposed initial and future-effective VOC standards will result in a total VOC emission reduction of approximately 300 pounds per day. Table VI-26 also shows that over half of the penetrants market currently meets the proposed 60 percent VOC standard, and about 37 percent currently meets the proposed 45 weight percent future effective standard. The complying products include both household and institutional (commercial) products. Although some of the complying products contain 1,1,1-trichloroethane, methylene chloride, or perchloroethylene, the proposed standards can be met without the use of these compounds. If penetrant products containing these compounds are removed from the survey data, about 53 percent of the penetrants comply with the 60 percent standard, and about 34 percent of the penetrants comply with the 45 percent standard (Survey).

Table VI-26
Penetrants*

Product Form	Proposed VOC Standard (wt %)	Complying Products	Complying Market Share (%)	Emission Reductions (lbs/day)	Adjusted Emission Reductions ** (lbs/day)
Aerosol	60 (2002)	35	55	140	160
Liquid	60 (2002)	9	55	<20	<20
Total	60 (2002)	44	55	140	160
Aerosol	45 (2005)	24	43	260	280
Liquid	45 (2005)	6	2	20	20
Total	45 (2005)	30	37	280	300

* Based on Mid-Term Measures 1994/1995 Consumer Products Survey.

** Emission reductions adjusted for complete market coverage (see Chapter IV).

Initial 60 percent VOC Standard:

As shown in the Table VI-26, over half of the penetrants market currently meets the proposed 60 percent VOC limit. The complying products include products with 40 percent or more LVP oils, and products using non-VOC solvents such as water, low vapor pressure volatile organic compound (LVP-VOC) solvents, perchloroethylene, 1,1,1-trichloroethane, or methylene chloride.

Since most noncomplying penetrants already contain at least ten percent non-VOC oil, most products will have to replace up to 30 percent of their VOC solvents or propellants with non-VOC compounds in order to reach the proposed 60 percent VOC level. Reformulation options (excluding the use of methylene chloride, perchloroethylene, and

1,1,1-trichloroethane) include: (1) adding more oil to the formulation; (2) replacing some of the VOC solvents with LVP-VOC solvents, acetone, or water; and (3) replacing liquefied gas propellants with non-VOC propellants such as carbon dioxide or hydrofluorocarbon 152a (HFC-152a).

The first option mentioned is to use more oil. Some penetrants comply with the proposed VOC standard solely because they have 40 percent by weight or more LVP oil (Brulin). For products with close to 40 percent oil, increasing the concentration of oil may be all that is necessary to achieve compliance. For most penetrants, simply adding more of the same oil already used in the formulation will result in a product that is too viscous for rapid penetration or results in a poor spray pattern. However, less viscous oils may be substituted, or different solvents may be used to reduce the overall viscosity of some penetrant formulations.

Another option is to replace some of the VOC solvent with an LVP-VOC hydrocarbon solvent. One manufacturer reported that their penetrant product (which complies with the 45 percent future effective standard) has been based on LVP-VOC solvents for at least 20 to 30 years, and is less flammable than products using conventional hydrocarbon solvents (LPS Labs, January 15; LPS Labs, March 25). Another manufacturer reported that they have already developed a prototype complying formulation with an LVP-VOC solvent that has performance close to that of the original noncomplying product (CRC).

Acetone is a fast drying non-VOC solvent that is not currently used in penetrants, but is currently used in some multipurpose dry lubricants. Although there are some concerns regarding its use (see “issues” below), some manufacturers have reported that acetone may have potential for use in reformulating some lubricant products (LPS Labs, April 18; Specialty Chemical Resources).

Water is currently used along with VOC solvents in some penetrant products. One manufacturer is currently selling a liquid formulation that meets the proposed 45 percent VOC limit, and is based on water, a glycol ether solvent, wetting agents to reduce surface tension, and water-soluble corrosion inhibitors (NCH). Another manufacturer is currently selling an aerosol penetrant that complies with the 60 percent VOC limit using water, a variety of VOC solvents, a corrosion inhibitor, colloidal graphite, and a compound that chemically dissolves rust (Guardsman Products). Another reformulation option that is not currently being used by lubricants, is water with dimethylether propellant (LPS Labs, April 30). One disadvantage of water-based formulations is that they may require more development work to ensure that the formulation will not corrode the aerosol container. Water-based formulations may require the use of corrosion inhibitors, or other formulation techniques which lower the potential for can corrosion (Rocafort).

Another option is to use a non-VOC propellant. Carbon dioxide is currently used in many multipurpose lubricants. However, since it is typically used at levels of only two to three percent by weight, the use of carbon dioxide alone will not result in a complying product unless the remainder of the product (the “concentrate”) is only slightly above

60 percent VOC. However, manufacturers can use a carbon dioxide propellant, along with other reformulation techniques, to formulate a complying product.

Hydroflurocarbon 152a (HFC-152a) is not currently used as a propellant in penetrants. However, it can be used to replace all or a portion of the hydrocarbon propellant in some multipurpose lubricants. The ability to use HFC-152a in lubricants will depend, in part, on the solubility of the particular hydrocarbon lubricant base in HFC-152a (Du Pont, May 6; LPS Labs, April 30).

Another option would be to use a lower percentage of a higher vapor pressure hydrocarbon propellant (such as A-85 or A-108) in place of a lower vapor pressure hydrocarbon propellant, such as A-46 (LPS Labs, April 30). This option would achieve a modest reduction in VOC content if the difference in propellant is made up with a non-VOC solvent.

A final option is to use a combination of the reformulation options mentioned above to achieve compliance. For example, if a manufacturer is concerned about the cost of HFC-152a propellant, and the viscosity of LVP solvents, they may use lower amounts of both HFC-152a and LVP-VOC solvents to achieve compliance.

Future Effective 45 percent VOC Limit:

As shown in Table VI-26, about 37 percent of the market currently meets the proposed 45 percent future effective VOC limit. The complying products utilize a high percentage of LVP oils, or non-VOC solvents such as water, LVP-VOC solvents, perchloroethylene, 1,1,1-trichloroethane, or methylene chloride.

The compliance options for achieving the proposed 45 percent VOC limit are the same as those described for achieving the proposed 60 percent VOC limit, except that a greater proportion of the VOC ingredients will need to be replaced with non-VOCs. As mentioned before, most noncomplying penetrants already contain at least 10 percent non-VOC oil. Therefore, to achieve the proposed 45 percent VOC level, manufacturers will need to replace up to 45 percent of the VOCs in the formulation with non-VOC ingredients. The most likely reformulation options (excluding the use of methylene chloride, perchloroethylene, and 1,1,1-trichloroethane) include: (1) replacing a significant portion of VOC solvents with non-VOC solvents such as LVP-VOC hydrocarbon solvents, acetone, or water; (2) using HFC-152a propellant; and (3) combining more than one of the reformulation options mentioned for achieving compliance with the proposed 60 percent VOC limit. Most products will not be able to achieve compliance with the proposed 45 percent VOC limit solely by increasing the concentration of oil, or by using a carbon dioxide or higher pressure hydrocarbon propellant. We are proposing a future effective date of 2005 due to the increased challenge presented by the 45 percent VOC level. We are also proposing an annual reporting requirement to determine manufacturers' progress in achieving the proposed VOC limits.

Issues:

1. Issue: Some manufacturers may comply with the proposed standards by replacing VOC solvents with toxic air contaminants such as methylene chloride or perchloroethylene.

Response: We do not believe that there will be a large increase in the use of these compounds as a result of the proposed standards. Many manufacturers have stated that they will not use these compounds due to concerns about their toxicity, and due to the warning labels required by many states. In addition, some manufacturers have stated that they may not use methylene chloride in their products due to a new limit on the occupational exposure to methylene chloride recently adopted by the Occupational Safety and Health Administration (Federal Register). Specifically, one manufacturer expressed concerns about: (1) the cost of modifications potentially necessary to reduce worker exposure to methylene chloride at the "filling plants" where products are manufactured, and (2) the potential for industrial or institutional customers to discontinue purchasing products containing methylene chloride (Diversified Brands, May 1).

We will assess manufacturers' progress in attaining the proposed limits, as we have done for other consumer products regulated by the ARB. If our assessment determines that the use of toxic air contaminants is increasing, we will further evaluate the public health impacts as explained in Chapter VII, "Environmental Impacts."

2. Issue: Acetone is not as desirable as other solvents because: (1) it is flammable; (2) it damages some plastics, elastomeric materials, and painted surfaces; (3) it has a strong odor; and (4) it is more costly than other solvents.

Response: Acetone is used in many consumer products, including multipurpose dry lubricants, aerosol paints, and brake cleaners. Acetone may not be used in current penetrant formulations because it is more expensive than existing solvents with the desired characteristics. Also, as stated in this chapter, some manufacturers have mentioned acetone as a potential means of reformulating some lubricants to attain the proposed standards. Therefore, it may be an option for some penetrant products. While manufacturers have raised some concerns regarding its use, many of these concerns are less significant if acetone is not the primary solvent in the product. For example, a penetrant formulation with 20 percent oil would typically only need 20 percent acetone to achieve the proposed 60 percent VOC limit (or 35 percent acetone to achieve the 45 percent VOC limit).

Flammability: Although acetone is highly flammable, many existing penetrants containing petroleum distillate solvents such as kerosene, and liquefied petroleum gas propellants such as propane and butane, are also highly flammable.

Damage to plastics, elastomeric materials, and painted surfaces: We agree that exposure to acetone can damage some types of plastics, elastomerics, and painted surfaces, depending on the concentration of acetone and the duration of exposure. However, we do not agree that this makes acetone inappropriate for use in penetrants. Penetrants currently contain many solvents that can damage the substrates mentioned

(Cole-Parmer). For example, some penetrants contain methylene chloride, which is used as a paint stripper, and has a severe effect on many types of plastics and elastomeric materials (Cole-Parmer). In addition, penetrants are primarily used on rusted metal parts like nuts and bolts, not on sensitive surfaces like plastics and painted surfaces. Accidental contact with sensitive surfaces (from overspray) would not likely cause damage because: (1) acetone is only part of the formulation, (2) acetone evaporates very quickly, and (3) the exposure to acetone from overspray would be very light.

Odor: Acetone does have a strong odor. However, manufacturers have found it acceptable for use in a wide variety of consumer products, as mentioned above. In fact, acetone is even used in some cosmetic products, such as nail polish removers. In addition, many of the petroleum based solvents used in penetrants (such as kerosene) have strong odors.

Cost: Acetone is not significantly more expensive than some of the solvents currently used in penetrants. The cost of acetone is about $0.39-$0.45/gallon, compared to $0.43 per pound for methylene chloride, and $0.32-$0.35 per pound for perchloroethylene (Chemical Market Reporter).

3. Issue: LVP hydrocarbon solvents may not be as effective as lower molecular weight hydrocarbon solvents because their viscosity and surface tension are too high for effective penetration.

Response: Manufacturers indicate that effective products can be made using LVP solvents. For example, one manufacturer is currently using a formulation that complies with the proposed 45 percent VOC limit, and is based on a LVP hydrocarbon solvent. The manufacturer uses specialized surfactants to increase the penetration of the formulation (LPS Labs, April 18). Another manufacturer has already formulated a prototype penetrant formulation that meets the proposed future effective 45 percent VOC standard using LVP solvents. According to the manufacturer, the formulation has efficacy close to that of the original noncomplying formulation (CRC).

4. Issue: It can be difficult to distinguish between penetrants and “multifunctional” multipurpose lubricants (as described in the “Multipurpose Lubricants” chapter).

Response: We agree that it can be difficult in some cases to distinguish between these two categories. Multifunctional multipurpose lubricants are formulated similarly to penetrants, and are generally labeled for use as penetrants as well as lubricants (and for displacing moisture and preventing corrosion). In addition, penetrants often make lubrication claims. However, since the proposed VOC limits are identical for these two categories, we do not expect difficulties to arise in interpreting the requirements of the proposed amendments.

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N. Rubber and Vinyl Protectant

Product Category Description:

Rubber and vinyl protectants are products designed to protect, preserve or renew vinyl and rubber substrates on the interior and exterior of a vehicle as well as rubber and vinyl items around the home. Some of these products are labeled to clean and protect rubber and vinyl, whereas other products are designed to exclusively protect rubber and vinyl. Rubber and vinyl protectants guard against fading, cracking, and drying caused by age, environmental pollution, and the sun's ultraviolet (UV) rays. These products are used on items such as automobile tires, dashboards, splash guards, bumpers, vinyl seats as well as household items including vinyl furniture, purses, and luggage.

This category also includes tire dressings which are products designed and labeled to clean and shine automobile tires, however they can often be used on other rubber and vinyl components. These products weatherproof and remove dirt and road grime from tires as well as provide protection against drying, cracking, and fading.

The rubber and vinyl protectant category does not include products primarily designed to clean the wheel rim, such as aluminum or magnesium wheel cleaners, and tire cleaners that are designed to exclusively clean the tire without leaving a protective coating.

As shown in Table VI-27, according to the Air Resources Board's (ARB) Mid-term Measures 1994/1995 Consumer Products Survey (Survey), 92 products were sold in California in 1995. Also, based on the Survy, approximately 20,000 pounds of rubber and vinyl protectants were sold daily in California during 1995. According to the Survey, these products emitted almost 2,000 pounds of volatile organic compounds (VOCs) per day. However, these emissions may have increased since the Survey was conducted due to the introduction and increased sales of solvent-based products (No Touch, May 29). The VOC content of the aerosol products reported in the Survey ranges from zero to 95 percent by weight with the sales weighted average VOC content being 15 percent by weight. The VOC content of the non-aerosol products which includes liquids and pumps is zero to 100 percent by weight with the sales weighted average VOC content being eight percent by weight.

Due to underreporting in the Survey, Table VI-27 also shows the adjusted VOC emissions. Using data from the U.S. EPA 1990 Consumer Products Survey and ARB's 1990 and 1991 Consumer Product Surveys, VOC emissions were raised to almost 3,000 pounds per day (see Chapter IV).

Table VI-27
Rubber and Vinyl Protectant*

Product Form	Number of Products	Category Sales (lb./day)	VOC Emissions (lbs./day)	Adjusted VOC Emissions (lbs./day)**
Aerosol	24	4,919	700	1,079
Liquid	50	3,199	900	1,373
Pump	18	12,053	240	366
Total	92	20,171	1,840	2,818

* Based on Air Resources Board Mid-term Measures 1994/1995 Survey.
** Emissions adjusted for complete market coverage (see Chapter IV).

Product Use and Marketing:

Rubber and vinyl protectants are used in both household and institutional settings and are available in liquid, aerosol, and pump spray dispensers. Institutional settings include car washes, professional automotive detailers, automotive repair shops, restaurants, hospitals, and schools.

Rubber and vinyl protectants are intended to extend the life and luster of rubber and vinyl components on the interior and exterior of an automobile. Both the institutional and household markets use these products to revitalize the appearance of leather and vinyl items on automobiles such as tires, bumpers, door moldings, and dashboards. Currently, most automotive manufacturers mold UV protectants and plasticizers directly into the rubber and vinyl components on their new cars. The protectants that are molded into the components inactivate over time, however the owner can prolong the life and luster of the rubber and vinyl components by topically replacing these protectants on a regular basis.

Rubber and vinyl protectants also enhance the gloss of vinyl and rubber as well as wood, leather and plastic. A household user may also find these products useful for cleaning and protecting vinyl and leather items around the home such as luggage, lawn furniture, vinyl seat covers and purses. They restore gloss to weathered and oxidized surfaces, increase resistance to dulling, cracking and hardening and protect and preserve beauty of interior and exterior surfaces (Malco). These products restore gloss and oils lost to evaporation as well as making the items easier to clean in the future. Some users prefer the gloss to be natural in appearance whereas other users may prefer a very glossy shine. Some products provide a more natural looking shine whereas solvent-based products claim to provide a “wet” glossy shine.

Although most of the rubber and vinyl components in an automobile can be effectively cleaned with ordinary soap and water, most professional detailers do not recommend this. They suggest using one of the many vinyl cleaners on the market, either a combination cleaner and protectant or a cleaner followed by a protectant (Storer et.al.).

Before applying a rubber and vinyl protectant, the surface should be clean and dry. The liquid or pump spray rubber and vinyl protectant should be worked into the material with a clean cloth or brush using a circular motion, allowed to dry and then buffed off with a dry towel. The oils in the products can often leave some surfaces slippery, therefore, many products warn users against applying rubber and vinyl protectants on seats, pedals or floors for safety reasons. If a surface is particularly sun-faded, it is sometimes beneficial to apply the protectant and allow it to sit on the substrate overnight and then buff it the next day to provide extra protection (Storer, et al.). Aerosol products are used for quick, convenient cleaning and they often require no wiping once they are applied (Armor All, "Tire Foam").

Rubber and vinyl protectants are sold in auto supply stores, hardware stores, drug stores, grocery stores, mass merchandisers, car dealerships and car detailing shops.

Product Formulation:

Rubber and vinyl protectants are available in both water-based and solvent-based formulations and both types of products claim to protect against sun, heat, cracking and fading. Most of the water-based aerosol and non-aerosol products comply with the proposed VOC limits and are accepted by both household and institutional users based on their large complying marketshare (Survey). However, manufacturers of the solvent-based products claim that their products protect and shine rubber and vinyl to a greater extent and last much longer than the water-based products (Blue Coral).

Both the water-based and solvent-based products have similar active ingredients, the difference is their carrier. These active ingredients include silicone oil which remains on the surface to provide a shiny appearance, plasticizers which restores the flexibility of plastic as it ages and protects vinyl against premature cracking and drying and UV protectants to provide protection from the sun's UV rays. The formulation for the aerosol products is similar to the non-aerosols except the aerosol formulations include propellants such as propane and isobutane (Survey).

The active ingredients make up a small portion of the total product, with the majority of the product being the carrier. In the case of water-based products, the carrier is water and they typically have a VOC content less than three weight percent. Water-based products also contain emulsifiers (surfactants) that provide some cleaning action and aid in dissolving the silicone oil. Due to the emulsifiers, these products typically have a white, milky appearance when they are applied and may take up to 15 minutes to dry and develop a shine.

The solvent-based products contain up to 100 percent petroleum distillates or mineral spirits which function as both active ingredients and carriers. Some solvent-based products also contain UV protectants, plasticizers and free radical scavengers which give the cleaned surface longer lasting protection and more shine (Blue Coral; Blue Coral, April 18). These UV protectants and free radical scavengers are not compatible with water-based systems because they can not be solubilized with emulsifiers (Blue Coral, April 18). The solvent-based products give the rubber or vinyl a "wet look" high gloss shine to tires, dashboards, vinyl and rubber trim and contain no water (Blue Coral). These products have a clear appearance when they are applied so that the user will immediately see a glossy shine.

Proposed VOC Standard:

The proposed VOC limit for the aerosol rubber and vinyl protectants is ten weight percent, effective in 2005. The proposed VOC limit for non-aerosol products is three weight percent, effective in 2000. We believe these VOC limits are feasible based on technology that is currently available. As mentioned above, most of the water-based non-aerosol products comply with the proposed limits and represent 87 percent of the market. It is primarily the solvent-based aerosol and non-aerosol products that will have to reformulate to meet the proposed VOC limits. Companies can meet these limits using water, low vapor pressure volatile organic compound (LVP-VOC) solvents and volatile methyl siloxanes (VMS).

As shown in Table VI-28, using adjusted emissions, the proposed standard will result in VOC emission reductions of approximately 2,000 pounds per day.

Water-based Products

Water-based non-aerosol products have been successfully dominating the rubber and vinyl protectant market for quite some time. Water-based products fundamentally serve the same functions as the solvent-based products and they have high product performance, good value, low VOCs and minimal environmental impacts. Water-based products are widely used and accepted in both the institutional and household markets. These products claim to guard against discoloration, protect dashboards from cracking and restore the new look instantly. These products are non-toxic and may contain no alcohol or solvents (Armor All, "Protectant"). They have excellent performance and high durability (Armor All, November 22). The durability of a product can vary depending on the substrate it is used on and whether that substrate is on the interior or exterior of a vehicle (No Touch, May 29). These products also rejuvenate and protect vinyl, plastic, rubber and finished wood, beautify surface luster and color, help prevent rotting, cracking and dulling, protects against water, oxidation, and extreme heat or cold and contain no corrosive chemicals (Chemsearch). In addition, new technologies are being developed to improve water-based products (Armor All, November 22). However, many water-based liquid products may not have the same "wet" glossy shine and their protection may not last as long there are aerosol products currently on the market that do produce this wet look such as "No Touch Wet N' Protect" tire cleaner (No Touch, May 29). A typical complying water-based non-aerosol product has 60 to 90 percent water, zero to 40 percent silicone oil and zero to three percent solvent. A typical complying water-based aerosol product has the same formulation with five to ten percent hydrocarbon propellant.

