State of California
AIR RESOURCES BOARD

Staff Report: Initial Statement of Reasons for the Proposed Airborne Toxic Control Measure for Emissions of Chlorinated Toxic Air Contaminants from Automotive Maintenance and Repair Activities

Volume II: Technical Support Document

I. INTRODUCTION

A. Overview

The compounds perchloroethylene (Perc), methylene chloride (MeCl), and trichloroethylene (TCE) are found in automotive consumer products commonly used in automotive maintenance and repair activities (AMR activities). The Air Resources Board (ARB or Board) has identified these compounds as toxic air contaminants (TACs) under California's Toxic Air Contaminant Identification and Control Program.

Once the compounds Perc, MeCl, and TCE were identified as TACs, the ARB was required under the Toxic Air Contaminant Identification and Control Program to: (1) prepare a report on the need and appropriate degree of regulation for the compounds, and (2) adopt regulations to reduce emissions of the compounds. These regulations are called airborne toxic control measures (ATCMs) or control measures. In this report, we use the terms regulation, control measure, and ATCM interchangeably. State law requires that such control measures for TACs without a Board-specified threshold exposure level be based on the best available control technology or a more effective control method in consideration of cost and risk.

This volume of the Initial Statement of Reasons for the Proposed Airborne Toxic Control Measure for Emissions of Chlorinated Toxic Air Contaminants from Automotive Maintenance and Repair Activities, presents information on the toxic air contaminant identification and control process, the report preparation process, and previous identification and control (regulatory) activities for Perc, MeCl, and TCE. It also presents information on consumer product regulatory activities. It then presents compound-specific physical characteristics and information on sources and ambient concentrations. That is followed by a discussion of typical automotive maintenance and repair activities, exposure, and health effects for these three compounds. Finally, this volume presents the proposed control measure, and its health, economic, and environmental impacts.

B. Purpose

At its November 21, 1996, hearing, the Board adopted amendments to exempt Perc from the volatile organic compound (VOC) definition in California's Regulation for Reducing VOC Emissions from Consumer Products (Consumer Products Regulation; section 94521, title 17, California Code of Regulations). This action allowed manufacturers to reformulate consumer products with Perc to meet the VOC limits of the Consumer Products Regulation.

During the hearing, the Board expressed concerns about the potential for an increase in the use of Perc in consumer products, and the possible health impacts that might result. Therefore, the Board directed the ARB staff to conduct an assessment under the State's toxic air contaminant control program of the need to control Perc use in consumer products. At the hearing, automotive consumer products, and specifically brake cleaning products, were identified as the consumer products category most likely to contain, or be reformulated to contain, Perc. Consequently, staff initially evaluated Perc use in brake cleaning products. The preliminary results of this initial assessment were discussed in the Perchloroethylene Needs Assessment for Automotive Consumer Products: Status Report released in June 1997 (June 1997 Status Report) and presented to the Board at its June 26, 1997, meeting. An additional update on the assessment, incorporating additional data and analyses, was provided to the Board in a May 1998 Memorandum. These documents indicated that, based on the available information, an ATCM should be developed to reduce Perc emissions from brake cleaning products. Later, as a result of preliminary information raising concerns about compound and product interchangeability, staff extended the evaluation to include the use of Perc, MeCl and TCE, not only in brake cleaning products, but also in carburetor cleaners, engine degreasers, and general purpose degreasers.

This report presents the information evaluated by the ARB staff, including: (1) analyses of two surveys of automotive consumer products manufacturers and AMR facility operators; (2) site visits to AMR facilities; and (3) chlorinated compound emissions and potential health impacts. It then discusses the recommended control measure and its impacts.

C. Regulatory Authority

The California Toxic Air Contaminant Identification and Control Program (Program), established under California law by Assembly Bill 1807 (Chapter 1047, Statutes of 1983) and set forth in Health and Safety Code (HSC) sections 39650 through 39675, is designed to protect public health by reducing emissions of TACs. This law mandates the identification and control of air toxics in California and complements the State's criteria air pollutant program. The identification phase of the Program requires the ARB, with the participation of other state agencies, to evaluate the health impacts of, and exposure to, substances and to identify those substances which pose the greatest health threat as TACs. ARB's evaluation is made available to the public and is formally reviewed by the Scientific Review Panel (SRP) established under HSC section 39670. Following ARB's evaluation and the SRP's review, the Board identified MeCl, TCE, and Perc as TACs at its July 1989, October 1990, and October 1991 Board hearings, respectively. In each case, the Board determined there was not sufficient available scientific evidence to support the identification of a threshold exposure level (ARB, 1989; ARB, 1990a; ARB, 1991a).

A threshold level can be defined as a level of pollutant exposure below which no adverse health effects are likely to occur. In their evaluations of Perc, MeCl, and TCE, staff from the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA) recommended that Perc, MeCl, and TCE be treated as having no threshold exposure level because: (1) all three compounds are potential human carcinogens, and (2) currently, there is insufficient evidence available to designate an exposure level below which no significant adverse health impacts are anticipated.

Following the identification of a substance as a TAC, HSC section 39665 requires the ARB, with participation of the air pollution control and air quality management districts (districts), and in consultation with affected sources and interested parties, to prepare a report on the need and appropriate degree of regulation for that substance. A needs assessment for Perc was conducted from 1991 to 1993 as part of the ARB's development of the ATCM for Emissions of Perchloroethylene from Dry Cleaning Operations (Dry Cleaning ATCM), August 1993 (title 17, California Code of Regulations, sections 93109 and 93110). During that assessment, the ARB staff determined that dry cleaning operations and solvent degreasing operations accounted for about 80 percent of the Perc use in California (ARB, 1993a). Therefore, staff focused their attention on dry cleaning and degreasing uses of Perc first and is now addressing other uses of Perc. This Initial Statement of Reasons serves as the report on the need and appropriate degree of regulation for MeCl and TCE.

It is important to note that the proposed ATCM is not a consumer products regulation. Consumer products regulations are developed under authority granted to the ARB by the California Clean Air Act (1998), and specifically Health and Safety Code section 41712. HSC section 41712 requires the ARB to adopt regulations to achieve the maximum feasible reduction in reactive organic compounds (ROCs) emitted by consumer products (note: ROC is equivalent to VOC). As discussed previously, we are proposing this ATCM under the authority granted to the ARB by Assembly Bill 1807 (The Toxic Air Contaminant Identification and Control Program) as codified in HSC sections 39650 through 39675.

However, since the automotive consumer products industry has previously been subject to regulations developed under ARB's Consumer Products Program, we have used the phrase "consumer products" and definitions similar to those in ARB's consumer products regulations in an attempt to make our ISOR more familiar and comprehensible to consumer products manufacturers, AMR facility operators, and others who may use these products.

D. Regulatory Activities

1. Airborne Toxic Control Measures

Once the ARB has evaluated the need and appropriate degree of regulation for a TAC, State law (HSC section 39666) requires the ARB to adopt regulations to reduce emissions of the TAC to the maximum extent feasible in consideration of cost, risk and other factors specified in HSC section 39665. To date, the ARB has developed nine ATCMs. The most recent, the ATCM for Emissions of Perchloroethylene from Dry Cleaning Operations, August 1993 (title 17, California Code of Regulations, sections 93109 and 93110), was expected to result in a 78 percent reduction in statewide Perc emissions from dry cleaning operations when it was fully implemented in 1998.

2. National Emission Standards for Hazardous Air Pollutants

In the federal Clean Air Act Amendments of 1990, the United States Environmental Protection Agency (U.S. EPA) identified Perc, MeCl, and TCE as hazardous air pollutants (HAPs) because they were either known to have or may have adverse effects on human health or the environment. Health and Safety Code section 39658 (b) requires the Board to designate federal HAPs as TACs, and the Board did so in 1993 (AB 2728, Tanner). Therefore, Perc, MeCl, and TCE are TACs both because they have been identified by the Board through the Toxic Air Contaminant Identification and Control Program and because they are HAPs (ARB, 1993b).

In December 1994, the U.S. EPA promulgated the National Emission Standard for Hazardous Air Pollutants: Halogenated Solvent Cleaning (the Degreasing NESHAP) to address emissions of halogenated solvents, including Perc, MeCl, and TCE from degreasing operations (40 CFR Parts 9 and 63). Under HSC section 39658 (b), which provides that U.S. EPA NESHAPs are also ATCMs under certain circumstances, the Degreasing NESHAP is the State ATCM for degreasing operations; therefore, under HSC section 39666 (d) it must be implemented and enforced by the districts, unless the districts seek and receive approval from the U.S. EPA to implement an alternative control measure. Sources subject to the Degreasing NESHAP were required to comply with the regulation beginning on December 2, 1997.

3. "Hot Spots"

In November 1997, ARB staff published the Risk Reduction Audits and Plans Guidelines for Halogenated Solvents Degreasing Operations to assist facilities that have been identified by the districts as significant risk facilities requiring risk reduction audits and plans under Assembly Bill 2588 (the Air Toxics "Hot Spots" Information and Assessment Act) and Senate Bill 1731 as set forth in HSC sections 44300 to 44394. This guideline document contains a self-conducted audit and checklist which helps facility operators determine possible options to reduce the potential risk posed by a facility's degreasing operations.

Automotive maintenance and repair facilities may be subject to the "Hot Spots" Program if: (1) they use substances that are included on the Air Toxic Hot Spot Program list of substances required by HSC section 44321, and (2) those substances are used in sufficient quantities to make the facility type subject. However, AMR facilities are not required to complete emission inventory plans or to submit these plans to the districts because they are not included as a specific facility type in Appendix E of the Emission Inventory Criteria and Guidelines (ARB, 1997e). Although retail gasoline service stations are currently subject to the "Hot Spots" Program, the districts typically require the reporting of only the toxic emissions from gasoline dispensing operations, even if other operations such as brake cleaning operations are occurring at the service station. However, the districts have the authority to evaluate an individual facility under the "Hot Spots" Program and require the facility to comply with the

"Hot Spots" Program if they have good cause to believe that the facility may pose a potential threat to public health.

4. Consumer Products

The Board not only has the authority to develop control measures to reduce emissions of TACs, it also has the authority to develop regulations to reduce emissions of criteria pollutants such as ozone. This section provides a brief background on the ARB's authority to regulate consumer products, followed by information on consumer product regulatory activities.

In 1988, the Legislature enacted the California Clean Air Act (Act), which declared that attainment of the California state ambient air quality standards is necessary to promote and protect public health, particularly that of children, older people, and individuals with respiratory diseases. The Legislature also directed that these standards be attained by the earliest practicable date. California adopted an ambient air quality standard for ozone in 1988. Strategies to reduce ambient ozone concentrations include decreasing emissions of reactive organic compounds (ROCs), also known as volatile organic compounds (VOCs).

The Act added HSC section 41712 requiring the ARB to adopt regulations to achieve the maximum feasible reduction in VOCs emitted by consumer products. To date, the Board has adopted the following six regulatory actions to fulfill the requirements of the Act as it pertains to consumer products:

- the Antiperspirant and Deodorant Regulation was approved in November 1989, and required a reduction in VOC emissions from antiperspirants and deodorants;
- the "Phase I, II, and III" Consumer Products Regulations, and the Midterm Measures II Regulation, were approved in October 1990, January 1992, July 1997, and October 1999, respectively, and required a reduction in VOC emissions from over 40 different consumer products categories; and
- the Aerosol Coatings Regulation was approved in March 1995, and required emissions reductions from 35 categories of aerosol paints and related coating products. In November 1998, the Board adopted revisions to many of the future effective VOC limits in the aerosol coatings regulation after a review of their technological and commercial feasibility.

Relevant to this proposal, the aerosol coatings regulation essentially prohibits "new or increased uses" of Perc. The aerosol coatings regulation allows Perc-containing aerosol coatings to be sold or used in California if they were sold in the State in 1992 and either complied with the standards of the aerosol coatings regulation or could be reformulated to comply with the standards without increasing the Perc content. Perc-containing aerosol coatings that were not sold or used in California in 1992, or those that could not be reformulated to comply with the standards of the aerosol coatings regulation without increasing the Perc content, are not allowed (ARB, 1995).

II. PUBLIC OUTREACH AND REPORT PREPARATION

A. Outreach Efforts

Outreach and public participation are important components of ARB's needs assessment and report preparation process. For this assessment, we developed an outreach program to involve consumer products manufacturers and their associations, AMR facility operators and their associations, national, state and local regulatory agencies, environmental/pollution prevention and public health advocates, and other interested parties. Through these efforts, we have been able to obtain detailed information on the use and emissions of chlorinated automotive consumer products. Additionally, these entities participated in the development and review of the necessary surveys and draft reports, conference calls, working group meetings, and workshops. They also have had a forum to address their concerns.

As part of our outreach program, we have made extensive personal contacts with industry and facility representatives as well as other affected parties through meetings, telephone calls, and mail-outs. Activities included:

- the formation of a Perc Needs Assessment working group;
- seven conference calls with the working group to discuss our activities;
- more than 500 telephone conversations with the working group and facility operators;
- mailing or faxing working group agendas, minutes, draft surveys, survey analyses, draft and final status reports to over 80 people;
- mailing workshop notices to a mailing list of over 6,000 people;
- mailing the Brake Cleaner and Perc-Containing Automotive Products Survey to 37 manufacturers and 23 other interested parties (including associations);
- mailing the Automotive Repair Facility Survey to 25,000 facilities;
- conducting eight meetings and four workshops;
- visiting 137 AMR facilities to gather information on the process and amount of brake cleaning products used, building dimensions, and receptor locations;
- visiting five additional AMR facilities to gather information on aqueous brake cleaning units; and
- visiting 16 additional AMR facilities and meeting with the Sacramento Valley Fire Marshals Association to discuss flammability issues.

B. Public Involvement

As described below, affected industries, other government agencies, and organizations interested in minimizing chlorinated solvent use have been involved in this assessment from the beginning. To increase the general public's participation in this assessment, we have made information available via the ARB's Internet web site (http://www.arb.ca.gov/toxics/acp.htm), and have conducted four public workshops.

1. Industry Involvement

Automotive consumer products manufacturers and brake service industry representatives have actively participated in the assessment process, providing technical information, comments and suggestions during the development of surveys, and comments on findings. Industry involvement in the process has also included:

- more than 250 telephone conversations with ARB staff;
- the return of 22 of 37 Brake Cleaner and Perc-Containing Automotive Products Surveys representing about 90 percent of California product sales;
- participation of 18 workgroup representatives to review survey and risk assessment results; and
- participation in all needs assessment conference calls and workshops.

2. Government Agency Involvement

Other local, state, and federal agencies with an interest in potential emissions of, or soil/groundwater contamination by, Perc, MeCl, and TCE have been involved in the assessment process to promote statewide consistency in addressing public health concerns and provide a multi-media perspective. These agencies include: air and sanitation districts, the California Department of Industrial Relations/Division of Occupational Safety and Health (Cal/OSHA), the California Environmental Protection Agency's (Cal/EPA's) Office of Environmental Health Hazard Assessment (OEHHA), Cal/EPA's Department of Toxic Substances Control (DTSC), and the U.S. EPA.

We have apprized the air districts of our activities through the California Air Pollution Control Officers Association's (CAPCOA) Toxics Committee, and have also requested information that they may have on the brake cleaning process and how districts regulate the AMR industry. This work has included telephone calls to the districts and presentations to the CAPCOA Toxics Committee.

We have reviewed information provided to us by the sanitation districts on increasing concentrations of Perc in the influent to publicly owned treatment works (POTWs). Additionally, a representative of the County Sanitation Districts of Los Angeles County has presented this information during the May 1999 and January 2000 workshops (CSDLA, 1999b).

We have also requested information that other agencies may have on chlorinated solvent cleaning and pollution prevention case studies. Both the U.S. EPA and DTSC have published pollution prevention guides for the automotive maintenance and repair industry that were reviewed in the preparation of this report.

3. Private Organization Involvement

Two private organizations have also been involved in the assessment process. The Institute for Research and Technical Assistance (IRTA) recently partnered with the U.S. EPA (the study's sponsor), DTSC, and the South Coast Air Quality Management District to conduct a study of the effectiveness of aqueous brake cleaning units. IRTA is a non-profit organization that assists industries, primarily small businesses, in reducing or eliminating their use of ozone depleting substances and chlorinated solvents through demonstration and evaluation of new technologies, solvent substitutes, and process modifications. IRTA invited ARB staff to join them in visits to Los Angeles area automotive repair facilities conducting brake service operations. These facilities were participants in a study of alternative brake cleaning products. IRTA has provided technical information on the availability, cleaning effectiveness, and relative cost of non-aerosol brake cleaning products.

Tri-TAC, a technical advisory committee sponsored by the League of California Cities, the California Association of Sanitation Agencies, and the California Water Environment Association presented information about the amount of chlorinated solvents reaching POTWs, and has participated in the development of the proposed ATCM.

C. Data Collection Tools to Assist in Report Preparation

ARB staff developed three surveys to gather Perc usage and emissions data for use in this assessment: the Brake Cleaner and Perc-Containing Automotive Products Survey (Manufacturer Survey), the Automotive Repair Facility Questionnaire (Facility Survey), and the Brake/Automotive Repair Facility Survey for site visits (Site Visit Survey). Additionally, information from the 1997 Consumer and Commercial Products Survey (Consumer Products Survey) was also used.

1. The Manufacturer Survey

The Manufacturer Survey was developed to gather current sales and formulation data for both chlorinated and non-chlorinated brake cleaning products from manufacturers. It also requested information on future formulation trends that could increase the Perc content of brake cleaning products and other automotive consumer products.

2. The Facility Survey

The Facility Survey was developed to estimate the number of facilities performing brake repair operations, the number of brake jobs performed, and the type and quantity of bulk liquid or aerosol product used.

3. The Site Visit Survey

The Site Visit Survey was developed to gather AMR facility process information and source characteristic information. Process information includes items such as the number of brake jobs performed per day and the amount and types of solvent used in the process. Process information was used to estimate facility emissions. Source characteristic information includes building dimensions and the location of the residential and off-site worker receptors, and is used, in conjunction with facility emissions and an air dispersion model, to assess potential health impacts from a given facility.

4. The Consumer Products Survey

The Consumer Products Survey contains sales and formulation data for all consumer products sold in California, including the four automotive consumer product categories addressd by the proposed ATCM. This survey was conducted in conjunction with the Consumer Products regulations.

III. PHYSICAL CHARACTERISTICS, SOURCES, AND AMBIENT CONCENTRATIONS OF PERCHLOROETHYLENE , METHYLENE CHLORIDE, AND TRICHLOROETHYLENE

This chapter summarizes the readily-available information on physical properties, sources and emissions, ambient concentrations, indoor sources and concentrations, atmospheric persistence, and Air Toxics "Hot Spots" (AB 2588) risk assessment information for Perc, MeCl, and TCE. The information comes from ARB's 1997 reference report, Toxic Air Contaminant Identification List – Summaries unless otherwise noted (ARB, 1997b). This chapter also discusses the presence of these compounds in other environmental media as it was presented in the technical support documents for either the proposed identification of the compound as a toxic air contaminant (MeCl and TCE), or the proposed ATCM (Perc).

A. Perchloroethylene

1. Physical Properties of Perc

Perc is a volatile chlorinated aliphatic hydrocarbon compound containing a double bond. At room temperature, Perc is a non-flammable, colorless, dense liquid with an ethereal odor. Although relatively insoluble in water, it is miscible in alcohol, ether, chloroform, and benzene. Perc decomposes slowly in water to yield trichloroacetic and hydrochloric acids, and is oxidized by strong oxidizing agents.

Physical Properties of Perchloroethylene

Synonyms: tetrachloroethylene; tetrachloroethene; 1,1,2,2-perchloroethylene; ethylene tetrachloride; perc; PCE; Nema; Tetracap; Tetropil; Perclene; Ankilostin; Didakene

CAS Number[1]:	127-18-4
Molecular Formula:	C_2Cl_4
Molecular Weight:	165.85
Boiling Point:	121 ^oC at 760 mm Hg
Melting Point:	-22 ^oC
Vapor Pressure:	18.47 mm Hg at 25 ^oC
Vapor Density:	5.7 (air = 1)
Density/Specific Gravity:	1.6230 at 20/4 ^oC
Log Octanol/Water Partition Coefficient:	3.40
Conversion Factor:	1 ppb = 6.78 $\mu g/m^3$

[1] The CAS Registry Number or CAS number is a unique accession number assigned by the Chemical Abstracts Service, a division of the American Chemical Society. Other than being guaranteed unique to a given compound, this number has no particular meaning. CAS Registry Numbers are assigned to every uniquely-identifiable substance.

2. Sources of Perc

Perc is used as a solvent primarily in dry cleaning operations. Perc is also used in degreasing operations, paints and coatings, adhesives, aerosols, specialty chemical production, printing inks, silicones, rug shampoos, and laboratory solvents.

There are no producers of Perc in California. The primary stationary sources that have reported emissions of Perc in California are dry cleaning plants, plating and polishing companies, and aircraft manufacturers (ARB, 1999a).

Perc was registered for use as a pesticide, however as of August 1, 1990, it is no longer registered for pesticidal use in California.

3. Emissions of Perc

The reported emissions of Perc from stationary sources in California are estimated to be at least 4.5 million pounds per year, based on data reported under the Air Toxics "Hot Spots" Program (AB 2588) from database year 1998 (ARB, 1999a).

4. Natural Occurrence of Perc

Perc does not occur naturally in the environment.

5. Ambient Concentrations of Perc

Perc is routinely monitored in California by the statewide ARB air toxics network. The ARB's ambient air monitoring network is designed to obtain ambient background, non-source influenced, concentration levels of air toxics from 21 ambient air toxic monitoring stations located statewide. According to ARB's toxics database, the 1998 statewide average concentration for Perc is 0.11 parts per billion (ppb) or 0.77 micrograms per cubic meter ($\mu g/m^3$).

The United States Environmental Protection Agency (U.S. EPA) has compiled ambient concentration data from Columbus, Ohio during 1989 with a mean concentration of 1.59 $\mu g/m^3$, or 0.23 ppb, and the range varied from 0.21 to 40 $\mu g/m^3$ or 0.03 to 5.90 ppb. They also reported concentrations of Perc from 13 study areas during 1989 to 1991. The overall range of concentrations from these areas were from 0.69 to 104 $\mu g/m^3$ or 0.10 to 15.34 ppb with a mean concentration of 3.6 $\mu g/m^3$ or 0.53 ppb.

6. Indoor Sources and Concentrations of Perc

Volatilization from dry cleaned garments is probably the largest source of Perc in indoor air. Brake cleaners, water repellents, and fabric finishes are also important sources of Perc.

Results from both indoor and personal monitoring in California homes indicate that people are exposed frequently to Perc from indoor air. The level of exposure varies among homes because of the different numbers and types of emission sources present in individual homes. In a large Southern California study, the 24-hour average concentrations for residential indoor air ranged from 2.27 to 6.72 $\mu g/m^3$ while concurrent outdoor concentrations ranged from 1.74 to 4.41 $\mu g/m^3$. Using personal nighttime sampling data to approximate indoor air exposure, the 12-hour average indoor nighttime concentrations ranged from 5.45 to 8.56 $\mu g/m^3$ in comparison to the outdoor nighttime concentrations which ranged from 1.24 to 5.72 $\mu g/m^3$.

The most recent California study was conducted in Woodland, California in the spring of 1990. The average concentration of Perc of 124 indoor samples was 1.44 $\mu g/m^3$. Mean indoor concentrations from the Woodland study are approximately 2.7 times greater than the outdoor mean concentration of 0.53 $\mu g/m^3$ from the same study.

7. <u>Atmospheric Persistence of Perc</u>

The dominant tropospheric loss process for Perc is expected to be by reaction with the hydroxyl (OH) radical. The calculated half-life and lifetime for Perc due to gas-phase reaction with the OH radical are 2 months and 3 months, respectively. Both nitrate radical and ozone chemical reaction removal processes are too long to compete with the OH radical reaction. The reaction of the OH radical with Perc has been shown to generate chlorine atoms and that in the atmosphere the reaction forms phosgene and hydrogen chloride as well as other, as yet unidentified, products. Therefore, Perc is sufficiently persistent to be transported throughout an air basin before it is degraded.

8. <u>Health Effects of Perc</u>

See Chapter VI.C. for a discussion of the health effects of Perc.