LVP-VOC Solvents

Manufacturers could also use LVP-VOC solvents to comply with the proposed limits. LVP-VOC solvents are synthetically produced isoparaffinic solvents that often can be used in place of conventionally produced petroleum solvents (Exxon). A company could replace some or all of the petroleum distillates in their product with LVP-VOC solvents or they could use a mixture of water, LVP-VOC solvents and VMS to meet the proposed limit. Some manufacturers claim that the dry time is too slow with these products and the excess will splash off or attract dirt, however users typically wipe off the excess and the dry time is not slower than water. Currently, there are products on the market the meet the proposed limit using LVP-VOC solvents. These products have a clear appearance when they are applied and dry quickly.

VMS

Finally, companies could use VMS to comply with the proposed limits. Currently companies use di-methyl silicone in their products to produce the shiny appearance not VMS. VMS would be a viable option for reformulating the solvent-based products to allow manufacturers to maintain their product's clear appearance as well as provide the wet look of the current solvent-based products (Armor All, May 6). The disadvantage to using VMS is its high cost, however it could be used along with an LVP-VOC solvent to decrease the amount used in a product. It may also be a good option for companies that have products with a VOC content close to the proposed limit. For example, formulations that consist of three to twenty percent VOC could replace a small amount of the VOC solvent in their product with VMS along with water or LVP-VOC solvents to meet the proposed VOC limit.

Table VI-28
Rubber and Vinyl Protectant*

Product Form	**VOC Standard (wt%)**	**Complying Products**	**Complying Market Share**	**Emission Reductions (lbs./day)***	**Adjusted Emission Reductions (lbs./day)****
Aerosol	10	7	16	220	460
Non-aerosol	3	40	87	1,080	1,680
Total	--------	47	---------	1,300	2,140

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Emissions adjusted for complete market coverage (see Chapter IV).

Issues:

1. Issue: Non-aerosol, solvent-based products should have a separate VOC limit from the water-based products because they have UV protectors, oxygen scavengers and plasticizers which make them unique. If a higher VOC limit for these products is not proposed, a product form will be eliminated.

Response: Water-based products dominate the market and are accepted and used by both household and institutional users. Most water-based products also have UV protectors and plasticizers to guard against discoloration and cracking, and they restore rubber and vinyl to look like new.

Setting a three percent VOC limit would not eliminate a product type because both the water-based and the solvent-based products are designed to perform the same function, i.e., protect and revitalize rubber and vinyl surfaces.

2. Issue: One manufacturer would like a separate product category based on the the level of UV protection the products provide, the existance of plasticizers and free radical scavengers in the products, the products can not contain water, and these products would have to meet specific testing protocals.

Response: We will continue to work with industry to investigate this request.

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O. Silicone-based Multipurpose Lubricant

Product Category Description:

The silicone-based multipurpose lubricant category consists of lubricant products which are: (1) designed and labeled to provide lubricity primarily through the use of silicone compounds such as polydimethylsiloxane; and (2) designed or labeled for general purpose lubrication, or for use in a wide variety of applications. For example, this category includes silicone-based lubricants labeled simply as “silicone lubricant,” or labeled for a variety of automotive uses. This category does not include industrial use products such as silicone mold release products, and “food-safe” or “food grade” silicone lubricants labeled exclusively for use on food processing equipment or other manufacturing equipment. However, mold release products or food safe silicone lubricants that are also labeled for nonindustrial lubricant uses, are included in this category.

Table VI-29 below summarizes the sales and emissions from silicone-based multipurpose lubricants, based on the results of the Air Resources Board (ARB) Mid-term Measures 1994/1995 Consumer Products Survey (Survey). The information in Table VI-29 does not include solid or semisolid products (primarily greases) because they are not a significant source of VOC emissions, and the proposed VOC standard does not apply to these products. As shown in Table VI-29, according to our Survey, 92 products were sold in California in 1995. Also, based on the Survey, approximately 1,600 pounds of these products were sold daily in California during 1995. According to the Survey, these products emitted about 1,300 pounds of VOCs per day.

The sales and emissions, as shown below, are primarily due to aerosol products, which represent about 97 percent of sales, and 98 percent of VOC emissions. The sales-weighted average VOC content for silicone-based multipurpose lubricants is about 81 percent, with an average VOC of about 81 percent for aerosols, and 72 percent for liquids (Survey).

Due to underreporting in the Survey, Table VI-X also show the adjusted VOC emissions. Using data from the U.S. EPA 1990 Consumer Products Survey and ARB’s 1990 and 1991 Consumer Products Surveys, VOC emissions were raised to 1,500 pounds per day.

Table VI-29
Silicone-based Multipurpose Lubricant*

Product Form	Number of Products	Category Sales (lbs./day)	VOC Emissions (lbs./day)	Adjusted VOC Emissions (lbs./day)**
Aerosol	83	1,540	1,260	1,480
Liquid	9	40	20	23
Total	92	1,580	1,280	1,500

* Based on Mid-Term Measures 1994/1995 Consumer Products Survey. Excludes solid and semisolid products (greases).

** Survey emissions adjusted for complete market coverage (see Chapter IV).

Product Use and Marketing:

Silicone-based multipurpose lubricants are used when a light, nonstaining lubricant coating is desired. These products are often chosen for use on sensitive surfaces such as plastic, rubber, wood, leather and vinyl, unless the solvent in the product is incompatible with these materials. Silicone-based multipurpose lubricants are sometimes used where extreme temperatures are encountered, since the silicone oils used in these products are stable over a wide temperature range (Dow Corning, April 14; United Chemical Technologies). Aerosol silicone lubricants are generally not used for heavy duty lubrication, where heavy loads are encountered.

Silicone-based multipurpose lubricants are used by household, institutional, and industrial users. Household consumers use silicone-based lubricants on a variety of objects including weather stripping, rubber bushings, window channels, casters, automotive trunk seals, car seat adjustment mechanisms, window tracks, exercise machines, drawer slides, zippers, and locks. Some silicone lubricants are also labeled to seal out moisture and protect objects such as distributor caps, ignition wires, battery terminals, generators, starters, radio antennas, chrome, brass, aluminum, guns, fishing tackle, garden equipment, and tire sidewalls (3M; Wynn Oil). Institutional and industrial customers use silicone-based multipurpose lubricants for many of the household uses mentioned above, as well as on commercial and industrial equipment such as molds, industrial blenders, bins, plastic gears, belts, conveyors, air tables, garment manufacturing equipment, paper cutters, and food processing equipment (Sprayon; Sprayway).

Silicone-based multipurpose lubricants are sold in hardware stores, automotive parts stores, and specialty stores. These products are also directly or through distributors to industrial or institutional users.

Product Formulation:

Silicone-based multipurpose lubricants are typically aerosol formulations, after removing silicone-based greases from consideration. Aerosol silicone-based lubricants contain a small percentage of silicone oil, with the remainder of the formulation consisting of solvents and propellants. After the product is sprayed out, the solvents and propellants evaporate away, leaving a thin layer of silicone oil.

Multipurpose aerosol silicone lubricants generally contain from two to six percent silicone oil (LPS Labs, March 25). The silicone oil is typically polydimethylsiloxane, or a closely related silicone oil with different "functional groups" attached to the silicone polymer chain to impart specified properties. For example, some alkyl-aryl siloxane oils are paintable, while polydimethylsiloxane oils are not (Diversified Brands; Specialty Chemical Resources, April 11; Dow Corning, April 11;).

The solvents used in multipurpose silicone lubricants include hexane, isohexane, heptane, various petroleum distillates, water, methylene chloride, 1,1,1-trichloroethane, and perchloroethylene. Solvent-based products contain one or more VOC solvents or typically one chlorinated solvent. Water-based products are emulsion products containing water as the primary carrier (the water phase), and VOC solvent, silicone oil, and liquefied hydrocarbon propellant (the “oil” phase). An emulsifier is included in the formulation to allow the water and oil phases to mix when shaken (LPS Labs, March 25; LPS Labs, April 18). The emulsions are “oil-out” emulsions like aerosol furniture polishes, with the oil as the continuous phase, and the water contained in tiny droplets (micelles) within the oil phase.

The propellants used include liquid petroleum gases (such as propane, butane, isobutane, and pentane), carbon dioxide, hydrofluorocarbon 134a (HFC-134a), and dimethyl ether.

Proposed VOC Standard and Compliance:

The proposed VOC limit for silicone-based multipurpose lubricants is 60 percent by weight in the year 2002. As shown in Table VI-30 below, using adjusted emissions, the proposed standard will result in VOC emission reductions of approximately 500 pounds per day. Table VI-30 also shows that about 17 percent of the market currently complies with the proposed 60 percent standard (when greases are removed from consideration). The complying products include lubricants for both household and institutional (commercial) use. Although many of the complying products contain 1,1,1-trichloroethane, methylene chloride, or perchloroethylene, the proposed standard can be met without the use of these compounds. When these compounds are removed from the survey data, about 11 percent of the market currently complies with the proposed standard. This complying market share consists primarily of water-based formulations.

Table VI-30
Silicone-based Multipurpose Lubricants*

Product Form	Proposed VOC Standard (wt %)	Complying Products	Complying Market Share (%)	Emission Reductions (lb./day)	Adjusted Emission Reductions (lbs./day)**
Total	60	29	16.6	440	500

* Based on Mid-Term Measures 1994/1995 Consumer Products Survey. Excludes solid and semisolid products (greases). Aerosols and liquids cannot be shown separately due to confidentiality concerns.

** Emissions reductions adjusted for complete market coverage (see Chapter IV).

Reformulation options (excluding the use of 1,1,1-trichloroethane, methylene chloride, perchloroethylene, and HFC-134a) include using water, acetone, or other non-VOC solvents, or switching to a non-VOC propellant such as carbon dioxide or HFC-152a propellant. Because most silicone lubricants contain from two to six percent non-VOC silicone oils, manufacturers will need to replace another 34 to 38 percent of the solvents and propellants in the formulation with non-VOC materials.

As mentioned above, there are several water-based complying formulations (both aerosol and liquid) that are currently on the market. These products are well below the proposed 60 percent VOC level. According to one manufacturer, the water-based product is cheaper to manufacture than the solvent-based counterpart (LPS Labs, March 25). The primary opposition to the water-based products is the dry time (the time required for the water in the product to evaporate after the product is sprayed). However, for some products the dry time is acceptable, as demonstrated by the water-based products currently on the market. Another option that is not currently being used in silicone lubricants, is water with dimethylether propellant (LPS Labs, April 30). One disadvantage of water-based formulations is that they may require more development work to ensure that the formulation will not corrode the aerosol container. Water-based formulations may require the use of corrosion inhibitors, or other formulation techniques which lower the potential for corrosion (Rocafort).

Another option is the use of acetone at a level of 34 to 38 percent, as required to reach the 60 percent VOC level. Some manufacturers are evaluating acetone as a possible means of reformulation (CRC; Specialty Chemical Resources, April 3). Acetone is not currently used in silicone-based multipurpose lubricants. However, it is currently used in significant quantities in some multipurpose “dry” lubricants, where a fast dry time is preferable. Manufacturers have stated that they are not currently using acetone in their silicone-based multipurpose lubricants because it is more expensive than most other petroleum-based solvents, it has a strong odor, and it may damage some types of plastics, elastomeric materials, and paints (Specialty Chemical Resources, April 3; Petro Chemical). However, for the reasons stated in the “Issues” section below, we believe that acetone can be used as a solvent in some silicone-based multipurpose lubricants.

Another option is to use a non-VOC propellant such as HFC-152a or carbon dioxide. HFC-152a is not currently used in silicone-based multipurpose lubricants. However, it can be used as a replacement for hydrocarbon propellants, or in combination with hydrocarbon propellants along with the use of non-VOC solvents to reach compliance with the proposed 60 percent VOC level. Carbon dioxide is currently used in silicone-based multipurpose lubricants. However, since carbon dioxide typically only constitutes about two to three percent of the overall formulation, other reformulation techniques must be used along with carbon dioxide in order to achieve compliance. A related option would be to use a lower percentage of a higher vapor pressure hydrocarbon propellant (such as A-85 or A-108) in place of a lower vapor pressure hydrocarbon propellant, such as A-46 (LPS Labs, April 30). This option would achieve a modest reduction in VOC content if the difference in propellant is made up with a non-VOC solvent.

Issues:

1. Issue: Some manufacturers may comply with the proposed standards by replacing VOC solvents with methylene chloride or perchloroethylene (toxic air contaminants), or with HFC-134a (a potent global warming compound).

Response: We do not believe that there will be a large increase in the use of these compounds as a result of the proposed standards. Many manufacturers have stated that they will not use methylene chloride or perchloroethylene due to concerns about their toxicity, and due to the warning labels required by many states. Finally, some manufacturers have stated that they may discontinue the use of methylene chloride in their products due to a new limit on the occupational exposure to methylene chloride recently adopted by the Occupational Safety and Health Administration (Federal Register). Specifically, one manufacturer expressed concerns about: (1) the cost of modifications potentially necessary to reduce worker exposure to methylene chloride at the "filling plants" where products are manufactured, and (2) the potential for industrial or institutional customers to discontinue purchasing products containing methylene chloride (Diversified Brands, May 1). In addition, HFC-134a is very expensive, and the U.S. EPA and some suppliers are discouraging its use in consumer products due to its high global warming potential. In addition, a major manufacturer of HFC-134a is only selling it for use in consumer products where it is necessary for safety reasons (Du Pont, April 1).

We will assess manufacturers' progress in attaining the proposed limits, as we have done for other consumer products regulated by the ARB. If our assessment determines that the use of toxic air contaminants is increasing, we will further evaluate the public health impacts as explained in ChapterVII, "Environmental Impacts."

2. Issue: Acetone is not as desirable as other solvents because: (1) it is flammable; (2) it damages some plastics, elastomeric materials, and painted surfaces; (3) it has a strong odor; and (4) it is more costly than other solvents.

Response: As mentioned in the chapter on multipurpose lubricants, acetone is used in many consumer products, including multipurpose dry lubricants, aerosol paints, and brake cleaners. While manufacturers have raised some concerns regarding its use, many of these concerns are less significant if acetone is not the primary solvent in the product. For example, a silicone-based multipurpose lubricant formulation with five percent silicone oil would typically only need 35 percent acetone to achieve the proposed 60 percent VOC limit.

Flammability: Although acetone is highly flammable, the petroleum-based solvents and propellants typically used in silicone-based multipurpose lubricants are also highly flammable.

Damage to plastics, elastomeric materials, and painted surfaces: We agree that exposure to acetone can damage some types of plastics, elastomerics, and painted surfaces, depending on the concentration of acetone and the duration of exposure. However, we do not agree that this makes acetone inappropriate for use in all silicone-based multipurpose lubricants. These products currently contain many solvents that can damage the substrates mentioned (Cole-Parmer). For example, some silicone-based multipurpose lubricant formulations contain methylene chloride, which is used as a paint stripper, and has a severe effect on many types of plastics and elastomeric materials (Cole-Parmer). Methylene chloride and other aggressive solvents are acceptable for use in some silicone-based multipurpose lubricants because the products are not used on the materials mentioned, or because the concentrations used or duration of exposure are not sufficient to damage the materials.

Odor: Acetone does have a strong odor. However, manufacturers have found it acceptable for use in a wide variety of consumer products, as mentioned above. In fact, acetone is even used in some cosmetic products, such as nail polish removers.

Cost: The cost of acetone is more than double the cost of some typical hydrocarbon solvents used in silicone-based multipurpose lubricants. However, it is not significantly more expensive than some of the other solvents currently used in silicone-based multipurpose lubricants. The cost of acetone is about $0.39-$0.45 per pound, compared to $0.43 per pound for methylene chloride, and about $0.32-$0.35 per pound for perchloroethylene (Chemical Market Reporter).

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P. Spot Remover

Product Category Description:

Spot removers are products designed to remove localized spots or stains on cloth or fabric such as drapes, carpets, upholstery, and clothing which do not require subsequent laundering to achieve stain removal. This category does not include dry cleaning fluid, laundry prewash, carpet and upholstery cleaner, or multi-purpose solvent products. These products are designed to eliminate odors, and remove tough stains such as blood, urine, grass stains, most foods, feces, vomit, grease, make-up, oil, and crayon. Spot removers generally work by penetrating the fibers of the area being cleaned and suspending the stain to be blotted away with an absorbent cloth.

As shown in Table VI-31, according to our Survey, 106 products were sold in California in 1995. Also, based on the Survey, approximately 2,720 pounds of spot removers were sold daily in California during 1995. The aerosol products account for 320 pounds, while the non-aerosol products account for 2,400 pounds sold per day. According to the Survey, the aerosol products emitted about 80 pounds of VOCs per day, while the non-aerosol products emitted about 180 pounds of VOCs per day. The VOC content of the aerosol products reported in the Survey ranges from 0 to 98 percent by weight with the sales weighted average VOC content being 32 percent by weight. The non-aerosol spot removers have a VOC content ranging from 0 to 100 percent by weight with the sales weighted average VOC content being 8 percent by weight.

Due to underreporting in the Survey, Table VI-31 also shows the adjusted VOC emissions. Using data from the U.S. EPA 1990 Consumer Products Survey and ARB's 1990 and 1991 Consumer Products Surveys, VOC emissions were raised to 380 pounds per day for aerosol products, and 620 pounds per day for non-aerosol products (See Chapter IV).

Table VI-31
Spot Remover*

Product Form	Number of Products	Category Sales (lbs./day)	VOC Emissions (lbs./day)	Adjusted VOC Emissions (lbs./day)**
Aerosol	30	218	80	380
Nonaerosol	75	2,391	180	620
Total	106	2,609	260	1,000

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Emissions adjusted for complete market coverage (see Chapter IV).

Product Use and Marketing:

Spot removers are used in both household and institutional settings for cleaning unwanted stains and spots on fabric or cloth such as clothing, carpets, drapes, and upholstery.

These products are sold in a variety of retail outlets including grocery stores, drug stores, retail warehouse outlets, and janitorial supply stores. They are also sold over the Internet. In addition, spot removers are sometimes sold in kits at furniture stores when a customer buys new furniture.

Spot removers are used to treat small isolated areas. While the product forms may differ slightly, most spot removers work in the same way and have similar claims. They are intended to be applied to the stained area and left to soak. The area is then blotted with a cloth, or sometimes the scrubbing cap of the container until the stain is gone. Depending upon the type of stain, subsequent applications of the spot remover may be needed. Most spot removers are not vacuumed up, but instead, evaporate on their own.

Aerosol spot removers are sprayed on the stain until the area is saturated. After saturating the stained area, the area is blotted, not rubbed, until the stain is gone (Hysan; Spot Shot Products).

Most of the non-aerosol spot removers are applied directly to the stain, then blotted with a clean absorbent cloth until the stain is gone (S.C. Johnson & Son). Others are applied to a clean cloth or sponge, or directly onto the stained area, and then rinsed away with water (Whink Carpet Stain Remover label). Another product type is brushed onto the stained area, with the stained area then covered with a clean cloth. More product is then put onto another cloth and held on top of the first cloth. This drives the soil onto the top cloth (Reckitt & Colman).

Sometimes a number of spot removers come packaged together in special kits, with each remover to be used on specific types of stains. One of these kits might include: (1) a tannin-based spotter for coffee, wine, or tea removal; (2) an all-purpose mild alkaline spotter for use on grease, traffic smudges, and other general stains; and, (3) a rust remover (Multi-Clean).

Product Formulation:

There are water-based spot removers and solvent-based spot removers. However, the distinction between the usage and efficiency of the two technologies is not definite.

The various spot removers included in a typical spotting kit rely upon different ingredients depending on the type of spot/stain it is intended to treat. Some may require acids, others require bases while others may rely on solvents, enzymes, or mild bleaches (ISSA). The formulations generally contain surfactants, solvents, propellants (aerosol forms), and proteolytic enzymes.

Nonionic surfactants (e.g. alcohol polyglycol ethers, fatty acid ethanoloamides, fatty acid esters), as the name implies, contain neither positively charged or negatively charged functional groups, and are used in water and solvent-based formulations. Nonionic surfactants have favorable detergent properties which are derived largely from having low micelle concentration, very good detergent performance, and soil antideposition characteristics with synthetic fibers. They are particularly effective in removing oily soil and some function as form boosters. Anionic surfactants (alkylaryl sulfonates) may also be used to solubilize the active ingredients in the liquid. These can be used in both water or solvent-based formulations.

Hydrocarbons and halocarbons (e.g. naphtha, percholorethylene, 1,1,1-trichloroethane or TCA) may be used as solvents and to aid the surfactant in penetrating the surface of the soil. Water is also often used as a solvent.