9. <u>AB 2588 Risk Assessment Information</u>

The Office of Environmental Health Hazard Assessment (OEHHA) reviews risk assessments submitted under the Air Toxics “Hot Spots” Program (AB 2588). Of the risk assessments reviewed as of April 1996, Perc was the major contributor to the overall cancer risk in 43 of the approximately 550 risk assessments reporting a total cancer risk equal to or greater than 1 in 1 million. Perc contributed to the total cancer risk in 79 of these risk assessments. Perc also was the major contributor to the overall cancer risk in 7 of the approximately 130 risk assessments reporting a total cancer risk equal to or greater than 10 in 1 million, and contributed to a total cancer risk in 34 of these risk assessments.

For non-cancer health effects, Perc contributed to the total hazard index in 35 of the approximately 89 risk assessments reporting a total chronic hazard index greater than 1, and presented an individual hazard index greater than 1 in 19 of these risk assessments. Perc also contributed to the total hazard index in 23 of the approximately 107 risk assessments reporting a total acute hazard index greater than 1, and presented an individual hazard index greater than 1 in 4 of these risk assessments.

10. Perc in the Environment (ARB, 1993a)

Besides the air, Perc is also found in water, soil, fatty foods, fish, and human blood. This section will discuss the presence of Perc in other environmental media.

a. Ground Water and Soil

Perc is a point-source ground water contaminant because of its widespread use and physical characteristics. When waste water containing Perc is discharged into the sewer or Perc is accidentally spilled onto the ground, it can migrate through the soil and into aquifers below. Perc is heavier than water. If discharged into the sewer, Perc can settle to the bottom of the sewer line and migrate through clay sewer pipe into the soil layers and groundwater aquifers. Perc in the sewer pipes can also volatilize to a gas and penetrate the sewer wall. The Perc can then travel through the soil layers into the ground water.

If organic carbon is present in the subsurface materials, Perc can decompose under anaerobic conditions through “sequential reduction”. This means that one chlorine atom at a time is removed from the Perc molecule and is replaced with hydrogen atoms. Perc is sequentially reduced to trichloroethene, then to cis-1,2-dichloroethene, and finally to ethene .

Perc can also be degraded by bacteria. There are several bacteria involved in the biodegradation of Perc, such as Clostridium cadaveris, Clostridium limosium, gram positive cocci, large gram positive rods, and filaments. In the degradation process, the Perc molecule is slowly broken down into a hydrogenate compound, with chlorine released as chlorine ions.

b. Ocean

Concentrations of Perc in the ocean are used as an indication of the environmental background concentration in surface waters. The average background concentrations of Perc in the North Atlantic Ocean range from 0.1 to 0.5 ppt (parts per trillion).

c. Precipitation

Perc can be present in precipitation or rainwater. Rainwater collected in 1982 in the Los Angeles area contained 21 ppt of Perc. Perc levels in rainwater in La Jolla, and snow in south-central California, ranged from 1.4 to 5.7 ppt. Rainwater collected in Portland, Oregon had Perc levels that ranged from 0.82 to 9.2 ppt. Rainwater in England’s industrial cities contained Perc concentrations up to 150 ppt.

d. Food

Food products have been found to contain Perc. It is believed that airborne Perc is the primary contaminant mechanism for foods. Perc has been found in foods such as: dairy products (0.3 to 13 micrograms of Perc per kilogram of dairy product (µg/kg)); meat, oils, and fats (0.01 to 7.0 µg/kg); beverages (2.0 to 3.0 µg/kg); fruits and vegetables (0.7 to 2.0 µg/kg); and fresh bread (1 µg/kg).

e. Fish

Several European studies have been conducted to determine if Perc accumulates in fish. Eel, cod, coalfish, dogfish, and bid from the Irish Sea were collected and analyzed. Fish tissue concentrations were as high as 43 nanograms of Perc per gram of fish (ng/g) (dry weight). Fifteen species of fish off the coast of Great Britain were found to have Perc levels ranging from between 30 to 100 ng/g.

f. Perc Ingestion by Humans

A study in Japan was conducted to determine the Perc blood levels in individuals who consume well water contaminated with Perc. The Perc levels in the well water ranged from 0.001 to 27 ppb. The study concluded that people who did not use well water for drinking or cooking had non-detectable Perc blood levels (detection limit was not reported). Those people who consumed or used well water had Perc blood levels ranging from 0.9 to 5.1 micrograms of Perc per liter of blood (µg/l).

B. Methylene Chloride

1. Physical Properties of MeCl

MeCl is a volatile, nonflammable, colorless, liquid with a sweetish chloroform-like odor. It is slightly soluble in water and miscible with alcohol, ether, and dimethylformamide. In the absence of moisture, at ordinary temperatures, MeCl is relatively stable. In dry air, MeCl decomposes at temperatures exceeding 120 ^{o}C. MeCl evaporates relatively quickly from water. Possible thermal breakdown products of MeCl include phosgene, chlorine, and hydrogen chloride.

Physical Properties of Methylene Chloride

Synonyms: dichloromethane; methylene dichloride; Freon 30; Aerothene NM; Somethine; methylene bichloride

CAS Number:	75-09-2
Molecular Formula:	CH_2Cl_2
Molecular Weight:	84.94
Boiling Point:	39.75 ^{o}C at 760 mm Hg
Melting Point:	-95 ^{o}C
Vapor Pressure:	349 mm Hg at 20 ^{o}C
Vapor Density:	2.93 (air = 1)
Density/Specific Gravity:	1.3255 at 20/4 ^{o}C
Log Octanol/Water Partition Coefficient:	1.30
Conversion Factor:	1 ppm = 3.47 mg/m^3

2. Sources and Emissions of MeCl

MeCl is used as a solvent, a blowing and cleaning agent in the manufacture of polyurethane foam and plastic fabrication, and in paint stripping operations. MeCl is also used in some aerosol consumer products, including aerosol paints, and automotive products. However, most consumer products manufacturers have already voluntarily phased out the use of MeCl. In addition, in the case of aerosol paints, the use will be restricted by a provision in ARB's regulation, "Regulation for Reducing Volatile Organic Compound (VOC) Emissions from Aerosol Coating Products" adopted March 1995. MeCl is also found in textiles, paper, plastic, glass, and pharmaceutical manufacturing. For some categories, such as paint removers and aerosols, emissions from evaporation equal the amount used.

Paint removers account for the largest use of MeCl in California, where MeCl is the primary ingredient in paint stripping formulations used for industrial, commercial, military, and domestic applications.

The primary stationary sources that have reported emissions of MeCl in California are manufacturers of ophthalmic goods, manufacturers of plastic foam products, and manufacturers of motor vehicles and car bodies (ARB, 1999a).

MeCl was registered for use as a pesticide; however as of August 1, 1990, it is no longer registered for pesticidal use in California.

3. Emissions of MeCl

The total emissions of MeCl from stationary sources in California are estimated to be approximately 3.5 million pounds per year, based on data reported under the Air Toxics "Hot Spots" Program (AB 2588) from data base year 1998 (ARB, 1999a).

4. Natural Occurrence of MeCl

MeCl does not occur naturally in the environment.

5. Ambient Concentrations of MeCl

MeCl is routinely monitored in California by the statewide ARB air toxics network. The ARB's ambient air monitoring network is designed to obtain ambient backgound, non-source influenced, concentration levels of air toxics from 21 ambient air toxic monitoring stations located statewide. According to ARB's toxics database, the 1998 statewide average concentration for MeCl is 0.62 parts per billion (ppb) or 2.15 micrograms per cubic meter ($\mu g/m^3$).

The U.S. EPA has also reported concentrations of MeCl from 13 study areas during 1989 to 1991. The overall range of concentrations from these areas were from 0.28 to 492 $\mu g/m^3$ (0.08 to 140.57 ppb) with an overall mean concentration of 5.6 $\mu g/m^3$ (1.6 ppb).

6. Indoor Sources and Concentrations of MeCl

Because MeCl is a constituent in many consumer products, short-term indoor concentrations may be several orders of magnitude higher than ambient concentrations. Results from a chamber study where a paint stripper was being used resulted in breathing zone exposures up to 2,000 parts per million (ppm) averaged over one hour with peak breathing zone concentrations of up to 33,000 ppm. Inhalation of MeCl from the indoor environment is expected to vary depending on the degree and manner of use of products containing MeCl.

Data on indoor concentrations of MeCl are extremely limited. During June of 1990, 125 households in Woodland, California were monitored for a variety of toxic air contaminants. Sixty-one homes were sampled for MeCl. The mean of those samples was 83 $\mu g/m^3$ or 23.92 ppb. The detection limit for MeCl was 0.7 $\mu g/m^3$ or 0.20 ppb. The 90th percentile was

160 µg/m^3 or 46.11 ppb, with a range from below the quantifiable limit of 0.7 to 1,700 µg/m^3 or 0.20 to 489.91 ppb. Mean indoor concentrations are approximately 5.5 times greater than the outdoor mean concentration of 15 µg/m^3 or 4.32 ppb from the same study. The use of household consumer products containing MeCl may account for its high prevalence in the homes tested.

As part of a study conducted in Los Angeles County, the indoor and outdoor air of eight homes was sampled during the summer and analyzed for several compounds including MeCl. For these homes, results show overnight indoor concentrations to range from 3.5 to 12.6 µg/m^3 or 0.3 to 3.6 ppb with daytime indoor concentrations ranging from 1.05 to 13.65 µg/m^3 or 0.3 to 3.9 ppb. Overnight outdoor concentrations range from 0.35 to 4.55 µg/m^3 or 0.1 to 1.3 ppb while daytime outdoor concentrations range from 0.7 to 13.65 µg/m^3 or 0.2 to 3.9 ppb. The results for this study indicate that indoor concentrations of MeCl in some homes may not be substantially higher than outdoor concentrations.

7. Atmospheric Persistence of MeCl

Reaction with hydroxyl radicals is the dominant mechanism removing MeCl from the atmosphere. The calculated half-life and lifetime of MeCl due to gas-phase reaction with the Oh radical are estimated to be about 0.6 years and 0.9 years, respectively. The product of the Oh radical-initiated reaction is formyl chloride, in 100 percent yield.

8. Health Effects of MeCl

See Chapter VI.C. for a discussion of the health effects of MeCl.

9. AB 2588 Risk Assessment Information

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics “Hot Spots” Program (AB 2588). Of the risk assessments reviewed as of April 1996, MeCl was the major contributor to the overall cancer risk in 30 of the approximately 550 risk assessments reporting a total cancer risk equal to or greater than 1 in 1 million and contributed to the total cancer risk in 112 of these risk assessments. MeCl also was the major contributor to the overall cancer risk in 8 of the approximately 130 risk assessments reporting a total cancer risk equal to or greater than 10 in 1 million, and contributed to the total cancer risk in 44 of these risk assessments.

For non-cancer health effects, MeCl contributed to the total hazard index in 24 of the approximately 89 risk assessments reporting a total chronic hazard index greater than 1. MeCl also contributed to the total hazard index in 30 of the approximately 107 risk assessments reporting a total acute hazard index greater than 1, and presented an individual hazard index greater than 1 in 8 of these risk assessments.

10. MeCl in the Environment (ARB, 1989)

Other routes of exposure to MeCl include the ingestion of drinking water and food products. The following comparisons simply illustrate the extent of exposures to MeCl by routes other than inhalation. The comparisons do not imply that equivalent doses via different exposure routes necessarily result in health effects that are equivalent. ARB staff believe that the greatest contribution to total intake is from inhalation of MeCl.

The ARB staff estimate that for the majority of California residents, the intake of MeCl through drinking water is less that 365 µg/year. Between January 1984, and December 1985, the California Department of Health Services (DHS) conducted a study in which groundwater from 2,947 wells, representing 819 public water systems, was analyzed for MeCl. Less than one percent of the wells sampled (eleven wells) contained MeCl at concentrations above the 0.5 µg/liter detection limit. For these eleven wells the median concentration was 3.0 µg/liter, the maximum was 10.0 µg/liter, and the minimum was 0.65 µg/liter.

Groundwater supplies roughly 40 percent of California's domestic use with surface water making up the other 60 percent. The DHS study did not monitor surface waters for MeCl. MeCl released into surface waters is not expected to remain due to its high volatility. The U.S. EPA used results from two major surveys (the National Organics Monitoring Survey and the National Screening Program for Organics in Drinking Water) to predict MeCl concentrations in the potable water of public water systems nationwide. Based on data from both groundwater and surface water, the EPA has estimated that 93.5 percent of U.S. population who are served by public drinking water systems receive water with no MeCl or levels less than 0.5 µg/liter. Furthermore, 99.6 percent of the population receive water with concentrations at or below 10 µg/liter.

ARB staff estimated a range of annual intake through drinking water based on the concentrations found in the DHS monitoring study (less than 0.5 to 10.0 µg/liter). Intake is based on an average drinking water consumption of two liters per day, resulting in an intake ranging from less than 365 µg/year to 7300 µg/year. Because MeCl is not expected to remain in surface waters and because MeCl was not detected in over 99 percent of the groundwater wells that DHS tested, ARB staff believe that the overwhelming majority of California population would have annual intakes less than those reported above.

C. Trichloroethylene

1. Physical Properties of TCE

TCE is a chlorinated aliphatic hydrocarbon compound containing a double bond. It is a dense, nonflammable, volatile, colorless liquid which is only slightly soluble in water but miscible with organic solvents and other halogenated compounds. Most fixed and volatile oils are dissolved by TCE. It is lipophilic. TCE has an odor threshold of 28 parts per million (ppm) and smells similar to ether or chloroform.

Physical Properties of Trichloroethylene

Synonyms: trichloroethene; ethinyl trichloride; Tri-Clene; Trilene; Trichloran; Trichloren; Westrosol; Gemalgene; Chlorylen; acetylene trichloride; 1,2,2-trichloroethylene

CAS Number:	79-01-6
Molecular Formula	C_2HCl_3
Molecular Weight:	130.40
Boiling Point:	86.7 °C
Melting Point:	-73 °C
Flash Point:	89.6 °C
Vapor Pressure:	100 mm Hg at 32 °C
Vapor Density:	4.53
Density:	1.4649 at 20/4 °C
Log Octanol/Water Partition Coefficient:	2.42
Conversion Factor:	1 ppb = 5.33µg/m^3

2. Sources of TCE

TCE is used in California in a variety of operations and products, including degreasing operations, polyvinyl chloride production, adhesive formulations, and paints and coatings. TCE is also used in miscellaneous chemical synthesis and solvent applications, and as a refrigerant and heat exchange liquid. The major use of TCE in California, and nationwide is as a degreasing solvent. It is not produced in California. Other sources that emit TCE include publicly owned treatment works; groundwater aeration and air strippers; sanitary sewers; surface impoundments; and municipal landfills. TCE is also present in trace concentrations in waste oil. According to the World Health Organization in its review of TCE, the compound is widely distributed in surface water, rain water, and well water.

The previously discussed 1984-85 DHS groundwater study sampled for TCE in the same 2,947 wells. TCE was found in 188 wells with a median concentration of 3.2 micrograms per liter (µg/l). A maximum concentration of 538 µg/l was also reported. The DHS noted that those wells supplying heavily urbanized areas generally had the higher concentrations of TCE. The DHS developed an action level for TCE of 5 µg/l.

The primary stationary sources that have reported emissions of TCE in California are manufacturers of pens and mechanical pencils, manufacturers of motor vehicle parts and accessories, and blast furnaces and steel mills (ARB, 1999a).

3. Emissions of TCE

The total emissions of TCE from stationary sources in California are estimated to be 179,000 pounds per year, based on data reported under the Air Toxics “Hot Spots” Program (AB 2588) from data base year 1998 (ARB, 1999a). No control measures have been adopted for TCE under California's air toxic program.

4. Natural Occurrence of TCE

TCE does not naturally occur in the environment.

5. Ambient Concentrations of TCE

TCE is routinely monitored in California by the statewide ARB air toxics network. The ARB’s ambient air monitoring network is designed to obtain ambient backgound, non-source influenced, concentration levels of air toxics from 21 ambient air toxic monitoring stations located statewide. According to ARB’s toxics database, the 1998 statewide average concentration for TCE is 0.03 parts per billion (ppb) or 0.16 micrograms per cubic meter (µg/m^3).

The United States Environmental Agency (U.S. EPA) has also compiled ambient air data from Lima, Ohio during 1990 to 1991. The data show a mean concentration of 0.71 µg/m^3 or 0.13 ppb. They also reported an overall mean concentration of TCE from 11 study areas during 1990 of 2.63 µg/m^3 or 0.49 ppb.

6. Indoor Sources and Concentrations of TCE

TCE has limited use as a solvent in consumer products and indoor concentrations of this chemical have been found to be quite varied. The most recent California study was conducted in Woodland, California during the spring of 1990. The indoor concentration of TCE of 125 homes ranged from 0.30 to 9.3 µg/m^3 or 0.06 to 1.74 ppb. The average indoor concentration was 0.65 µg/m^3 or 0.12 ppb.

The California Total Exposure Assessment Methodology (TEAM) studies were conducted during 1984 and 1987. Los Angeles and Contra Costa County were included during 1984, while Los Angeles was the only area for the 1987 study. Investigators collected volatile organic compounds (VOCs) using personal air, outdoor, and fixed-site indoor samplers. Direct comparisons of TCE concentrations indoors and outdoors were matched. Mean indoor concentrations of TCE ranged from 0.63 to 3.97 $\mu g/m^3$ or 0.12 to 0.74 ppb. Median indoor concentrations of TCE are 2 to 5 times greater than ambient concentrations although indoor concentrations appear to be very dependent upon the use of consumer products containing TCE.

Concentrations of VOCs in 10 public-access buildings were monitored for three days. Volatile organic compounds were measured at three new buildings before and after occupancy. Mean three-day TCE concentrations after occupancy ranged from 7.94 to 37.68 $\mu g/m^3$ or 1.49 to 7.07 ppb which the authors indicated could have been attributed to use of commercial cleaning products.

7. Atmospheric Persistence of TCE

The primary removal mechanism of airborne TCE is its reaction with hydroxyl (OH) radicals in the troposphere. The calculated half-life and lifetime for TCE due to gas-phase reaction with the OH radical are estimated to be 4 days and 6 days, respectively. The reaction forms formyl chloride and phosgene and chlorine atoms (leading to hydrochloric acid formation in the atmosphere), together with other, unidentified, products.

8. Health Effects of TCE

See Chapter VI.C. for a discussion of the health effects of TCE.

9. AB 2588 Risk Assessment Information

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics “Hot Spots” Program (AB 2588). Of the risk assessments reviewed as of April 1996, TCE was the major contributor to the overall cancer risk in 3 of the approximately 550 risk assessments reporting a total cancer risk equal to or greater than 1 in 1 million and contributed to the total cancer risk in 55 of the risk assessments. TCE also contributed to the total cancer risk in 16 of the approximately 130 risk assessments reporting a total cancer risk equal to or greater than 10 in 1 million.

For non-cancer health effects, TCE contributed to the total hazard index in 5 of the approximately 89 risk assessments reporting a total chronic hazard index greater than 1.

10. TCE in the Environment (ARB, 1990)

Other routes of exposure to TCE include the ingestion of drinking water and food products. Water appears to present the major source of exposure through ingestion.

According to the World Health Organization, in its review of TCE, the compound is widely distributed in surface water, rain water, and well water. For example, McConnel et al. (1975) reported that rain water contained TCE in the range of a few micrograms per liter.

Cothern et al. (1986) estimated, based on U.S. EPA surveys, that of the approximately 23 million persons exposed to levels of TCE ranging from 0.5 to 5.0 µg/L, 76 percent of the people obtained their water from surface water supplies. The higher concentrations in this range, however, are thought to come from groundwater systems.

The California Department of Health Services measured a number of toxic compounds including TCE in large public water systems in California (January 1984 to December 1985). Approximately 3,000 wells were sampled. TCE was found in 188 of the wells with a median concentration of 3.2 µg/L. A maximum concentration of 538 µg/L was also reported. The CDHS noted that those wells supplying heavily urbanized areas generally had the higher concentrations of TCE. The Department of Health Services developed an action level for TCE of 5 µg/L. This is based on a cancer risk estimate by the National Academy of Science of a 10^{-6} excess risk of cancer due to lifetime exposure to drinking water containing 5 µg/L TCE.

Concentrations of TCE were also measured in tap water during the TEAM 84 studies. For the February and May sampling times in Los Angeles, the weighted median (and range) of TCE concentrations in water were 0.04 (0.03-0.24) µg/L and 0.03 (0.03-0.56) µg/L, respectively. For the Contra Costa samples, the weighted median (and range) of TCE concentrations was 0.05 (0.03-0.09) µg/L. The median levels of TCE in Los Angeles and Contra Costa were very similar, but the maximum concentrations were higher in Los Angeles.

There is limited information on the concentrations of TCE found in food, especially in food purchased in California. There are reports of TCE in food measured in European countries. McConnel et al. (1975) reviewed the levels of TCE in foods in Great Britain and Europe and reported a range of 0.02 µg/kg measured in Yugoslavian wine to 60 µg/kg measured in tea.

Ofstad et al. (1981) reported on TCE concentrations in fish in Norway. The concentrations of TCE ranged from 5 µg/kg in a commercial salmon fillet to approximately 400 µg/kg in the cod liver oil.

Uhler and Diachenko (1987) reported the concentrations of volatile halocarbons in process water as well as in processed foods. Out of 15 processing plants, two had detectable amounts of TCE in the process water. None of the food items measured in the 15 plants had detectable levels of TCE (limit of less than 1 nanogram [ng] per gram of food).

Entz and Diachenko (1990) reported the concentrations of TCE in 50 margarine samples purchased in 1980-1982 and 18 samples purchased in 1984, all from the Washington, D.C. area. Out of the 50 samples, one sample had TCE concentrations in the 100-500 ppb ranges, nine samples were in the 10-50 ppb range, seven samples were in the 3-10 ppb range, and 35 samples had undetectable amounts of TCE. Of the 18 samples measured in 1984, three samples were in the 10-50 ppb range, one was in the 3-10 ppb range, and 14 samples had undetectable amounts of TCE.

IV. SUMMARY OF AUTOMOTIVE MAINTENANCE AND REPAIR ACTIVITIES

During the needs assessment phase, usage of perchloroethylene (Perc), methylene chloride (MeCl), and trichloroethylene (TCE) was examined in four automotive consumer product categories: brake cleaners, carburetor and fuel-injection air intake cleaners (carburetor cleaners), engine degreasers, and general degreasers (including most aerosols and some bulk parts washers). This chapter provides a description of each product category and information on how and where the products are used (based on information collected from surveys and site visits).

A. Description of Product Categories

1. Brake cleaner

Automotive brake cleaners are designed to remove oil, grease, brake fluid, brake pad material, and dirt from motor vehicle brake mechanisms. These products are sometimes labeled for use in cleaning dirt or grease from other motor vehicle parts and may be used interchangeably. Automotive brake cleaners are sold in both aerosol and liquid forms.

Aerosol brake cleaners are typically sprayed on the entire brake assembly prior to service or repairs to wet down dust and to remove oil, grease, or other contaminants. Aerosol brake cleaners are also used on individual components after disassembly, often to remove greasy fingerprints or other contaminants from friction surfaces.

Liquid or bulk brake cleaners are used primarily by professional mechanics. The solvent-based bulk brake cleaners can be converted in the shop to an aerosol by using a refillable sprayer that is pressurized using the shop air compressor. Once the product is pressurized, it is used in the same way as the pre-packaged aerosol products. Liquid products can also be transferred to hand-held pump sprayers for use. There are also solvent-based and water-based portable brake cleaning units that are comprised of a base reservoir of cleaning solution with a collection pan on top and a nozzle and brush. Mechanics position the unit under the wheel and typically spray down the entire brake assembly with the cleaning solution and use the brush as necessary to clean the brake components. The dirty solution then drips off the brake assembly and is collected in the pan and routed into the reservoir where it may be filtered to remove brake dust, oil and grease. Some companies that supply these devices to shops establish a recycling schedule where they routinely pick up the spent bath solution and replace it with a fresh bath. Other companies aqueous systems depend on the mechanic to replace or recharge the water-based solutions. There are also portable brake cleaning units available that can be filled with the mechanic’s choice of solvent brake cleaner.