Proteolytic (protein-cleaving) enzymes help to break down protein stains derived from sources such as milk, cocoa, blood, egg yolk, and grass, which may normally be resistant to removal by detergents alone.

Propellants (e.g. CO_2, butane, propane) are used in the aerosol spot removers to expel the ingredients onto the substrate. Most of the aerosol spot removers use VOC propellants, while some of the VOC solvent or exempt solvent-based products use CO_2 as their propellant.

Some of the solvent-based low-VOC products contain exempt chlorinated compounds such as TCA, perchloroethylene, and methylene chloride. However, regulatory developments and health and safety concerns are prompting companies to develop formulations that do not depend on these ozone depleting or toxic solvents. The United States EPA lists methylene chloride as a hazardous air pollutant and the ARB lists it as a toxic air contaminant. Many of the solvent-based products reported in the 1994/1995 Mid-term Measures Survey were using TCA in their formulations during 1995. Due to the 1996 production phaseout of TCA, many manufacturers have reformulated their products with other ingredients such as terpenes and d-limonene, while the move toward water-based systems and lower VOC products continues throughout the industry (HAPPI). ARB staff assumes the TCA in these products as being replaced with VOCs, due to the phaseout of TCA.

Proposed VOC Standard and Compliance:

The proposed VOC standards for spot removers are as follows: 25 weight percent for aerosol forms, and eight weight percent for non-aerosol forms, effective in 2000.

As shown in Table VI-32 below, which is based on our Survey, ten aerosol products comply with the proposed 25 percent standard, representing a 78 percent of the aerosol market.

Also shown in Table VI-32, 49 non-aerosol products comply with the proposed eight percent standard. These products represent an estimated 80 percent of the non-aerosol market.

Table VI-32
Spot Remover*

Product Form	**Proposed VOC Standard (wt. %)**	**Complying Products**	**Emissions Reductions (lbs./day)**	**Adjusted Emission Reductions (lbs./day)****
Aerosol	25	10	20	80
Nonaerosol	8	49	120	300
Total	---	59	140	380

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Emissions adjusted for complete market coverage (see Chapter IV).

A few of the aerosol spot removers which comply with the proposed standard use varying amounts of perchloroethylene or methylene chloride, with CO_2 as the propellant. It is assumed that because of the phaseout of TCA, many of the products in the spot remover category which reported use of TCA in the Survey are now using VOC solvents instead.

One manufacturer says that his product can comply with the 25 percent aerosol standard and not decrease product efficacy, by increasing his water content slightly while removing a small amount of VOC propellant and solvents (Plaze, April 16).

The non-aerosol spot removers that comply with the proposed limit are water-based with one to ten percent of low vapor pressure volatile organic compounds (LVP-VOCs), and zero to three percent inorganics.

Issues:

1. Issue: A certain amount of solvents are needed in spot removers in order to break grease up, and in order to evaporate quickly to avoid resoiling. Some types of spot removers (removers for ink, tars, oil, grease, paint) need additional VOCs for product efficacy (Multi-Clean).

Response: The vast majority of aerosols and non-aerosols an already meet the proposed standards without additional reformulation. The proposed standards were chosen to reflect the levels of VOC needed for adequate performance, as evidenced by the compliant markeshares. In addition, there are water-based spot removers designed to clean greasy stains while leaving no sticky residue (Hysan; Quest; S.C. Johnson & Son).

2. Issue: One manufacturer requested that we set the aerosol standard somewhere in the mid-20's weight percent order for products to maintain efficacy (Spot Shot, March 13). Another stated that product efficacy would not be compromised and that costs would be minimal to reformulate to the 25 percent level (Plaze, April 17).

Response: We have set the proposed aerosol standard at 25 percent.

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Q. Undercoatings (Aerosols)

Product Category Description:

Aerosol undercoatings are products designed to protect the automobile undercarriage from corrosion and to deaden sound. These products can be applied to wheel wells, fenders, the hood, rocker panels, firewalls, and any other auto surface to prevent corrosion. Undercoatings seal out water, prevent rust, protect surfaces from salt damage, and resist abrasion. The protective layer applied serves as an under-chassis finish and is a non-paint layer that is typically asphaltic or asphaltic/rubber in nature (Joseph; Sherwin-Williams, March 12; 3M, April 17; 3M, “Undercoating;” “X” Labs; Winzer). After the undercoating has been applied, some types may be painted (3M, April 17; Sherwin-Williams, Product Literature).

Another important feature of undercoatings is their ability to reduce road noise caused by stone throw or other road debris. By applying an undercoating to wheel wells and the undercarriage, road noise can be reduced (Joseph; Sherwin-Williams, Product Literature; 3M, “Undercoating;” “X” Labs; Winzer). Manufacturers also indicate that undercoatings can be used for minor roof repair, to fill driveway cracks, and to seal tree wounds, rain gutters, downspouts, and foundations (Sherwin-Williams, Product Literature; 3M, “Undercoating;” “X” Labs; Winzer).

Undercoatings do not include products designed exclusively to provide corrosion resistance to internal panels. Although designed to prevent corrosion, these products are formulated differently and are not designed to be applied to the automobile undercarriage. Mineral oil or similar compounds are used as the active ingredient instead of asphalt or rubberized asphalt (3M, “Rust-Fighter-I”). This category also excludes liquid undercoatings because they are already regulated by the local air districts.

As shown in Table VI-33, according to our Survey, 32 aerosol undercoating products were sold in California in 1995 by 19 companies. Also, based on the Survey, approximately 700 pounds of aerosol undercoatings were sold daily in California during 1995. According to the Survey, these products emitted about 400 pounds of VOCs per day. The VOC content of products reported in the Survey ranges from about 30 to 75 percent by weight with the sales weighted average VOC content being 50 percent by weight.

Due to underreporting in the Survey, Table VI-33 also shows the adjusted VOC emissions. Using data from the U.S. EPA 1990 Consumer Products Survey and ARB's 1990 and 1991 Consumer Product Surveys, VOC emissions were raised to about 500 pounds per day (see Chapter IV).

Table VI-33
Undercoatings (Aerosols)*

Product	Number of Products	Category Sales (lbs./day)	VOC Emissions (lbs./day)	Adjusted VOC Emissions (lbs./day)**
Total	32	740	380	480

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Emission reductions adjusted for complete market coverage (see Chapter IV).

Product Use and Marketing:

Nineteen companies reported that they sold undercoatings in California during 1995. These companies indicated that undercoatings are used in both the household and institutional setting (Survey). Aerosol forms of undercoatings are primarily used for touch up and repair when the original factory-applied undercoating has been damaged. Institutional users of undercoatings are typically autobody repair shops. For consumer use, the products are sold at auto parts stores and discount stores.

Manufacturers recommend that for the user’s safety, undercoatings only be applied in well-ventilated areas (3M, “Undercoating;” “X” Labs; Winzer; Sherwin-Williams, MSDS). Before applying an undercoating to the surface to be coated, rust scale, oil and grease is removed and all surfaces are cleaned and dried (“X” Labs; Winzer; 3M, “Undercoating”). The aerosol can should be shaken until the agitator ball moves freely. Apply a uniform coat by spraying 12 to 18 inches from the surface to be coated using smooth, overlapping strokes (3M, “Undercoating;” “X” Labs; Winzer). After the initial coating has dried, additional coats may be applied to build up a thicker coating or create different textures (Winzer; “X” Labs). Manufacturers caution that the undercoating should not be sprayed near any portion of the automobile exhaust system (3M “Undercoating;” “X” Labs; Winzer). It is advised to mask around the area being sprayed and that any overspray must be wiped off immediately (Joseph).

It is important that an undercoating remains soft and flexible after application. If an undercoating becomes hard or brittle, it may eventually crack and pull away from the surface. Water will seep into the cracks, become trapped, and may actually accelerate corrosion. A similar situation is likely to occur if an undercoating is applied to a surface that hasn’t been thoroughly cleaned and dried. In this situation, the undercoating isn’t able to adhere to the surface (Pfanstiehl).

Product Formulation:

Low Vapor Pressure Components

In most undercoatings the active ingredients are low vapor pressure components (Survey, 3M, MSDS 8883; Sherwin-Williams, March 12). Manufacturers indicate that the two basic “actives” in undercoatings are asphalt and a rubberized polymer (Sherwin-Williams, MSDS; 3M, MSDS 8881; Winzer MSDS; 3M, April 17). For reinforcement other hydrocarbon polymers may be also be added to formulations (Sherwin-Williams, March 12). Another type of undercoating that does not contain asphalt or rubber, produces a finish that is similar to a softened petroleum wax (Lilly Industries, March 20). Although undercoatings differ in their active ingredients most of the other components in the formulation are the same and serve similar functions in each undercoating type (Sherwin-Williams, March 12; 3M, MSDS 8881; Winzer).

Asphalt is a black, tar like substance obtained through petroleum refining (LeSota). Manufacturers indicate that typically the asphaltic portion of their undercoating products is obtained in bulk as a mixture thinned with toluene (Sherwin-Williams, March 12). The asphalt mixture is then “let down” with additional solvents such as toluene or mineral spirits. These solvents cut the bulk asphalt to make it sprayable. Emulsions of water and toluene are also used to let down the asphalt (Sherwin-Williams, March 12; Zahrobsky).

A number of coatings are labeled as “rubberized.” Manufacturers describe these as “premium” products because they are more durable, provide better corrosion resistance and are also better able to deaden sound (Sherwin-Williams, March 12; 3M, April 17). Rubberized undercoatings generally contain a synthetic latex such as a styrene-butadiene polymer in addition to the asphalt (3M, April 17). These polymers increase the elasticity of the product formulation (3M, April 17). No performance standards are available which specify the amount of rubberized polymer that needs to be present in a rubberized formulation. Therefore, products may make a label claim to be rubberized by adding as little as two tenths of a percent of a rubber component (3M, April 17). In general, durability as well as water and corrosion resistance increase as the percentage of rubber in the product increases. Products with higher percentages of rubber components also require more solvent to keep the rubber in solution (3M, April 17).

For some product formulations it is recommended that the undercoating not be painted. Typically asphaltic undercoatings are not paintable (Sherwin-Williams, Product Literature; “X” Labs; Winzer). The solvents used in the paint, particularly aromatic solvents, may dissolve the undercoating layer which leads to pitting and cracked paint (3M, April 17). While there is no specific limit which enables an undercoating to become paintable, products with a rubber content of at least five percent are more likely to be paintable. However, in most instances, the undercoating is not painted (3M, April 17).

Solvents

Typical solvents used in undercoatings include mineral spirits, toluene, naphtha, xylene and aliphatic hydrocarbons (Sherwin-Williams, March 12). In general, to keep the asphaltic portion solubilized, aromatics such as toluene are needed (Sherwin-Williams, March 12; 3M, April 17). Aliphatics are generally used in products with a higher rubber content. As stated above, as the rubber content increases more solvent is required. Hence these products generally have a higher VOC content than products that are primarily asphalt based (Survey; 3M, April 17).

For emulsion systems containing water, a fast evaporating solvent such as methanol or xylene may be added to the formulation to speed the dry time of the undercoating (Sherwin-Williams, April 9).

Exempt/Inorganic Components

Most undercoatings contain components that are able to deaden sound, add texture and increase thickness or "build." These components are sometimes called fillers (Sherwin-Williams, March 12). Fillers make an undercoating better able to tolerate stone throw and provide better impact resistance (3M, April 17). The fillers provide a finished look that resembles an orange peel or is bumpy (Pfanstiehl). The particular exempt or inorganic component added depends on the desired finished appearance (3M, April 17). Fillers help with spray pattern, and thicken and provide texture to the undercoating. Fillers also allow a product to go further (Lilly Industries, April 16). The filler chosen depends on the solvents used in the undercoating. Some fillers will swell when water is used in the formulation, which could clog the valve system. Because aerosol undercoatings generally are used for touch up and repair, the filler can also help in matching the texture to the original undercoating finish (3M, April 17). Fillers are chosen for a particular gel structure, fluffiness and for sag resistance. Particle size is also important. For example, talc is a larger particle and provides better reinforcement. Cost is also a consideration. A filler such as calcium carbonate is less expensive than other fillers (Zahrobsky). Typical fillers used are talc, silica, bentonite, clay (Lilly Industries, March 20; Sherwin-Williams, March 12; 3M, MSDS 8883; 3M, MSDS 8881). Calcium carbonate (limestone) is also added to formulations for its sound deadening properties (Collantes, May 13). Carbon black may also be added to formulations as a pigment (Sherwin-Williams, MSDS; Collantes, May 13).

Propellants

All of the aerosol undercoatings reported in the ARB's 1995 Survey use typical blends of hydrocarbon propellants (Survey). Propellant blends of propane, isobutane, and butane account for about 20 weight percent of currently marketed undercoating products (Survey).

Proposed VOC Standard and Compliance:

The proposed VOC limit for aerosol undercoatings is 40 percent by weight, effective in 2002. This standard is based on the reported range of VOCs and the technical feasibility of the proposed standard. As shown in Table VI-34, using adjusted emissions, the proposed standard will result in VOC emission reductions of approximately 120 pounds per day (see Chapter IV for more information). This adjustment is reflected in Table VI-34, the last column on the right.

Nine products are currently able to comply with the proposed standard of 40 percent. The nine products include undercoatings that contain asphalt and products that contain both asphalt and rubber (Survey). The complying products are used in both household and institutional settings, and are used and accepted by consumers based on a complying marketshare of 12 percent. Most of the complying products are water emulsions (Survey).

Table VI-34
Undercoating*

Proposed VOC Standard (wt. %)	Complying Products	Complying Market Share (%)	Emissions Reductions (lbs./day)	Adjusted Emissions Reductions (lbs./day)**
40	9	12	100	120

*   Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Emission reductions adjusted for complete market coverage (see Chapter IV).

The ARB staff recognizes, however, that the complying "rubberized" products may have only small amounts of a polymer included in the formulation. Manufacturers producing products with a higher rubber content will be challenged to meet the proposed standard. However, a number of reformulation options are available to comply with the proposed standard using chemicals and technologies that are currently available. Using water emulsion technology, exempt solvents such as acetone, non-VOC propellants, or a combination of these technologies should allow the 40 percent standard to be achieved. It may also be possible to increase the undercoating "solids," or formulate with polymers that are more water soluble. Formulators may also investigate using dimethyl ether as a propellant in water-based products. Microemulsion solvents may also be a reformulation tool.

<u>Exempt Solvents</u>

Acetone, an exempt solvent, is a possible reformulation option. Although some manufacturers indicate that acetone may evaporate too quickly, and increase the flammability of the undercoating (Sherwin-Williams, March 12), Survey data indicate that it is used (Survey).

<u>Non-VOC Propellants</u>

Aerosol undercoatings that currently do not meet the proposed 40 weight percent standard could also reformulate using non-VOC propellants such as hydrofluorocarbon 152a (HFC-152a), a hydrocarbon/HFC-152a blend, or a compressed gas such as carbon dioxide. Survey data indicate that carbon dioxide is not used extensively in consumer products (Survey). ARB staff believes that if formulators elect to reduce the VOC in their products by using a non-VOC propellant, HFC-152a is most likely to be chosen as a replacement. HFC-152a is compatible with a number of chemicals typically used in aerosol formulations and has been successfully used as a propellant for a number of years (Applegate). ARB staff acknowledges that HFC-152a is considerably more expensive than commonly used hydrocarbon propellants, and, therefore has set a proposed standard that is achievable using other technologies. One way to lower the cost associated with HFC-152a and still reduce VOC content would be to blend HFC-152a with hydrocarbon propellants (Applegate).

Dimethyl ether (DME)

DME is another propellant that may hold promise as a reformulation option. Although it is a VOC, because it is soluble with water, it may be used to reduce the VOC content of non-complying formulations (Daly). ARB staff is aware that DME is being used successfully as a propellant and co-solvent in aerosol coatings (Sherwin-Williams, Krylon MSDS) so it may hold promise as an option for reformulating undercoatings.

Microemulsion Solvents

Currently available for use in reformulating are “microemulsion solvents” which are solvent-continuous microemulsions with high water content and low viscosity. A number of solvents, including acetone, toluene, and naphtha, are soluble with these microemulsion solvents (DOW). The continuous phase of some available microemulsion solvents are aliphatic hydrocarbons (DOW). Because a number of currently marketed products are formulated with aliphatic hydrocarbons, it is likely that microemulsion solvents could be used in undercoatings to reduce the VOC content while maintaining a higher rubber content (Survey).

Polymers

A wide variety of water emulsion polymers and water soluble polymers are available that could have application for undercoatings. For example, latex paints utilize emulsion polymers such as the vinyl acrylics (Klein; Gordon).

Issues:

1. Issue: Premium undercoating products could be eliminated if the VOC standard is set too low.

Response: As noted previously, premium products, in general, are rubber-containing products. Because there are a variety of commercially available formulations, including rubberized formulations, that comply with the proposed standard, ARB staff believes the technology exists to reformulate all undercoatings to comply with the proposed standard by 2002 (Survey).

2. Issue: HFC-152a use is cost prohibitive.

Response: Use of HFC-152a is one reformulation option that a manufacturer may choose. ARB staff notes that all of the currently complying products do not use HFC-152a as a propellant (Survey). Other options to meet the proposed standard include water emulsion technology, exempt solvent (acetone) use, DME, microemulsion solvents, higher solids, or water soluble polymers.

3. Issue: Water emulsions take too long to dry and the emulsifiers may cause the undercoating to resolubilize when it becomes wet.

Response: Water-based products are available, and based on sales, are used and accepted by consumers (Survey). It is unlikely that these products would continue to be used if the undercoating solubilized when in contact with water, or did not dry in a timely manner.

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R. Wasp and Hornet Insecticide

Product Category Description:

Wasp and hornet insecticides are pesticide products designed to kill biting or stinging flying insects such as wasps, hornets, yellow jackets, and bees. They are intended to do this from some distance (typically 20 to 30 feet) by spraying high volume bursts or streams of insecticide at the insect or its hiding place. These products must knockdown and kill the insects rapidly to avoid attack. Most of these products dispense the insecticide in a liquid form while others produce a foam which blankets the insect or nest with the insecticide. This category includes household products, products used by professional pest control operators and products used in institutional settings such as utility or telecommunication companies.

All wasp and hornet insecticide products sold in California must be preregistered with the United States Environmental Protection Agency (U.S. EPA) according to the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), and the California Department of Pesticide Regulation (DPR).

As shown in Table VI-35, based on the Air Resources Board's (ARB) Mid-term Measures 1994/1995 Consumer Products Survey (Survey), 29 products were sold in California in 1995. Also, based on the Survey, approximately one million pounds of wasp and hornet insecticides were sold daily in California during 1995. According to the Survey, these products emitted about 1,000 pounds of volatile organic compounds (VOCs) per day. The VOC content of products reported in the Survey ranges from zero to 97 percent by weight with the sales weighted average VOC content being 37 percent by weight.

Due to underreporting in the Survey, Table VI-35 also shows the adjusted VOC emissions. Using data from the U.S. EPA 1990 Consumer Products Survey and ARB's 1990 and 1991 Consumer Product Surveys, VOC emissions were raised to almost 1,300 pounds per day (see Chapter IV).

Table VI-35
Wasp and Hornet Insecticide*

Product Form	Number of Products	Category Sales (lbs./day)	VOC Emissions (lbs./day)	Adjusted VOC Emissions (lbs./day)**
Aerosol	29	2,820	1,060	1,280

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Survey emissions were adjusted for complete market coverage (see Chapter IV).

Product Use and Marketing:

Wasp and hornet insecticides are used in both household and institutional settings. Homeowners use a wasp and hornet insecticide to kill wasps, hornets, yellow jackets or bees around their home. Control of wasps and hornets is sometimes difficult because if they are not killed quickly they may become agitated and attack the user. The object is to kill all wasps and hornets in the nest quickly and thoroughly. The ingredients in wasp and hornet sprays are similar to crawling bug insecticides; however, they have unique propellant and aerosol hardware systems to produce a jet type spray that reaches from ten to over twenty feet. This allows the user to spray the insecticide into inaccessible nests located in areas such as rooftops or trees. A new type of product available is an insecticide contained in a 22 foot foam blast which allows the user to stand back and "lock" the wasps inside their nest with a blanket of foam. It is recommended that users attempt to eradicate wasps and hornets in the late afternoon or evening when insects are at rest and to wear protective clothing (Enforcer).

The institutional market is somewhat smaller than the household market and includes products for utility and telecommunication companies as well as hospitals, hotels and golf courses. These products are often carried with utility or telecommunication employees as they work around exposed or un-insulated high power electrical sources. Because of this, most of these companies require the wasp and hornet insecticides used by their workers to have a dielectric breakdown voltage of 20,000 volts or greater based on test method ASTM D877 (PG&E, SMUD). Dielectric breakdown voltage is the voltage above which electrical current will be conducted through the product.

In addition to the specifications issued by utility companies for dielectric strength, the U.S. EPA has specific labeling requirements for liquid aerosol products used near electrical equipment (40 Code of Federal Regulations Part 158.190). Typically, products intended for use around electrical equipment will have the dielectric breakdown voltage specified on the label. However, this claim can not be specified on the label unless the company has tested the dielectric strength of the product and has made these data available to the U.S. EPA.

The U.S. EPA also requires that warnings be placed on the label of a liquid insecticide that may be used around electrical equipment. This warning is required if the dielectric breakdown voltage is below 5,000 volts. If this is the case, the U.S. EPA requires that a shock hazard statement be put on the label stating "Do not apply this product in or on electrical equipment due to the possibility of shock hazard" (U.S. EPA, December 1996). Because household wasp and hornet sprays do not suggest that they be used around electrical equipment, it is up to the company to determine if these requirements are applicable to their product. Many companies that sell household wasp and hornet insecticides do choose to put this warning on their labels (IQ Products Company).

Finally, these products are also used at hospitals, hotels, or golf courses and by professional pest control operators that are contracted by homeowners or other facilities to eradicate wasps or hornets.

Wasp and hornet insecticides can be purchased by household consumers in a number of retail outlets including home and garden stores, grocery stores, drug stores, warehouse outlets, mass merchandisers and hardware stores. Many utility or telecommunication type companies contract directly with a manufacturer or distributor for their wasp and hornet insecticides. Pest control operators typically purchase products from warehouse outlets or certified pesticide distributors.

Product Formulation:

Wasp and hornet insecticides rely on active ingredients that are toxic to the pests to provide insecticidal activity. Active ingredients work by a variety of mechanisms to provide their killing action, and very often more than one active is needed to achieve the desired results. These active ingredients typically comprise only a very small percentage (e.g., less than one percent by weight) of the formulation with the balance of the formulation consisting of “inert” ingredients. Strictly speaking, “inert” ingredients are not actually inert, but are the components in a product which are not listed as and “active” ingredient. For wasp and hornet sprays, inert ingredients are generally the liquids in the product which solubilize the pesticides. These ingredients are chosen by the manufacturers to achieve stability of the active ingredient, convenience in handling and application, and to maximize killing power.

Active Ingredients

The actives used in wasp and hornet insecticides are contact poisons that accomplish their killing action when they hit the pest and penetrate its internal body through the exoskeleton or outerbody. The important characteristics of a wasp and hornet spray are good knockdown, good kill, good residual activity and good compatibility with the inert ingredients. Because there is no single insecticidal chemical that possesses all of these qualities in abundance, most wasp and hornet sprays are formulated using two or more actives (Johnsen, November 1996).

Insecticide active ingredients used today have a wide range of “activity.” Activity is the measure of the “speed” and the “extent” of the toxic effects. The speed in which the active ingredient immobilizes an insect is referred to as its “knockdown” ability. The extent of the toxic effects, or whether the toxic effects are lethal, does not always correspond to good knockdown. Therefore, a combination of a knockdown agent and a killing agent is commonly used to provide all around performance, and sometimes a synergist such as piperonyl butoxide is added to optimize performance (Johnsen, December 1996).

Pyrethroids are one of the most widely used active ingredients in wasp and hornet insecticides. These are contact poisons that penetrate rapidly into the nervous system to cause paralysis or death. The initial effect occurs so quickly that within a few minutes the insect is incapable of moving or flying away. Because pyrethroids have fast knockdown and low mammalian toxicity, they are popular active ingredients for wasp and hornet sprays (McEwen, p. 162).

Because natural pyrethrins are expensive and breakdown very quickly, many products contain synthetic pyrethroids that possess a wide range of activity, toxicity and stability. For example, tetramethrin has a knockdown effect greater than natural pyrethrins, while resmethrin and permethrin have a weaker knockdown effect but a much higher toxicity towards a variety of insects. Permethrin is a widely used residual pesticide because it is photostable and resistant to degradation by the oxygen or humidity in ambient air (Johnsen, December 1996).

The latest generation of synthetic pyrethrins such as deltamethrin, tralomethrin, and halomethrin show activities and stability many times higher than earlier synthetic pyrethrins. These new compounds can provide both excellent knockdown and residual kill, and may do so at much lower concentrations. Deltamethrin is one of the most active pyrethroid insecticides available. It has been used outside of the United States for many years and was just introduced here in 1994. Deltamethrin has high residual activity, very low vapor pressure which allows the pesticide to remain on treated surfaces and it is compatible with water-based formulations (Slatter, et al., United Industries, April 23).

As mentioned above, most pyrethroids produce a rapid knockdown, but the insects can often quickly recover because they are rapidly detoxified in the insect by enzymatic action. Therefore, synergists such as piperonyl butoxide are usually added to enhance the killing power of the active ingredients. Synergists extend the knockdown dose by deactivating the enzymes insects use to detoxify the pyrethroid.

Organo-phosphates such as chlorpyrifos and malathion are another important class of active ingredients used in wasp and hornet insecticides. Chlorpyrifos is commonly used because it has good knockdown and is relatively inexpensive (United Industries, April 23). Organo-phosphates are phosphoric acid derivatives that generally act against the insects by inhibition of the enzyme acetylcholinesterase. This disturbs the function of the nervous system to cause paralysis and death. Organo-phosphates, as a class, present higher mammalian toxicity than pyrethroids and carbamates, but compounds with relatively low human toxicity have been widely used in consumer insecticide products (McEwen, pp. 179-180).

Carbamates or carbamic acid derivatives are another major class of active ingredients used in insecticides. Carbamates such as propoxur are used in wasp and hornet insecticides and act similar to organo-phosphates by inhibiting the enzyme acetylcholinesterase (McEwen, p. 199). However, propoxur has been listed by the U.S. EPA as a hazardous air pollutant.

<u>Inert Ingredients</u>

As mentioned earlier, the active ingredients make up only a small portion of the end use product. The bulk of the formulation consists of the inert ingredients, the propellants and the carrier system. The propellants are typically hydrocarbon blends or carbon dioxide. Carriers typically include petroleum solvents, water and low vapor pressure volatile organic compound (LVP-VOC) solvents (Survey).

Prior to 1996, traditional solvent formulations relied on petroleum distillates, aromatic distillates and 1,1,1-trichloroethane (TCA) as the carriers for the active ingredients. TCA was a very good carrier for these products because it is electrically non-conductive and non-flammable. The daily TCA emissions in 1995 from wasp and hornet sprays were 217 pounds in Californa (Survey). The Federal Clean Air Act (FCAA) prohibited production of TCA starting in 1996. Because the Survey was conducted in 1995, manufacturers have chosen to replace TCA with either VOCs or LVP-VOCs (Hysan, Quest). The replacement of TCA with VOCs is reflected in our emissions estimates.

The inert ingredients can also play a role in the knockdown time of the products. TCA enhanced the effects of the active ingredients and decreased the knockdown time by stunning the pests with a freezing effect from rapid evaporation. The inert ingredients currently used so not produce the same type of stunning effect as TCA. Testing shows that petroleum distillate products can have a knockdown time of four to six seconds while water-based products have a knockdown time of nine to fifteen seconds (S.C. Johnson Wax, April 15). Some wasp and hornet insecticides that use LVP-VOC solvents as the carrier have a knockdown rate below one second (AgrEvo, April 22). This quick knockdown is a result of the active ingredients used in the product as well as the LVP-VOC solvent carrier.

Inert ingredients also play a role in the spray characteristics of aerosol products. By tailoring the valve design, propellant blends and carrier mixture properties such as viscosity and surface tension, formulators can produce products with desired spray patterns. For instance, wasp and hornet insecticides require a strong jet spray with large droplets that can reach up to 25 feet to get up into trees and rooftops. Some of the institutional products have such a powerful spray that an entire 16 ounce can is typically expelled in a few seconds, similar to a fire extinguisher.

Water has become a widely used inert ingredient for wasp and hornet insecticides as shown by the fact that water-based products represent over 60 percent of the household market (Survey). These products are typically comprised of 60 to 80 percent water, 10 to 20 percent hydrocarbon propellant and approximately one to two percent active ingredients. Water-based products use emulsifiers and dispersal agents to create a dispensable water/oil mixture where the active ingredient is still dissolved in the oil phase. Typically, water-based insecticides have an oil-out emulsion system. This is necessary for the product to penetrate the insects' hard exoskeleton and provide the kill (United Industries, April 23).

Another type of formulation available today includes LVP-VOC solvents as the carrier, or a mixture of LVP-VOC solvent and petroleum distillates. As mentioned above, many manufacturers have chosen to replace the TCA in their products with LVP-VOC solvents. In addition, companies have chosen to replace all or some of the traditional petroleum solvent distillates with LVP-VOC solvents to reduce the regulated VOC content of their products in anticipation of new VOC regulations (AgrEvo April 18; Hysan). LVP-VOC solvents also provide the dielectric breakdown voltage required by the institutional market and are less flammable than traditional petroleum solvent carriers.

Proposed VOC Standard and Compliance:

The proposed VOC limit for wasp and hornet insecticides is 40 weight percent. This limit would be effective in 2006, one year after the year listed in the table of standards. The additional year is proposed to give companies additional time to complete their FIFRA and DPR registrations for reformulated products. Companies that want to sell new or reformulated products in California must register their products with the U.S. EPA and DPR. The registration requires companies to submit results of efficacy and toxicological studies to demonstrate that the product can meet its label claims and will not present harmful effects to human health.

According to the Survey, there are five complying products that represent an estimated 67 percent of sales in California in 1995. As shown in Table VI-36, using adjusted emissions, the proposed standard will result in VOC emission reductions of 500 pounds per day.

Table VI-36
Wasp and Hornet Insecticide*

Product Form	Proposed VOC Standard (wt. %)	Complying Products	Complying Market Share (%)	Emissions Reductions (lbs./day)	Adjusted Emissions Reductions (lbs./day)**
Aerosols	40	5	67	420	500

* Based on Mid-term Measures 1994/1995 Consumer Products Survey.
** Emission reductions adjusted for complete market coverage (see Chapter IV).

Manufacturers will be able to meet this limit using technologies that are currently available and widely accepted in both the household and institutional markets. In addition, companies will be able to maintain their dielectric strength and knockdown capabilities with a variety of reformulation options. Compliance with the proposed standard is expected to be accomplished by reformulating solvent-based products with water-based systems, LVP-VOC solvents, or some combination of these systems.

All of the water-based products comply with the proposed 40 percent standard along with a few products that have LVP-VOC solvents in their formulation. The bulk of the products that will be reformulated use traditional petroleum distillates as carriers. Below is a discussion of the possible reformulation options that companies may use to meet the proposed 40 percent VOC limit.

Water-based Systems

Water-based products typically have a VOC content below 20 percent. They are available in the traditional aerosol spray formulations as well as the new foaming products that have become popular in the household market. As discussed earlier, water-based technologies have been successfully marketed for several years and represent over 60 percent of the household market (Survey).

There are several advantages to reformulating a wasp and hornet insecticide to a water-based system. They are non-flammable, have reduced health risks from toxicity and they are compatible with most household applications. In addition, advances in emulsion and active ingredient technology allow for efficacious water-based formulations that provide insect control similar to that of solvent-based products (Slatter, et al.).

Flammability concerns with wasp and hornet insecticides may be one driving force for reformulating to water-based systems. In household products, there is a tremendous consequence of safety liability. In addition to safety concerns, flammable products place economic burdens on retailers and distributors that must warehouse these products. The

National Fire Protection Association (NFPA) model codes, NFPA 30 and NFPA 30B, classify liquid and aerosol products in levels of flammability from I to III, with I being the least flammable. Warehouses that store products in the higher flammability levels are required to install expensive fire protection equipment or risk not being covered by fire insurance.

The issue of flammability is also compounded by the phase-out of TCA required by Title VI of the Federal Clean Air Act (FCAA). In the past, TCA was heavily relied on as a non-flammable, non-conductive cosolvent in these products. If manufacturers choose to replace TCA with VOC solvents, their products will be elevated to a high flammability classification which could be avoided by switching to a water-based system.

In addition to non-flammability, reformulation with water-based systems allows companies to substitute inherently safe ingredients for inert ingredients that may have potential toxic effects. Many compounds in petroleum distillates such as hexane and xylene are identified in the FCAA as hazardous air pollutants. Also, these compounds are considered by the U.S. EPA as “inert ingredients of toxilogical concern” for FIFRA registration. When a company substitutes water for an inert on U.S. EPA's list of inerts of toxilogical concern the registration process takes much less time and requires less data (DPR, March 17).

For indoor uses, water-based formulations do not leave odorous, staining or oily residues that may damage furniture, carpeting and flooring. For outdoor applications, water-based formulations have the advantage of being less harmful to plants than petroleum distillates.

The performance of water-based products has also been successfully demonstrated by their popularity in the household market. Water-based products have good biological activity and they achieve the spray pattern necessary for these types of products. Furthermore, advances in active ingredient and emulsion technology will further improve the performance of water-based products.

As mentioned earlier, the activity of a wasp and hornet insecticide is determined by the active ingredients in the product and to some extent the inert ingredients. Because water-based systems are compatible with most of the major active ingredients currently used in wasp and hornet insecticides formulators have a wide range of active ingredients available for reformulation. For example, pyrethroids' are stable in water emulsions, and many of the newer, highly active, pyrethroids can also be carried in water-based emulsions (e.g., deltamethrin).

Deltamethrin is one of the most active pyrethroid insecticides. It has been available for many years outside of the United States (U.S.) and was introduced in the U.S. in 1994. It will be available to all insecticide manufacturers upon completion of the FIFRA registration process. Deltamethrin is especially effective for residual control, is photostable, and will not bioaccumulate. In addition, it is very compatible with water-based systems. The aerosol formulations under development consist of one to four percent concentrate, six to nine percent “oil” phase, with the remainder of the formula consisting of water, propellants and corrosion inhibitors. Because of its high activity, deltamethrin may be used to increase the knockdown time of water-based systems. Currently, water-based products have acceptable knockdown. However, with the availability of new actives, such as deltamethrin, the knockdown time may be decreased. (Slatter, et al.; United Industries, April 23).

Finally, water-based products can satisfactorily achieve the necessary spray characteristics for wasp and hornet insecticides, which are a high discharge rate and large droplet size. In order to achieve the desired spray pattern, manufacturers may have to change the valving system they are currently using with their TCA or petroleum distillates products; however, these types of systems are widely used and available. Because most water-based products contain about 20 percent VOC, the proposed 40 percent VOC limit would give manufacturers a lot of flexibility in achieving the desired spray pattern with water-based formulations.

LVP-VOC Solvents

Another option available to meet the proposed 40 percent limit is the use of LVP-VOC solvents. The LVP-VOC solvents used in wasp and hornet insecticides typically are synthetically produced isoparaffinic solvents that often can be used in place of conventionally produced petroleum solvents (Exxon). Products containing LVP-VOC solvents have VOC contents ranging from zero to 65 percent, and are sold in both the household and institutional markets.

LVP-VOC solvents are beneficial to use because of their non-flammability and electrical non-conductivity. LVP-VOCs are generally mor expensive than traditional petroleum solvents (~$0.85/pound compared to $0.25/pound). To reduce costs, manufacturers could use a combination of LVP-VOCs, petroleum solvents and/or water to meet the proposed 40 percent limit.

As mentioned earlier, many manufacturers have already reformulated their high VOC products using LVP-VOC solvents in anticipation of future VOC regulations. Therefore, it has already been demonstrated as a good alternative to using traditional petroleum solvents. Also, LVP-VOC solvents are compatible with all of the actives currently used in the TCA and petroleum distillate products. In addition, significant retooling of the valve system or other hardware would not be required to produce the desired spray pattern (AgrEvo, April 22; MGK, April 23).

As mentioned above, some companies have concerns about maintaining the dielectric strength of their products for safety reasons. By replacing TCA or the VOCs with LVP-VOC solvents, manufacturers can produce non-flammable and non-conductive products. In addition, some of these products have knockdown times less than one second (AgrEvo, April 22).

Due to their reduced volatility, LVP-VOC solvents remain for some time as an oily residue on the sprayed substrate, which may be unacceptable to the user. However, companies with as much as 96 percent of these LVP-VOC solvents in their products have not had any complaints to this effect (AgrEvo, April 22). This is primarily because these products are typically sprayed in trees or on rooftops where oily residues are not a concern.

In conclusion, manufacturers have many options for reformulating their products to meet the proposed 40 percent VOC limit. The technologies are currently available and are successful in both the household and institutional markets. As seen above, water-based products have been available for many years and are widely accepted by consumers. The use of LVP-VOC solvents is a more recent development, but many of these products are registered with the U.S. EPA and DPR and meet the demands of both the household and institutional markets. In addition to what is currently available, companies have until 2006 to explore ways to improve upon the current technologies to create new products that are efficacious and meet their needs.

Issues:

1. Issue: Some industry representatives have pointed out that water-based wasp and hornet insecticides may pose a hazard to utilities employees that work around exposed or un-insulated high power electrical equipment. Many utility and telecommunication companies avoid this hazard by requiring their workers to use wasp and hornet sprays that have dielectric strengths of 20,000 volts or higher (SMUD, PG&E). In addition, some companies have expressed concerns with selling water-based products to household consumers due to shock hazard risks.

Response: Major insecticide manufacturers have indicated that current and future water-based products with VOC contents well below the proposed 40 percent limit will be safe and effective for household consumers. This is true because the electrical lines and junctions in residential areas are well insulated, shock hazard risks from using these products are minimal. In addition, millions of water-based products have been sold in the last several years without any cases of electrocution reported due to the use of these products (United Industries, April 23). The proposed limit gives manufacturers the flexibility to explore different reformulation options that may include water, LVP-VOC solvents or petroleum distillates.

Although water-based products will meet the needs of the household market, they will not currently meet the needs of the utility and telecommunication companies. However, companies can use LVP-VOC solvents to comply with the proposed standard and maintain the dielectric strength of their products. Products containing these LVP-VOC solvents are currently being successfully marketed and used.

2. Issue: Manufacturers have expressed concern with the slower knockdown time of the water-based products. A fast knockdown time is necessary to protect users from being attacked by agitated wasps and hornets.

Response: As discussed earlier, knockdown is based on the extent and speed of the active ingredients in a product, and to some extent the inert ingredients. Currently, testing shows that water-based wasp and hornet insecticides take approximately 9 to 14 seconds to knockdown the pests compared to 4 to 6 seconds for petroleum distillate based products.

While the knockdown time of the water-based products is somewhat longer, they are very successful in the household market (United Industries, April 23).

Also, manufacturers can choose to meet the proposed limit using LVP-VOC solvents or a blend of LVP-VOC solvents, petroleum distillates or water. At least one manufacturer has stated that products containing high levels of LVP-VOC solvents have knockdown times under one second (AgrEvo, April 23).

In addition to using LVP-VOC solvents to maintain the knockdown time of high VOC products, the development of new highly active synthetic pyrethroids, such as deltamethrin, may allow decreased knockdown times and high insecticidal activity in low VOC wasp and hornet insecticides.

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VII.

ENVIRONMENTAL IMPACTS

A. SUMMARY OF ENVIRONMENTAL IMPACTS

Air Resources Board (ARB) staff has studied the potential environmental impacts of the proposed amendments to the Consumer Products Regulation (Regulation). This analysis shows that the proposed amendments would have positive environmental impacts by contributing to air quality improvement statewide. Reductions in both ground level ozone and particulate matter with diameters less than ten micrometers are anticipated. In accordance with California Environmental Protection Agency policy, we conducted a health risk assessment that shows that public health would be improved by reducing volatile organic compound (VOC) emissions. Moreover, ARB staff has determined that no significant adverse environmental impacts should occur as a result of the proposed amendments. Potential impacts on water quality and landfill loading were all considered, and no negative impacts were identified. The following environmental analysis provides the basis for our findings.

B. LEGAL REQUIREMENTS APPLICABLE TO THE ANALYSIS

The California Environmental Quality Act (CEQA) and ARB policy require an analysis to determine the potential adverse environmental impacts of proposed regulations. Because the ARB's program involving the adoption of regulations has been certified by the Secretary of Resources (see Public Resources Code section 21080.5), the CEQA environmental analysis requirements are allowed to be included in the ARB Staff Report or Technical Support Document in lieu of preparing an environmental impact report or negative declaration. In addition, the ARB will respond in writing to all significant environmental points raised by the public during the public review period or at the Board hearing. These responses will be contained in the Final Statement of Reasons for the proposed amendments to the Regulation.

Public Resources Code section 21159 requires that the environmental impact analysis conducted by ARB include the following: (1) an analysis of the reasonably foreseeable environmental impacts of the methods of compliance, (2) an analysis of reasonably foreseeable feasible mitigation measures, and (3) an analysis of reasonably foreseeable alternative means of compliance with the Regulation.