2. Carburetor Cleaner

Carburetor and fuel-injection air intake cleaners are products designed to remove fuel deposits, oil, dirt, and other contaminants from a carburetor, choke, throttle body of a fuel-injection system, or associated linkages. Carburetor and fuel-injection air intake cleaners are used during routine maintenance and repairs by both “do-it-yourself” and professional mechanics. These products are sometimes also labeled for use in cleaning dirt or grease from other motor vehicle parts, including brake parts. Both aerosol and liquid products are sold, but each form is used in a different manner.

The aerosols are used to remove deposits from carburetors, throttle bodies, and associated parts, usually while they are still attached to the engine. Aerosols can be used to remove fuel deposits from the inside surfaces of carburetors by spraying into the carburetor throat while the engine is running, or by spraying the carburetor wells or throttle plate with the engine off and then starting and idling the engine. The solvents in the product combine with the fuel and are carried throughout the inside passages of the carburetor, eventually reaching the combustion chamber. Many automotive maintenance and repair (AMR) facilities that responded in the Facility Survey stated that they also used carburetor cleaners for cleaning brakes.

Since aerosol products are designed to be sprayed down the carburetor throat, they are subject to U.S. EPA regulations for fuel additives which require manufacturers to register their formulations. The U.S. EPA also requires manufacturers to collectively fund a literature search on the potential health effects of using their products. Currently, manufacturers can only register formulations with compounds containing five elements: carbon, hydrogen, oxygen, nitrogen, and sulfur. However, formulations containing other elements were registered prior to the 1990 federal Clean Air Act Amendments. These formulations have been essentially grandfathered from the requirement that they contain only compounds with the five elements mentioned. Some of these grandfathered products contain chlorinated solvents such as MeCl and Perc (ARB, 1999).

There are two types of liquid carburetor, choke, or fuel-injection air intake cleaners. The first type is added directly to the fuel lines or the fuel tank of the vehicle to remove deposits from fuel injectors, engine intake valves, and the combustion chamber. These products are often labeled as fuel-injection, intake, or engine deposit cleaners or engine flush or fuel treatments. Carburetor or fuel-injection air intake cleaners that are designed exclusively to be introduced directly to the fuel lines or fuel tank prior to introduction into the carburetor or fuel injectors are not subject to the proposed ATCM.

The second type of liquid carburetor cleaner requires carburetors and associated parts to be disassembled and immersed in a container of the liquid product for several minutes or longer. Some products include a basket within the solvent container that can be used to hold the parts that are immersed, while others must be poured into a separate container to soak parts. Often, sensitive parts made of plastic or rubber must be removed prior to immersion to prevent damage. The cleaned parts are then removed from the solution and pressure rinsed with water. These types of cleaners are often labeled as "Carburetor and Metal Parts Cleaners" or "Carburetor and Cold Parts Cleaners" and indicate that the product may be used for a variety of parts cleaning tasks. Some of the products contain chlorinated solvents such as Perc, MeCl, and monochlorotoluene.

3. Engine Degreasers

Engine degreasers are specialty cleaning products designed to remove grease, grime, oil and other contaminants from the external surfaces of automotive engines and other mechanical parts and are available in both aerosol and liquid forms. The liquid forms of engine degreasers can further be broken down into solvent-based or water-based concentrates that need to be diluted with water before use. Engine degreasers can also be used to clean engines on motorcycles, boats, lawnmowers, and other powered vehicles. Typically, the entire cleaning process requires a combination of chemicals, using various combinations of solvents to first dissolve the contaminants, and physical action to remove the engine surface contaminants. As a first step, many products instruct users to apply the product when the engine is still warm. Other products direct the user to leave the engine running when applying the product. Most products direct the user to wait 10 to 15 minutes to allow the solvents to penetrate the oil and grime. For tough-to-remove deposits, the user may need to scrub the soil with a brush. At this point, surfactants in water-based products emulsify the dissolved oil into the water contained in the product. The final step requires the user to rinse the emulsified mixture to wash away the contaminants. Although some product labels direct users to dispose of the wash effluent in accordance with applicable environmental regulations, some facilities may discharge the wash effluent into the sewer system.

4. General Purpose Degreasers

General degreasers consist of products designed to remove grease, grime, oil, or other oil-based contaminants from a variety of surfaces. This definition also includes products that are designed to clean miscellaneous metallic parts. These products are currently sold and labeled as solvent parts cleaners or metallic parts cleaners. General degreasers typically do not include products specifically labeled as engine degreasers, tire, gasket or paint removers, or electronics cleaners. This category also does not include general cleaners which are typically defined as products designed for general purpose cleaning, such as floor, kitchen, counter top, bathroom, tile or glass cleaners.

For the proposed ATCM, general degreasers can be defined as aerosols labeled to clean automotive parts, bulk solvent parts cleaners that may be dispensed as an aerosol via a pressurized air sprayer or pump sprayer, or bulk liquids sold in containers designed to permit disassembled parts to be immersed within them. Aerosol general degreasers include only metallic parts cleaners and solvent parts cleaners. A metallic parts cleaner is defined as an organic liquid that is designed to dissolve grease, dirt, or other contaminants solely from miscellaneous metallic parts.

B. Users of Automotive Consumer Products in California

Automotive consumer products are used in a variety of applications and industries throughout California. They are most commonly used in AMR activities at service stations, fleets, general automotive repair shops, dedicated brake repair shops, and new and used car dealerships. The majority of Californians look to these facilities for their maintenance and repair needs. In these facilities, automotive consumer products remove grease, grime, and dirt from a variety of automobile parts. Examples of applications include engine degreasing, the servicing of carburetors and throttle bodies, and brake service and repair operations. These commercial facilities will use both aerosol and liquid products (chlorinated and non-chlorinated) contained in a variety of delivery mechanisms. However, not all vehicle owners look to commercial facilities for their vehicle care needs. Some owners prefer to perform their own services at their residences or other locations. Since most people do not have the benefit of hydraulic lifts, air compression systems, and specialty tools and equipment, the services that they can perform are generally limited. Nonetheless, brake repair and engine degreasing are common do-it-yourself activities. People who service their own vehicles will also use both aerosol and liquid products, but if they use a liquid, it is more likely to be one that is easily converted into an aerosol or pump sprayer.

Some private businesses and government agencies maintain vehicle fleets that are used for a variety of tasks and these fleets can consist of cars, vans, trucks, buses, and other task-specific vehicles. Many fleets operate their own maintenance and repair facilities to handle their maintenance and repair needs. Typically, these fleet operations are indistinguishable from their commercial counterparts with the exception that their services are not available to the general public. Normally, fleet facilities and commercial facilities tend to be similarly equipped and use similar automotive consumer products.

Automotive consumer products used for AMR activities are not limited to cars, trucks, and buses, but can also be used in non-traditional applications on a limited basis. These applications include, but are not limited to, off-road vehicles, marine vessels, and aviation. The ARB believes that automotive consumer products are selected for these applications because they are readily available and suitable for light-duty tasks such as small parts cleaning and degreasing.

C. How Brake Service and Repair Jobs Are Performed

Surveys and site visits revealed that of the four categories of concern, brake cleaners account for the majority of product usage and that the usage occurs primarily in conjunction with brake service operations. As a result, it is important to have a basic understanding of how brake jobs are performed, especially since products from all four automotive consumer product categories discussed here have been used in conjunction with brake service operations.

1. The Brake Service Process

Brake service operations are normally performed directly on the vehicle, with the vehicle raised to a comfortable working height for the mechanic. Brake service operations can include inspections, adjustments, brake pad replacements and rotor resurfacing, and usually require the disassembly, replacement or repair, and reassembly of the brakes.

Brake cleaners are routinely used in brake service operations while engine degreasers, carburetor cleaners, and general purpose degreasers are used less frequently. As discussed in the brake cleaner product category description, automotive brake cleaning products are designed to remove oil, grease, brake fluid, brake pad dust, or dirt from motor vehicle brake mechanisms and generally come in either an aerosol or liquid form. Many mechanics have discovered that products in the other three product categories are designed to remove similar types of grease, dirt, and grime, and can be used interchangeably on a variety of applications. Brake cleaners are applied before, during, and after brake disassembly to dissolve contaminants, and sometimes after reassembly as a final cleaning process to remove oil, brake fluid, and fingerprints that may have inadvertently been redeposited on the brake assembly. After application, the brake cleaner and dissolved contaminants either drip off, or are wiped away from the brake parts.

Many facilities use portable brake cleaning units for brake service and repair operations. Portable brake cleaning units, which include bird bath type units, can be used independently or in conjunction with an aerosol product depending on mechanic preference. They are typically not used in conjunction with other liquid products with the possible exception of liquid products that can be converted to aerosols or pump sprayers. Mechanics use these units in their initial cleaning step to remove the heavier accumulations of grease, grime, and dirt, but many facilities use these units exclusively. Again, some may use aerosols as a follow-up process to remove oil, brake fluid, and fingerprints that may have inadvertently been redeposited on the brake assembly.

Brake parts manufacturers typically issue guidelines and offer instructional materials outlining their recommendations on how their parts should be used in conjunction with brake service operations. When asked about why aqueous based units are demonstrated in their ASE (Automotive Service Excellence) certification clinics, representatives for these manufacturers listed performance, cost, and worker exposure as reasons for not using aerosol products (Raybestos, 1999; Federal-Mogul/Wagner, 1999).

2. Regulatory Issues

To control asbestos exposure from brake and clutch surfaces, the California Occupational Safety and Health Administration adopted mandatory methods for brake and clutch service beginning on July 3, 1996 (title 8, California Code of Regulations, section 5208, Appendix F). This regulation requires that either a negative pressure enclosure/HEPA vacuum system, or a low pressure/wet cleaning method using an aqueous solution, be used to clean asbestos-containing brake parts during brake and clutch inspection, disassembly, repair, and assembly operations.

However, we observed that mechanics tend to use any brake cleaning product they choose after the reassembly process to remove fingerprints, residual grease, and brake fluid. In addition, mechanics may use any brake cleaning products, including water, petroleum solvent parts washers, or other brake cleaners for cleaning non-asbestos brakes. For these purposes, some mechanics use aerosol brake cleaners.

V. EMISSIONS FROM AUTOMOTIVE MAINTENANCE AND REPAIR ACTIVITIES

In order to estimate emissions of perchloroethylene (Perc), methylene chloride (MeCl), and trichloroethylene (TCE) from the four automotive consumer product categories described in Chapter IV, ARB staff used a variety of tools. Specifically, surveys were used to obtain information on product content and composition as well as usage data from automotive maintenance and repair (AMR) facilities statewide. Additionally, site visits were conducted to expand knowledge of AMR activities and how products are used in these activities. This section presents an analysis of the methodologies used to estimate Perc, MeCl, and TCE emissions and summarizes the findings.

A. Brake Cleaner and Perc-Containing Automotive Products (Manufacturer) Survey

In March 1997, the ARB surveyed manufacturers of brake cleaning products to gather sales and formulation data for both chlorinated and non-chlorinated brake cleaning products, as well as information on future formulation trends that could increase the Perc content of brake cleaning products and other automotive consumer products (MeCl and TCE information was not collected from this survey). Perc product sales in the Manufacturer Survey responses account for about 90 percent of total statewide Perc brake cleaning product sales based on the ARB's 1990 Consumer Products Survey (ARB, 1996a).

From the returned surveys (22 surveys out of 37), we received information on 89 different brake cleaning products, 33 of which contain Perc. Based on reported sales of over 2,000,000 units ranging in size from 10 ounces to 55 gallons and Perc content from about 22 to 98 percent, Perc usage was estimated to be approximately 2,400,000 pounds per year (lbs/yr) or 178,000 gallons per year (gal/yr) from Perc-containing brake cleaning products. This usage is extrapolated to 100 percent to capture total Perc brake cleaning product sales, and determine that 1996 Perc sales were approximately 2.7 million pounds. Two subsequent ARB consumer product surveys in 1996 and 1998 found approximately 2.7 and 3.0 million pounds of Perc from California brake cleaning product sales. Of this amount, data from the Manufacturer Survey indicated that approximately 290,000 pounds of Perc brake cleaning product sales (10 percent) are used in residential applications.

The amount of Perc from the Manufacturer Survey is more than the estimated California Perc use from brake cleaning products in the U.S. EPA 1990 Database (ARB's 2,700,000 lbs/yr versus U.S. EPA's 470,000 lbs/yr) (ARB,1996a). It is important to note that the estimate from the U.S. EPA 1990 Database may not be representative of California usage since it was based on a nationwide study. However, some of the difference may be attributed to the reformulation of brake cleaning products that contained 1,1,1-trichloroethane (TCA), which has been phased out under the Montreal Protocol. For comparison, 1991 Perc usage in dry cleaning operations was approximately 14,800,000 lbs/yr or 1,100,000 gal/yr (ARB, 1993a). Table V-1 summarizes the Manufacturer Survey data.

Table V-1. Summary of Manufacturer Survey Information

Product Type	**Number of Products**	**Product Size**		**Units Sold in California1**	
		Aerosol (oz)	**Liquid (gal)**	**Industrial/ Institutional**	**Retail/ Household**
Perc Products	33	10 to 22	1 to 55	1,883,604	254,009
Non-Perc Products	56	12 to 21	1 to 55	2,397,228	377,901

B. Automotive Service Facility Questionnaire (Facility Survey)

1. <u>Background</u>

As previously discussed, California brake cleaning product sales were extrapolated from the Manufacturer Survey responses to determine that brake cleaning products sold in 1996 contained almost 2.7 million pounds of Perc. In order to verify that this amount was used by automotive maintenance and repair facilities, a survey of automotive maintenance and repair facilities was conducted. This survey requested information on the number of facilities performing brake repair operations, the number of brake jobs performed, and the types and quantities of bulk liquid and aerosol products used.

The survey mailing list was based on information available from existing databases maintained by the California Department of Consumer Affairs, Bureau of Automotive Repair (BAR), the California Board of Equalization, and the United States Census Bureau. These databases showed that there were about 31,000 to 34,000 facilities in the automotive repair and car dealer standard industrial classification (SIC) codes in California as summarized in Table V-2. The BAR database appeared to be the most comprehensive, and identified facilities that, by their name, would most likely not perform brake services. For example, any facility with the words “body”, “paint”, “transmission”, etc. was removed. In January 1998, surveys were mailed to approximately 25,000 remaining automotive maintenance and repair facilities and 6,820 usable surveys were returned (725 were incomplete and were not considered). The number of usable surveys returned was sufficient to be considered representative and accurate for all facilities statewide (2.5% margin of error, 99% confidence level). A copy of the survey form can be found in Appendix B.

Table V-2. Number of Businesses by SIC Code

SIC	Business Type	Number of Facilities
551	new and used car dealers	2,400
552	used car dealers	6,700
554	gas stations, gas & convenience food stores, other gas & truck stops	9,600
7533-4, 7536-8	general auto repair, other auto repair, tire retread	12,800 to 14,800
7539	brake and related auto repair	

Sources: The California Board of Equalization and the 1992 U.S. Economic Census (http://govinfo.kerr.orst.edu/cgi-bin/econ-list?02-state.cas)

2. Summary of Findings

Analysis of the survey data allowed for the determination of the number of facilities performing brake jobs, the various techniques used, the number of facilities using chlorinated products, the amount of chlorinated products used, and market share by product type and manufacturer. In some cases, the Facility Survey results were compared to the Manufacturer Survey results in order to correct for any under-reporting that may have occurred. Since the Manufacturer Survey did not collect information regarding MeCl and TCE from the product manufacturers, no adjustments can be made for these two compounds. As a result, emissions of MeCl and TCE from the Facility Survey may be under-reported.

Table V-3 summarizes the techniques that automotive maintenance and repair facility operators reported used in conjunction with brake service and repair operations. Of the 4,865 facilities performing brake jobs, 3,561 facilities reported using brake cleaning products, 258 facilities reported using other products such as carburetor cleaners or general purpose degreasers, 409 facilities reported using nothing, and 2,151 facilities reported using a aqueous-based portable brake cleaning unit, generally in conjunction with other products. Based on the techniques used, Table V-4 summarizes the product formulations used in the Facility Survey. Of the 3,561 facilities that reported using brake cleaning products, the majority of the facilities (2,192 facilities or approximately 62 percent) reported using a non-chlorinated brake cleaning product. An additional 1,369 facilities reported using products that contained some combination of Perc, MeCl, and TCE. Table V-5 shows total aerosol and bulk product usage and estimated statewide usage.

Table V-3. Brake Cleaning Techniques Used in Facility Survey[1]

Cleaning Technique Used	Number of Facilities Using Technique
Brake cleaning products	3561
Portable brake cleaning unit (aqueous) used in conjunction with aerosols	1514
Portable brake cleaning unit used exclusively	637
Other automotive consumer products[2]	248
Other cleaning techniques	10
No technique reported[3]	409

1. A facility may use more than one cleaning technique.
2. Refers to carburetor cleaners, engine degreasers, and general purpose degreasers.
3. The survey did not request information on the use of solvent-based portable brake cleaning units. As a result, some facilities that reported using nothing may actually be using these units.

Table V-4. Product Formulations Used in Facility Survey

Product Formulation	Number of Facilities Using Product
Non-Chlorinated Products	2192
Chlorinated Products	1363[1]
Perc Products	836
Perc/MeCl Products	443
Perc/TCE Products	27
Perc/MeCl/TCE Products	44
Other Chlorinated Products[2]	13
Unknown Formulations	43

1. Note: Thirty-seven facilities used more than one type of chlorinated product.
2. Other chlorinated products include Perc/TCA, TCE, and TCA formulations.

The Facility Survey contained two fields that requested information on the number of brake jobs performed per week, and the amount of product used per brake job. The product of these two fields is total usage, allowing for verification of usage estimates. Performing this calculation yields 164,000 to 172,000 lbs/year. Although this is only 75 percent of the 218,000 to 228,600 lbs/year of aerosol use identified above, it is reasonable because some products are also used for non-brake applications (based on site visits, see Part C).

Table V-5. Aerosol and Bulk Product Usage for Surveyed Facilities[1]

Compound	Usage	Aerosol Use [lbs/yr]	Bulk Use [lbs/yr]	Statewide Use [lbs/yr[2]]
Perc	**Brake Use Only**	213,800 to 228,500	9,000 to 9,600	824,600 to 881,400
	Brake & Non-Brake Use	218,400 to 234,000	9,000 to 9,600	841,600 to 901,500
MeCl	**Brake Use Only**	23,100 to 33,100	900 to 1,000	88,900 to 126,500
	Brake & Non-Brake Use	24,200 to 34,800	900 to 1,000	92,900 to 132,800
TCE	**Brake Use Only**	2,800 to 7,200	300 to 400	11,700 to 27,900
	Brake & Non-Brake Use	2,900 to 7,700	300 to 400	11,900 to 30,000

1. Rounded to nearest hundred pounds
2. Range of use is due to the range of Perc contents reported in the Manufacturer Survey. Usage is multiplied by the ratio of the total number of facilities (25,243) to the number used in the survey (6820), i.e., 3.701.

Biases for four areas where potential under-reporting could take place were identified and quantified: (1) the percent of facilities using Perc, (2) the percent of Perc-based products, (3) the amount of Perc used per job, and (4) the number of jobs performed. Each of these evaluations is discussed separately below. Again, this analysis is only conducted for Perc.

a. Percent of facilities using Perc

From the survey, 3,561 facilities used Perc or non-chlorinated aerosol products. This accounts for 73 percent of the 4,865 facilities performing brake work. This is consistent with the industry-sponsored study by John Norton of the George Mason University School of Business Administration which showed that 77 percent of the respondents nationwide used aerosols (Norton, 1993). The Facility Survey indicates that about 37 percent of these facilities use Perc-based brake cleaning products (the Norton study did not request information on whether the aerosol cleaners were Perc or non-Perc cleaners). Additionally, the data showed that for facilities using brake cleaners, 37 percent of the brake jobs were performed using a Perc-based brake cleaner. Additionally, 40 percent of the facilities visited during the site visits used a Perc-based product. Therefore, it does not appear that the percent of facilities using Perc has been under-reported.

b. Percent of Perc-based products

The under-reporting of the percent of Perc-based products can be quantified in one of two ways: (1) by looking at the actual numerical distribution of the different product titles reported, or (2) by identifying the percent of units sold that contain Perc. Table V-6 summarizes the actual number of products and their relative percent and shows that the Facility Survey under-reports the percent of Perc-based products by about 14 percent compared with the Manufacturer Survey.

Table V-6. Proportion of Products that Contain Perc

	Facility Survey	Manufacturer Survey
Total Number of Products	183[1]	89
Number of Perc Products	58	33
Percent of Total	32	37

1. There were additional products with unknown formulations, but they were discounted because they only represent 1.6 percent of the total number of product entries.

Table V-7 presents the number of survey entries, where each entry represents a unit of product, while Table V-8 presents the total number of units sold. Comparing Table V-7 to Table V-8 it is apparent that the Facility Survey under-reports the proportion of survey entries that contain Perc, again by about 14 percent.

Table V-7. Proportion of Facility Survey Entries that Contain Perc

Total Number of Entries	3,622
Number of Perc Entries	1,366
Percent of Total	38

Table V-8. Proportion of Manufacturer Survey Entries that Contain Perc[1]

Total Units Sold	4,280,832
Perc Units Sold	1,883,604
Percent of Total	44

1. Units sold include bulk products. However, their numbers constitute less than 0.3 percent of the total.

This under-reporting is likely a result of the emphasis on Perc in the cover letter that accompanied the Facility Survey, and was observed during a few site visits to facilities that had previously submitted surveys. Correcting this bias requires adding 16 percent ([0.44 - 0.38]/0.38), to the range of product estimated earlier in Table V-5 to yield approximately 144,300 lbs/year. Additionally, if the 1.6 percent of products for which formulation data could not be obtained are assumed to be Perc-based products, then an additional 3,900 to 7,300 lbs/year can be added to the total Perc usage.

c. Number of cans used

As previously discussed, reported usage was verified by calculating the product of the number of brake jobs per week and the quantity of solvent used per brake job. For some facilities, this calculated usage was higher than the reported usage indicating that some facilities could be under-reporting their true usage. In many cases, this means that product was most likely used for other tasks besides brake service and repair. Extrapolating statewide yields an additional 127,000 to 137,000 pounds per year Perc that could be included in the total Perc usage.

d. Number of Brake Jobs

There is a potential for an across the board under-reporting of the number of brake jobs performed which can be approximated by applying the normal brake service frequency to the number of vehicles registered in California. According to the 1996 ARB Mobile Source Emissions Inventory database, there are approximately 24 million vehicles registered in California. Information from the Brake Manufacturer's Council indicates that light duty cars and trucks, which account for 88 percent of the registered vehicles (ARB, 1998), typically have their brakes serviced every 3.5 years (Brake Pad Partnership Steering Committee, 1999). Providing that fleets and the remaining 12 percent of vehicles (medium and heavy duty trucks and buses) may require more frequent servicing, the average brake service frequency is approximately once every 3 years. The result is 8,067,000 brake jobs per year or 2,747,000 more brake jobs than represented by the extrapolated Facility Survey result of 5,320,000 brake jobs per year. Assuming, based on the Facility Survey, that 73 percent of these additional brake jobs are performed using a cleaning product, that 37 percent of these are Perc, and that each Perc brake job requires approximately 14.4 ounces of product, an additional 668,000 pounds of Perc per year could be included in the total Perc usage.

e. Total usage

Adding each of the biases evaluated above to the baseline usage of 901,500 pounds per year (from Table V-5) gives 1,858,100 pounds per year as shown in Table V-9.

Table V-9. Total Perc Usage

Baseline Usage	Pounds per Year
ARB baseline estimate - brake cleaning products (max.)	901,500
Adjustments	
Potential under-reporting of Perc-based products used	144,300
Potential under-reporting of products with no formulation data	7,300
Potential under-reporting of the amount of Perc used per job	137,000
Potential under-reporting of the number of brake jobs performed	668,000
Total	1,858,100

The Facility Survey accounts for almost 1.9 million pounds of Perc used per year. Considering the residential usage of approximately 290,000 pounds as discussed in Part A, total Perc usage is almost 2.2 million pounds per year. This is approximately 200,000 pounds less than the amount of Perc brake cleaning product reported sold in the State in the Manufacturer Survey. However, it is about a 750,000 pounds more than the 1.45 million pounds of Perc per year estimated from the amount of Perc that would be used on 24 million vehicles being serviced every 3 years (using Perc for 20 percent of all brake jobs, and 14.4 ounces per job). Therefore, the assignment of these biases is reasonable and appropriate.