Our analysis of the reasonably foreseeable environmental impacts of the methods of compliance is presented in Sections C and D below. Because no significant adverse environmental impacts associated with the proposed amendments to the Regulation are identified, an analysis of feasible mitigation measures is unnecessary. However, we will continue to monitor implementation of the Regulation to ensure that no adverse impacts occur in the future.

Alternative means of compliance with the Regulation have been studied. One compliance alternative is already available to manufacturers of consumer products, the Alternative Control Plan (ACP). The ACP regulation, Title 17, California Code of Regulations, sections 94540-94555, is a voluntary market-based regulation that utilizes the concept of an aggregate emission cap, or "bubble." An emissions bubble places an overall limit on the aggregate emissions from a group of products, rather than placing a limit on the VOC content of emissions from each individual product. To be approved, an ACP must demonstrate that the total VOC emissions under the bubble would not exceed the emissions that would have resulted had the products been formulated to meet the VOC standard established for each product. In other words, some products in an ACP could exceed the established VOC standards in the Regulation as long as those increased emissions were offset by additional products that overcomply with the established VOC standards. The ACP provides manufacturers with flexibility, but preserves the overall environmental benefits of emission reductions (ARB, 1994a).

Another mechanism that is available for manufacturers is the Innovative Products Provision specified in section 94511 of the Regulation. This provision allows a manufacturer to formulate products that exceed the mass-based standard specified in the Regulation for a particular product category. The manufacturer must conclusively demonstrate that, through some characteristic of the higher VOC product, its use will result in less VOC emissions compared to a representative complying product.

Absent the aforementioned, at this time, ARB staff is unaware of any other scenarios that would serve as alternatives to reformulation of consumer products. However, ARB staff continues to study additional compliance options to allow manufacturers added flexibility. One concept being developed by ARB staff, looks at the relative reactivity of different VOC species using a scale developed by Dr. William P. L. Carter. The concept of maximum incremental reactivity (MIR) is a way to determine a compound's likelihood to react in the atmosphere to form ozone (Carter, 1994; ARB, 1996). Based on MIR values, a manufacturer could exceed the mass-based VOC standard by reformulating with VOCs that have lower reactivity. This voluntary program would provide an additional compliance option.

C. EMISSIONS REDUCTIONS AND OTHER POTENTIAL ENVIRONMENTAL IMPACTS

<u>Impact on Ground Level Ozone</u>

The beneficial environmental impact of the proposed amendments to the Regulation would be a reduction in the VOC emissions from previously unregulated consumer products. VOCs react in the atmosphere to contribute to tropospheric ozone formation. Therefore, the reduction in VOC emissions resulting from these amendments, is expected to contribute to improved air quality and public health. The proposed amendments contain VOC limits for

18 product categories. As reported in the Survey, these products emit about 18 tons per day (tpd) of VOC to the atmosphere (Survey). The adjusted emissions, due to potential underreporting in the Survey, are about 31 tpd (U.S. EPA, 1990; ARB, 1990, 1991). The product categories, their emissions, and expected emission reductions as a result of the proposed amendments are shown in Table VII-1. Depending on the product category, the standards become effective beginning in 2000 with some effective dates extended to 2005. These standards are designed to achieve a
50 percent reduction in VOC emissions from these product categories. Once all of the standards are in place, using the adjusted emissions, VOC emissions would be reduced by about 15 tpd. These VOC emissions reductions are the primary positive environmental impacts to be gained from this proposed Regulation.

Impact on Particulate Matter

By reducing VOCs, the proposed amendments would also have an additional positive environmental impact by reducing the amount of particulate matter in the atmosphere. Of interest here are secondary particles, i.e., particles that are formed by chemical reactions in the atmosphere with aerodynamic diameters less than ten micrometers (PM_{10}) (Finlayson-Pitts, 1986; Appel, 1979). Particulate matter is responsible for reducing visibility and may be inhaled deep into lungs (Seinfeld, 1989). For a further description of the effects of particulate matter on the environment and health refer to Chapter IV of this report. One mechanism of gas to particle conversion may involve reactions of VOCs with ozone to form low vapor pressure products which combine with other molecules to form new particles or which condense on preexisting particles (Seinfeld, 1989; Finlayson-Pitts, 1986). Typically the low vapor pressure compounds involve reactions of hydrocarbons containing seven or more carbon atoms (Seinfeld, 1989). In another study, data suggest that cycloalkenes are the principal secondary organic aerosol precursor. Data indicated that hexanedioic and pentanedioic acids were among the most abundant aerosol constituents of probable secondary origin (Appel, 1979). Therefore, by reducing the VOC content of consumer products, as proposed in these amendments, a positive environmental impact results as fewer VOCs would be emitted to further react to form particulate matter in the atmosphere.

Table VII-1
Summary of Emissions and Emission Reductions from the Proposed Standards

Product Category	VOC Emissions Adjusted (Pounds/Day)	Adjusted Emission Reductions (Pounds/Day)	Percent Emission Reductions
Automotive Rubbing or Polishing Compound			
All Forms	2,020	660	33
Automotive Wax, Polish, Sealant or Glaze			
All Other Forms	3,800	1,340	35
Hard Paste Wax	1,320	480	36
Instant Detailers	To be determined	80	
Bug and Tar Remover	1,620	640	40
Carpet and Upholstery Cleaner			
Aerosols	560	80	14
Non-Aerosols - Dilutables	1,180	700	59
Non-Aerosols - Ready to Use	300	100	33
Floor Wax Stripper			
Non-Aerosols	6,400	3,340	54
General Purpose Degreaser			
Aerosols	1,180	540	46
Non-Aerosols	4,200	2,780	66
Hair Shine	1,180	500	42
Heavy-duty Hand Cleaner or Soap	6,000	4,540	76
Metal Polish / Cleanser	680	280	41
Multi-purpose Lubricant			
Excluding Solids / Semisolids	11,800	4,700	40
Nonselective Terrestrial Herbicide			
Non-Aerosols	6,800	5,220	77
Paint Remover or Stripper	4,000	420	10
Penetrant			
Excluding Solids / Semisolids	1,100	300	27
Rubber and Vinyl Protectant			
Aerosols	1,480	460	31
Non-Aerosols	1,800	1,680	93
Silicone-based Multi-purpose Lubricant			
Excluding Solids / Semisolids	1,480	500	34

Table VII-1 (continued)
Summary of Emissions and Emission Reductions from the Proposed Standards

Product Category	VOC Emissions Adjusted (Pounds/Day)	Adjusted Emission Reductions (Pounds/Day)	Percent Emission Reductions
Spot Removers			
Aerosols	380	100	26
Non-Aerosols	620	420	68
Undercoating			
Aerosols	480	120	25
Wasp and Hornet Insecticide	1,280	500	39
Total Emissions (TPD)	**61,600 (30.8)**	**30,600 (15.3)**	**50**

Risk Assessment for Reduced Exposure to Ozone and PM_{10}

It is not possible to accurately estimate the health risk reductions that would result from the adoption of this regulation due to lack of data. However, we are able to use indicators that allow us to indirectly assess the reduced health risk that would result from the proposed regulation. It has long been known that exposure to ground level ozone and PM_{10} have adverse impacts on public health. Research has shown that, when inhaled, ozone and PM_{10} can cause respiratory problems, aggravate asthma, and impair the immune system (U.S. EPA, 1996). It has also been shown that exposure to ozone can temporarily reduce lung capacity by 15 to 20 percent (U.S. EPA, 1996). PM_{10} has also been linked to premature death (U.S. EPA, 1996). Although it is not easily quantified, we are able to use recent information made available by U.S. EPA which clearly shows that reducing ozone and PM_{10} concentrations improves public health (U.S. EPA, 1996). As a corollary to this, it follows that by reducing VOC emissions, a known contributor to ozone and PM_{10} formation (see Chapter IV), public health would be improved. The U.S. EPA recently analyzed about 90 PM_{10} studies and about 200 recent ozone studies that looked at the effects of these pollutants on human health. Based on this analysis, and studies that looked at the health benefits that would be achieved by revising the national ambient air quality standards downward, U.S. EPA was able to qualitatively estimate the health benefits that result from lower ozone and PM_{10} concentrations. These estimates indicate that there would be significant reductions in breathing problems, in hospital admissions, and missed school and work days (U.S. EPA, 1996). Illness in children, conditions such as inflamed lungs and lung damage, bronchitis, and episodes when asthmatic children require medical treatment would all be significantly reduced (U.S. EPA, 1996).

ARB staff is not able to directly compare the estimated health risk reductions resulting from the proposed regulation with the health risk reductions from similar regulations. However, we are able to compare the VOC emission reductions from this proposed regulation with other consumer product regulations adopted by the ARB. From the total adjusted VOC emissions of about 31 tpd from 18 product categories, this regulation is designed to achieve the maximum feasible VOC emission reduction. When fully implemented the proposed regulation would reduce VOC emissions from these categories by 50 percent. This compares favorably with other consumer product regulations adopted by ARB. The antiperspirant and deodorant regulation reduces VOC emissions from over 4 tpd to less than 1 tpd, an 80 percent reduction (ARB, 1995b). The Phase II consumer products regulation reduces VOC emissions from over 28 tpd to about 19 tpd, a 35 percent reduction (ARB, 1991b). The ARB has also adopted an aerosol coating regulation that, when fully implemented, will reduce VOC emissions by 60 percent, from 30 tpd to 12 tpd (ARB, 1995a).

The 50 percent VOC emission reduction that this regulation would achieve also compares favorably to similar regulations adopted by other environmental agencies. For example, the South Coast Air Quality Management District has adopted an architectural and industrial maintenance coating regulation that reduces VOC emissions by 75 percent (SCAQMD, 1996). At the federal level, U.S. EPA has proposed a national consumer product regulation to reduce VOC emissions from 24 consumer product categories by 20 percent (U.S. EPA, 1996b).

In summary, our health risk analysis shows that, by achieving the maximum feasible reduction, this regulation would reduce health risks by a similar magnitude as other regulations adopted by the ARB and other environmental agencies. To what extent this regulation would reduce ozone and PM_{10} concentrations is difficult to quantify and contingent on many factors. It is clear, however, that by reducing VOC emissions, ozone and PM_{10} concentrations would be reduced. Therefore, by reducing ozone and PM_{10} concentrations, this regulation would reduce the health risks posed by exposure to these pollutants.

Impact on Global Warming

The theory of global warming is based on the premise that emissions of anthropogenic pollutants, together with other naturally-occurring gases, absorb infrared radiation in the atmosphere, thereby increasing the overall average global temperature (U.S. EPA, 1995a). The proposed amendments to the Regulation could have an impact on global warming, depending on the reformulation option chosen by manufacturers. To meet the VOC standards proposed for some aerosols, manufacturers may choose to replace or blend the typical hydrocarbon propellants. Options for propellant replacement include using hydrofluorocarbon (HFC) compounds and, to a lesser extent, recycled carbon dioxide. Because these compounds are specifically exempted from the definition of VOC contained in section 94508 of the Regulation, they may be used to reduce the overall VOC content of a consumer product. However, ARB staff has determined that even if all aerosol products were reformulated to use HFCs or carbon dioxide as propellant, the impact on global warming would be negligible.

HFCs are non-chlorinated methane and ethane derivatives which contain hydrogen and fluorine. The most likely HFC to be chosen to replace hydrocarbon propellants is hydrofluorocarbon-152a (HFC-152a) (Applegate, 1995). To some extent 1,1,1,2-tetrafluoroethane (HFC-134a) may also be used (Survey). HFCs absorb infrared energy and therefore can contribute to global warming (Wallington, 1994). The global warming potential (GWP) of HFC-152a, is 50 times greater than hydrocarbon propellants and 150 times greater than carbon dioxide. The GWP of HFC-134a is eight times greater than that of HFC-152a (Daly, 1993). However, we are aware that a manufacturer of HFC-134a and the U.S. EPA are discouraging its use in consumer products (Du Pont, 1992; Du Pont, 1997). Because HFC-152a is more likely to be considered as a propellant replacement, our analysis is based on its use (Applegate, 1995; Du Pont, 1992). Based on the Survey, about 14 tpd are emitted from the aerosol products being considered for regulation (Survey). Estimating that 30 percent of these formulations is propellant, i.e. 4.2 tpd, and that all propellant is replaced with HFC-152a, its emissions would increase by no more than 4.2 tpd. This small increase in HFC-152a emissions would have a negligible impact on global warming. By comparison, although it has a much smaller global warming potential, nearly 100 million tons per day of carbon dioxide, the primary man-made greenhouse gas of concern, is emitted into the atmosphere from existing processes. Furthermore, ARB staff does not believe that all aerosols would be reformulated with HFC-152a to reduce the VOC content. The standards proposed allow manufacturers to choose other reformulation options. This, combined with the fact that HFC-152a is quite expensive, when compared to hydrocarbon propellants (HFCs are about $1.85 per pound, versus hydrocarbon propellants at $0.25 per pound), may make manufacturers choose other reformulation options. However, ARB staff acknowledges that these price differentials are subject to change, at which point use of HFC-152a may increase.

As mentioned above, carbon dioxide is the primary man-made greenhouse gas of concern. However, Survey data indicate that carbon dioxide is not used extensively at present (Survey). Although carbon dioxide has found some use as a replacement propellant in consumer products, it is not considered a likely replacement for hydrocarbon propellants in the near future. Therefore, its use in aerosols due to the proposed Regulation would have no impact on global warming. In addition, most carbon dioxide used as a propellant is a recycled by-product of existing processes and therefore does not increase global warming due to carbon dioxide (ARB, 1995b).

Impact on Stratospheric Ozone Depletion

The ARB staff has determined that the proposed amendments would have a minimal, if any, impact on stratospheric ozone depletion. Stratospheric ozone shields the earth from harmful ultraviolet (UV) radiation (U.S. EPA, 1995b). Its depletion causes higher UV radiation levels at the earth's surface (Hoffman, 1990; U.S. EPA, 1995b). The increase in UV radiation leads to a greater incidence of skin cancer, cataracts, and impaired immune systems (UNEP, 1996). Reduced crop yields and diminished ocean productivity is also anticipated (U.S. EPA, 1995b; UNEP, 1996). Because the reactions which form tropospheric ozone are driven by UV radiation, it is conceivable that a reduction in stratospheric ozone may also result in an increase in photochemical smog formation because of the increased UV radiation (ARB, 1995a).

Compounds such as chlorofluorocarbons (CFCs) and other halocarbons (e.g. halons, 1,1,1-trichloroethane (TCA), and carbon tetrachloride) cause the destruction of the UV protective stratospheric ozone (Hoffman, 1990; U.S. EPA, 1995b). These compounds are generally very stable and do not degrade appreciably in the troposphere (Hoffman, 1990; Wallington, 1994; U.S. EPA, 1995b). Instead, they gradually diffuse into the stratosphere where they release chlorine or bromine atoms. Bromine atoms released from halons are even more reactive than chlorine atoms (U.S. EPA, 1995b).

ARB staff is not aware of any ozone-depleting materials other than TCA that are used in the consumer product categories being considered for regulation (Survey). This chemical is classified by the U.S. EPA as a Class I ozone-depleting compound. Class I compounds have the highest ozone-depletion potential, a measure of the relative ability of a compound to deplete the stratospheric ozone layer. However, we do not expect the use of TCA to continue. According to the Montreal Protocols and the 1990 Federal Clean Air Act amendments, all ozone depleting compounds, including TCA, were scheduled for production phase-out by 1995 (U.S. EPA, 1995b; Wallington, 1994). Because of the regulatory pressure on ozone-depleting compounds generally, and the production phase-out of TCA specifically, we do not expect any adverse impact on the stratospheric ozone layer due to the proposed amendments to the Regulation. Manufacturers have also indicated that products currently using TCA are being reformulated.

Because it lacks chlorine, HFC-152a probably contributes only slightly to ozone depletion (Wallington, 1994). As evidence of this, HFC-152a is not included on the list of compounds that are scheduled for phase-out under the Federal Clean Air Act requirements. Therefore, if manufacturers choose HFC-152a as a replacement for hydrocarbon propellants, no additional decrease in stratospheric ozone is expected (ARB, 1995b; Daly, 1993).

Impacts on Water Quality and Solid Waste Disposal

We do not expect an adverse impact on water quality or solid waste disposal from the proposed amendments to the Regulation. The Regulation is designed so that all current product forms will be available. Because of this, we do not anticipate any changes in packaging or disposal due to the Regulation. Additionally, some products may be able to reformulate by increasing the “active” ingredients, or product solids, thereby reducing the VOC content of the product. In these instances, fewer cans or containers may be necessary to complete a task. This would be a positive environmental impact as fewer cans would need disposal.

D. OTHER POTENTIAL ENVIRONMENTAL IMPACTS

Impact of Use of Toxic Air Contaminants

Pursuant to Health and Safety Code section 39650 et seq., the ARB is required to identify and control Toxic Air Contaminants (TAC). The Health and Safety Code defines a TAC as "... an air pollutant which may cause or contribute to an increase in mortality or in serious illness, or which may pose a hazard to human health." A number of chemicals currently used in the consumer product formulations considered for regulation have been identified as TACs (Survey; ARB, 1993). In accordance with CEQA, we are required to mitigate potential adverse environmental impacts that may occur as a result of our regulations. An increased use in TACs in these consumer products could lead to a potential adverse environmental impact.

Solvents commonly used in consumer products that have been identified as TACs, such as xylene and toluene, are also VOCs (Survey; ARB 1993). This Regulation is designed to reduce the VOC content of consumer products which should lead to a reduction in the use of TACs that are also VOCs. This would be a positive environmental impact of the Regulation. However, two TACs used in some consumer products, methylene chloride (MeCl) and perchloroethylene (Perc), are specifically exempted from the VOC definition in section 94508 of the Regulation. Because of this, the following describes why we believe the proposed amendments would not result in any increased use of these compounds. Therefore, no additional mitigation measures are needed beyond what are already in place in the Regulation.

Methylene Chloride (MeCl)

MeCl, also known as dichloromethane, is a colorless, volatile liquid that is currently used in some consumer products. It is a chlorinated hydrocarbon solvent that is non-flammable (Survey; ARB, 1989; OSHA 3144, 1997; U.S. EPA, 1994). Inhaling the vapors causes mental confusion, nausea, and headaches (MeCl MSDS, 1986; Harvard Health Letter, 1986; ARB, 1989). Once in the body, MeCl generates carbon monoxide, which leads to decreased oxygen carrying capacity in the blood (U.S. EPA, 1994). During acute exposure, MeCl acts as an anesthetic and may eventually lead to death. Studies on laboratory animals also indicate that chronic exposure causes cancer (ARB, 1989; OSHA 3144, 1997; U.S. DHS, 1993a). Of particular interest for this rulemaking is its use in paint remover or strippers (strippers) and lubricants (Survey).

Background

Based on available data, the Occupational Safety and Health Administration (OSHA) first established a standard for MeCl exposure in the workplace in 1970. Using information from the American National Standards Institute, the limit was established at 500 parts per million (ppm) for an 8-hour time-weighted average (TWA) (OSHA 3144, 1997). In 1986, the National Toxicology Program (Department of Health and Human Services) published studies showing that long term exposure to high concentrations of MeCl will produce malignant liver and lung tumors in mice and benign mammary tumors in female rats. As a result of these studies, MeCl was declared a B2 substance, probable human carcinogen, by the U.S. EPA. The U.S. EPA determined that although there was inadequate human evidence of carcinogenicity, there was sufficient evidence of carcinogenicity in animals (ARB, 1989).

In 1988, MeCl was added to the Proposition 65 list of "Chemicals Known to the State to Cause Cancer" (Safe Drinking Water and Toxic Enforcement Act of 1986) (Prop 65; Prop 65, 1997). Also, the U.S. EPA designated MeCl as a hazardous air pollutant (HAP), pursuant to section 112(b) of the Federal Clean Air Act because it was known to have, or possibly have, adverse effects on human health or the environment (ARB, 1993).

Because additional scientific data clearly indicated that the established OSHA standard was inadequate to protect workers, OSHA adopted a revised standard for MeCl with an effective date of April 10, 1997. To protect worker health, the standard was lowered from 500 ppm to 25 ppm for an 8-hour TWA (OSHA 3144, 1997; 29 CFR, 1997).

<u>Perchloroethylene</u>

Perchloroethylene (Perc) is a chlorinated aliphatic hydrocarbon compound. It is a non-flammable, colorless liquid solvent that is used in a variety of consumer products (ARB, 1991). The most likely route of exposure is via inhalation. Perc vapors are an eye and respiratory tract irritant. It is a central nervous system depressant and chronic exposure may lead to liver toxicity, kidney dysfunction and neurological effects (ARB, 1991).

<u>Background</u>

The Department of Health and Human Services determined that Perc may reasonably be anticipated to be a carcinogen. Long-term studies in which animals were exposed to high levels of Perc resulted in liver and kidney cancers. However, Perc has not been shown to cause cancer in humans (U.S. DHS, 1993b). It has also been identified as a TAC by the ARB and as a Proposition 65 compound (ARB, 1991; Prop 65, 1997). Perc is also listed as a HAP under section 112(b) of the Federal Clean Air Act (ARB, 1993).

In 1996, the U.S. EPA exempted Perc from its definition of VOC because it was determined that the compound had a very low likelihood of contributing to ground level ozone formation (61 CFR, 1996). Although ARB was concerned about the increased use of Perc in California, and possible adverse environmental impacts as a result, ARB classified Perc as a "low reactive" VOC compound and exempted Perc from the VOC definition in late 1996 (ARB, 1996). This provided needed conformity with the federal VOC definition. ARB's analysis of Perc's potential to form ground level ozone demonstrated that Perc had a very low photochemical reactivity. No other negative environmental impacts were identified because of the exemption, except a possible impact on toxicity. ARB staff found that there was a slight potential for increased emissions of Perc to have an adverse health impact (ARB, 1996).

<u>Mitigation Measures</u>

ARB staff has determined that beyond the mitigation measures currently in place in the Regulation, and those proposed in these amendments, no additional mitigation measures are warranted. The reasons for this conclusion are discussed below. Of the 18 consumer product categories currently considered for regulation in the mid-term measures, MeCl is used in strippers, spot removers and lubricants. Perc is used in lubricants, general purpose degreasers and spot removers (Survey). Both are excellent solvents and have been exempted from the VOC definition in the Regulation. Because of this, we were concerned that to comply with this Regulation, manufacturers may reformulate with these compounds, or increase their use in currently marketed products. In light of the Survey data, and our CEQA responsibility, the proposed standards for strippers, lubricants, general purpose degreasers and spot removers were intentionally set at levels which are currently achievable without using any additional MeCl or Perc.

Paint Strippers

For strippers, a two-tiered standard is proposed. In determining the proposed Tier I and Tier II standards we considered the possibility of increased use of MeCl. In light of this, a Tier I VOC standard of 65 weight percent is proposed. Survey data indicate that all reported stripper technologies have products that currently comply with the proposed standard (Survey). As evidence of this, 26 percent of products currently comply with the proposed Tier I standard without using MeCl. Based on our market share data, products without MeCl as the active stripping solvent are effective in stripping coatings (Survey).

In 2005, we are proposing that the VOC standard for strippers be reduced to 50 weight percent. Over 15 percent of the market share currently comply with the proposed Tier II standard without using MeCl (Survey). ARB staff realizes that this standard may be a reformulation challenge for some manufacturers. However, with currently available and emerging technologies, we believe the standard is achievable without increased use of MeCl.

Lubricants

Based on the Survey, some lubricants use Perc and MeCl in current formulations (Survey). In light of this, ARB staff has intentionally proposed VOC standards for these products that are achievable without an increased use of Perc or MeCl. For example, for multipurpose lubricants we are proposing a two-tiered standard. Effective in 2002, we are proposing a VOC standard of 60 weight percent. Eleven percent of currently marketed products are able to comply with this standard without the use of TACs. In 2005, we propose to lower the VOC standard to 45 weight percent. Currently, nine percent of the products comply with this proposed standard without using TACs.

For silicone-based multipurpose lubricants, we are proposing a VOC standard of 60 weight percent effective in 2005. Based on the Survey, 11 percent of currently marketed products are able to comply without using TACs. This, combined with the proposed effective date of 2005, gives manufacturers ample time to investigate reformulation options that exclude TACs.

For penetrants, we are proposing a two-tiered standard. Effective in 2002, we are proposing a VOC standard of 60 weight percent. Fifty-three percent of currently marketed products are able to comply with this standard without the use of TACs. In 2005, we propose to lower the standard to 45 weight percent. Currently, 34 percent of products marketed comply with this proposed standard without using TACs.

Spot Removers

The proposed VOC standard for aerosol spot removers is 25 weight percent in 2000. Fifty-four percent of currently marketed products are able to comply with this proposed standard. The proposed VOC standard for non-aerosols is eight weight percent. Eighty percent of the presently marketed products are able to comply with this proposed standard. The standards for aerosol and non-aerosol spot removers are achievable without an increased use in Perc or MeCl as evidenced by the fact that the complying marketshare is unchanged when you exclude products that contain TACs (Survey).

General Purpose Degreasers

Similarly, a small number of general purpose degreasers reported in the Survey are formulated with TACs. However, based on the fact that the complying marketshare is unchanged when you exclude products that contain TACs, the proposed VOC standards of 50 weight percent for aerosols and 10 weight percent for non-aerosols are achievable without using TACs as a reformulation option.

Summary

Regarding Perc, we are not anticipating that these proposed VOC standards would lead to increased use as noncomplying products are reformulated. One large manufacturer of lubricants has indicated that they will not use TACs as a means to comply with the proposed standards (WD 40, 1997). We also believe that by allowing manufacturers until 2005 to comply with the more stringent VOC standards, that additional technologies may emerge to allow added reformulation options. Moreover, ARB's analysis of possible toxic impacts as a result of exempting Perc from the VOC definition for consumer products indicates that, of source categories using Perc, consumer products account for less than 10 percent of overall Perc emissions (ARB, 1996). All other emission sources of Perc far overwhelm any potential adverse health impacts associated with consumer products possibly reformulating with Perc. As a further safeguard, section 94513 of the Regulation was recently amended to add subsection (e) (ARB, 1997a). This subsection establishes a reporting requirements for manufacturers using Perc in their current products and newly introduced products. This reporting requirement will enable us to track any increased Perc usage. At such time as the available data indicate a significant increase in Perc usage, additional measures will be taken to discourage its use.

We are also proposing to add subsection 94513(g) to the Regulation which would establish an annual reporting requirement to determine manufacturers' progress in meeting the proposed standards. This requirement would allow us to track the use of TACs. Should data indicate an increased use in either Perc or MeCl, the proposed standards would be reconsidered. Also, we believe manufacturers are likely to be dissuaded from reformulating with TACs because of additional labeling required by Proposition 65 (Prop 65). For example, some noncomplying strippers contain little or no MeCl (Survey). Typically these products are marketed as being safer for the user (Sunnyside). Because of this, it is unlikely that manufacturers would change their marketing strategy and reformulate these noncomplying strippers by using MeCl. Manufacturers have also indicated that they are studying worker exposure in light of the revised OSHA standard. If exposure exceeds the OSHA limit, manufacturers will have to consider the cost of installing additional equipment to protect workers versus reformulating products without MeCl. Customer exposure concerns may also lead to reformulating products without MeCl even if worker exposure can be controlled (Sherwin-Williams, 1997).

Regarding the environmental impact of using TACs, overall ARB staff anticipates a positive environmental impact because the amount of TACs that are VOCs should be reduced as products are reformulated to comply with the Regulation. ARB staff has further determined that there is the possibility of an adverse environmental impact from these amendments if manufacturers choose to comply with the standards by reformulating with TACs that are not considered VOCs. However, we believe that by proposing VOC standards that are currently achievable without using TACs, and by giving manufacturers long lead times before the standards become effective, it is unlikely to occur. The additional safeguard of reporting requirements would further discourage their use.

E. IMPACTS ON THE STATE IMPLEMENTATION PLAN FOR OZONE

The ARB staff has determined that these amendments to the Regulation would achieve the performance standard required to meet the State Implementation Plan (SIP) commitment from the Mid-term Measures. Overall, VOC emissions from the mid-term measures consumer product categories would be reduced by 50 percent, as required by the SIP.

Background

The Federal Clean Air Act amendments of 1990 require an ozone attainment plan from every area unable to meet the national ambient air quality standard for ozone. To assist California air districts to meet the challenge of attaining the ozone standard, the ARB and air districts developed the SIP (ARB, 1994b). State law provides the legal authority to ARB to develop regulations affecting a variety of mobile sources, fuels, and consumer products. The regulations that are already adopted, and measures proposed for adoption constitute the ARB's portion of the SIP. The SIP serves as a "road map" to guide California to attain and maintain the national ambient air quality standard for ozone. The SIP was submitted to the U.S. EPA on November 15, 1994, and the consumer products element was formally approved on August 21, 1995.

The consumer products element of the SIP is comprised of near-term, mid-term, and long-term measures. The near-term measures are comprised of existing consumer product regulations, the Alternative Control Plan, and the aerosol coatings regulation. Of the 265 tpd (includes aerosol paint) available for regulation from this category, the near-term measures are designed to achieve a 30 percent reduction from the 1990 baseline emissions, by 2000. The mid-term measures commitment in the SIP was to adopt regulations to cover additional product categories not subject to existing regulations. Our commitment regarding the mid-term measures is to achieve an additional 25 percent reduction from the 1990 baseline, by 2005. This translates into a 50 percent reduction from currently unregulated categories. The long-term measures rely on new technologies, market incentives and consumer education, and will achieve an additional emission reduction of 30 percent from the 1990 baseline emissions by 2010 (ARB, 1994c).

Mid-Term Measures

Based on the 1990 baseline emissions, we estimated VOC emissions of 120 tpd from unregulated consumer products categories. In the ARB 1995 Mid-term Measures Survey, however, manufacturers reported approximately 46 tpd of VOC emissions, indicating uncontrolled emissions have been overestimated (Survey). Of these 46 tons, 17.8 tpd of VOC emissions from 18 product categories are proposed for regulation at this time. However, due to underreporting in the Survey, VOC emissions were adjusted using data from the U.S. EPA 1990 Consumer Products Survey and the ARB's 1990 and 1991 Consumer Product Survey (U.S. EPA, 1990; ARB, 1990, 1991). These data increase VOC emissions to 30.8 tpd from these product categories. Therefore, the proposed amendments being considered for adoption by the ARB on July 24, 1997, are designed to achieve a 50 percent reduction from the adjusted VOC emissions of 30.8 tpd, or a reduction of 15.3 tpd, when all standards are fully effective in 2005.

Summary

The total reported emissions of 46 tpd fall far below our previous emission inventory estimate of 120 tpd available for regulation in the Mid-term Measures. The disparity will be evaluated and ARB staff will update the consumer products inventory for the Board at an informational hearing in November of this year. The disparity in emissions reported, versus those estimated raises a concern that the proposed amendments would not achieve the necessary emission reductions to meet our SIP commitment, leading to a potential shortfall in tons reduced. We are, however, meeting the SIP performance standard of achieving a 50 percent reduction from the adjusted emissions of 30.8 tpd. Having met the prescribed performance standard, these amendments would not necessarily result in a SIP emission shortfall, but rather, a SIP problem which must be addressed in an update to the SIP (ARB, 1997b). Because these proposed amendments would achieve the performance standard for VOC reductions, the Mid-term Measures SIP commitment is being fulfilled. The question of whether, or to what extent, an overall SIP shortfall or problem exists, will be addressed when the SIP inventory for all source categories is updated. Based on modeling analyses using the updated SIP inventory, we will be adjusting the estimate of the tons of VOCs that need to be reduced from consumer products, as well as all other source categories. Any potential shortfall in emission reductions from consumer products will be addressed at that time.

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VIII.

ECONOMIC IMPACTS

A. INTRODUCTION

This chapter discusses the estimated economic impacts we anticipate from implementation of the 29 proposed standards, including the impacts from the four two-tier standards. These twenty-nine standards will hereafter be referred to as the "Phase III" standards. Economic impact analyses are inherently imprecise by nature, especially given the highly competitive nature of the consumer products market. While we quantified the economic impacts to the extent feasible, some projections are necessarily qualitative and based on general observations and facts about the consumer products industry. This impacts analysis, therefore, serves to provide a general picture of the economic impacts typical businesses subject to the proposed Phase III standards might encounter; we recognize individual companies may experience different impacts than projected.

The overall impacts are first summarized in Section B, followed by a more detailed discussion of specific aspects of the economic impacts in the sections listed below:

(C) Economic Impact Analysis on California Businesses as required by the California Administrative Procedure Act (APA);
(D) Analysis of Potential Impacts to California State or Local Agencies;
(E) Analysis of the Cost-Effectiveness (C.E.) of the Proposed Standards;
(F) Analysis of the Impacts to Raw Materials Cost; and
(G) Analysis of the Combined Impacts on Per-Unit Cost from Recurring (Raw Materials) and Nonrecurring Cost
(H) Analysis of the Potential Impacts from the Alternative Control Plan (ACP) Regulation.

It is important to note that we conducted the economic impacts analysis shown in this report to meet recently-enacted legal requirements under the APA. As such, this analysis represents a significant update to and expansion of the methodology we used to conduct the cost-effectiveness analyses for the original Phase I-II consumer products rulemaking.

The economic impacts analysis was prepared in consultation with ARB's Economic Studies Section (section) of the Research Division. The section is staffed with professionals who carry out a broad range of assignments for the ARB and other organizations, including the Governor's Office; Cal/EPA boards, offices and departments; and local air pollution control agencies. The section manages extramural research contracts; develops methodologies; collects, analyzes and distributes economic and financial data; conducts economic and financial analyses, including the economic impact analyses of the Board's regulations; oversees the economic impact analyses of the regulations promulgated by all Cal/EPA boards, offices and departments; and carries out other related tasks as needed by the ARB. The staff hold Ph.D, J.D., M.B.A., M.A., and B.S. degrees in economics, business, chemical engineering, microbiology, and environmental resource science. Members of the section have taught economics, accounting, finance, and computer science at the university level; have given invited talks and presented technical papers to major universities, academic associations, and government agencies; and have worked in the private sector in credit analysis, accounting, auditing, production control, environmental consulting, and business law.

B. SUMMARY OF FINDINGS

Overall, most affected businesses will be able to absorb the costs of the proposed Phase III requirements with no significant adverse impacts on their profitability. This finding is indicated by the staff's estimated change in "return on owner's equity" (ROE) analysis. The analysis found that the overall change in ROE ranges from negligible to a decline in ROE of slightly over 5 percent, with an average change in ROE of about 2.3 percent. However, the proposed measures may impose economic hardship on some businesses with small or no margin of profitability. These businesses, if hard pressed, can seek relief under the variance provision of the consumer products regulation for extensions to their compliance dates. Such extensions may provide sufficient time to minimize the cost impacts to these businesses. Because the proposed measures would not alter significantly the profitability of most businesses, we do not expect a noticeable change in employment; business creation, elimination or expansion; and business competitiveness in California. We also found no significant adverse economic impacts to any local or State agencies.

Our analysis shows that the cost-effectiveness of the Phase III standards is similar to the cost-effectiveness of the Phase I-II consumer products regulation and other existing ARB regulatory programs. We estimate the individual cost-effectiveness of each separate proposed standard as ranging from no cost (net savings or no cost) to about $5.60 per pound of VOC reduced (in 1997 dollars). For the four categories with two-tier standards, we estimate the cumulative cost-effectiveness of the two-tier standards ranges from about $0.90 to $6.30 per pound of VOC reduced. These ranges are comparable in magnitude to those reported for other ARB consumer products regulations and measures.

While determining the maxima and minima cost-effectiveness values is useful for establishing boundaries, it is also useful to determine the average cost-effectiveness of the Phase III standards. To this end, an estimate of the average cost-effectiveness as an emissions reduction-weighted value provides more insight into the overall cost-effectiveness of the standards than a simple arithmetic mean of the calculated individual values. Unlike a simple arithmetic mean, a weighted average accounts for the relative efficiency as well as the relative magnitude of the emission reductions for each standard. Overall, the emission reductions-weighted average (ERWA) cost-effectiveness for the Phase III standards is about $0.70 per pound of VOC reduced. That is, the average cost across all the Phase III categories to reduce one pound of VOCs is less than a dollar. This estimated average cost-effectiveness compares favorably with the cost-effectiveness of the ARB programs mentioned previously.

One way to project the potential change in product prices is to determine the potential change in raw materials cost, which generally has the biggest influence in product cost. Our analysis indicates that reformulations to comply with the Phase III standards can result in raw material changes with negligible cost (net savings or no cost) up to a cost increase of about $0.60 per unit. We also estimate the unit sales-weighted average cost increase to range from $0.03 to $0.07 per unit. Again, these estimated cost increases compare favorably to the change in per unit cost projected for the Phase I-II and other existing ARB consumer product regulations. The analysis assumed the present cost for raw materials; depending on the formulations chosen by manufacturers and the future price of raw materials, this range may be lower at the actual compliance dates. To the extent that the projected cost changes are ultimately passed on to the consumer, the actual retail price of Phase III-compliant products may be different than suggested by this analysis.

C. ECONOMIC IMPACTS ANALYSIS ON CALIFORNIA BUSINESSES AS REQUIRED BY THE CALIFORNIA ADMINISTRATIVE PROCEDURE ACT (APA)

Legal Requirements

Section 11346.3 of the Government Code requires State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination or creation, and the ability of California business to compete with businesses in other states.

Also, State agencies are required to estimate the cost or savings to any state or local agency and school district in accordance with instructions adopted by the Department of Finance. The estimate shall include any nondiscretionary cost or savings to local agencies and the cost or savings in federal funding to the state.

Findings

Potential Impact on California Businesses - Overall, most affected businesses will be able to absorb the costs of the proposed measures with no significant adverse impacts on their profitability. However, the proposed measures may impose economic hardship on some businesses with small or no margin of profitability. These businesses, if hard pressed, can seek relief under the variance provision of the consumer products regulation for extensions to their compliance dates. Such extensions may provide sufficient time to minimize the cost impacts to these businesses. Also, the Alternative Control Plan's high level of flexibility through emissions averaging may help these businesses to mitigate their costs. Because the proposed measures would not alter significantly the profitability of most businesses, we do not expect a noticeable change in employment; business creation, elimination or expansion; and business competitiveness in California.

Discussion

This portion of the economic impacts analysis is based on a comparison of the return on owners' equity (ROE) for affected businesses before and after inclusion of the cost to comply with the proposed Phase III requirements. The data used in this analysis are obtained from publicly available sources, the ARB's Mid-Term Measures 1994/1995 Consumer Products Survey (Survey), and the staff's cost-effectiveness analysis discussed later in this chapter.

Affected Businesses

Any business which manufactures or markets consumer products subject to the requirements of the Phase III requirements can be directly affected. Also potentially affected are businesses which supply raw materials or equipment to these manufacturers or marketers and distribute or retail consumer products. The focus of this analysis, however, will be on manufacturers or marketers because these businesses would be directly affected by the proposed measures.

The consumer products subject to the proposed measures are manufactured or marketed by a large number of companies worldwide. According to the ARB's Consumer Products Registration Database, there are 161 manufacturers or marketers which market Phase III products in California. These companies manufacture and market a broad range of automotive, household, and personal care products and pesticides, including an estimated total of 1,586 complying and 1,850 noncomplying products (based on reported figures and adjusted for possible survey underreporting). Of these manufacturers or marketers, thirty-four (mostly medium- or small-sized firms) are located in California. These companies accounted for 18 percent of noncomplying and 12 percent of complying products manufactured or marketed in California as shown in Table VIII-1.

TABLE VIII-1. Number of Noncomplying and Complying Products Marketed in California

Product Type	California Firms		Non-California Firms		Total	
Noncomplying Products	325	18%	1,525	82%	1,850	100%
Complying Products	184	12%	1,402	88%	1,586	100%
Total	509		2,927		3,436	
Firms	**34**		**127**		**161**	

The companies in Table VIII-1 fall primarily into six standard industrial classifications (SICs). A list of these industries which we have been able to identify is provided in Table VIII-2. The industry with the most noncomplying products is specialty cleaning, polishing and sanitation preparation (SIC 2842); followed by lubricating oils and greases (2992); soap and detergents (SIC 2841); paints and coatings (SIC 2851); pesticides and agricultural chemicals (SIC 2879); and perfume, cosmetics and other toilet preparation (SIC 2844).

TABLE VIII-2. Industries with Businesses Potentially Affected by the Phase III Limits

SIC*	Industry	# of Product Categories	# of Noncompliant Products
2841	Soap and Other Detergents, Except Specialty Cleaners	2	169
2842	Speciality Cleaners, Polishing, and Sanitation Preparations	15	1209
2844	Perfume, Cosmetics and Other Toilet Preparations	1	13
2851	Paints, Varnishes, Lacquers, Enamels and Allied Products	2	130
2879	Agricultural Chemicals, Not Elsewhere Classified	2	100
2992	Lubricating Oils and Greases	3	229

* SIC 2841 includes product category codes 800a, b.
SIC 2842 includes product category codes 200b; 210a, b, c; 215; 505a, b, c; 520; 430; 225a, b; 535; 545a, b.
SIC 2844 includes product category code 770.
SIC 2851 includes product category codes 230; 840.
SIC 2879 includes product category codes 300; 320.
SIC 2992 includes product category codes 620; 650; 640.