Facilities that service and repair brakes do not account for the full amount of brake cleaner sold in California. The additional brake cleaner is potentially being used in three additional areas: (1) facilities that were not sent a facility survey; (2) larger residential usage than previously estimated; and, (3) emissions from the more difficult to quantify off-road, marine, and aviation categories.

C. Brake/Automotive Repair Shop Survey (Site Visits)

In an effort to increase understanding of AMR activities as related to the use of automotive consumer products, ARB staff conducted site visits to 137 AMR facilities across the state (21 additional visits were conducted to observe aqueous-based brake cleaning equipment and to evaluate flammability issues). The areas visited included Sacramento, San Diego, the Los Angeles area, the San Francisco Bay Area, and the North State area. Facilities in Foothill and Sierra Nevada communities were also visited. During the site visits, process and source characteristic information was collected so that modeling could be performed to estimate the potential health impacts associated with Perc, MeCl, and TCE emissions from the use of automotive consumer products. Information collected included building dimensions, the location of potential residential and off-site worker receptors, and product usage information. The site visits were also an opportunity to talk with shop owners and service technicians about their experiences using chlorinated and non-chlorinated aerosol and liquid products and portable brake cleaning units. The site visits focused primarily on brake cleaning product usage that occurred in conjunction with brake service and repair operations.

1. Product Usage

Of the 137 facilities, 55 were using a chlorinated product, most of which were Perc-based. Overall, the majority of facilities were using non-chlorinated products.   Table V-10 summarizes the types of aerosol and liquid products used to do brake work at the site visit facilities.

Many facilities indicated that they felt that chlorinated and non-chlorinated products performed similarly, although a few mechanics indicated definite preferences. A large motivating factor in determining which product was purchased by the facility at any particular time was cost. When replenishing their supply of aerosol brake cleaners, facilities typically asked their suppliers to send the least expensive product. Depending on pricing at the time, this could be either a chlorinated or non-chlorinated product. Furthermore, due to mechanic preferences, some facilities maintained stocks of both chlorinated and non-chlorinated products.

Table V-10. Product Formulations Used in Site Visit Facilities

Product Formulation[1,2]	Number of Facilities Using Product	Product Size	
		Aerosol (oz)	Liquid (gal)
Non-Chlorinated Products	82	5 to 19	1 to 55
Chlorinated Products	55	17 to 25	1
Perc Products	43	19 to 20	1
Perc/MeCl Products	10	17 to 25	none observed
Perc/TCE Products	2	18 to 24	none observed

1. The site visits did not reveal any products the were comprised of either MeCl or TCE as the sole chlorinated component or any multicomponent products consisting of Perc, MeCl, and TCE. This does not indicate that these product formulations do not exist.
2. A product is considered chlorinated if it contains Perc, MeCl, or TCE.

Liquid products are not necessarily convenient to use in the gallon-sized containers they typically come in. As a result, most facilities converted these into aerosol form or into pump sprayers for easier use. The use of portable brake cleaning units (both aqueous and solvent-based) was also prevalent during the site visits. As discussed in Chapter IV, these units can be used either independently or in conjunction with aerosol products. However, a facility that uses both aerosol brake cleaning products and portable brake cleaning units may not necessarily use these products in tandem. One mechanic may prefer to use the aerosol exclusively and another at the same facility may prefer to use the portable unit exclusively. This mode of use between the two products was the most common observed. The data showed that 78 of the 137 facilities were using a portable brake cleaning unit. Table V-11 summarizes site visit observations of whether portable brake cleaning units were used in conjunction with other products.

Table V-11. Use of Portable Brake Cleaning Units in Site Visit Facilities

Portable Brake Cleaning Unit Usage	Number of Facilities
Used in conjunction with aerosols	69
Used exclusively	9
Total:	78

Portable brake cleaning units gained their popularity as a means to satisfy the asbestos brake dust control regulations. However, many facilities indicated that they also used these units on non-asbestos brakes because they discovered that they worked equally well in controlling brake dust from non-asbestos brakes. Additionally, many shops reported cost savings associated with the use of these units, even after taking into consideration the cost of having the spent baths changed or replaced. In fact, some shops encouraged their technicians to minimize their use of aerosol products in favor of the portable units.

Most of the shops that were visited did not have pre-established guidelines outlining how much aerosol product was to be used. Instead, these facilities relied upon what the mechanic felt was an appropriate amount to complete the task. Additionally, some facilities also reported using brake cleaning products for small parts cleaning and degreasing on a limited basis. A common complaint, however, was that some mechanics would use an excessive amount of aerosol product and that it was difficult for the owner or shop foreman to control this usage; even if pre-established usage criteria was in place. Many facilities felt that the use of portable brake cleaning units minimized these problems and reduced operating costs.

When using liquid-based cleaning methods such as portable brake cleaners, drying time is a reasonable concern. However, most of the 78 facilities that were using these units indicated that drying time was not an issue. According to the mechanics, since brake jobs are typically performed on a per axle basis, the brake assembly on one end has ample time to dry while the other is being serviced. By the time the tires are re-installed, both assemblies have had ample drying time. None of the facilities visited reported any problems, safety concerns, or customer complaints associated with the use of portable brake cleaning units or other liquid cleaning methods.

In addition to aerosols, liquid products, and portable brake cleaning units, other cleaning methods observed included soap and water and brushing. These methods were used at only a few of the facilities visited.

2. Source Characteristics

Source characteristic information was needed to estimate potential health impacts and assist in the development of the generic facilities (discussed in Chapter VI and Appendix D). The information collected here includes the number of brake jobs performed at each facility and the physical dimensions of the service area. The number of brake jobs came directly from the facility owners and shop foremen. When obtaining the physical dimensions, only the portion of the facility building where service work was performed (and hence from where any potential emissions would be emanating) was measured. Other areas of the facility, such as the customer waiting area and adjacent storage rooms, were not considered if they were separated by a normally closed door. If the door was normally open, then those areas were considered as part of the area from which emissions would occur. Table V-12 summarizes the average number of brake jobs and building dimensions (in terms of facility volume) for the site visit facilities. A more detailed compilation of source characteristic information for each facility is presented in Appendix D.

Table V-12. Summary of Source Characteristics

Average Number of Brake Jobs [jobs/year]	Total Number of Brake Jobs [jobs/year]	Average Facility Volume [m^3]	Range of Facility Volumes [m^3]
936	111,956	3,769	206 to 70,679

3. Receptor Locations

Another piece of information collected during the site visits was the location of the nearest residential and off-site worker receptors. The data shows that many receptors tended to be located 50 to 100 meters away from the facility; however, there were a significant number of receptors located less than 30 meters away. Table V-13 summarizes the number of facilities that had receptors located less than 20, 30, 50, and 100 meters away from the facility.

Table V-13. Number of Site Visit Facilities with Receptors at Various Distances[1]

Receptors Less than 20 meters		Receptors Less than 30 meters		Receptors Less than 50 meters		Receptors Less than 100 meters	
Resident	Worker	Resident	Worker	Resident	Worker	Resident	Worker
17	45	33	65	48	84	68	103

1. Receptor distances measured from edge of the facility building.

The facilities with either a residential or off-site worker receptor located nearby tended to be smaller facilities. Larger facilities, which include dealerships and fleets, usually had a buffer created by a large site footprint surrounding the building that housed the service operations. As a result, this limited the proximity of receptors to these facilities. With the smaller facilities, the nearest off-site receptor could be much closer. For all 137 facilities, residential receptor distances ranged from 5 meters to 3219 meters (approx. 2 miles) and off-site worker receptor distances ranged from 2 meters to 483 meters. At the 54 facilities that were modeled, residential receptor distances ranged from 6 meters to 2414 meters (approx. 1.5 miles) and off-site worker receptor distances ranged from 3 meters to 483 meters. See Table VI-2 and Appendix D for more information on modeling results.

4. Emissions from Site Visits

The majority of the information collected during the site visits focused primarily on brake service and repair activities. As a result, emissions estimates (as well as potential health impacts) are based primarily on the number of brake jobs performed. Other activities occurring at the facility impact emissions to the extent that any product used on those activities is also used to perform brake work. This impact is included because ARB staff quantified the total usage of the product used to do brake work, even if it was used to complete other tasks. Therefore, emissions and health impacts are associated with overall product usage rather than just brake service and repair activities.

In quantifying Perc, MeCl, and TCE emissions from automotive consumer products, ARB staff looked at various studies, including those by the ARB, U.S. EPA, and John Norton of George Mason University (Norton, 1993), and could not find sufficient information representative of California automotive maintenance and repair facilities. Therefore, to estimate emissions from individual automotive maintenance and repair facilities, information from the 137 site visits was used to estimate these emissions.

Information was also collected from the California Board of Equalization, the California Department of Consumer Affairs' Bureau of Automotive Repair, and the United States Economic Census to estimate that there are about 31,000 to 34,000 AMR facilities in California (BOE, 1997a; BOE, 1997b; BAR, 1997; U.S. Economic Census, 1992). Based on the standard industrial classification (SIC) breakdown within the United States Economic Census, approximately 21,000 of these facilities may perform brake services in California. These facilities can be grouped into five categories: service stations, fleets, new and used car dealerships, brake shops, and general automotive repair facilities. Table V-14 gives a description of each facility category.

Table V-14. Description of Automotive Maintenance and Repair Facility Categories

Facility Category	Category Description
Service Stations	Offer automotive repair services where gasoline and other fuels can be purchased. These facilities repair mainly passenger and light-duty vehicles.
Fleets	Governmental agencies and private companies operate fleets of vehicles ranging from passenger cars to heavy-duty trucks and buses. Fleet centers typically encompass a large area, which limits how close offsite receptors can be located.
New and Used Car Dealerships (Dealerships)	Many new and used car dealerships offer a complete range of brake repair services in addition to other automotive repair services. Their services are not limited to customers who purchased a vehicle from them.
Brake shops	Some shops limit their services to brake service and repair activities. In many cases, however, additional repair services are often available.
General Automotive Repair	Includes independently-owned shops, franchises, chain shops, tire replacement and repair shops, and passenger car and truck rental and leasing.

The site visit data indicated that the quantity of Perc, MeCl, and TCE that is emitted per brake job varies with several factors. These factors include the individual mechanic who is servicing the vehicle, the chlorinated content in the product, and the manner in which the product is used. Emissions are also impacted by the size and operating schedule of the facility. Furthermore, the aerosol spray cans that contain the products come in several sizes with the chlorinated content ranging from 20 percent to 99 percent according to manufacturers' material safety data sheets. As a result, the emission estimates summarized in Tables V-15 and V-16 reflect the variability in Perc, MeCl, and TCE content in brake cleaning products and the use of chlorinated brake cleaning products on small parts cleaning, degreasing, and other activities. Based on observations during site visits, up to 100 percent of the Perc, MeCl, and TCE contained in aerosol products may be emitted to the air when used in these activities.

Table V-15. Emission Estimates from Site Visits by Facility Category[1]

Facility Category	Number of Facilities Visited	Range of Annual Perc Emissions [pounds/year]	Range of Annual MeCl Emissions [pounds/year][2]	Range of Annual TCE Emissions [pounds/year][2]
Service Stations	12	20 to 214	0	0
Fleets	6	18 to 1,305	0	0
New and Used Car Dealerships	24	41 to 1,525	0	0
Brake Shops	6	58 to 152	0	0
General Automotive	89	1.6 to 2,091	1.8 to 82	39 to 196

1. Based on usage of brake cleaning products. Emissions based on usage from all four automotive consumer product categories may be higher.
2. MeCl or TCE in brake cleaning products were not observed in use at service stations, fleets, dealerships, or brake shops. Since we didn't specifically look for MeCl and TCE, this does not indicate that emissions of these pollutants do not occur at these facility categories.

Table V-16. Total Emissions of Perc, MeCl, and TCE Estimated from Site Visits

Total Perc Emissions[1] [pounds/year]	Total MeCl Emissions [pounds/year]	Total TCE Emissions [pounds/year]
14,886 to 20,066	125	235

1. Some facilities use a Perc-containing brake cleaning product which shows a Perc content range on the Material Safety Data Sheet; therefore, a range is presented for Perc emissions.

D. Summary of Emissions

Emissions of Perc, MeCl, and TCE from the Facility Survey and site visits are presented in Table V-5 and Table V-16 based on facilities that service and repair brakes and use brake cleaning products. The Facility Survey also contains information on emissions from all four automotive consumer product categories under consideration. Table V-17 summarizes the total emissions from all four automotive consumer product categories at all facilities surveyed by the Facility Survey.

Table V-17. Estimated Maximum Emissions from the Facility Survey

Compound	Emissions [lbs/yr]
Perc	1,858,100
MeCl	224,400
TCE	37,000

The 1997 Consumer and Commercial Products (consumer product) Survey collected sales data from the four automotive consumer product categories. This survey shows emissions of Perc, MeCl, and TCE greater than what is represented by the Facility Survey. As mentioned in Part B, this difference can be attributed to: (1) facilities that were not sent a facility survey; (2) larger residential usage than previously estimated; and, (3) emissions from the more difficult to quantify off-road, marine, and aviation categories. Since the consumer product survey represents a more complete picture of total compound emissions, it used to make the final emission estimates. Table V-18 summarizes the estimated statewide emissions of Perc, MeCl, and TCE from the four automotive consumer product categories.

Table V-18. Statewide Emission Estimates from Automotive Consumer Products[1]

Compound	Emissions [tons/day]
Perc	4.2
MeCl	0.7
TCE	0.3
Total	5.2

1. Source: 1997 Consumer and Commercial Products Survey.

VI. POTENTIAL HEALTH IMPACTS OF PERCHLOROETHYLENE, METHYLENE CHLORIDE, AND TRICHLOROETHYLENE FROM AUTOMOTIVE MAINTENANCE AND REPAIR ACTIVITIES

A. An Overview of Health Risk Assessment

A health risk assessment (HRA) is an evaluation or report that a risk assessor (e.g., Air Resources Board, district, consultant, or facility operator) develops to describe the potential a person or population may have of developing adverse health effects from exposure to a facility's emissions. Some health effects that are evaluated could include cancer, developmental effects, or respiratory illness. The pathways that can be included in an HRA depend on the toxic air pollutants that a person (receptor) may be exposed to, and can include breathing, the ingestion of soil, water, crops, fish, meat, milk, and eggs, and dermal exposure. For this HRA, we are evaluating the impacts for Perc, MeCl, and TCE via the breathing or inhalation pathway only. We are not evaluating other pathways of exposure because at this time the Office of Environmental Health Hazard Assessment (OEHHA) does not routinely use methods for assessing exposure to volatile compounds such as Perc, MeCl, and TCE by exposure routes other than inhalation. Such multiple exposure pathway (multipathway) assessments are traditionally used for lipophilic (fat-loving), semivolatile, or low volatility compounds such as dioxins, polycyclic aromatic hydrocarbons (PAHs), or polychlorinated biphenyls (PCBs).

Generally, to develop an HRA, the risk assessor would perform or consider information developed under the following four steps. The four steps are Hazard Identification, Dose-Response Assessment, Exposure Assessment, and Risk Characterization.

1. Hazard Identification

In the first step, the risk assessor would determine if a hazard exists, and if so, would identify the exact pollutant(s) of concern and the type of effect, such as cancer or respiratory effects.

For this assessment, the pollutants of concern (Perc, MeCl, and TCE) have been formally identified under the AB 1807 Program as toxic air contaminants (TACs) through an open, regulatory process by the ARB (ARB 1991a; ARB 1989; ARB 1990a). In addition, Perc, MeCl, and TCE are hazardous air pollutants under the Federal Clean Air Act (42 U.S.C. 7412).

2. Dose-Response Assessment

In this step of risk assessment, the assessor would characterize the relationship between a person's exposure to a pollutant and the incidence or occurrence of an adverse health effect.

This step of the HRA is performed for the ARB by OEHHA. OEHHA supplies these dose-response relationships in the form of cancer potency factors or unit risk factors (URFs) for carcinogenic effects and reference exposure levels (RELs) for non-carcinogenic effects. The URFs and RELs that are used in California can be found in one of three references: (1) The California Air Pollution Control Officer's Association (CAPCOA) Air Toxics "Hot Spots" Program, Risk Assessment Guidelines, October 1993; (2) The OEHHA Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part I, The Determination of Acute RELs for Airborne Toxicants, March 1999; and (3) The OEHHA Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part II, Technical Support Document for Describing Available Cancer Potency Factors, April 1999. The individual URFs and RELs for Perc, MeCl, and TCE that we are using for this HRA are presented in Section B, Part 2.

3. Exposure Assessment

In this step of the risk assessment, the risk assessor estimates the extent of public exposure by looking at who is likely to be exposed, how exposure will occur (e.g., inhalation and ingestion), and the magnitude of exposure.

For automotive maintenance and repair (AMR) activities, the receptors that are likely to be exposed include residents or off-site workers located near the facility. Onsite workers certainly could also be impacted by the emissions; however, they are not included in this HRA because Cal/OSHA has jurisdiction over on-site workers. More discussion on workplace exposure can be found in Chapter VIII. Exposure was evaluated for Perc, MeCl, and TCE via the breathing or inhalation pathway only. The magnitude of exposure was assessed through the following process. Emissions were quantified using emission factors determined from site visits, facility, and manufacturer surveys, and input from industry representatives. During the site visits, other information such as physical dimensions of the source and receptor locations were obtained. Computer air dispersion modeling was used to provide downwind ground-level concentrations of the TACs at near-source, residential, and off-site worker locations.

4. Risk Characterization

This is the final step of risk assessment. In this step, the risk assessor combines information derived from the previous steps. Modeled concentrations, which are determined through exposure assessment, are combined with the URFs (for cancer risk) and RELs (for non-cancer effects) determined under the dose-response assessment. This step integrates this information to quantify the potential cancer risk and non-cancer health impacts.

B. The Tools Used for this Risk Assessment

The tools and information that are used to estimate the potential health impacts from a facility include an air dispersion model and pollutant-specific health effects values. Information required for the air dispersion model includes emission estimates, physical descriptions of the source, and emission release parameters. Combining the output from the air dispersion model and the pollutant-specific health values provides an estimate of the off-site potential cancer and non-cancer health impacts from the emissions of a toxic air contaminant. For this assessment, we are estimating the potential health impacts from Perc, MeCl, and TCE emitted during AMR activities. A brief description of the air dispersion modeling and pollutant-specific health effects values is provided in this Chapter. A more detailed discussion, including example calculations for determining individual acute and chronic health impacts and both individual, regional, and statewide cancer risk is presented in Appendix C. Memorandums regarding modeling results can be found in Appendices D and E.

1. Air Dispersion Modeling

Air dispersion models are used to estimate the downwind, ground-level concentrations of a pollutant after it is emitted from a facility. The downwind concentration is a function of the quantity of emissions, release parameters at the source, and appropriate meteorological conditions. The two models that were used during this HRA are SCREEN3, version 96043, and ISCST3, version 97363. Appendix D provides additional details on the modeling results. Appendix C provides an example calculation illustrating how the outputs from these models are used to calculate potential health impacts. The U.S. EPA recommends the SCREEN3 model for first order screening calculations and ISCST3 model for refined air dispersion modeling (U.S. EPA, 1995a; U.S. EPA, 1995b). Both models are currently used by the ARB, districts, and other states.

2. Pollutant-Specific Health Effects Values

Dose-response or pollutant-specific health effects values are developed to characterize the relationship between a person's exposure to a pollutant and the incidence or occurrence of an adverse health effect. A unit risk factor (URF) or cancer potency factor is used when estimating potential cancer risks and reference exposure levels (RELs) are used to assess potential non-cancer health impacts.

As presented in Chapter VI, Section C, exposure to Perc, MeCl, and TCE may result in both cancer and non-cancer health effects. The inhalation URFs and non-cancer acute and chronic RELs that are used for this HRA are listed in Table VI-1. Also included in Table VI-1 are the non-cancer acute and chronic toxicological endpoints for Perc, MeCl, and TCE. During this assessment, new acute RELs were adopted by OEHHA for Perc and MeCl. Table VI-1 reflects the most current OEHHA-adopted health effects values for these compounds. The acute impacts presented in the June 1997 Status Report or Needs Assessment (ARB, 1997a) used the previous acute REL for Perc. In that report, the acute non-cancer results were all reported to be less than a hazard index of 1.0. Generally, hazard indices of less than 1.0 are not considered to be a concern to public health. A hazard index is the ratio of the modeled concentration for a toxic pollutant and the reference exposure level for that pollutant. Since the current acute Perc REL is 2.94 times higher than the previous REL and it is used as a denominator in non-cancer hazard index calculations, the net result of the current REL, if it were applied to the results presented in the 1997 Needs Assessment, would show a decrease in the acute hazard indices by a factor of 2.94. Currently, OEHHA is in the process of reviewing studies for developing new or updating existing chronic RELs. MeCl and TCE are among the compounds under review. Once the chronic RELs are adopted by OEHHA, they may be used in HRAs.

Table VI-1. Pollutant-Specific Health Effects Values Used for Determining Potential Health Impacts [1]

Compound	Cancer Unit Risk Factor $(ug/m3)^{-1}$	Non-cancer Reference Exposure Levels (ug/m3)		Toxicological Endpoints	
		Acute	Chronic	Acute	Chronic
Perchloroethylene (Perc)	5.9 E-6	20,000	35	central nervous system; eye & respiratory irritation	kidney; liver and gastrointestinal system
Methylene Chloride (MeCl)	1.0 E-6	14,000	3000	central nervous system	central or peripheral nervous system; liver and gastrointestinal system
Trichloroethylene (TCE)	2.0 E-6	none	640	none	central or peripheral nervous system; liver and gastrointestinal system

1. Health effects values and toxicological endpoints were obtained from three sources:
   A) California Air Pollution Control Officer's Association, Air Toxics Hot Spots Program, Revised 1992 Risk Assessment Guidelines, October 1993.
   B) Office of Environmental Health Hazard Assessment, Air Toxic Hot Spots Program Risk Assessment Guidelines, Part II, Technical Support Document for Describing Available Cancer Potency Factors, April 1999.
   C) Office of Environmental Health Hazard Assessment, Air Toxic Hot Spots Program Risk Assessment Guidelines, Part I, The Determination of Acute Reference Exposure Levels for Airborne Toxicants.

A URF is defined as the estimated upper-confidence limit (usually 95%) probability of a person contracting cancer as a result of constant exposure to a concentration of $1 \mu g/m^3$ over a 70-year lifetime. In other words, using the URF for Perc as an example, which is 5.9×10^{-6} (microgram per cubic meter)$^{-1}$ or $(\mu g/m^3)^{-1}$, the potential excess cancer risk for a person continuously exposed over a 70-year lifetime to $1 \mu g/m^3$ of Perc is estimated to be no greater than 5.9 chances in 1 million (OEHHA, 1999b).

An REL is used as an indicator of potential non-cancer adverse health effects. An REL is defined as a concentration level at or below which no adverse health effects are anticipated. Reference Exposure Levels are designed to protect most sensitive individuals in the population by including safety factors in their development and can be created for both acute and chronic exposures. An acute exposure is defined as one or a series of short-term exposures generally lasting less than 24 hours. Consistent with risk guidelines, a 1-hour exposure is used to determine acute non-cancer impacts (CAPCOA, 1993). Chronic exposure is defined as long-term exposure usually lasting from one year to a lifetime.

C. Potential Health Effects of Perchloroethylene, Methylene Chloride, and Trichloroethylene

This section summarizes the cancer and non-cancer impacts that can result from exposure to Perc, MeCl, and TCE.