Study Approach

This study covers six industries with at least 161 affected businesses. The approach used in evaluating the potential economic impact of the proposed measures on these businesses is outlined as follows:

(1) Affected businesses which responded to the Survey were classified by the size of their sales in each industry in order to select a typical business for each industry.
(2) Compliance cost was estimated for each of these businesses.
(3) Estimated cost was adjusted for federal and state taxes.
(4) The three-year average ROE was calculated for each of these businesses by averaging their ROEs for 1994 through 1996. ROE is calculated by dividing the net profit by the net worth. The adjusted cost was then subtracted from net profit data. The results were used to calculate an adjusted three-year average ROE. The adjusted ROE was then compared with the ROE before the subtraction of the adjusted cost to determine the potential impact on the profitability of the business. A reduction of more than ten percent in profitability is considered to indicate a potential for significant adverse economic impacts.

The threshold value of ten percent has been used consistently by the ARB staff to determine impact severity (ARB, 1991; ARB, 1995). This threshold is consistent with the thresholds used by the United States Environmental Protection Agency and others.

Assumptions

The ROEs before and after the subtraction of the adjusted compliance costs were calculated for a typical business in each industry listed in Table VIII-2 using financial data for 1994 through 1996. The calculations were based on the following assumptions:

(1) A typical business on a nationwide basis in each industry is representative of a typical California business in that industry;
(2) All affected businesses were subject to federal and state tax rates of 35 percent and 9.3 percent, respectively; and
(3) Affected businesses are not able to increase the prices of their products, nor can they lower their costs of doing business through short-term cost-cutting measures.

Given the limitation of available data, staff believes these assumptions are reasonable for most businesses at least in the short run; however, they may not be applicable to all businesses.

Results

Typical California businesses are affected by the proposed Phase III requirements to the extent that the implementation of these requirements would change their profitability. Using ROE to measure profitability, we found that the average ROE of sample businesses in affected industries declined by over 2 percent as shown in Table VIII-3. This represents a minor change in the average profitability of typical businesses in California.

TABLE VIII-3. Changes in Return on Owner's Equity (ROEs) for Typical Businesses in Affected Industries

SIC*	Industry	ΔROE
2841	Soap and Other Detergents, Except Specialty Cleaners	5.15%
2842	Speciality Cleaners, Polishing, and Sanitation Preparations	2.61%
2844	Perfume, Cosmetics and Other Toilet Preparations	0.02%
2851	Paints, Varnishes, Lacquers, Enamels and Allied Products	0.66%
2879	Agricultural Chemicals, Not Elsewhere Classified	4.23%
2992	Lubricating Oils and Greases	1.25%
Average		**2.32%**

Note: "Δ" means change or difference; all ΔROEs shown are negative (i.e., shows a decline in profitability)

As shown in Table VIII-3, the projected change in profitability of typical businesses in the six affected industries varied widely. Within the SICs shown, the predicted decline in profitability of a typical business ranged from a high of about 5 percent to a low of 0.02 percent. This variation in the impact of the proposed measures can be attributed mainly to two factors. First, some businesses incur higher costs due to the type of products or the number of noncompliant products they manufacture or market. For instance, the estimated annualized costs for sample businesses ranged from a high of about $53,000 to a low of about $16,000. Second, the performance of businesses may differ from year to year. Hence, the average 1994 through 1996 financial data used may not be representative of an average-year performance for some businesses.

The estimated potential impacts to businesses' ROEs may be high for the following reasons. First, annualized costs of compliance are estimated using, in part, the current prices of raw materials. Raw material prices usually tend to fall as higher demand for these materials induces economy of scale production. Second, affected businesses probably would not absorb all of the increase in their costs of doing business. They might be able to either pass some of the cost on to consumers in the form of higher prices, reduce their costs, or do both.

Potential Impact on Consumer - The potential impact of the proposed measures on consumers depends upon the ability of affected businesses to pass on the cost increases to consumers. In the short run, competitive market forces may prevent businesses from passing their cost increases on to consumers. Thus, we do not expect a significant change in retail prices in the short run. In the long run, however, if businesses are unable to bring down their costs of doing business they would pass their cost increases on to consumers. In such a case, we estimate a maximum increase of less than 0.4 percent in product prices. Price increases, however, would vary from industry to industry. They would range from a low of about 0.05 percent in agricultural chemical industry to high of about 0.5 percent in specialty cleaners, polishing, and sanitation preparations industry.

On a per-unit basis, the impact to the consumer due to raw materials costs would range from no change (no cost or cost savings) to a cost increase of up to about $0.60 per unit. On a unit sales-weighted average basis, the average cost increase would range from $0.03 to $0.07 per unit. It should be noted that this range may be lower under actual implementation of the Phase III standards, depending on the reformulation/ marketing strategies adopted by the manufacturers and actual market prices of the product ingredients at the compliance dates.

The proposed measures may also affect consumers adversely if they result in reduced performance attributes of the products. However, this scenario is unlikely to occur for the following reasons. First, for every proposed Phase III standard, there are already complying products in the market that have acceptable performance attributes; indeed, complying products represent siginificant shares in many of their respective categories. Thus, the industry already has the technology to manufacture the compliant products that meet consumer expectation. Second, marketers are unlikely to introduce a product which does not meet their consumer expectations. This is because such an introduction would be damaging not only to the product sale, but also to the sale of other products sold under the same brand name (impairing so-called “brand equity”). Finally, the Board has provided, under its existing consumer products program, flexibility to businesses whose situations warrant an extension to their compliance dates. For companies which can justify such variances, the additional time may afford more opportunity to explore different formulation, cost-cutting, performance-enhancing, or other marketing strategies which can help make the transition to new complying products nearly transparent to consumers.   In addition, companies may also be able to cut their costs by participating in an emissions averaging plan under the Alternative Control Plan (ACP). The ACP regulation provides a high level of flexibility and can help manufacturers to choose lower-cost reformulation routes.

Potential Impact on Employment - The proposed measures are not expected to cause a noticeable change in California employment and payroll. According to *Ward's Business Directory of U.S. manufacturing industries*, California employment in the industries affected by the proposed measures was less than 1,500 in 1994 or about 10 percent of national employment in those industries as shown in Table VIII-4. This represents less than one percent of total manufacturing jobs in California. These employees generated over $51 million in payroll, accounting for about 0.1 percent of total California manufacturing payroll in 1994.

TABLE VIII-4. California Employment and Payroll in Affected Industries

SIC	Number of Employees*		Payroll*	
	California	CA Share as % of US	California ($ million)	CA Share as % of US
2841	136	9.4	5.1	9.5
2842	297	9.5	9.1	9.5
2844	59	14.6	1.8	14.5
2851	541	10.5	18.1	10.5
2879	160	12.5	7.3	12.5
2992	276	8.2	10.0	8.2
Total	1,469	10	51.4	10

* Estimated based on data obtained from the following sources:
1) Ward's Business Directory, Manufacturing USA, Industry Analyses, Statistics, and Leading Companies, Fifth Edition, 1995.
2) Department of Finance, California Statistical Abstract, 1996.

Potential Impact on Business Creation, Elimination or Expansion - The proposed measures would have no noticeable impact on the status of California businesses. This is because the reformulation costs are not expected to impose a significant impact on the profitability of businesses in California. However, some small businesses with little or no margin of profitability may lack the financial resources to reformulate their products in a timely manner. Should the proposed measures impose significant hardship on these businesses, temporary relief in the form of a compliance date extension under the variance provision may be warranted. Also, these marginal businesses may be able to improve their profitability by participating in the ACP program, which would give them more flexibility in choosing reformulation approaches that mitigate costs.

While some individual businesses may be impacted, the proposed measures may provide business opportunities for other California businesses or result in the creation of new businesses. California businesses which supply raw materials and equipment or provide consulting services to affected industries may benefit from increased industry spendings on reformulation.

Potential Impact on Business Competitiveness - The proposed measures would have no significant impact on the ability of California businesses to compete with businesses in other states. Because the proposed measures would apply to all businesses that manufacture or market certain consumer products regardless of their location, the staff's proposal should not present any economic disadvantages specific to California businesses.

Although most California businesses are medium- or small-sized, their competitive position, as measured by the value of shipments per employee, is not significantly different from U.S. businesses. Table VIII-5 compares the value of shipments per employee in affected industries for California and the U.S as a whole. On average, the value of shipments per employee is about 8 percent lower in California than the U.S. However, this value varies widely from industry to industry. In some industries in which California has large businesses such as paints and allied products, and lubricating oils and greases, the value of shipment per employee is higher for California than the U.S. In the same industries, California's share of U.S. shipments is also higher than the average, indicating that the difference in the value of shipments per employee between California and U.S. can be explained mostly by the difference in firm sizes. Thus, the competitive position of most California businesses are not expected to change because of the cost increase resulting from the proposed measures.

Nonetheless, the proposed measures may have an adverse impact on the competitive position of some small, marginal businesses in California if these businesses lack resources to develop commercially acceptable products in a timely manner. In such cases, as stated above, the impact can be mitigated to a degree with a justifiable compliance extension under the variance provision of the consumer products regulation, or with the higher level of formulation flexibility afforded by participation in the ACP program.

TABLE VIII-5. Value of Shipments by Affected Industries

SIC	Value of Shipments ($ million)		Value of Shipments Per Employee ($)	
	California	% of U.S.	California	U.S.
2841	62.8	9.4	461,633	464,144
2842	80.2	6.5	269,438	394,892
2844	11.6	8.4	197,925	342,639
2851	176.3	11.7	325,667	292,455
2879	56.4	7.0	353,667	629,810
2992	156.1	10.0	565,778	463,931
Total	**543.4**	**9.2**	**369,922**	**400,573**

Source: Ward's Business Directory, Manufacturing USA, Industry Analyses, Statistics, and Leading Companies, Fifth Edition, 1995.

D. ANALYSIS OF POTENTIAL IMPACTS TO CALIFORNIA STATE OR LOCAL AGENCIES

We have identified only one State or local agency, specifically the California Prison Industry Authority (PIA), which manufactures or markets products that are subject to the staff's proposed standards. Among the wide variety of consumer and institutional goods it produces, the PIA makes a line of general purpose degreasers subject to the Phase III standards. Discussions with PIA staff indicate that these products already comply with the applicable proposed standard. In addition, the PIA already has operational date-coding equipment which can meet the date-coding requirements of the regulation (PIAa, 1997) (PIAb, 1997). Based on these facts, we have determined that the proposed Phase III standards will not create costs or savings, as defined in Government Code section 11346.5(a)(6), to any State agency or in federal funding to the State, costs or mandate to any local agency or school district whether or not reimbursable by the State pursuant to Part 7 (commencing with section 17500), Division 4, Title 2 of the Government Code, or other nondiscretionary savings to local agencies.

E. ANALYSIS OF THE COST-EFFECTIVENESS (C.E.) OF THE PROPOSED STANDARDS

Introduction

In the following analysis, we evaluate the anticipated cost-effectiveness of the proposed Phase III standards. Such an evaluation allows us to compare the efficiency of the Phase III standards in reducing a pound of VOC relative to the efficiencies of other existing regulatory programs. To do this, we applied a well-established methodology for converting compliance costs to an annual basis. We then report the ratio of the annualized costs to the annual emission reductions in terms of "dollars (to be) spent per pound of VOC reduced." For perspective, we compare the estimated cost-effectiveness of the standards to the cost-effectiveness of other ARB regulations and control measures.

Methodology

The cost-effectiveness of a standard is generally defined as the ratio of total dollars to be spent to comply with the standard (as an annual cost) to the mass reduction of the pollutant(s) to be achieved by complying with that standard (in annual pounds). Annual costs include annualized nonrecurring (fixed) costs (e.g., total research and development (R&D), product and consumer testing, equipment purchases/modifications, etc.) and annual recurring costs (e.g., raw materials, labeling, packaging, etc.).

In this analysis, we essentially treated each standard as a separate regulation. This approach represents an expansion and upgrade of previous analyses conducted by ARB staff, in which groups of product categories were evaluated collectively for cost-effectiveness. We determined the fixed and recurring costs for each category and subcategory with a proposed Phase III standard; thus, a total of 29 individual cost-effectiveness analyses were conducted. In addition, we report four "cumulative" cost-effectiveness values, one for each of the four categories with two-tier standards. The cumulative cost-effectiveness value is the sum of the individual or "incremental" cost-effectiveness values for each of the first and second-tier standards. With the level of detail presented and the treatment of each standard's cost-effectiveness independent of the other proposed standards, the cost-effectiveness analysis in this report represents the most comprehensive ARB staff has conducted to date on a proposed consumer products rulemaking.

We annualized nonrecurring fixed costs using the Capital Recovery Method as recommended under guidelines issued by the California Environmental Protection Agency (Cal/EPA). Using this method, we multiply the estimated total fixed costs to comply with each standard by the Capital Recovery Factor (CRF) to convert these costs into equal annual payments over a project horizon (i.e., the projected useful life of the investment) at a discount rate (Cal/EPA, 1996). We then sum the annualized fixed costs with the annual recurring costs and divide by the annual emission reductions to calculate the cost-effectiveness of each standard, as shown by the following general equation (example shown is for calculating cost-effectiveness from pre-regulatory to Tier 1 compliance; calculation for incremental cost-effectiveness of Tier 1 to Tier 2 compliance is similar):

Cost-Effectiveness

$$= \frac{(\text{Annualized Fixed Costs})^{\text{Pre-Reg VOC}}_{\text{Tier 1 Limit}} + (\text{Annual Recurring Costs})^{\text{Pre-Reg VOC}}_{\text{Tier 1 Limit}}}{(\text{Annual Mass Reduction in VOC})^{\text{Pre-Reg VOC}}_{\text{Tier 1 Limit}}} \qquad (1)$$

where:

$$\text{Annualized Fixed Costs} = (\text{Fixed Costs}) \times \frac{i\,(1+i)^n}{(1+i)^n - 1} \qquad (2)$$

$i(1+i)^n/((1+i)^n-1)$	=	Capital Recovery Factor (CRF)
i	=	discount interest rate over project horizon, %
n	=	number of years in project horizon
Fixed Costs	=	total nonrecurring cost per product category
	=	(Nonrecurring Cost per Product) x (Total Noncompliant Products in the Category)

As shown by the 29 raw materials cost analyses in Appendix F, a convenient method for estimating the annual recurring cost portion of overall cost-effectiveness is to separate Equation (1) into two fractions, one for the nonrecurring costs and one for the recurring costs. It can then be shown that the C.E. fraction for recurring costs can be simplified and calculated as follows:

$$\text{Annual Recurring Costs C.E.} = \frac{(\text{Compliant Materials Cost}) - (\text{Baseline Materials Cost})}{(\text{Baseline VOC Content}) - (\text{Compliant VOC Content})} \qquad (3)$$

where,

Baseline Materials Cost	=	cost of raw materials for product before reformulation to Tier 1/Tier 2 limit, $/lb product
Baseline VOC Content	=	product VOC weight fraction before reformulation to Tier 1/Tier 2 limit, lb VOC/lb product
Compliant Materials Cost	=	cost of raw materials for Tier1/Tier2 compliant product, $/lb product
Compliant VOC Content	=	Tier 1/Tier2 compliant product VOC weight fraction, lb VOC/lb product.

To use Equation (3), we determined the sales-weighted average VOC contents of both compliant and noncompliant products in each Phase III category, based on sales data and the speciated formulations in the ARB database. To the extent feasible, we then determined the detailed formulations which most closely reflect the sales-weighted average compliant and noncompliant VOC contents. These formulations, in turn, were designated as compliant and baseline formulations, respectively. Distributor-level prices from *Chemical Market Reporter* (March 10, 1997) or from discussions with industry representatives were used to calculate the baseline and compliant material costs based on these designated formulations. Unspecified ingredients or ingredients for which prices were unknown were grouped into an "all others" classification and assigned a default low and high cost of $3.50 and $7.00 per pound, respectively (ARB, 1997, Volume II, p.56). These analyses are shown in Appendix F and discussed in more detail in "Analysis of Impacts to Raw Materials Cost" later in this section.

Assumptions

We calculated the cost-effectiveness with an assumed project horizon of 10 years, a commonly cited period for an investment's useful lifetime in the chemical processing industry. We also assumed a fixed interest rate of 10 percent throughout the project horizon. These assumptions are conservative and constitute standard practice in cost-effectiveness analyses of air pollution regulations. Based on these assumptions, the CRF is 0.16274.

We assumed products reformulated to meet the Phase III standards will be marketed throughout the U.S. by national marketers. Except for the aerosol coatings regulation (Title 17, CCR, §§94520-94528), we found that businesses generally formulate products compliant with the Phase I-II and antiperspirant/deodorant regulations for the entire nation, rather than incurring the additional cost of setting up a California versus 49-state product distribution system. We believe the same strategy will be employed by companies subject to the Phase III standards. We therefore assumed that, for the annualized fixed cost portion of Equation (1), it is appropriate to either use the fixed cost for national production divided by the national emission reductions or, equivalently, use the California-apportioned (by population) annualized fixed cost divided by the California-apportioned emission reductions under Phase III.

For the annual recurring costs, we assumed compliant reformulations would result in cost changes only as a result of changes in a product's raw materials and their associated prices. Changes in packaging, labeling, distribution and other recurring costs were assumed to be negligible relative to baseline levels of these costs. The ARB staff recently conducted a comprehensive technical assessment of the 55 percent VOC hairspray standard, which will require extensive reformulations and revolutionary changes to existing products. The staff's assessment found that changes to recurring costs other than hairspray raw material costs were expected to be negligible (ARB, 1991, Volume II, p.54). Based on this finding and because the proposed Phase III standards are designed to preserve product forms, we believe our assumptions regarding the recurring costs are reasonable.

It is important to note that, in this analysis and the subsequent analyses on per-unit cost increases, we assumed that all manufacturers will conduct their own research and development, purchase their own equipment, and make all other expenditures and efforts necessary to reformulate their products. Essentially, each manufacturer and marketer is assumed to “reinvent the same wheel” and directly conduct all reformulation and R&D efforts. In reality, however, a large portion of the consumer products market is manufactured by contract fillers. These businesses, who usually conduct their own reformulation efforts in-house, fill products for a large number of consumer product marketers. Contract fillers are therefore able to avoid duplication of reformulation efforts by applying “technology transfer” between product lines of different companies. The full extent to which contract fillers make products for other companies under each Phase III category is unknown. However, to the extent contract fillers are used by companies to make complying products, the actual cost to comply with the Phase III standards for the entire industry is likely to be less than predicted, resulting in more cost-effective emission reductions than indicated in this analysis.

Results

A review of relevant technical literature and industry trade journals provided little information that could be used to estimate costs. In addition, we have had very limited success with cost surveys in the past and did not expect one to provide much useful information in this rulemaking. To illustrate, during the Phase II rulemaking, we sent 3000 requests for cost information to manufacturers and other industry representatives. We received only six responses, of which only three yielded any usable data (ARB, 1991, p.VI-1). Nevertheless, we prepared at industry’s request a cost survey to gather data from manufacturers subject to the proposed rulemaking. However, the lack of industry response to the survey prevented us from using the affected industry's data in this analysis. We therefore developed estimates for the Phase III nonrecurring costs based on analogous costs reported by ARB staff for the Phase II consumer products rulemaking. The Phase II nonrecurring costs are applicable for this analysis since they were based on staff’s detailed estimates of labor, R&D, equipment purchase, and other costs involved in product reformulations for generic household, automotive, personal care, and pesticide categories, all of which are included in Phase III (ARB, 1991, Appendix D).

The Phase II nonrecurring investment costs, reported in 1991 dollars, were adjusted to 1997 dollars using a well-established method of ratioing chemical engineering plant cost indices as follows (Peters and Timmerhaus, 1980):

$$\text{Non-Recurring Costs (in 1997 dollars)} = \text{Non-Recurring Costs (in 1991 dollars)} \times \frac{\text{C.E. 1997 index}}{\text{C.E. 1991 index}}$$

where,

C.E. 1997 index	=	1997 Chemical Engineering Plant Cost Index
	=	383.4 (assuming prelim. Jan'97 index applies to 1997)
C.E. 1991 index	=	361.3 (*Chemical Engineering*, April 1997)

We believe the original Phase II cost estimates were beneficial at the time of rulemaking for predicting the costs to comply with those standards. However, having recently completed a detailed technical assessment of the hairspray second-tier standard, we believe those original cost estimates grossly overestimated true nonrecurring costs for Phase II by about a factor of ten. The aforementioned hairspray technical assessment projects industry will spend on average, based on real-world expenditures to date, an estimated $100,000 per noncompliant hairspray product to meet the second-tier standard ($20MM-$50MM total cost divided by an estimated 350 noncompliant hairspray products; ARB, 1997, *op cit.* at Vol.II, page 54). Because the hairspray category arguably represents a worst-case scenario, with its two-tier standards requiring extensive reformulations, R&D, and consumer/safety testing, we believe the $100,000 per product nonrecurring costs for hairsprays is a reasonable, order-of-magnitude upper boundary for average per-product reformulation costs under the Phase III standards. We therefore adjusted the Phase II estimates to be consistent (same order of magnitude) as the $100,000 per product real-world average expenditures for hairsprays.