1. Perchloroethylene

Exposure to Perc may result in both cancer and non-cancer health effects. The probable route of human exposure to Perc is inhalation (ARB, 1997b).

a. Cancer

The OEHHA staff has performed an extensive assessment of the potential health effects of Perc, reviewing available carcinogenicity data. OEHHA concluded that Perc is a potential human carcinogen with no identifiable threshold below which no carcinogenic effects are likely to occur. The Board formally identified Perc as a toxic air contaminant (TAC) in October 1991 (ARB, 1991a). The State of California under Proposition 65 listed Perc as a carcinogen in April 1988 (OEHHA, 1999c). Table VI-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

In 1990, the U.S. Congress listed Perc as a hazardous air pollutant (HAP) in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). The U.S. EPA has classified Perc in Group B2/C, as a probable human carcinogen, on the basis of sufficient evidence for carcinogenicity in animals and inadequate evidence in humans. The International Agency for Research on Cancer (IARC) has classified Perc in Group 2A, as a probable human carcinogen, based on sufficient evidence in animals and limited evidence in humans (ARB, 1997b).

Epidemiological studies have provided some indication that the use of dry cleaning solvents, primarily Perc, poses an increased risk of cancer for exposed workers. However, investigators were unable to differentiate among exposures to various solvents, and other possible confounding factors, like smoking, were not evaluated. Perc increased the incidence of hepatocellular tumors in laboratory mice after oral and inhalation exposure and mononuclear cell leukemia and kidney tumors in rats after inhalation (ARB, 1997b).

b. Non-Cancer

Short-term (acute) and long-term (chronic) exposure to Perc may result in non-cancer health effects. Acute toxic health effects resulting from short term exposure to high levels of Perc may include headaches, dizziness, rapid heartbeat, and irritation or burns on the skin, eyes, or respiratory tract. Massive acute doses can induce central nervous system depression resulting in respiratory failure. Chronic exposure to lower Perc concentration levels may result in dizziness, impaired judgement and perception, and damage to the liver and kidneys (ARB, 1996b). Workers have shown signs of liver toxicity following chronic exposure to Perc, as well as kidney dysfunction and neurological effects. Effects on the liver, kidney, and central nervous systems from chronic inhalation exposure to Perc have been reported in animal studies (ARB, 1997b).

In addition to CAPCOA and OEHHA listing Perc as having acute and chronic non-cancer RELs (CAPCOA, 1993; OEHHA, 1999a), the U.S.EPA established an oral Reference Dose (RfD) for Perc of 0.01 milligrams per kilogram per day based on hepatotoxicity in mice and weight gain in rats. The U.S. EPA has not established a Reference Concentration (RfC) for Perc (ARB, 1997b). Table VI-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

Epidemiological studies of women working in the dry cleaning industry showed some adverse reproductive effects, such as menstrual disorders and spontaneous abortions, but study design prevented significant conclusions. Women exposed to drinking water contaminated with solvents including Perc, showed some evidence of birth defects. Inhalation exposure of pregnant rodents to 300 parts per million Perc produced maternal toxicity and fetotoxicity manifested as developmental delays and altered performance in behavioral tests in the offspring of exposed mice and rats. However, Perc is not considered to be a teratogen (ARB, 1997b).

2. Methylene Chloride

Exposure to MeCl (also known as dichloromethane) may result in both cancer and non-cancer health effects. The probable route of human exposure to MeCl is inhalation (ARB, 1997b).

a. Cancer

The OEHHA staff has performed an extensive assessment of the potential health effects of MeCl, reviewing available carcinogenicity data. The OEHHA staff agreed with U.S. EPA and IARC that MeCl is either a possible or probable human carcinogen with no identifiable threshold below which no carcinogenic effects are likely to occur. The Board formally identified MeCl as a toxic air contaminant (TAC) in July 1989 (ARB, 1989). The State of California under Proposition 65 listed MeCl as a carcinogen in April 1988 (OEHHA, 1999c). Table VI-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

In 1990, the U.S. Congress listed MeCl as a HAP in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). The U.S. EPA has classified MeCl in Group B2, as a probable human carcinogen. The IARC has classified MeCl in Group 2B, as a possible human carcinogen (ARB, 1997b).

b. Non-Cancer

Short-term (acute) and long-term (chronic) exposure to MeCl may result in non-cancer health effects. MeCl vapor is irritating to the eyes, respiratory tract, and skin. It is also a central nervous system depressant including decreased visual and auditory functions and may cause headache, nausea, and vomiting. Acute toxic health effects resulting from short term exposure to high levels of MeCl may include pulmonary edema, cardiac arrhythmias, and loss of consciousness. Chronic exposure can lead to bone marrow, hepatic, and renal toxicity. MeCl is metabolized by the liver with resultant carboxyhemoglobin formation (ARB, 1997b).

In addition to CAPCOA and OEHHA listing MeCl as having acute and chronic non-cancer RELs (CAPCOA, 1993; OEHHA 1999a), the U.S.EPA established an oral Reference Dose (RfD) for MeCl of 0.06 milligrams per kilogram per day based on liver toxicity in rats, and is currently reviewing a Reference Concentration (RfC) (ARB, 1997b). Table VI-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

No information on adverse reproductive effects in humans from inhalation or oral exposure has been found, but fetotoxicity was observed in pregnant rodents exposed by inhalation to high concentrations of MeCl throughout pregnancy as evidenced by reduced fetal body weight and reduced skeletal ossification (ARB, 1997b).

3. Trichloroethylene

Exposure to Trichloroethylene (TCE) may result in both cancer and non-cancer health effects. The probable routes of human exposure to TCE are inhalation and ingestion (ARB, 1997b).

a. <u>Cancer</u>

The OEHHA staff has performed an extensive assessment of the potential health effects of TCE, reviewing available carcinogenicity data. The OEHHA staff agrees with U.S. EPA and IARC that TCE is a probable human carcinogen with no identifiable threshold below which no carcinogenic effects are likely to occur. The Board formally identified TCE as a toxic air contaminant (TAC) in October 1990 (ARB, 1990a). The State of California under Proposition 65 listed TCE as a carcinogen in April, 1988 (OEHHA, 1999c). Table VI-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

In 1990, the U.S. EPA listed TCE as a HAP pursuant to subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). The U.S. EPA has classified TCE in Group B2/C, as a probable human carcinogen. The International Agency for Research on Cancer classified TCE in Group 2A, as a probable human carcinogen, based on sufficient evidence in animals and limited evidence in humans (ARB, 1997b).

The U.S. EPA considers the epidemiologic data on TCE carcinogenicity in humans to be inconclusive. Increases in testicular cancer have been reported in inhalation studies in animals. Carcinogenic responses to TCE inhalation studies in animals are increased incidences of hepatocellular carcinoma and adenoma in male mice; lung adenocarcinomas and malignant lymphomas in female mice; malignant liver tumors in B6C3F1 mice; and renal tumors in rats (ARB, 1997b).

b. <u>Non-Cancer</u>

Short-term (acute) and long-term (chronic) exposure to TCE may result in non-cancer health effects. TCE is a central nervous system depressant and has been used as an anesthetic. It is mildly irritating to the eyes and respiratory tract. Occupational exposure to TCE has resulted in nausea, headache, loss of appetite, weakness, dizziness, ataxia, and tremors. Acute exposures to high concentrations has caused irreversible cardiac arrhythmias, nerve and liver damage and death. Chronic exposure to TCE has also been shown to cause respiratory irritation, renal toxicity, and immune system depression. Alcohol consumption in humans increases the toxicity of TCE and causes "degreaser's flush", which are red blotches on the skin (ARB, 1997b).

A chronic non-cancer REL is listed in the California Air Pollution Control Officers Association (CAPCOA), Revised 1992, Risk Assessment Guidelines, October 1993. Table VI-1 presents the current health effects values that are used in this HRA for determining the potential health impacts. The U.S. EPA currently is reviewing the Reference Concentration (RfC) and the oral Reference Dose (RfD) for TCE (ARB, 1997b).

There is inadequate information to determine whether TCE causes reproductive toxicity in humans. One study reported increased miscarriages in nurses exposed to TCE as well as other anesthetics. An association was found between elevated levels of contaminants, including TCE, in drinking water and congenital heart disease in children. Other studies have not reported adverse reproductive effects in humans exposed to TCE in drinking water. In animal studies, an increase in abnormal sperm morphology in mice exposed by inhalation was reported. Exposure of rats and mice to TCE by inhalation causes a significant delay in fetal maturation and an increase in embryotoxicity (ARB, 1997b).

D. Factors that Affect the Outcome of a Health Risk Assessment at Automotive Maintenance and Repair Facilities

Factors that affect the outcome of potential health impacts at AMR facilities from the use of aerosol and liquid products that contain some combination of Perc, MeCl, or TCE include: (1) the concentration of Perc, MeCl, or TCE in the product(s) used; (2) the facility operating schedule; (3) product use; (4) the physical dimensions of the facility; and (5) local meteorology. The combinations of these factors will ultimately determine the potential impact. Due to the variability of these factors, the potential health impacts can also vary. For example, if only the Perc-content were to increase, and all other factors were held constant, the resulting potential health impacts would also increase. Ultimately, each scenario of interest must be independently analyzed to determine the impacts of the individual factors.

To provide perspective for some of the factors that can affect the HRA results, a discussion looking at the variability of meteorological data sets on specific and generic facilities, the brake job frequency, and building orientation at the generic facilities is provided here for your information. Variability arises from differences in the characteristics of facilities, or inputs used in the models, such as the period of meteorological data, or differences in brake job frequencies week to week. In short, variability can be thought of as the natural variation in conditions or parameters. We are also including a qualitative discussion of the uncertainties in the HRA process. Uncertainty is defined as a lack of knowledge about factors that impact risk where uncertainty may be reduced by further study (U.S. EPA, 1995c). In short, uncertainty can be thought of as the level of confidence in estimating a particular condition or parameter. Variability and uncertainty can be interrelated in the HRA process.

Meteorological conditions can be a source of variability in an HRA. Annual average, model-estimated concentrations from representative off-site meteorological data were used to determine the potential cancer risk and non-cancer hazard indices for 13 specific and three generic facilities using ISCST3. Maximum-hourly concentrations were used to determine the non-cancer acute hazard indices. The methods used to obtain these concentration are consistent with current risk assessment guidance (CAPCOA, 1993). The modeling analyses are discussed in Appendix D and example calculations using this information are in Appendix C.

If source-specific operating conditions are held constant, changes in the meteorology will drive any changes in the health impact estimates. That is, because meteorology conditions vary from hour-to-hour and year-to-year, so too will the health impact estimates. In addition, meteorological conditions will vary depending upon which region of the state a facility is located. The meteorology data sets used in this HRA represent collection periods of as long as six years and are representative of 10 different regions.

Another situation where variability is present in the HRA is the number of brake jobs performed per week. If all other variables remain constant, the potential health impacts are proportional to the number of jobs performed at the facility; therefore, if half the jobs are performed, then the potential health impacts are halved, if the jobs double, the potential health impacts double. In addition to the number of jobs impacting the results, if the nature of the services provided at the facility changes or the brand of product changes these too can impact results. For this HRA, we used the data from our survey data and site visits to estimate that small (G-01) facilities perform 20 brake jobs per week and medium (G-02), and large (G-03) facilities both perform 60 brake jobs per week. The results in Tables VI-7 to VI-13 reflect this assumption.

The building orientation is another parameter that can provide variability in dispersion characteristics and therefore the range of concentration and potential health impacts. For example, rectangular buildings can be arranged so that they are oriented with the smallest side parallel (or at zero degrees), diagonal (or forty-five degrees), or the shorter side perpendicular (ninety degrees) to the predominant wind direction. A building orientation of zero, ninety, and forty-five degrees will yield the highest to lowest concentrations, respectively. For use in modeling generic facilities, the zero orientation was chosen because it is impossible to predict the orientation of the approximately 25,000 AMR facilities in California. By choosing this orientation with default meteorological data, the wind direction is oriented along the length of the rectangle buildings producing maximum concentrations. This practice provides confidence that in most cases we are sure to encompass the potential health impacts of any facility in the State. To evaluate the generic facilities with representative off-site meteorology, the facilities were oriented in the same standard position, however, the representative off-site meteorology was not forced along the length of the rectangle buildings. This exercise provides a range of variability that could result from the three generic facilities using both default and regional meteorological data. See Appendix D for a detailed discussion of the air dispersion modeling methodology used for generic facilities including a sensitivity analysis discussion illustrating the effects of building orientation under default meteorological conditions.

Risk assessment is a complex process which requires the integration of many variables that are intended to simulate real-life processes. Although ARB staff used current California risk assessment methodology, including the most recent cancer potency factors and reference exposure levels, and U.S. EPA approved air dispersion models to conduct the health risk assessments, there is uncertainty in health risk assessment.

An example of uncertainty included in the derivation of its health values used in the risk assessment is the extrapolation of toxicity data from animals to humans. Other examples of uncertainty in an HRA are included in the air dispersion models. For example, while representative off-site meteorological data provides an improved estimate of the dispersion of emissions from a facility over default meteorological data, regional meteorological data is not necessarily site specific. Since regional meteorological data for the facility is not compiled at the actual facility site, there is some uncertainty in the modeled results. Due to microenvironmental factors, the representative off-site meteorological data can either overestimate or underestimate modeled concentrations at AMR facilities. It should be noted that when site-specific or representative off-site meteorological data is not available default meteorological data is typically used. Default meteorology data consists of a standard range of tabulated meteorological conditions. The intent of applying default meteorological conditions is to gain an understanding of the worst-case meteorology that could result in a maximum ground-level impact caused by a particular source.

Effects of exposure to more than one carcinogen or toxicant are also not quantified in risk assessment (CAPCOA, 1993). For example, compounds may act synergistically where effects are greater than additive. Compounds may also have antagonistic effects where effects are less than additive. In these cases, the risk assessment could overestimate or underestimate the potential risks.

Although we are not able to quantify uncertainty in this HRA, to help address the variability in risk assessment, we have provided ranges in our risk assessment results regarding product content and usage, meteorological data sets, building orientation impacts, and receptor type.

E. Summary of the Potential Health Impacts from Automotive Maintenance and Repair Facilities

This section presents the potential health impacts from four types of analyses that were performed for AMR facilities. These four analyses include the results from 54 site-specific HRAs at facilities where site visits were completed. For these 54 facilities, the individual carcinogenic and non-carcinogenic impacts at near source, residential, and worker receptor locations were estimated. Secondly, for 13 of these 54 specific facilities, the regional cancer risk was also evaluated. The third exercise was the estimation of individual receptor potential cancer and non-cancer health impacts from three representative generic facilities. These generic facilities were established utilizing the information from the 137 site visits and two surveys that targeted AMR facilities and product manufacturers. The three generic facilities are modeled using ten representative off-site meteorological data sets and also were evaluated with default meteorological conditions to simulate a location where regional meteorological data was not available. These ten meteorological data sets are the same as the ones used for 13 of the site-specific facilities in exercise one and all of the facilities in exercise two. The fourth analysis uses data from ARB's ambient monitoring network to estimate the statewide cancer impacts from the use of Perc, MeCl, and TCE in AMR activities.

1. Potential Individual Receptor Impacts at Specific Facilities

The ARB staff conducted individual HRAs for 54 of the facilities staff visited and found to be using Perc, MeCl, or TCE-containing automotive consumer products. These facilities represent a broad range of AMR facilities and allow for a reasonable approximation of health impacts statewide. These 54 facilities are a subset of the 137 AMR facilities where ARB staff has conducted site visits. The other 83 facilities were not assessed because they did not use Perc, MeCl, or TCE-containing products. See Appendix D for a detailed presentation of the air dispersion modeling inputs and results for each of the 54 HRAs. Appendix C provides an example calculation illustrating how the outputs from these models are used to calculate potential health impacts.

All 54 HRAs at specific facilities used facility dimensions, emission release characteristics, operating schedule, product use, and product content information that was obtained during the site visits. The two air dispersion models that were used during this HRA are SCREEN3, version 96043, and ISCST3, version 97363. Thirteen of the 54 HRAs were refined HRAs that used representative off-site meteorological data and were performed using the ISCST3 air dispersion model. The selection criteria that was used to determine which facilities would be run with ISCST3 can be found in Appendix F. Forty-one of the HRAs used default meteorological data and the SCREEN3 air dispersion model.

Table VI-2 provides an overview of the potential health impacts from the 54 specific facility HRAs. These 54 facilities are divided into three groups. The first group contains 29 facilities that use Perc and were run with default meteorology data. The second group was also run with default meteorology and includes 12 facilities that used products with multicomponent formulations of Perc and MeCl, or Perc and TCE. The third group has 13 facilities, all used Perc, and were run with ISCST3 using representative off-site meteorology data. Table VI-2 also includes columns that reflect the number of facilities in each modeled group and at each receptor type with potential cancer risks above ten chances per million and one chance per million. In addition, also noted in Table VI-2 are the number of facilities with potential non-cancer hazard indices above one. These results are presented for information purposes only.

Overall, Table VI-2 shows potential carcinogenic risk ranging from <0.01 to 60 chances per million. All three receptor types, (the near source, maximum exposed individual resident (MEIR), and the maximum exposed individual (off-site) worker (MEIW)) show individual potential cancer risks toward the higher end of this range of potential cancer risk. Regarding non-cancer impacts from the site visits, the modeling results and hazard index estimates show that it is unlikely for significant acute or chronic non-cancer health effects to result from the emissions of Perc, MeCl, and TCE from these facilities. In addition, both the chronic and acute hazard indices are less than 0.3 at near-source, MEIR, and MEIW locations. Generally, hazard indices less than 1.0 are not considered to be a concern to public health. Tables VI-3 to VI-5 present the individual cancer and non-cancer (acute and chronic) potential health impacts for each of the 54 specific facilities at the near-source, MEIR, and MEIW locations, respectively.

Annual average concentrations from representative off-site meteorological data were used to determine the potential cancer risk and non-cancer hazard indices presented for the 13 facilities using ISCST3 in Table VI-2. Maximum-hourly concentrations were used to determine the non-cancer acute hazard indices. The methods used to obtain these concentrations are consistent with current risk assessment guidance (CAPCOA, 1993).

Table VI-2. Overview of the Potential Health Impacts for the Fifty-Four Specific Facilities[1]

Grouped Model Runs [2] (n=54)	Rec. Type [3]	Receptor Distances [4] (m)	Potential Cancer Risk [5] (x/million)	No. Fac.[6] Above 10 Per Million	No. Fac.[6] Above 1 Per Million	Range of Acute Hazard Indices	Range of Chronic Hazard Indices	No. Fac. Above H.I. of 1 [6,7]
Perc [8] (n=29) (SCREEN3)	NS	20 to 30	0.08 to 50	12	24	<0.01 to <0.2	<0.01 to <0.3	0
	MEIR	6 to 802	0.01 to 22	5	14	<0.01 to <0.2	<0.01 to <0.2	0
	MEIW[9]	6 to 483	0.02 to 15	1[10]	19	<0.01 to <0.2[11]	<0.01 to <0.2[11]	0
Multiple Component[12] Product (n=12) (SCREEN3)	NS	20 to 25	1 to 46	8	12	<0.01 to <0.2	<0.01 to <0.3	0
	MEIR	20 to 2414	<0.01 to 35	2	8	<0.01 to < 0.08	<0.01 to <0.2	0
	MEIW[9]	3 to 49	>0.6[11] to 23	2[10]	10	<0.01 to <0.2[11]	<0.01 to <0.3[11]	0[10]
Perc [8] (n=13) (ISCST3)	NS	32 to 51	2 to 60	10	13	<0.01 to <0.2	<0.02 to <0.3	0
	MEIR	25 to 146	0.05 to 60	6	10	<0.01 to <0.04	<0.01 to <0.3	0
	MEIW[9]	24 to 151	0.3 to 11	1	11	<0.01 to <0.2	<0.01 to <0.2	0

1. All numbers have been rounded.
2. Modeled facilities are divided into three groups of 29, 12, and 13 facilities. The first group is run using the SCREEN3 model with only Perc-containing products. The second group was run using SCREEN3 with automotive products that contain combination formulations of Perc/MeCl and Perc/TCE. The third group was run using ISCST3 at facilities that use Perc-containing automotive products.
3. Results are presented for three receptor types.
   NS (near-source) identifies the location closest to the facility where modeled concentrations could be estimated.
   MEIR (maximum exposed individual resident) represents the residential location that receives the estimated maximum exposure from a facility's emissions.
   MEIW (maximum exposed individual (off-site) worker) identifies the off-site industrial or commercial location that receives the estimated maximum exposure from a facility's emissions.
4. The distance for the near-source receptor is measured from the center of the volume source. The distance listed for the MEIR and MEIW receptors is the estimated distance away from the outside edge of the building to the residential or worker receptor.
5. Potential cancer risk presented in this column reflect the range of results for each modeled group by receptor type.
6. These columns reflect the number of facilities in each modeled group and at each receptor type with potential health impacts above ten chances per million, one chance per million, and hazard indices above one. These results are presented for information purposes only.
7. Includes both chronic and acute hazard indices.
8. These facilities use Perc-containing automotive products which show a Perc content range on the MSDS.
9. Where appropriate, the potential cancer risk estimates are adjusted for a working lifetime of 46 years and to allow for an operating schedule at an off-site facility that does not coincide with, or is shorter than, that of the facility being assessed.
10. The number of facilities may be higher than is listed here because the location of some receptors is closer than the minimum modeled distance. We are unable to predict potential pollutant concentrations and health impacts within the minimum modeled distance. When receptors are located closer than the minimum modeled distance, the potential impacts at the minimum modeled distance are used.
11. The MEIW is located within 20 to 30 meters of the center of the volume source, which is the minimum distance modeled; therefore, the potential health impacts are likely to be greater than those listed here. However, we do not anticipate the impacts to be higher than a hazard index of 1.
12. These facilities use products with multcomponent formulation of Perc/MeCl or Perc/TCE.

a. Potential Health Impacts at the Near Source Location for the Specific Facilities

Table VI-3 summarizes the maximum potential cancer and non-cancer health impacts at each of the 54 specific facilities. The maximum potential health impacts are estimated to occur at near-source locations. Overall, Table VI-3 shows potential carcinogenic risk ranging from 0.05 to 60 chances per million. Non-cancer acute and chronic hazard indices are less than 0.3 at near-source location. Generally, hazard indices less than 1.0 are not considered to be a concern to public health.

For these 54 facilities, we selected a minimum receptor distance of 20 to 51 meters from the center of the volume source or building to define a near-source location. The reason the minimum modeled distance varies by facility is because the air dispersion models must allow for the building dimensions or footprint. The purpose of estimating the potential health impacts at a near-source location is to illustrate what the potential health impacts can be if a receptor was located close to the facilities which were assessed, rather than having an increased "buffer" distance between the receptor location and the edge of the building. During the 137 site visits, ARB staff observed that receptors are present within 51 meters at 87 of the AMR facilities. For a breakdown of the number of facilities with residential and worker receptors within 20, 30, 50 and 100 meters that were observed during the site visits see Table V-12.

Table VI-3. Summary of the Specific Facility Near-Source Potential Health Impacts [1,2]

Facility (n=54)	Facility Type	Individual Cancer Risk (per million)	Acute Hazard Index	Chronic Hazard Index
Group A = Perc-Using Facilities Modeled with SCREEN3 (N=29)				
E [3]	Service Station	2.0 to 2.9	<0.06	<0.02
H [3]	Fleet	0.3 to 0.4	<0.01	<0.01
L [3]	Service Station	4.7 to 6.8	<0.2	<0.04
N	Dealership	3.7	<0.01	<0.02
Q [3]	General Automotive	27 to 39	<0.2	<0.2
R [3]	General Automotive	35 to 50	<0.05	<0.3
V	Brake Shop	0.5	<0.01	<0.01
A-13 [3]	General Automotive	0.08 to 0.1	<0.01	<0.01
A-14 [3]	General Automotive	0.6 to 0.9	<0.03	<0.01
A-15 [3]	General Automotive	2.0 to 2.7	<0.04	<0.02
A-16[3]	General Automotive	4.0 to 5.9	<0.02	<0.03
A-21 [3]	Brake Shop	3.7 to 5.0	<0.04	<0.03
A-29 [3]	Fleet	24 to 35	<0.05	<0.2
A-30 [3]	Fleet	3.1 to 10	<0.05	<0.06
A-31 [3]	General Automotive	11 to 16	<0.02	<0.08
A-32 [3]	General Automotive	0.6 to 0.9	<0.03	<0.01
A-35 [3]	Brake Shop	3.9 to 5.6	<0.2	<0.03
A-36 [3]	Dealership	22 to 31	<0.04	<0.2
A-50 [3]	General Automotive	5.8 to 8.4	<0.08	<0.05
A-51 [3]	General Automotive	4.7 to 5.2	<0.2	<0.03
A-54 [3]	General Automotive	8.9 to 13	<0.09	<0.07
A-73 [3]	General Automotive	14 to 16	<0.04	<0.08
A-84	General Automotive	23	<0.09	<0.2
A-87 [3]	Dealership	11 to 19	<0.02	<0.1

Table VI-3. Summary of the Specific Facility Near-Source Potential Health Impacts (continued) [1,2]

Facility (n=54)	Facility Type	Individual Cancer Risk (per million)	Acute Hazard Index	Chronic Hazard Index
Group A = Perc-Using Facilities Modeled with SCREEN3 (N=29) (continued)				
A-88 [3]	General Automotive	8.9 to 22	<0.2	<0.2
A-89 [3]	General Automotive	4.6 to 6.6	<0.01	<0.04
A-90 [3]	Service Station	6.0 to 8.7	<0.3	<0.05
A-93 [3]	General Automotive	10 to 15	<0.08	<0.08
A-94 [3]	Service Station	2.0 to 2.9	<0.04	<0.02
Group B = Multicomponent-Using Facilities Modeled with SCREEN3 [4] (N=12)				
D	Service Station	18	<0.09	<0.09
G	Fleet	22	<0.05	<0.2
M	Dealership	46	<0.1	<0.3
S	Brake Shop	12	<0.02	<0.06
A-20	General Automotive	27	<0.04	<0.2
A-39	General Automotive	9.7	<0.01	<0.04
A-49	General Automotive	11	<0.09	<0.06
A-63	General Automotive	1.0	<0.04	<0.01
A-71	General Automotive	1.5	<0.06	<0.01
A-72	General Automotive	2.9	<0.2	<0.02
A-82	General Automotive	20	<0.03	<0.1
A-85	General Automotive	43	<0.2	<0.3
Group C = Perc-Using Facilities Modeled with ISCST3 (N=13)				
A-07 [3]	General Automotive	13 to 19	<0.04	<0.1
A-08 [3]	General Automotive	29 to 41	<0.02	<0.3
A-09 [3]	General Automotive	41 to 60	<0.02	<0.3
A-28 [3]	Fleet	12 to 18	<0.03	<0.09
A-52 [3]	General Automotive	9.9 to 11	<0.05	<0.06

Table VI-3. Summary of the Specific Facility Near-Source Potential Health Impacts (continued) [1,2]

Facility (n=54)	Facility Type	Individual Cancer Risk (per million)	Acute Hazard Index	Chronic Hazard Index
Group C = Perc-Using Facilities Modeled with ISCST3 (N=13) (continued)				
A-83 [3]	General Automotive	12 to 18	<0.02	<0.09
A-86 [3]	Dealership	8.0 to 13	<0.01	<0.07
A-92 [3]	Service Station	3.2 to 4.7	<0.05	<0.03
I [3]	Fleet	11 to 16	<0.03	<0.08
O [3]	General Automotive	4.5 to 6.6	<0.2	<0.04
P [3]	Brake Shop	2.3 to 3.3	<0.01	<0.02
T	General Automotive	15	<0.02	<0.08
U [3]	General Automotive	19 to 28	<0.02	<0.2

1. Near-source is defined as the modeled minimum receptor distance of 20 to 51 meters from the building center, or ranging from 2 to 40 meters away from the outside edge of the building.
2. All numbers have been rounded.
3. These facilities use a Perc-containing automotive products which shows a Perc-content range on the Material Safety Data Sheet (MSDS); therefore, a range is presented for the potential cancer risk.
4. These facilities use products with multicomponent formulations of Perc/MeCl or Perc/TCE.

b. <u>Potential Health Impacts at the MEIR for the Specific Facilities</u>

Table VI-4 summarizes the potential cancer and non-cancer health impacts at the maximum exposed individual resident (MEIR). The MEIR is defined as the residential receptor location that receives the estimated maximum exposure from a facility's emissions relative to other residential locations. Overall, Table VI-4 shows the MEIR potential carcinogenic risk range from <0.01 to 60 chances per million. Non-cancer acute and chronic hazard indices are less than 0.3 at the MEIR location. Generally, hazard indices less than 1.0 are not considered to be a concern to public health. An example calculation is presented in Appendix C illustrating how a facility's potential health impacts were assessed. This example shows emission calculations, steps through the air dispersion modeling, and concludes with a calculation of potential health impacts.

A contributing factor to any decrease in potential risk at the MEIR is the increased "buffer" distance created by the facility fence line or the location of the nearest resident when compared to the near-source location. The distance to the MEIR at the specific facilities was estimated to range from approximately 6 to 2414 meters.

Table VI-4. Summary of the Potential Health Impacts at the Maximum Exposed Individual Resident (MEIR) from the Specific Facilities [1]

Facility (n=54)	Facility Type	Receptor Distance [2] (meters)	Individual Cancer Risk (per million)	Acute Hazard Index	Chronic Hazard Index
Group A = Perc-Using Facilities Modeled with SCREEN3 (N=29)					
E [3]	Service Station	801	0.01 to 0.02	<0.01	<0.01
H [3]	Fleet	802	<0.01 to 0.01	<0.01	<0.01
L [3]	Service Station	232	0.2 to 0.3	<0.01	<0.01
N	Dealership	400	0.07	<0.01	<0.01
Q [3]	General Automotive	76	7.9 to 11	<0.06	<0.06
R [3]	General Automotive	46	15 to 22	<0.02	<0.2
V [4]	Brake Shop	6	>0.5	<0.01[5]	<0.01[5]
A-13 [3]	General Automotive	73	0.01 to 0.02	<0.01	<0.01
A-14 [3]	General Automotive	107	<0.1	<0.01	<0.01
A-15 [3]	General Automotive	76	0.4 to 0.5	<0.01	<0.01
A-16 [3]	General Automotive	305	0.08 to 0.1	<0.01	<0.01
A-21 [3]	Brake Shop	114	0.4 to 0.5	<0.01	<0.01
A-29 [3]	Fleet	152	3.3 to 4.8	<0.01	<0.03
A-30 [3]	Fleet	483	0.1 to 0.4	<0.01	<0.01
A-31 [3]	General Automotive	229	0.3 to 0.5	<0.01	<0.01
A-32 [3]	General Automotive	137	0.04 to 0.06	<0.01	<0.01
A-35 [3]	Brake Shop	152	0.3 to 0.4	<0.02	<0.01
A-36 [3]	Dealership	152	1.6 to 2.4	<0.01	<0.02
A-50 [3]	General Automotive	15	5.8 to 8.4	<0.08	<0.05
A-51 [3]	General Automotive	23	3.5 to 3.8	<0.2	<0.02
A-54 [3]	General Automotive	38	3.7 to 5.4	<0.05	<0.03
A-73 [3]	General Automotive	322	0.2 to 0.3	<0.01	<0.01
A-84	General Automotive	38	10	<0.05	<0.05

Table VI-4. Summary of the Potential Health Impacts at the Maximum Exposed Individual Resident (MEIR) from the Specific Facilities (continued) [1]

Facility (n=54)	Facility Type	Receptor Distance [2] (meters)	Individual Cancer Risk (per million)	Acute Hazard Index	Chronic Hazard Index
Group A = Perc-Using Facilities Modeled with SCREEN3 (N=29) (continued)					
A-87 [3]	Dealership	152	0.9 to 1.5	<0.01	<0.01
A-88 [3]	General Automotive	12	8.9 to 22	<0.2	<0.2
A-89 [3]	General Automotive	76	0.7 to 1.1	<0.01	<0.01
A-90 [3,4]	Service Station	14	>6.0 to >8.7	<0.3[5]	<0.05[5]
A-93 [3,4]	General Automotive	8	>10 to >15	<0.08[5]	<0.08[5]
A-94 [3]	Service Station	23	1.4 to 2.1	<0.04	<0.02
Group B = Multicomponent-Using Facilities Modeled with SCREEN3 [6] (N=12)					
D	Service Station	152	1.6	<0.01	<0.01
G	Fleet	398	1.2	<0.01	<0.01
M	Dealership	20	35	<0.08	<0.2
S	Brake Shop	460	0.2	<0.01	<0.01
A-20	General Automotive	46	8.1	<0.02	<0.04
A-39	General Automotive	46	3.8	<0.01	<0.02
A-49	General Automotive	30	5.6	<0.06	<0.03
A-63	General Automotive	2414	<0.01	<0.01	<0.01
A-71	General Automotive	30	0.8	<0.04	<0.01
A-72	General Automotive	53	0.8	<0.05	<0.01
A-82	General Automotive	37	8.9	<0.02	<0.05
A-85	General Automotive	30	23	<0.08	<0.2
Group C = Perc-Using Facilities Modeled with ISCST3 (N=13)					
A-07 [3]	General Automotive	27	13 to 19	<0.03	<0.1
A-08 [3]	General Automotive	27	7.8 to 11	<0.02	<0.06
A-09 [3]	General Automotive	25	41 to 60	<0.02	<0.3
A-28 [3]	Fleet	83	0.9 to 1.4	<0.01	<0.01

Table VI-4. Summary of the Potential Health Impacts at the Maximum Exposed Individual Resident (MEIR) from the Specific Facilities (continued) [1]

Facility (n=54)	Facility Type	Receptor Distance [2] (meters)	Individual Cancer Risk (per million)	Acute Hazard Index	Chronic Hazard Index
Group C = Perc-Using Facilities Modeled with ISCST3 (N=13) (continued)					
A-52 [3]	General Automotive	42	2.8 to 3.0	<0.04	<0.02
A-83 [3]	General Automotive	30	9.7 to 14	<0.02	<0.07
A-86 [3]	Dealership	141	1.3 to 2.2	<0.01	<0.02
A-92 [3]	Service Station	54	0.3 to 0.5	<0.02	<0.01
I [3]	Fleet	146	1.8 to 2.6	<0.01	<0.02
O [3]	General Automotive	92	0.05 to 0.07	<0.04	<0.01
P [3]	Brake Shop	37	0.2 to 0.3	<0.01	<0.01
T	General Automotive	27	13	<0.01	<0.07
U [3]	General Automotive	27	19 to 28	<0.02	<0.2

1. All numbers have been rounded.
2. The distance listed here is the estimated distance away from the outside edge of the building to the MEIR.
3. These facilities use a Perc-containing brake cleaner which shows a Perc-content range on the Material Safety Data Sheet (MSDS); therefore, a range is presented for the potential cancer risk.
4. The MEIR is located closer than 20 meters to the center of the volume source, which is the minimum distance modeled; therefore, the potential health impacts are likely to be greater than those listed here. The impacts shown here are at the near-source location of 20 to 51 meters.
5. The MEIR is located within 20 to 30 meters of the center of the volume source, which is the minimum distance modeled; therefore, the potential health impacts are likely to be greater than those listed here. However, we do not anticipate the impacts to be higher than a hazard index of 1.
6. These facilities use products with multicomponent formulations of Perc/MeCl or Perc/TCE.

c. Potential Health Impacts at the MEIW for the Specific Facilities

Table VI-5 summarizes the potential cancer and non-cancer health impacts at the maximum exposed individual (off-site) worker (MEIW). The MEIW is defined as the off-site industrial or commercial location that receives the estimated maximum exposure from a facility's emissions relative to other industrial or commercial locations.

Overall, Table VI-5 shows the MEIW potential carcinogenic risk range is from 0.02 to 23 chances per million. Non-cancer acute and chronic hazard indices are less than 0.3 at near-source location. Generally, hazard indices less than 1.0 are not considered to be a concern to public health. An example calculation is presented in Appendix C that illustrates how a facility's potential health impacts were assessed. This example shows emission calculations, steps through the air dispersion modeling, and concludes with a calculation of potential health impacts.

The distance to the MEIW at these facilities was estimated to range from 3 to 483 meters. Using guidance from OEHHA, the exposure period of an off-site worker was adjusted to allow for a shorter working lifetime and a shorter operating schedule. This first adjustment is made to allow for a shorter working lifetime, 46 years, rather than a 70-year exposure lifetime which is assumed for residential exposure. The second adjustment which allows for operating schedules is appropriate only when the operating schedule of the off-site facility does not coincide with, or is shorter than, that of the facility being assessed (OEHHA, 1997).

Table VI-5. Summary of the Potential Health Impacts at the Maximum Exposed Individual (Off-site) Worker (MEIW) from the Specific Facilities [1]

Facility (n=54)	Facility Type	Receptor Distance [2] (meters)	Individual Cancer Risk [3] (per million)	Acute Hazard Index	Chronic Hazard Index
Group A = Perc-Using Facilities Modeled with SCREEN3 (N=29)					
E [4]	Service Station	36	0.4 to 0.6	<0.03	<0.01
H [4]	Fleet	302	0.02 to 0.03	<0.01	<0.01
L [4]	Service Station	27	1.4 to 2.0	<0.08	<0.03
N	Dealership	110	0.3	<0.01	<0.01
Q [4]	General Automotive	61	5.3 to 7.7	<0.07	<0.07
R [4]	General Automotive	30	10 to 15	<0.03	<0.2
V [5]	Brake Shop	18	0.2	<0.01	<0.01
A-13 [4]	General Automotive	18	0.03 to 0.04	<0.01	<0.01
A-14 [4,5]	General Automotive	6	>0.3 to >0.5	<0.03 [6]	<0.01 [6]
A-15 [4]	General Automotive	30	0.5 to 0.7	<0.03	<0.01
A-16 [4]	General Automotive	30	0.8 to 1.2	<0.01	<0.02
A-21 [4]	Brake Shop	12	1.4 to 1.9	<0.03	<0.03
A-29 [4]	Fleet	322	0.3 to 0.4	<0.01	<0.01

Table VI-5. Summary of the Potential Health Impacts at the Maximum Exposed Individual (Off-site) Worker (MEIW) from the Specific Facilities (continued) [1]

Facility (n=54)	Facility Type	Receptor Distance [2] (meters)	Individual Cancer Risk [3] (per million)	Acute Hazard Index	Chronic Hazard Index
Group A = Perc-Using Facilities Modeled with SCREEN3 (N=29) (continued)					
A-30 [4]	Fleet	483	0.03 to 0.09	<0.01	<0.01
A-31 [4,5]	General Automotive	6	>4.9 to >7.1	<0.02 [6]	<0.08 [6]
A-32 [4]	General Automotive	17	0.3 to 0.5	<0.03	<0.01
A-35 [4]	Brake Shop	15	1.7 to 2.5	<0.2	<0.03
A-36 [4]	Dealership	76	2.2 to 3.1	<0.02	<0.04
A-50 [4]	General Automotive	15	2.9 to 4.1	<0.08	<0.05
A-51 [4,5]	General Automotive	6	>2.0 to >2.2	<0.2 [6]	<0.03 [6]
A-54 [4,5]	General Automotive	15	>4.3 to >6.2	<0.09 [6]	<0.07 [6]
A-73 [4]	General Automotive	15	7.7 to 8.8	<0.04	<0.08
A-84 [5]	General Automotive	9	>7.9	<0.09 [6]	<0.2 [6]
A-87 [4]	Dealership	46	2.1 to 3.5	<0.01	<0.04
A-88 [4]	General Automotive	23	2.9 to 7.2	<0.2	<0.08
A-89 [4]	General Automotive	24	1.4 to 2.0	<0.01	<0.02
A-90 [4,5]	Service Station	15	>3.1 to >4.4	<0.3 [6]	<0.05 [6]
A-93 [4]	General Automotive	30	2.3 to 3.3	<0.05	<0.04
A-94 [4,5]	Service Station	9	>1.1 to >1.6	<0.04 [6]	<0.02 [6]
Group B = Multicomponent-Using Facilities Modeled with SCREEN3 [7] (N=12)					
D	Service Station	32	3.7	<0.04	<0.04
G	Fleet	28	8.7	<0.03	<0.08
M	Dealership	15	23	<0.09	<0.2
S	Brake Shop	41	2.8	<0.01	<0.03
A-20	General Automotive	49	3.3	<0.02	<0.04
A-39	General Automotive	23	2.6	<0.01	<0.03
A-49 [5]	General Automotive	6	>5.8	<0.09 [6]	<0.06 [6]
A-63 [5]	General Automotive	3	>0.6	<0.04 [6]	<0.01 [6]

Table VI-5. Summary of the Potential Health Impacts at the Maximum Exposed Individual (Off-site) Worker (MEIW) from the Specific Facilities (continued) [1]

Facility (n=54)	Facility Type	Receptor Distance [2] (meters)	Individual Cancer Risk [3] (per million)	Acute Hazard Index	Chronic Hazard Index
Group B = Multicomponent-Using Facilities Modeled with SCREEN3 [7] (N=12) (continued)					
A-71[5]	General Automotive	15	>0.8	<0.06 [6]	<0.01 [6]
A-72	General Automotive	21	1.1	<0.09	<0.01
A-82	General Automotive	37	3.7	<0.02	<0.05
A-85 [5]	General Automotive	8	>21	<0.2 [6]	<0.3 [6]
Group C = Perc-Using Facilities Modeled with ISCST3 (N=13)					
A-07 [4]	General Automotive	46	2.3 to 3.4	<0.02	<0.04
A-08 [4]	General Automotive	27	7.9 to 11	<0.02	<0.2
A-09 [4]	General Automotive	25	4.6 to 6.7	<0.02	<0.08
A-28 [4]	Fleet	122	0.3 to 0.4	<0.01	<0.02
A-52 [4]	General Automotive	28	4.5 to 4.9	<0.03	<0.06
A-83 [4]	General Automotive	27	4.3 to 6.2	<0.02	<0.07
A-86 [4]	Dealership	151	0.3 to 0.6	<0.01	<0.01
A-92 [4]	Service Station	28	1.4 to 2.0	<0.05	<0.02
I [4]	Fleet	84	1.1 to 1.6	<0.02	<0.03
O [4]	General Automotive	24	2.3 to 3.3	<0.2	<0.03
P [4]	Brake Shop	27	0.7 to 1.0	<0.01	<0.02
T	General Automotive	27	5.7	<0.01	<0.07
U [4]	General Automotive	27	2.9 to 4.2	<0.01	<0.05

1. All numbers have been rounded.
2. The distance listed here is the estimated distance from the outside edge of the building to the MEIW.
3. Where appropriate, the potential risk estimates are adjusted for a working lifetime of 46 years and to allow for an operating schedule at an off-site facility that does not coincide with, or is shorter than, that of the facility being assessed.
4. These facilities use a Perc-containing brake cleaner which shows a Perc-content range on the Material Safety Data Sheet (MSDS); therefore, a range is presented for the potential cancer risk.
5. The MEIW is located closer than 20 to 51 meters to the center of the volume source, which is the minimum distance modeled; therefore, the potential health impacts are likely to be greater than those listed here. The impacts shown here are at the near-source location of 20 to 51 meters.
6. The MEIW is located within 20 to 30 meters of the center of the volume source, which is the minimum distance modeled; therefore, the potential health impacts are likely to be greater than those listed here. However, we do not anticipate the impacts to be higher than a hazard index of 1.
7. These facilities use products with multicomponent formulations of Perc/MeCl or Perc/TCE.

2. Regional Cancer Risk from Specific Facilities

For the 13 specific facilities that were modeled using representative off-site meteorological data and the ISCST3 model, ARB staff has also estimated the potential regional cancer risk on the population surrounding each facility. Regional population exposure to Perc, MeCl, and TCE concentrations from each of the 13 specific facilities was estimated by spatially matching regional population census data collected from the Department of Finance (DOF) and the ISCST3 modeling results. To deal with limitations in the population data resolution, estimates of the high and low ranges of concentration were utilized in this analysis. These concentration estimates result in high and low potential cancer risk estimates. See Appendix D for a detailed presentation of the regional concentrations from the 13 specific facilities. Appendix C provides a more detailed discussion of the methodology and an example calculation that converts the modeled regional concentrations found in Appendix D to cancer risk estimates.

Table VI-6 summarizes the data in Appendix D by providing, for each of the 13 specific facilities, the range of annual average concentrations anticipated over a one-kilometer grid-cell centered on each facility. This table also provides the range of corresponding potential cancer risk, the average one-kilometer grid-cell population, and the near source, MEIR, and MEIW individual potential cancer risk. The lower end of the concentration range at each facility provides an estimate of the average concentration that all of the receptors are exposed to within the one-kilometer grid-cell. The upper end of the concentration range illustrates the modeled maximum annual concentration that is anticipated near each facility where high concentration gradients may exist. Due to the resolution of the census data, we are unable to estimate the population exposed to the upper end of the concentration range; however, some of the populous are exposed at or near these concentrations due to the proximity of adjacent receptors as evidenced in the MEIR and MEIW analyses.

Overall, Table VI-6 shows that the populous around the 13 specific facilities are exposed to a range of potential cancer risk of 0.006 to 60 chances per million. The range of individual cancer risk estimates are also included in Table VI-6 to put the one-kilometer grid-cell concentrations and risk into perspective with the individual cancer risk shown in Tables VI-2 to VI-5. As stated above, the near source, MEIR, and MEIW locations are indicative of the upper range of the concentrations and potential cancer risk that is estimated within one-kilometer of each of the 13 facilities.

As mentioned prior, the spatial resolution of the population data is a limiting factor to this analysis. That is, model results indicate that ambient air concentrations rapidly decrease at distances farther than 100 meters from each facility or one-tenth of a grid-cell. Thus, the reported average concentration experienced within the central one-kilometer square grid-cell is lower that the average concentration experienced within a 100-meter radius of each facility. With the utilized population data and analysis tools, we are unable to quantify the populous living within 100 meters from each source, that will generally experience the higher concentrations. Use of more highly resolved population data, land-use data, and parcel maps could refine such estimates. Improvements in the availability of digitized census information down to the block level (e.g., 70 to 100 persons) in a Geographic Information System (GIS) format is key to improving the estimation of regional or near field population exposure estimates. In addition to the digitized block level census data, digitized parcel or land use data and high resolution street maps in a GIS format are other key requirements for improving these estimates.

Table VI-6. Summary of the Potential Regional Population and Individual Cancer Risk for the Thirteen Specific Facilities Modeled with ISCST3 [1,2]

Facility (n=13)	Range Of Facility [3] Specific Annual Average Conc. In One-Kilometer Grid-Cell (ug/m3)	Range Of Cancer Risk In One-Kilometer Grid-Cell (chances per million)	1998 Average Population Within One-Kilometer Grid-Cell	Individual Cancer Risk (chances per million)		
				Near Source	Maximum Exposed Resident	Maximum Exposed Worker [4]
A-07	4.7 E-3 to 3.3	0.03 to 19	5,843	19	19	3.4
A-08	9.3 E-3 to 7.0	0.05 to 41	5,628	41	11	11
A-09	6.4 E-2 to 10.1	0.4 to 60	2,155	60	60	6.7
A-28	1.0 E-2 to 3.0	0.06 to 18	2,501	18	1.4	0.4
A-52	3.3 E-3 to 1.8	0.02 to 11	3,971	11	3.0	4.9
A-83	2.5 E-2 to 3.0	0.1 to 18	732	18	14	6.2
A-86	9.1 E-3 to 2.2	0.05 to 13	1,845	13	2.2	0.6
A-92	9.8 E-4 to 0.8	0.006 to 4.7	3,399	4.7	0.5	2.0
I	5.8 E-2 to 2.7	0.3 to 16	1,408	16	2.6	1.6
O	1.0 E-2 to 1.1	0.06 to 6.6	1,930	6.6	0.07	3.3
P	4.6 E-3 to 0.6	0.03 to 3.3	2,369	3.3	0.3	1.0
T	4.2 E-3 to 2.5	0.02 to 15	6,603	15	13	5.7
U	2.4 E-2 to 4.7	0.1 to 28	3,683	28	28	4.2

1. All numbers have been rounded.
2. The higher end of the Perc-content range was used for facilities that use Perc-containing automotive products that show a Perc-content range on the Material Safety Data Sheet (MSDS).
3. Column entries derived by multiplying the unit emission rate concentrations presented in Appendix C by the upper Perc-content range facility specific emissions rate presented in Table D-17 of Appendix D.
4. Where appropriate, the potential risk estimates are adjusted for a working lifetime of 46 years and to allow for an operating schedule at an off-site facility that does not coincide with, or is shorter than, that of the facility being assessed.