Table VIII-6 shows our estimates for per-product and total annualized nonrecurring costs for each of the 25 product categories/subcategories subject to the 29 proposed Phase III standards. As shown, we project a per-product annualized nonrecurring cost range of about $1400 to about $19 thousand dollars. With about 2000 noncompliant products that would need to be reformulated, the overall total annualized fixed cost to industry is projected to range from about $3.1 million to about $33 million dollars per year, with a general breakdown as follows: household care products (51%), automotive care products (35%), personal care products (8%) and pesticides (6%).

Table VIII-7 shows the overall results of our cost-effectiveness analysis, with separate cost-effectiveness fractions representing the annualized nonrecurring and annual recurring costs. In general, Table VIII-7 shows that the annualized nonrecurring fixed costs (i.e., R&D, product testing, etc.) have a relatively small impact on overall cost-effectiveness for most Phase III categories. For the most part, the raw materials cost (i.e., annual recurring cost) has the most significant impact on overall cost-effectiveness.

Table VIII-7 shows that the estimated cost-effectiveness (arithmetic mean of low and high values) ranges from $0.00 (net savings or no cost for several categories) to about $5.60 per pound VOC for an individual standard (second-tier standard for heavy duty hand cleaner/soap). The cumulative cost-effectiveness for the four two-tier standards ranges from about $0.90 (paint remover) to about $6.30 per pound of VOC reduced (heavy duty hand cleaner).

Another useful quantity to report is the emission reductions-weighted average (ERWA) cost-effectiveness. This value is the sum of the products of the emission reductions for each standard and its associated cost-effectiveness, divided by the sum of the total emission reductions for all Phase III standards. In contrast to a simple arithmetic mean of the reported cost-effectiveness values, the ERWA cost-effectiveness accounts for the relative magnitude of emission reductions and the relative efficiency of each standard in achieving those reductions. Thus, the ERWA cost-effectiveness is, in theory, a better indicator of the true average cost-effectiveness for achieving a pound of reduction under Phase III. As shown in Table VIII-7, the ERWA cost-effectiveness is about $0.70 per pound of VOC reduced. Thus, the average cost to reduce one pound of VOCs under Phase III is less than a dollar, indicating that total industry-wide annual compliance costs for Phase III should be about $9 million per year.

[INSERT TABLE VIII-6]
Estimated Total Annualized Non-Recurring Fixed Costs to Comply with Phase III Standards

(See graphics file)

[INSERT TABLE VIII-7]
Estimated Cost-Effectiveness for Phase III Standards

(See graphics file)

Table VIII-8 shows a comparison of the cost-effectiveness for the Phase III standards relative to other ARB consumer product regulations and control measures. As shown, the Phase III cost-effectiveness range is consistent with the cost-effectiveness of other ARB regulations and programs.

TABLE VIII-8. Comparison of Cost-Effectiveness for Phase III and Other ARB Consumer Product Regulations/Measures (adjusted to 1997 dollars)

Regulation/Control Measure	Cost-Effectiveness (Dollars per Pound VOC Reduced)
Phase III Consumer Products Regulation [1]	$0.00 to $5.60 ($0.70 avg.)
Hairsprays[2]	$2.10 to $2.50 ($2.25 avg.)
Aerosol Coating Products [3]	$2.85 to $3.20
Phase II Consumer Products Regulation [4]	<$0.01 to $1.10
Phase I Consumer Products Regulation [5]	net savings to $1.80
Antiperspirants and Deodorants [6]	$0.54 to $1.30
Architectural and Industrial Maintenance Coatings [7]	net savings to $6.90

Cost-effectiveness values for previous years adjusted to 1997 dollars using the following *Chemical Engineering* Plant Cost indices: 383.4 (1997), 381.1 (1995), 361.3 (1991), and 357.6 (1989-1990); *Chem. Eng.*, April 1996/1997.

[1] Range reported as min./max. for each individual Phase III standard; cumulative C.E. for two-tier standards ranges from $0.90 to $6.30; average C.E. of $0.80/lb reduced reported as an emission reductions-weighted average cost-effectiveness

[2] Reported as sales-wtd average, incremental 2nd-tier cost-effectiveness (80% VOC to 55% VOC); ARB, 1997

[3] ARB, 1995

[4] ARB, 1991

[5] ARB, 1990

[6] ARB, 1989a

[7] Suggested Control Measure, developed with the California Air Pollution Control Officers Association; ARB, 1989b

F. ANALYSIS OF THE IMPACTS TO RAW MATERIALS COST

Introduction

In this analysis, we evaluate the anticipated cost impacts from the Phase III standards on raw material costs. As stated previously, the raw material costs generally constitute the major portion of the compliance costs. Evaluating the impacts to raw material costs provides only an indicator of possible impacts to the retail prices of Phase III products (assuming the cost impacts are passed on partially or fully to consumers). Because of the highly competitive nature of the consumer products market, it is not possible to accurately predict the final retail price of Phase III compliant products. However, the cost of some compliant-product ingredients are likely to decrease in the future as their supplies increase to meet increased demand. Thus, to the extent the raw materials cost impacts are passed on to consumers, the final retail prices may be lower than suggested by this analysis.

Methodology

As discussed previously, we determined the detailed formulations which most closely reflect the "typical" (sales-weighted average) compliant and noncompliant VOC contents. These formulations, in turn, were designated as compliant and baseline formulations, respectively. Distributor-level ingredient prices from *Chemical Market Reporter* (March 10, 1997) or from discussions with industry representatives were used to calculate the baseline and compliant material costs for these formulations. Unspecified ingredients or ingredients for which prices were unknown were grouped into an "all others" classification and assigned a default low and high cost of $3.50 and $7.00 per pound, respectively (ARB, 1997, Volume II, p.56). These analyses and the detailed formulations evaluated (with individual weight fractions and unit prices per pound) are shown as cost spreadsheets in Appendix F. While these formulations may not reflect the exact composition of existing noncompliant products and compliant products that will be marketed, we believe they are reasonably representative for the purposes of these raw material cost analyses.

Assumptions

As noted previously, we assumed changes in packaging, labeling, distribution and other recurring costs to be negligible relative to baseline levels of these costs. Average unit size was assumed to be 16 weight ounces unless otherwise noted in the cost spreadsheets. Worst-case formulations using HFC-152a as propellant were assumed for compliant aerosol products unless otherwise noted; alternative formulations using other non-VOC propellants, compressed gases, or dimethyl ether (DME) may allow lower-cost compliant products.

Results

As shown in Table VIII-9, the anticipated raw materials cost changes range from no cost (net savings or no cost) to about $0.60 increase per unit (rubber/vinyl protectant, hair shine, and heavy duty hand cleaner/soap). On a unit sales-weighted average basis, the average raw materials cost increase ranges from $0.03 to $0.07 per unit (see "Analysis of the Combined Impacts from Raw Material and Non-recurring Costs").

[INSERT TABLE VIII-9]
Estimated Impacts to Raw Materials Cost ($/Unit of Product) for Phase III Standards

(See graphics file)

Table VIII-10 shows a comparison of the impacts to raw materials cost under the Phase III standards relative to those of other ARB consumer product regulations. As shown, the raw materials cost impacts under Phase III are comparable with those of other ARB regulations.

TABLE VIII-10. Comparison of Raw Materials Cost Impact for Phase III and Other ARB Consumer Product Regulations (in unadjusted dollars)

Regulation	Cost Impact (Increased Dollars per Unit of Product)
Phase III Consumer Products Regulation [1]	$0.00 to $0.60 ($0.03 - $0.07 avg.)
Hairsprays[2]	($0.10) to $0.45
Aerosol Coating Products [3]	$0.30 to $0.34
Phase II Consumer Products Regulation [4]	<$0.01 to $0.60
Phase I Consumer Products Regulation [5]	net savings to $0.25
Antiperspirants and Deodorants [6]	$0.25

[1] Phase III Staff Report; ARB, 1997. $0.03 per unit increase reported asa unit sales-weighted average

[2] $0.45/unit reported as a worst-case scenario using high-level of HFC-152a as propellant in "premium" products; figures in "( )" indicate potential for cost savings

[3] ARB, 1995

[4] ARB, 1991

[5] ARB, 1990

[6] Estimate based on assumption of using HFC-152a to replace HC propellants and meet the 0% HVOC limit

G. ANALYSIS OF THE COMBINED IMPACTS ON PER-UNIT COST FROM RECURRING (RAW MATERIAL) AND NON-RECURRING COST

Introduction

In this analysis, we evaluated the combined impacts of both recurring (i.e., raw material costs) and nonrecurring costs from the Phase III standards on per-unit cost. Although the raw material costs generally constitute the major portion of the compliance costs, in some categories the nonrecurring (fixed) cost was the significant contributor. In performing this analysis, we used fixed costs and raw material costs as determined in Sections E and F of this chapter, respectively. All assumptions as noted previously remain in effect.

Methodology

This analysis combines recurring and annualized non-recurring costs from Sections E and F to estimate the total cost increase on a per-unit basis. Three factors were required for each category. These included the number of units sold, the recurring cost and the nonrecurring cost. The number of units sold in each category was estimated from the sales-weighted average VOC content, the adjusted emissions in each category and the typical unit size. The number of units could not be determined directly from the Survey because many manufacturers reported sales by weight rather than by units. We therefore estimated the number of units sold in each product category per day using the following equations:

$$\text{Units per Day} = \frac{\text{Total Sales (pounds per day) x 16 (ounces per pound)}}{\text{Average Unit Size (ounces per unit)}}$$

where,

$$\text{Total Sales (lbs / day)} = \frac{\text{Total Emissions (tons VOC / day) x 2000 (lbs / ton)}}{\text{Sales - Weighted Average VOC Content (lb VOC / lb product)}}$$

The non-recurring cost was calculated on a per-unit basis using the low and high estimates from Section E and dividing by the total number of units sold (per year) in each category. This cost was annualized using the Capitol Recovery Factor as described in Section E over a ten year period at a 10 percent discount rate. The recurring cost was derived directly on a per-unit basis for each category from Table VIII-9.

Results

As shown in Table VIII-11, the combined fixed and raw material cost changes range from no cost (net savings or no cost) to about $0.60 increase per unit (aerosol rubber/vinyl protectant, hair shine, heavy duty hand cleaner/soap, silicone-based multi-purpose lubricant). We estimate the unit sales-weighted average increase ranges from $0.03 to $0.07 per unit. This cost increase is consistent with the range in cost increase for the raw materials alone, as depicted in Table VIII-9. Although a few categories saw substantial increases due to the inclusion of the fixed costs, Table VIII-11 shows that the purchase of raw materials generally drives any increase in per-unit cost of the Phase III products.

Table VIII-11. **Estimated Per-Unit Cost Increases from Annualized Non-Recurring and Annual Recurring Costs**

(See graphics file)

H. ANALYSIS OF THE POTENTIAL IMPACTS FROM THE ALTERNATIVE CONTROL PLAN (ACP) REGULATION

If adopted by the Board, the proposed Phase III standards will be incorporated in section 94509 of the consumer products regulation (Title 17, California Code of Regulations, §§94507-94517). The Alternative Control Plan (ACP), a voluntary regulation designed to allow multi-product VOC averaging as an alternate means of complying with the VOC limits, applies to products subject to section 94509. Thus, adoption of the Phase III standards will automatically allow manufacturers and marketers with approved ACP plans to conduct VOC emissions averaging across regulated product lines. The following analysis evaluates the potential impacts the ACP may have on Phase III products and manufacturers/marketers.

The benefits of emissions averaging or “bubbling” for consumer product manufacturers have been documented by ARB staff (ARB, 1994). In general, emissions averaging under approved ACP plans allows manufacturers to choose the least-cost or other advantageous reformulation options for its product lines. Rather than directly complying with each and every Phase III standard, manufacturers can choose to “overcomply” with some reformulations in order to offset the “undercompliance” of other product lines. The ACP regulation requires the net resulting emissions from products under such averaging plans to be no greater than the level which would have resulted had all the products under the ACP bubble directly complied with the applicable standards. In short, the same emission reductions are achieved while providing a high degree of formulation and marketing flexibility to manufacturers. We anticipate that such emissions averaging will also benefit manufacturers subject to the Phase III standards.

Some concerns about the ACP’s potential impacts on product competitiveness were raised by one company during the adoption hearing for the aerosol coatings regulation (Title 17, CCR, §§94520-94528). Essentially, the small-business manufacturer was concerned that, with its product line comprised solely of aerosol paints, it would not be able to compete effectively with other manufacturers that could benefit from the ACP (and therefore reduce the prices of their competing aerosol paints) by averaging their emissions across aerosol paint and other consumer product lines (ARB, 1995, Vol.II, X-8). The Board addressed this concern by effectively prohibiting cross regulation emissions averaging (i.e., aerosol paints could be averaged with each other but not with other consumer products). The ACP also includes a provision for the trading of surplus credits, with external trades designed for use primarily by small businesses. The purchase of such credits by small businesses is expected to provide some flexibility to small manufacturers whose only remaining option would be to reformulate and directly comply with the standards.

Overall, most affected businesses will benefit from the ACP regulation. The ACP is completely voluntary and imposes no additional costs to businesses to comply with the VOC standards. Manufacturers who take advantage of the ACP’s emissions averaging provisions are presumably doing so because it costs less than direct compliance with the standards or it provides some other market benefits. According to previous staff analyses, the potential cost differential which might result from competition under the ACP between small and large firms would not necessarily cause extreme hardship on small firms (ARB, 1995, Vol.II, X-13). However, inclusion of the proposed Phase III standards in the ACP regulation may increase the level of competition for some products and may lead to the elimination of some marginal producers for those products. Such competition may also have minor impacts on California employment and payroll. However, the impact is expected to be positive in the long term. Any potential impacts on the ability of California businesses to compete with businesses in other states are also expected to be minimal.

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IX.

FUTURE ACTIVITIES

The purpose of this chapter is to discuss the future activities the ARB staff has planned.

In the next year we plan to work with industry representatives to investigate alternative reactivity-based VOC standards for the 18 categories included in the Mid-term Measures as well as the 13 product categories we have postponed for further investigation. Future efforts will also include working with industry representatives to investigate applying reactivity principles to the existing antiperspirant/deodorant and Phase I and II consumer product categories. To facilitate this process, we will continue to hold regular meetings of the Mid-term Measures and Reactivity Subgroups of the Consumer Products Working Group. We will also consult with the Reactivity Scientific Advisory Committee established by ARB Chairman Dunlap. In addition, we will continue to hold individual meetings, teleconferences and videoconferences with the consumer products industry. A more detailed discussion of our future activities follows.

A. POSTPONED CATEGORIES

As discussed in Chapter II, we first identified 32 product categories from our Survey results that appeared to warrant further investigation for inclusion in the Mid-term Measures. Later, we decided to drop the selective terrestrial herbicide product category because industry provided data confirming that most of the VOCs in these products form salts that are not emitted. The proposed regulation contained herein would address 18 of the 31 remaining product categories.

We decided to postpone consideration of 13 categories because further study is needed to determine the feasibility of regulating these categories. These categories warrant further study because they are: 1) health benefit products which require consultation with the Department of Health Services (DHS), public health experts, and industry experts to ensure that any proposed standard would not adversely impact public health by compromising product efficacy; 2) soap products for which the majority of VOCs may not be emitted because they go down-the-drain and are biodegraded in the sewer system; 3) 100 percent solvent categories which require further technical study regarding potential reformulation options; and 4) multipurpose "dry" lubricants which also require further technical study. Table IX-1 below lists the 13 product categories requiring further study.

TABLE IX-1
Product Categories Requiring Further Study

Product Category Name	Comments
Antimicrobial Hand or Body Cleaners	Health benefit products which require DHS and public health experts review
Disinfectants	Health benefit products which require DHS and public health experts review
Medicated Astringents/Toners	Health benefit products which require DHS and public health experts review
Non-medicated Astringents/Toners	Health benefit products which require DHS and public health experts review
Facial Cleaners or Soaps	Awaiting down-the-drain studies
General Use Hand or Body Cleaners or Soaps	Awaiting down-the-drain studies
Hand Dishwashing Detergents	Awaiting down-the-drain studies
Liquid Laundry Detergents	Awaiting down-the-drain studies
Multipurpose Solvents	100 percent solvent; evaluating reformulation options
Paint Brush Cleaners	100 percent solvent; evaluating reformulation options
Paint Thinner	100 percent solvent; evaluating reformulation options
Rubbing Alcohol	100 percent solvent; evaluating reformulation options
Multipurpose Dry Lubricants	Evaluating reformulation options

Regarding the health benefit products, we have contacted DHS to request their assistance in evaluating the feasibility of regulating the VOC content of these products without compromising public health. If, after consultation with DHS, public health experts, and industry experts, we determine that it may be feasible to regulate these categories, we will form a panel of public health experts to assist us in developing appropriate VOC standards.

Regarding the soap products, we are currently working with the Soap and Detergent Association which is conducting a study to determine the fraction of VOCs that are emitted from these products. If the down-the-drain studies determine that these soap products have negligible emissions because most of the VOCs are biodegraded in the sewer system, the development of proposed standards may not be warranted.

Regarding the 100 percent solvent products, we will be working with the Reactivity Subgroup, the Reactivity Scientific Advisory Committee, and Dr. William P.L. Carter to evaluate a reactivity-based regulatory strategy for these categories. Because these products are by their nature 100 percent VOCs, it may not be feasible to develop mass-based VOC standards that would reduce their VOC content. With regard to multipurpose “dry” lubricants, we will continue to work with manufacturers of these products to evaluate reformulation options.

B. REACTIVITY

Prior to the development of the consumer products element of the State Implementation Plan (SIP), the consumer products industry expressed interest in using a reactivity-based strategy for controlling VOC emissions from consumer products. Therefore, the ARB included a commitment in the SIP to investigate the feasibility of incorporating a reactivity scheme into the consumer products program. To facilitate the development of a reactivity-based control strategy, we formed the Reactivity Subgroup of the Consumer Products Working Group. The Reactivity Subgroup consists of representatives from the consumer products industry, academia, U.S. EPA, ARB and local air districts. To date, the Reactivity Subgroup has met six times. During these meetings, the ARB has presented concepts for developing a reactivity-based control strategy.

With the traditional mass-based VOC standards, all VOCs in consumer products are treated equally, with no consideration of the reactivity of individual compounds (other than considering compounds as either reactive or negligibly-reactive). However, chamber studies (under ARB contract) conducted by Dr. William P.L. Carter of the University of California at Riverside, have demonstrated that VOCs in consumer products form ozone at differing rates and amounts. Dr. Carter has developed the maximum incremental reactivity (MIR) scale which is a numeric scale used to rank VOCs by their ozone formation potential. With the MIR scale, VOCs with a greater tendency to form ozone are assigned a higher MIR value than VOCs which are less reactive in the atmosphere. Such a relative reactivity scale serves as the basis for the ARB’s existing Low Emissions Vehicle (LEV) program.

Using this regulatory approach, standards could be based on the reactivity of the VOCs in consumer products rather than the mass of VOCs. Consumer products could then be compared by their overall ozone formation potential per mass of the product rather than simply the total mass of VOCs in the product. Under a reactivity-based control strategy, manufacturers could comply with the standard by substituting less reactive VOCs for more reactive VOCs instead of reducing the VOC content of their products. Thus, a reactivity-based control strategy would provide manufacturers more flexibility in reformulating their products to comply with ARB’s standards. It could also allow manufacturers to sell products that exceed a mass-based VOC standard if the alternative reactivity-based standard is achieved. Since the existing mass-based approaches indirectly reduce ozone formation by reducing the mass of VOCs emitted, a properly designed reactivity program should at least be equivalent in ozone reductions relative to the existing programs.

We plan to hold additional Reactivity Subgroup meetings during 1997 and 1998 to enable us to investigate development of a reactivity-based regulation. Our preliminary thoughts are to develop voluntary reactivity-based standards that manufacturers subject to the Mid-term Measures regulation could comply with as an alternative to complying with the mass-based VOC standards. For the 100 percent solvent categories, however, a mass-based program may not be feasible; in these cases, mandatory reactivity standards may be the only feasible way to reduce the ozone formation from these products.