3. Potential Individual Health Impacts from Generic Facilities

In addition to assessing the potential health impacts at the 54 specific facilities, ARB staff also conducted an HRA for three representative generic facilities (G-01, G-02, and G-03). These generic facilities were established utilizing the information from the 137 site visits, discussions with industry representatives, and two surveys that targeted AMR facilities and products manufacturers. The characteristics of the generic facilities represent the range of characteristics exhibited by the research of actual facilities and allow for the reasonable approximation of health impacts statewide.

The generic facility assessments were run with the ISCST3 air dispersion model and the resulting concentrations were used to estimate individual receptor potential cancer and non-cancer health impacts. The three generic facilities are modeled using ten representative off-site meteorological data sets and also were evaluated with default meteorological conditions to simulate a location where regional meteorological data was not available. These ten meteorological data sets are the same as those used for 13 of the site-specific facilities (group c) in exercise one and all facilities in exercise two. See Appendix F for a discussion outlining how the generic facilities were defined and Appendix D for a list of the meteorologic data sets. Appendix C provides an example calculation illustrating how modeled concentrations are used to estimate potential cancer and non-cancer health impacts.

In addition to evaluating these generic facilities for the use of brake cleaning products, estimates of the potential health impacts from the use of engine degreasers, carburetor-choke cleaner, and general degreasers were also completed. Section four of Appendix D includes a detailed presentation of the modeled concentrations from the three generic facilities using all four types of automotive consumer products. Appendix F outlines the emissions, usage, and content assumptions that were used for the three other product categories. The inputs for the generic modeling are listed in Appendix D.

Tables VI-7 and VI-8 provide an overview of the potential health impacts from the three generic facility HRAs using Perc-containing brake cleaners. These tables show the range of cancer and non-cancer health impacts at the minimum modeled distance using representative off-site meteorological data and default conditions, respectively. We are summarizing the health impacts from Perc-only brake products in Tables VI-7 and VI-8, rather than other formulations, because the health impacts of this formulation exhibit the highest potential health impacts.

The purpose of showing these health impacts at these receptor distances is because receptors do reside in close proximity to AMR facilities. During the 137 site visits, ARB staff observed that receptors are present within 51 meters at 87 of the AMR facilities. For a breakdown of the number of facilities with residential and worker receptors within 20, 30, 50 and 100 meters that were observed during the site visits see Table V-12.

Table VI-7 shows that the potential carcinogenic risk for a near source, residential receptor over all ten representative off-site meteorological sets range from approximately 18 to 64 chances per million at the smallest facility (G-01). The middle facility (G-02) potential near-source, residential receptor cancer risk ranges from 28 to 110 chances per million and at the largest facility (G-03), the near-source, residential receptor cancer risk ranges from 15 to 50 chances per million. Note, however, that modeled concentrations and potential risk could be either higher or lower depending on the actual building orientation and regional location. See Appendix D for a sensitivity analysis discussion illustrating the effects of building orientation under default meteorological conditions.

Table VI-8 which presents the results using default meteorology, shows the facility G-01 near-source, residential receptor cancer risk ranges from 61 to 89 chances per million, facility G-02 near-source, residential receptor cancer risk ranges from 86 to 125 chances per million, and at facility G-03, the residential receptor cancer risk ranges from 38 to 56 chances per million.

Regarding non-cancer impacts from the generic facilities, the modeling results and hazard index estimates in Tables VI-7 and VI-8 show that it is unlikely for significant acute or chronic non-cancer health effects to result from the emissions of Perc-containing brake cleaners. Both the chronic and acute hazard indices are less than 0.6 at the minimum modeled distance. Generally, hazard indices less than 1.0 are not considered to be a concern to public health.

Table VI-7. Overview of the Potential Health Impacts for the Three Generic Facilities Using Off-site Representative Meteorology [1]

Generic Facilities	Rec. Type [2]	Distance From Building Center [3] (m)	Off-site Representative Meteorology [4]		
			Range of Cancer Risk [5] (x/million)	Range of Acute Hazard Indices	Range of Chronic Hazard Indices
G-01	Resident	20	18 to 64	<0.05 to <0.09	<0.09 to <0.4
	Worker		7.6 to 27		
G-02	Resident	20	28 to 110	<0.04 to <0.08	<0.2 to <0.6
	Worker		12 to 47		
G-03	Resident	30	15 to 50	<0.02 to <0.03	<0.08 to <0.3
	Worker		6.3 to 21		

1. All numbers have been rounded.
2. Where appropriate, the potential risk estimates are adjusted for a working lifetime of 46 years and to allow for an operating schedule at an off-site facility that does not coincide with, or is shorter than, that of the facility being assessed.
3. The distance listed is the estimated distance from the center of the facility to the receptor.
4. Annual average and maximum hourly concentrations for all ten meteorological sets are listed in Appendix D.
5. The range reflects two common Perc concentrations observed in specific facility modeling.

Table VI-8. Overview of the Potential Health Impacts for the Three Generic Facilities Using Default Meteorology [1]

Generic Facilities	Rec. Type [2]	Distance From Building Edge [3] (m)	Default Conditions [4]		
			Range of Cancer Risk [5] (x/million)	Range of Acute Hazard Indices	Range of Chronic Hazard Indices
G-01	Resident	20	61 to 89	<0.06 to <0.08	<0.3 to <0.5
	Worker		26 to 38		
G-02	Resident	20	86 to 125	<0.06 to <0.08	<0.5 to <0.6
	Worker		36 to 53		
G-03	Resident	30	38 to 56	<0.03 to <0.04	<0.3 to <0.4
	Worker		16 to 24		

1. All numbers have been rounded.
2. Where appropriate, the potential risk estimates are adjusted for a working lifetime of 46 years and to allow for an operating schedule at an off-site facility that does not coincide with, or is shorter than, that of the facility being assessed.
3. The distance listed is the estimated distance from the edge of the facility to the receptor.
4. Meteorological conditions were taken from the SCREEN3 model. See Appendix D for more modeling information.
5. The range reflects two common Perc concentrations observed in specific facility modeling.

Tables VI-9 to VI-11 present the individual cancer and non-cancer (acute and chronic) potential health impacts for the three generic facilities using three specific meteorological data sets that span the range of modeled concentrations. These three regional meteorological data sets are for Oakland, Burbank, and Anaheim. These three locations provide a lower, medium, and higher concentrations, respectively. To select these three meteorological data sets, we evaluated the annual concentrations from all ten meteorological data sets. All concentrations and resulting potential health impacts are provided for all ten meteorological data sets in Appendix D. Table VI-12 presents the potential health impacts for the three generic facilities using default meteorological conditions.

Tables VI-9 to VI-12 also summarize the maximum potential health impacts from the three generic facilities using all four categories of automotive consumer products under the four different meteorological data sets described above. As described above, and in more detail in Chapter 4, the four product categories are brake cleaners, carburetor-choke cleaners, engine degreasers, and general degreasers. In addition to including the total maximum potential health impacts from the four different product categories, we also are presenting four constituent formulations of brake cleaning products. The four brake cleaner constituent formulations used for this HRA are a Perc-only product (94%), Perc/MeCl (55%/25%), Perc/MeCl/TCE (40%/30%/20%), and Perc/TCE (55%/43%). These are identified in Tables VI-9 to VI-12 as formulations A, B, C, and D. Formulations A', B', C', and D' include the brake cleaner that is identified by the same letter (e.g., A' corresponds to A) and include the three other product categories.

Overall, Tables VI-9 to VI-12 show that none of the generic facilities, regardless of the brake cleaner formulation or the inclusion of all four product categories, present hazard indices greater than 0.6. Generally, hazard indices less than 1.0 are not considered to be a concern to public health.

Table VI-9 lists the results from generic facilities using the Anaheim meteorological data, brake cleaners of various formulations, and include the results from the use of all four product categories. Table VI-9 shows potential carcinogenic risk for a potential near-source, residential receptor range from approximately 35 to 68 chances per million at the smallest facility (G-01). The middle facility (G-02) potential near-source, residential receptor cancer risk ranges from 61 to 112 chances per million and at the largest facility (G-03), the near source, residential receptor cancer risk ranges from 28 to 52 chances per million.

Table VI-10 lists the results from generic facilities using the Burbank meteorological data, brake cleaners of various formulations, and include the results from the use of all four product categories. Table VI-10 shows potential carcinogenic risk for a potential near-source, residential receptor range from approximately 26 to 52 chances per million at the smallest facility (G-01). The middle facility (G-02) potential near-source, residential receptor cancer risk ranges from 47 to 88 chances per million and at the largest facility (G-03), the near source, residential receptor cancer risk ranges from 19 to 38 chances per million.

Table VI-11 lists the results from generic facilities using the Oakland meteorological data, brake cleaners of various formulations, and include the results from the use of all four product categories. Table VI-11 shows potential carcinogenic risk for a potential near-source, residential receptor range from approximately 15 to 31 chances per million at the smallest facility (G-01). The middle facility (G-02) potential near-source, residential receptor cancer risk ranges from 23 to 45 chances per million and at the largest facility (G-03), the near source, residential receptor cancer risk ranges from 12 to 23 chances per million.

Table VI-12 lists the results from generic facilities using default meteorological data, brake cleaners of various formulations, and include the results from the use of all four product categories. Table VI-12 shows potential carcinogenic impacts for a potential near-source, residential receptor range from approximately 49 to 100 chances per million at the smallest facility (G-01). The middle facility (G-02) potential near-source, residential receptor cancer risk ranges from 69 to 130 chances per million and at the largest facility (G-03), the near source, residential receptor cancer risk ranges from 31 to 59 chances per million.

Tables VI-13 and VI-14 itemize the individual product and total potential risk contributions from carburetor-choke cleaners, engine degreasers, and general degreasers under an average meteorological data set and under default conditions, respectively. The average meteorological data set was derived by averaging the modeled concentrations at each receptor distance for all ten representative off-site meteorological sets listed in Appendix D. See Appendix D for a detailed presentation of all modeling results. The emissions, use, and formulation assumptions used for the three product categories are discussed in Appendix F.

Table VI-13 shows the individual product and total potential near-source, residential cancer risk for all three generic facilities using the average meteorological data for the three product categories (i.e., carburetor-choke cleaners, engine degreasers, and general degreasers) range from 1.2 to 4.4 chances per million. The non-cancer hazard indices for both acute and chronic impacts are less than 0.1. The results from Table VI-13 are used with all regional meteorological data sets and are included in Tables VI-9 to VI-11 for the A', B', C', and D' formulation potential health impacts.

Table VI-14 shows the individual product and total potential near-source, residential cancer risk at all three generic facilities using the default meteorological data for the three product categories (i.e., carburetor-choke cleaners, engine degreasers, and general degreasers) ranges from 2.3 to 11 chances per million. The non-cancer hazard indices for both acute and chronic impacts are less than 0.1. The results presented in Table VI-14 are used with default meteorological conditions; therefore, they are included in Table VI-12 for the A', B', C', and D' formulation potential health impacts.

Table VI-9. Summary of the Potential Health Impacts at Various Distances for Three Generic Facilities Using Four Different Brake Product Formulations and Four Product Categories at the Meteorological Site Yielding the Highest Concentrations (Anaheim) [1,2]

Fac. Type	Formulations	Potential Cancer Risk (chances per million) [3,4]								Hazard Index [5]	
		20 Meters [6]		30 Meters		40 Meters		100 Meters		20 Meters	20 Meters
		Resident	Worker	Resident	Worker	Resident	Worker	Resident	Worker	Acute	Chronic
G-01	A [7]	64	27	34	14	21	8.9	4.0	1.7	<0.09	<0.4
	A' [8]	68	29	36	15	22	9.5	4.3	1.8	<0.2	<0.4
	B [9]	40	17	21	9.1	13	5.6	2.5	1.1	<0.09	<0.2
	B' [8]	44	19	24	10	15	6.2	2.8	1.2	<0.2	<0.2
	C [10]	35	15	19	7.9	12	4.9	2.2	0.9	<0.08	<0.2
	C' [8]	40	17	21	8.9	13	5.5	2.5	1.1	<0.2	<0.2
	D [11]	47	20	25	11	15	6.6	3.0	1.3	<0.06	<0.2
	D' [8]	52	22	27	12	17	7.2	3.3	1.4	<0.1	<0.2
G-02	A [7]	110	47	84	36	54	23	11	4.8	<0.08	<0.6
	A' [8]	112	48	86	37	56	24	12	4.9	<0.1	<0.6
	B [9]	69	29	53	23	34	15	7.1	3.0	<0.08	<0.4
	B' [8]	72	31	55	24	36	15	7.4	3.2	<0.1	<0.4
	C [10]	61	26	47	20	30	13	6.2	2.7	<0.07	<0.3
	C' [8]	63	27	49	21	31	13	6.5	2.8	<0.09	<0.3
	D [11]	81	35	63	27	40	17	8.4	3.6	<0.05	<0.4
	D' [8]	84	36	65	27	42	18	8.6	3.7	<0.07	<0.4

Table VI-9. Summary of the Potential Health Impacts at Various Distances for Three Generic Facilities Using Four Different Brake Product Formulations and Four Product Categories at the Meteorological Site Yielding the Highest Concentrations (Anaheim) (continued) [1,2]

Fac. Type	Formulations	Potential Cancer Risk (chances per million) [3,4]								Hazard Index [5]	
		20 Meters [6]		30 Meters		40 Meters		100 Meters		30 Meters	30 Meters
		Resident	Worker	Resident	Worker	Resident	Worker	Resident	Worker	Acute	Chronic
G-03	A [7]	--	--	50	21	39	17	12	5.1	<0.03	<0.3
	A’ [8]	--	--	52	22	40	17	12	5.2	<0.04	<0.3
	B [9]	--	--	32	14	25	11	7.5	3.2	<0.03	<0.2
	B’ [8]	--	--	33	14	26	11	7.8	3.3	<0.04	<0.2
	C [10]	--	--	28	12	22	9.2	6.6	2.8	<0.03	<0.2
	C’ [8]	--	--	29	12	23	9.6	6.8	2.9	<0.04	<0.2
	D [11]	--	--	37	16	29	12	8.8	3.7	<0.02	<0.2
	D’ [8]	--	--	39	16	30	13	9.1	3.9	<0.03	<0.2

1. All numbers have been rounded.
2. Annual average concentrations for all ten meteorological sets listed in Appendix D were used to determine which meteorological site is presented in this table. The meteorological site that yields the smallest, medium, and largest concentrations may be different when evaluating acute rather than chronic concentrations. We selected meteorological sets based on chronic concentrations since these potentially provide the most significant health impacts.
3. The distance listed is the estimated distance from the center of the facility to the receptor.
4. Where appropriate, the potential risk estimates are adjusted for a working lifetime of 46 years and to allow for an operating schedule at an off-site facility that does not coincide with, or is shorter than, that of the facility being assessed.
5. Hazard index listed here are the highest found for this facility in this meteorological data set. Facility G-03 was at 30 meters.
6. Results are not available for G-03 facilities since the minimum modeled distance is 30 meters.
7. Formulation A is a Perc brake cleaner with 94% Perc by weight.
8. Formulations A’, B’ ,C’, and D’ include the brake cleaner used in the corresponding letter (e.g., A’ corresponds to brake cleaner A) plus the use of carburetor-choke cleaner (CC), engine degreaser (ED), and general degreaser (GD) were modeled with average meteorological data. The health impacts for CC, ED, and GD were derived at each receptor distance using the average concentrations from all ten meteorological sites. See Table VI-12 for the potential health impacts from each individual product type and Appendix D for a detailed presentation of all modeling results.
9. Formulation B is a Perc/MeCl brake cleaner with a 55% and 25% by weight Perc and MeCl content, respectively.
10. Formulation C is a Perc/MeCl/TCE brake cleaner with a 40%, 30%, and 20% by weight Perc, MeCl, and TCE content, respectively.
11. Formulation D is a Perc/TCE brake cleaner with a 55% and 43% by weight Perc and TCE content, respectively.

Table VI-10. Summary of the Potential Health Impacts at Various Distances for Three Generic Facilities Using Four Different Brake Product Formulations and Four Product Categories at the Meteorological Site Yielding Middle Range Concentrations (Burbank) [1,2]

Fac. Type	Formulations	Potential Cancer Risk (chances per million) [3,4]								Hazard Index [5]	
		20 Meters [6]		30 Meters		40 Meters		100 Meters		20 Meters	20 Meters
		Resident	Worker	Resident	Worker	Resident	Worker	Resident	Worker	Acute	Chronic
G-01	A [7]	47	20	25	11	16	6.6	3.0	1.3	<0.09	<0.3
	A' [8]	52	22	28	12	17	7.3	3.3	1.4	<0.2	<0.3
	B [9]	30	13	16	6.8	9.8	4.2	1.9	0.8	<0.09	<0.2
	B' [8]	34	15	18	7.8	11	4.8	2.2	0.9	<0.2	<0.2
	C [10]	26	11	14	5.9	8.6	3.7	1.7	0.7	<0.08	<0.2
	C' [8]	31	13	16	6.9	10	4.3	2.0	0.8	<0.2	<0.2
	D [11]	35	15	19	7.9	12	4.9	2.3	1.0	<0.06	<0.2
	D' [8]	40	17	21	8.9	13	5.5	2.5	1.1	<0.1	<0.2
G-02	A [7]	86	36	63	27	41	17	8.5	3.6	<0.08	<0.5
	A' [8]	88	38	65	28	42	18	8.8	3.7	<0.1	<0.5
	B [9]	54	23	40	17	26	11	5.4	2.3	<0.08	<0.3
	B' [8]	57	24	42	18	27	11	5.6	2.4	<0.1	<0.3
	C [10]	47	20	35	15	22	9.5	4.7	2.0	<0.07	<0.2
	C' [8]	50	21	37	16	24	10	5.0	2.1	<0.09	<0.2
	D [11]	63	27	47	20	30	13	6.3	2.7	<0.05	<0.3
	D' [8]	66	28	49	21	31	13	6.6	2.8	<0.07	<0.3

Table VI-10. Summary of the Potential Health Impacts at Various Distances for Three Generic Facilities Using Four Different Brake Product Formulations and Four Product Categories at the Meteorological Site Yielding Middle Range Concentrations (Burbank) (continued)[1,2]

Fac. Type	Formulations	Potential Cancer Risk (chances per million) [3,4]								Hazard Index [5]	
		20 Meters [6]		30 Meters		40 Meters		100 Meters		30 Meters	30 Meters
		Resident	Worker	Resident	Worker	Resident	Worker	Resident	Worker	Acute	Chronic
G-03	A [7]	--	--	37	16	31	13	9.0	3.8	<0.03	<0.2
	A' [8]	--	--	38	16	32	14	9.3	3.9	<0.04	<0.2
	B [9]	--	--	23	9.9	20	8.4	5.7	2.4	<0.03	<0.2
	B' [8]	--	--	24	10	21	8.8	6.0	2.5	<0.04	<0.2
	C [10]	--	--	19	8.3	16	7.0	4.7	2.0	<0.03	<0.08
	C' [8]	--	--	21	8.7	17	7.4	5.0	2.1	<0.04	<0.09
	D [11]	--	--	27	12	23	9.9	6.7	2.8	<0.02	<0.2
	D' [8]	--	--	28	12	24	10	6.9	3.0	<0.03	<0.2

1. All numbers have been rounded.
2. Annual average concentrations for all ten meteorological sets listed in Appendix D were used to determine which meteorological site is presented in this table. The meteorological site that yields the smallest, medium, and largest concentrations may be different when evaluating acute rather than chronic concentrations. We selected meteorological sets based on chronic concentrations since these potentially provide the most significant health impacts.
3. The distance listed is the estimated distance from the center of the facility to the receptor.
4. Where appropriate, the potential risk estimates are adjusted for a working lifetime of 46 years and to allow for an operating schedule at an off-site facility that does not coincide with, or is shorter than, that of the facility being assessed.
5. Hazard index listed here are the highest found for this facility in this meteorological data set. Facility G-03 was at 30 meters.
6. Results are not available for G-03 facilities since the minimum modeled distance is 30 meters.
7. Formulation A is a Perc brake cleaner with 94% Perc by weight.
8. Formulations A', B' ,C', and D' include the brake cleaner used in the corresponding letter (e.g., A' corresponds to brake cleaner A) plus the use of carburetor-choke cleaner (CC), engine degreaser (ED), and general degreaser (GD) were modeled with average meteorological data. The health impacts for CC, ED, and GD were derived at each receptor distance using the average concentrations from all ten meteorological sites. See Table VI-12 for the potential health impacts from each individual product type and Appendix D for a detailed presentation of all modeling results.
9. Formulation B is a Perc/MeCl brake cleaner with a 55% and 25% by weight Perc and MeCl content, respectively.
10. Formulation C is a Perc/MeCl/TCE brake cleaner with a 40%, 30%, and 20% by weight Perc, MeCl, and TCE content, respectively.
11. Formulation D is a Perc/TCE brake cleaner with a 55% and 43% by weight Perc and TCE content, respectively.

Table VI-11. Summary of the Potential Health Impacts at Various Distances for Three Generic Facilities Using Four Different Brake Product Formulations and Four Product Categories at the Meteorological Site Yielding the Lowest Concentrations (Oakland) [1,2]

Fac. Type	Formulations	Potential Cancer Risk (chances per million) [3,4]								Hazard Index [5]	
		20 Meters [6]		30 Meters		40 Meters		100 Meters		20 Meters	20 Meters
		Resident	Worker	Resident	Worker	Resident	Worker	Resident	Worker	Acute	Chronic
G-01	A [7]	27	11	14	6.1	8.9	3.8	1.8	0.75	<0.08	<0.2
	A’ [8]	31	13	17	7.1	10	4.4	2.0	0.9	<0.2	<0.2
	B [9]	17	7.2	9.0	3.8	5.6	2.4	1.1	0.47	<0.08	<0.08
	B’ [8]	21	9.0	11	4.9	7.0	3.0	1.4	0.6	<0.2	<0.09
	C [10]	15	6.3	7.9	3.4	4.9	2.1	1.0	0.4	<0.07	<0.06
	C’ [8]	19	8.2	10	4.4	6.4	2.7	1.3	0.5	<0.2	<0.07
	D [11]	20	8.4	11	4.5	6.6	2.8	1.3	0.6	<0.05	<0.08
	D’ [8]	24	10	13	5.5	8.0	3.4	1.6	0.7	<0.09	<0.09
G-02	A [7]	42	18	35	15	23	9.8	4.9	2.1	<0.07	<0.3
	A’ [8]	45	19	37	16	24	10	5.2	2.2	<0.09	<0.3
	B [9]	27	11	22	9.5	15	6.2	3.1	1.3	<0.07	<0.2
	B’ [8]	29	12	24	10	16	6.7	3.4	1.4	<0.09	<0.2
	C [10]	23	9.9	20	8.3	13	5.4	2.7	1.2	<0.06	<0.1
	C’ [8]	26	11	21	9.1	14	6.0	3.0	1.3	<0.08	<0.1
	D [11]	31	13	26	11	17	7.3	3.6	1.6	<0.04	<0.2
	D’ [8]	34	14	28	12	18	7.8	3.9	1.7	<0.06	<0.2

Table VI-11. Summary of the Potential Health Impacts at Various Distances for Three Generic Facilities Using Four Different Brake Product Formulations and Four Product Categories at the Meteorological Site Yielding the Lowest Concentrations (Oakland) (continued)[1,2]

Fac. Type	Formulations	Potential Cancer Risk (chances per million) [3,4]								Hazard Index [5]	
		20 Meters [6]		30 Meters		40 Meters		100 Meters		30 Meters	30 Meters
		Resident	Worker	Resident	Worker	Resident	Worker	Resident	Worker	Acute	Chronic
G-03	A [7]	--	--	22	9.2	16	6.8	5.2	2.2	<0.03	<0.2
	A' [8]	--	--	23	9.7	17	7.2	5.5	2.3	<0.03	<0.2
	B [9]	--	--	14	5.8	10	4.3	3.3	1.4	<0.02	<0.2
	B' [8]	--	--	15	6.3	11	4.7	3.6	1.5	<0.03	<0.2
	C [10]	--	--	12	5.1	8.8	3.8	2.9	1.2	<0.02	<0.05
	C' [8]	--	--	13	5.6	9.8	4.2	3.1	1.3	<0.03	<0.05
	D [11]	--	--	16	6.8	12	5.0	3.8	1.6	<0.02	<0.07
	D' [8]	--	--	17	7.3	13	5.5	4.1	1.8	<0.02	<0.07

1. All numbers have been rounded.
2. Annual average concentrations for all ten meteorological sets listed in Appendix D were used to determine which meteorological site is presented in this table. The meteorological site that yields the smallest, medium, and largest concentrations may be different when evaluating acute rather than chronic concentrations. We selected meteorological sets based on chronic concentrations since these potentially provide the most significant health impacts.
3. The distance listed is the estimated distance from the center of the facility to the receptor.
4. Where appropriate, the potential risk estimates are adjusted for a working lifetime of 46 years and to allow for an operating schedule at an off-site facility that does not coincide with, or is shorter than, that of the facility being assessed.
5. Hazard index listed here are the highest found for this facility in this meteorological data set. Facility G-03 was at 30 meters.
6. Results are not available for G-03 facilities since the minimum modeled distance is 30 meters.
7. Formulation A is a Perc brake cleaner with 94% Perc by weight.
8. Formulations A', B' ,C', and D' include the brake cleaner used in the corresponding letter (e.g., A' corresponds to brake cleaner A) plus the use of carburetor-choke cleaner (CC), engine degreaser (ED), and general degreaser (GD) were modeled with average meteorological data. The health impacts for CC, ED, and GD were derived at each receptor distance using the average concentrations from all ten meteorological sites. See Table VI-12 for the potential health impacts from each individual product type and Appendix D for a detailed presentation of all modeling results.
9. Formulation B is a Perc/MeCl brake cleaner with a 55% and 25% by weight Perc and MeCl content, respectively.
10. Formulation C is a Perc/MeCl/TCE brake cleaner with a 40%, 30%, and 20% by weight Perc, MeCl, and TCE content, respectively.
11. Formulation D is a Perc/TCE brake cleaner with a 55% and 43% by weight Perc and TCE content, respectively.

Table VI-12. Summary of the Potential Health Impacts at Various Distances for Three Generic Facilities Using Four Different Brake Product Formulations and Four Product Categories based on Default Meteorological Data [1,2]

Fac. Type	Formulations	Potential Cancer Risk (chances per million) [3,4]								Hazard Index [5]	
		20 Meters [6]		30 Meters		40 Meters		100 Meters		20 Meters	20 Meters
		Resident	Worker	Resident	Worker	Resident	Worker	Resident	Worker	Acute	Chronic
G-01	A [7]	89	38	67	29	52	22	18	7.5	<0.08	<0.5
	A’ [8]	100	43	75	32	58	25	20	8.4	<0.2	<0.5
	B [9]	56	24	42	18	33	14	11	4.7	<0.08	<0.3
	B’ [8]	67	29	50	21	39	17	13	5.6	<0.2	<0.3
	C [10]	49	21	37	16	29	12	9.7	4.1	<0.08	<0.2
	C’ [8]	60	26	45	19	35	15	12	5.0	<0.2	<0.3
	D [11]	66	28	50	21	38	16	13	5.5	<0.05	<0.3
	D’ [8]	77	33	58	25	45	19	15	6.4	<0.1	<0.3
G-02	A [7]	125	53	103	44	86	37	38	16	<0.1	<0.7
	A’ [8]	130	55	107	46	90	38	39	17	<0.1	<0.7
	B [9]	79	34	65	28	54	23	24	10	<0.08	<0.4
	B’ [8]	84	36	69	29	58	25	25	11	<0.1	<0.4
	C [10]	69	29	57	24	48	20	21	8.8	<0.07	<0.3
	C’ [8]	74	31	61	26	51	22	22	9.5	<0.09	<0.3
	D [11]	92	39	76	32	64	27	28	12	<0.05	<0.4
	D’ [8]	97	41	80	34	67	29	29	12	<0.07	<0.4

Table VI-12. Summary of the Potential Health Impacts at Various Distances for Three Generic Facilities Using Four Different Brake Product Formulations and Four Product Categories based on Default Meteorological Data (continued)[1,2]

Fac. Type	Formulations	Potential Cancer Risk (chances per million) [3,4]								Hazard Index [5]	
		20 Meters [6]		30 Meters		40 Meters		100 Meters		30 Meters	30 Meters
		Resident	Worker	Resident	Worker	Resident	Worker	Resident	Worker	Acute	Chronic
G-03	A [7]	--	--	56	24	49	21	26	11	<0.04	<0.3
	A' [8]	--	--	59	25	51	22	27	11	<0.05	<0.3
	B [9]	--	--	36	15	31	13	16	6.9	<0.04	<0.2
	B' [8]	--	--	38	16	33	14	17	7.3	<0.05	<0.2
	C [10]	--	--	31	13	27	12	14	6.0	<0.03	<0.2
	C' [8]	--	--	33	14	29	12	15	6.5	<0.04	<0.2
	D [11]	--	--	42	18	37	16	19	8.1	<0.02	<0.2
	D' [8]	--	--	44	19	39	16	20	8.5	<0.03	<0.2

1. All numbers have been rounded.
2. Meteorological data conditions from the SCREEN3 dispersion model were used in the ISCST3 model to determine the potential health impacts listed in this table.
3. The distance listed is the estimated distance from the edge of the facility to the receptor. The distance listed for facility G-03 is 30 meters.
4. Where appropriate, the potential risk estimates are adjusted for a working lifetime of 46 years and to allow for an operating schedule at an off-site facility that does not coincide with, or is shorter than, that of the facility being assessed.
5. Hazard indices listed here are the highest found for this facility in this meteorological data set.
6. Results are not available for G-03 facilities since the minimum modeled distance is 30 meters.
7. Formulation A is a Perc brake cleaner with 94% Perc by weight.
8. Formulations A', B' ,C', and D' include the brake cleaner used in the corresponding letter (e.g., A' corresponds to brake cleaner A) plus the use of carburetor-choke cleaner (CC), engine degreaser (ED), and general degreaser (GD) were modeled with default meteorological data. The health impacts for CC, ED, and GD were derived at each receptor distance using the default meteorological data conditions from the SCREEN3 air dispersion model. See Table VI-13 for the potential health impacts from each individual product type and Appendix D for a detailed presentation of all modeling results.
9. Formulation B is a Perc/MeCl brake cleaner with a 55% and 25% by weight Perc and MeCl content, respectively.
10. Formulation C is a Perc/MeCl/TCE brake cleaner with a 40%, 30%, and 20% by weight Perc, MeCl, and TCE content, respectively.
11. Formulation D is a Perc/TCE brake cleaner with a 55% and 43% by weight Perc and TCE content, respectively.

Table VI-13. Summary of the Potential Health Impacts at Various Distances for Three Generic Facilities Using Carburetor Cleaner, Engine Degreaser, and General Degreaser based on Average Meteorological Data [1,2]

Fac. Type	Product Category	Potential Cancer Risk (chances per million) [3,4]								Hazard Index [5]	
		20 Meters [6]		30 Meters		40 Meters		100 Meters		20 Meters	20 Meters
		Resident	Worker	Resident	Worker	Resident	Worker	Resident	Worker	Acute	Chronic
G-01	CC [7]	0.7	0.3	0.4	0.2	0.2	0.1	0.05	0.02	<0.03	<0.01
	ED [7]	2.2	0.9	1.2	0.5	0.7	0.3	0.1	0.06	<0.02	<0.01
	GD [7]	1.5	0.7	0.8	0.3	0.5	0.2	0.1	0.04	<0.01	<0.01
	Total [9]	4.4	1.9	2.4	1.0	1.4	0.6	0.3	0.1	<0.05	<0.01
G-02	CC [7]	0.4	0.2	0.3	0.1	0.2	0.09	0.04	0.02	<0.02	<0.01
	ED [7]	1.3	0.5	1.0	0.4	0.6	0.3	0.1	0.06	<0.01	<0.01
	GD [7]	0.9	0.4	0.7	0.3	0.4	0.2	0.09	0.04	<0.01	<0.01
	Total [9]	2.6	1.1	2.0	0.8	1.2	0.6	0.2	0.1	<0.02	<0.01
G-03	CC [7]	--	--	0.2	0.08	0.2	0.07	0.05	0.02	<0.01 [8]	<0.01 [8]
	ED [7]	--	--	0.6	0.2	0.5	0.2	0.1	0.06	<0.01 [8]	<0.01 [8]
	GD [7]	--	--	0.4	0.2	0.3	0.1	0.1	0.04	<0.01 [8]	<0.01 [8]
	Total [9]	--	--	1.2	0.5	1.0	0.4	0.3	0.1	<0.01 [8]	<0.01 [8]

1. All numbers have been rounded.
2. The modeled concentrations for all ten meteorological sets listed in Appendix D were averaged at each receptor distance to determine the concentrations that would be used to estimate the potential health impacts listed in this table. See Appendix D for a detailed presentation of all modeling results. The potential health impacts in this table were derived from emissions and use information contained in Appendix F.
3. The distance listed is the estimated distance from the center of the facility to the receptor.
4. Where appropriate, the potential risk estimates are adjusted for a working lifetime of 46 years and to allow for an operating schedule at an off-site facility that does not coincide with, or is shorter than, that of the facility being assessed.
5. Hazard indices listed here are the highest found for this facility for the averaged meteorological data set.
6. Results are not available for G-03 facilities since the minimum modeled distance is 30 meters.
7. CC means carburetor-choke cleaner; ED means engine degreaser; GD means general degreaser.
8. Receptor distance of 30 meters
9. The total potential health impacts from carburetor-choke cleaner (CC), engine degreaser (ED), and general degreaser (GD) at each receptor distance are used in Tables VI-8 to VI-10.

Table VI-14. Summary of the Potential Health Impacts at Various Distances for Three Generic Facilities Using Carburetor Cleaner, Engine Degreaser, and General Degreaser based on Default Meteorological Data [1,2]

Fac. Type	Product Category	Potential Cancer Risk (chances per million) [3,4]								Hazard Index [5]	
		20 Meters [6]		30 Meters		40 Meters		100 Meters		20 Meters	20 Meters
		Resident	Worker	Resident	Worker	Resident	Worker	Resident	Worker	Acute	Chronic
G-01	CC [7]	1.8	0.8	1.3	0.6	1.0	0.4	0.4	0.2	<0.03	<0.01
	ED [7]	5.3	2.3	4.0	1.7	3.1	1.3	1.0	0.4	<0.02	<0.02
	GD [7]	3.7	1.6	2.8	1.2	2.1	0.9	0.7	0.3	<0.01	<0.01
	Total [9]	11	4.7	8.1	3.5	6.2	2.6	2.1	0.9	<0.05	<0.03
G-02	CC [7]	0.8	0.4	0.7	0.3	0.6	0.3	0.3	0.1	<0.02	<0.01
	ED [7]	2.5	1.1	2.0	0.9	1.7	0.7	0.7	0.3	<0.01	<0.01
	GD [7]	1.7	0.7	1.4	0.6	1.2	0.5	0.5	0.2	<0.01	<0.01
	Total [9]	5.0	2.2	4.1	1.8	3.5	1.5	1.5	0.6	<0.03	<0.02
G-03	CC [7]	--	--	0.4	0.2	0.3	0.1	0.2	0.07	<0.01 [8]	<0.01 [8]
	ED [7]	--	--	1.1	0.5	1.0	0.4	0.5	0.2	<0.01 [8]	<0.01 [8]
	GD [7]	--	--	0.8	0.3	0.7	0.3	0.4	0.2	<0.01 [8]	<0.01 [8]
	Total [9]	--	--	2.3	1.0	2.0	0.8	1.1	0.5	<0.01 [8]	<0.01 [8]

1. All numbers have been rounded
2. Meteorological data conditions from the SCREEN3 dispersion model were used in the ISCST3 model to determine the potential health impacts listed in this table. See Appendix D for a detailed presentation of all modeling results. The potential health impacts listed in this table are based on the emissions and use information contained in Appendix F.
3. The distance listed is the estimated distance from the edge of the facility to the receptor.
4. Where appropriate, the potential risk estimates are adjusted for a working lifetime of 46 years and to allow for an operating schedule at an off-site facility that does not coincide with, or is shorter than, that of the facility being assessed.
5. Hazard indices listed here are the highest found for this facility for the default meteorological data set.
6. Results are not available for G-03 facilities since the minimum modeled distance is 30 meters.
7. CC means carburetor-choke cleaner; ED means engine degreaser; GD means general degreaser.
8. Receptor distance of 30 meters
9. The total potential health impacts from carburetor-choke cleaner (CC), engine degreaser (ED), and general degreaser (GD) are used in Table VI-11.

4. Statewide Exposure to Perc, MeCl, and TCE

a. Perchloroethylene Population-Weighted Exposure

ARB staff conducted an analysis of the estimated statewide population-weighted exposure to Perc. To do this, ARB staff used data from ARB's air toxics monitoring network and population data to obtain an estimated population-weighted Perc exposure. ARB staff chose Perc for this analysis because it is the highest contributor to ambient risk of the three compounds affected by this regulation.

The statewide population-weighted exposure is based on ambient data collected by the ARB and population figures from the Department of Finance (DOF). The ambient air monitoring network is designed to obtain outdoor ambient background, non-source-influenced, concentration levels of air toxics from 21 ambient air toxics monitoring stations located statewide.

The methodology used to complete the analysis of the population exposure estimate of Perc consists of two parts. The first part is an estimate of the Perc exposure in a given air basin, which yields an average exposure for each air basin that was analyzed. Due to data limitations, population exposure estimates were calculated differently for different air basins. Our analysis of the Perc exposure covers six air basins, and approximately 72 percent of the statewide population. The following Table VI-15 shows the estimated air basin population-weighted exposure for the six basins used in this analysis. For a complete discussion on the methodology used in this analysis see Appendix E.

As shown in Table VI-15, on average, Perc exposure in the listed air basins has decreased about 50 percent since 1990 levels. There is insufficient data to quantify how the ambient reductions in Perc correspond to reductions in commercial and industrial Perc use. However, reductions in ambient levels of Perc are likely the result of regulations or programs such as the Dry Cleaning ATCM and voluntary modifications to work practices from sources using Perc due to the AB 2588 Air Toxics "Hot Spots" Program.

Table VI-15. Air Basin Population-Weighted Perchloroethylene Exposure based on 1990 Census (ppb-year/person)[1]

Air Basin	1990	1991	1992	1993	1994	1995	1996	1997
South Coast	0.590	0.542	0.430	0.472	0.410	0.392	0.330	0.264
South Central Coast	0.181	0.160	0.124	0.095	0.110	0.100	0.104	0.081
San Diego	0.280	0.261	0.262	0.193	0.204	0.244	0.133	0.124
San Francisco	0.196	0.223	0.158	0.124	0.082	0.091	0.068	0.071
San Joaquin Valley	0.121	0.131	0.105	0.410	0.067	0.070	0.064	0.056
Sacramento Valley	0.070	0.075	0.058	0.051	0.181	0.053	0.054	0.053

1. Only air basins with Perchloroethylene monitoring are included in this table. Air basin population-weighted exposure is calculated using mean of monthly means for all sites within basin. Population exposure units are a concentration for a given duration per person. For this analysis, the units are ppb-year/person.

In the second part of the analysis, the overall statewide population-weighted exposure was calculated by multiplying the estimated annual average Perc exposure for a given air basin by its population, added across all basins, then divided by the total population of the State. Table VI-16 shows the estimated statewide population-weighted Perc exposure from 1990 to 1997.

Table VI-16. Estimated Statewide Population-Weighted Perchloroethylene Exposure (ppb-year/person)[1]

1990	1991	1992	1993	1994	1995	1996	1997
0.382	0.362	0.290	0.322	0.262	0.251	0.203	0.168

1. Population exposure units are a concentration for a given duration per person. For this analysis, the units are ppb-year/person

b. Statewide Exposure to MeCl and TCE

To determine ambient concentrations of MeCl and TCE, ARB staff used the statewide average concentrations from ARB's ambient toxics database. One limitation in using this data is that in many cases MeCl and TCE measurements are below the level of detection (LOD). In these cases, measured values are set to one-half the LOD. For example, over two-thirds of the MeCl measurements are below the LOD; therefore, the statewide average concentration is driven by one-half the LOD, rather than a true ambient mean. Table VI-17 shows the statewide average concentration for MeCl and TCE from 1990 to 1997.

Table VI-17. Statewide Average Concentration for MeCl and TCE (ppb)[1]

Compound	1990	1991	1992	1993	1994	1995	1996	1997
MeCl	1.09	1.27	0.75	0.93	0.79	0.77	0.66	0.66
TCE	0.115	0.086	0.061	0.036	0.047	0.035	0.034	0.033

1. Used statewide average of monthly average. Data from ARB's ambient toxics database.

5. <u>Potential Reductions in Ambient Levels of Perc, MeCl, and TCE from the Proposed ATCM</u>

In addition to the risk reduction benefits for on-site workers and near-source receptors, we would expect a reduction in overall ambient levels of Perc, MeCl, and TCE. By reducing ambient levels of these compounds, overall statewide risk reduction benefits can be achieved. The potential decrease in ambient levels of Perc, MeCl, and TCE emitted by the four product categories can be estimated if we know their contribution to ambient levels. By estimating emissions of Perc, MeCl, and TCE from the four product categories and dividing by total emissions respectively, we can estimate the percentage of Perc, MeCl, and TCE emissions attributed to the four product categories. Table V1-18 shows the reduction in ambient levels we would expect based on the proposed ATCM.

Table VI-18. Estimated Potential Reductions in Ambient Levels of Perc, MeCl, and TCE from the Proposed ATCM

Compound	Percent Reduction in Ambient Levels[1,2]
Perc	26
MeCl	5
TCE	37

1. Assumes emissions are proportional to ambient levels.
2. Inventory used to determine reduction in ambient levels does not include all sources of emissions; therefore, potential reduction may be slightly overestimated.

a. <u>Potential Reduction in Ambient Levels of Perc</u>

To estimate total statewide emissions of Perc we compiled data from ARB's 1996 Air Toxic "Hot Spots" Emission Inventory (Hot Spots Inventory), ARB's 1997 Consumer and Commercial Product Survey (Consumer Products Survey), ARB's 1997 Aerosol Coatings Inventory, and dry cleaning emissions estimates. To estimate statewide emissions from dry cleaners we used projected post-regulation emissions from the "Technical Support Document:

Proposed Airborne Toxic Control Measure and Proposed Environmental Training Program for Perchloroethylene Operations, August 27, 1993" (Perc Dry Cleaning TSD) (ARB, 1993a).

The Perc Dry Cleaning TSD estimated that dry cleaning emissions would be reduced by 78 percent from 1991 emissions to post-regulation emissions. The ATCM for Perc Dry Cleaning Operations required transfer and vented machines be phased out by October 1998; therefore, to represent 1997 emissions we assumed that approximately 75 percent of transfer and vented machines have been phased out and replaced by converted and closed loop machines. The assumptions used in Chapter 10 of the Perc Dry Cleaning TSD were used to determine that the 1991 estimate of 13.6 tons per day would be reduced to 4.7 tons per day for 1997.

We estimated that approximately 16.3 tons per day of Perc are emitted from the sources in the Hot Spots Inventory, Consumer Products Inventory, 1997 Aerosol Coatings Inventory, and estimated dry cleaning emissions. We recognize that these inventories listed above do not include all sources of Perc. For example, degreasing operations not accounted for in the Hot Spots Inventory, could account for a significant contribution to overall Perc emissions.

Therefore, this analysis may slightly underestimate total Perc emissions, thereby overestimating the potential ambient contribution from the four product categories. In the future, to allow us to better refine this analysis, ARB is currently in the process of completing an area source inventory for air toxics which will be available in 2000.

Based on the Consumer Products Inventory, we determined that Perc emissions from the four product categories account for approximately 4.2 tons per day. If we assume that Perc emissions are directly proportional to ambient levels, then we would expect that ambient concentrations of Perc would be reduced by approximately 26 percent upon full implementation of the proposed ATCM.

b. Potential Reduction in Ambient Levels of MeCl and TCE.

To estimate total statewide emissions of MeCl and TCE we compiled data from the Hot Spots Inventory, the Consumer Products Inventory, and the 1997 Aerosol Coatings Inventory. We recognize that these inventories do not include all sources of emissions of MeCl and TCE. For example, there may be some facilities that emit these compounds which were not included in the Hot Spots Inventory. Therefore, this analysis may slightly underestimate the total emissions of MeCl and TCE, thereby overestimating the potential contribution from the four product categories. We estimated that approximately 13.5 tons per day of MeCl and 0.8 tons per day of TCE are emitted from the sources in these inventories. To better refine this analysis, ARB is in the process of completing an area source inventory for air toxics which will be available in 2000.

From the Consumer Products Inventory, we determined that MeCl emissions from the four product categories account for approximately 0.7 tons per day, while TCE accounts for approximately 0.3 tons per day. If we assume that MeCl emissions are directly proportional to ambient levels, then we would expect that ambient concentrations of MeCl would be reduced by approximately 5 percent upon full implementation of the proposed ATCM. Additionally, if we assume that TCE emissions are directly proportional to ambient levels, then we would expect that ambient concentrations of TCE would be reduced by approximately 37 percent upon full implementation of the proposed ATCM.

F. Multipathway Health Risk Assessment

In evaluating the potential health effects of a pollutant, it is important to identify the different manners by which an individual could be exposed to the pollutant. The pathways that can be included in an HRA, depend on the toxic air pollutants that a person (receptor) may be exposed to, and can include inhalation, dermal exposure, and the ingestion of soil, water, crops, fish, meat, milk, and eggs. For this HRA, we are evaluating the impacts for Perc, MeCl, and TCE via the breathing or inhalation pathway only. We are not evaluating other pathways of exposure because at this time OEHHA does not routinely use methods for assessing exposure to volatile compounds such as Perc, MeCl, and TCE by exposure routes other than inhalation. Such multiple exposure pathway (multipathway) assessments are traditionally used for lipophilic (fat loving), semivolatile, or low volatility compounds such as dioxins, polycyclic organic compounds (PAHs), or polychlorinated biphenyls (PCBs) (CAPCOA, 1993).

VII. THE PROPOSED CONTROL MEASURE AND ALTERNATIVES

In the previous two chapters we assessed emissions and potential risk from the use of automotive consumer products containing the toxic air contaminants (TACs) Perc, MeCl, or TCE at automotive maintenance and repair (AMR) facilities. Statewide, we estimated that each day AMR activities emit more than five tons of Perc, MeCl, and TCE to the atmosphere.

This chapter describes and provides the basis for the proposed Airborne Toxic Control Measure for Emissions of Chlorinated Toxic Air Contaminants from Automotive Maintenance and Repair Activities. Included in the basis for the proposed control measure is a discussion of the options that staff evaluated to remove chlorinated compounds from automotive consumer products. This chapter also describes alternatives to, and the technical feasibility of, the proposed control measure.

A. The Proposed Control Measure

The proposed control measure would minimize emissions of Perc, MeCl, and TCE from automotive maintenance and repair activities by regulating automotive consumer product content and usage. Specifically, the proposed control measure requires that aerosol and liquid brake cleaners, carburetor or fuel-injection air intake cleaners (carburetor cleaners), engine degreasers, and general purpose degreasers sold or intended for sale in California not contain Perc, MeCl, or TCE. The proposed ATCM language provides for the detection limits of the prescribed test method by stating that a product is considered to contain Perc, MeCl, or TCE if it has one percent or more (by weight) of any of the three compounds Perc, MeCl, or TCE. This also addresses the issue of inadvertent contamination that may occur when manufacturers convert a production line from one product to another. The proposed ATCM also prohibits AMR facility owners and operators from using automotive consumer products that contain Perc, MeCl, or TCE in their facilities.

The first action ensures that we address residential and off-road use of aerosol and liquid automotive consumer products containing chlorinated compounds and labeled as brake cleaners, carburetor cleaners, engine degreasers, and general purpose degreasers as well as commercial use in AMR facilities. The second action ensures that facility operators do not purchase bulk liquid containers of Perc, MeCl, and TCE with the express intent of using it in a spray bottle or compressed air sprayer.

The proposed control measure would require the removal of Perc, MeCl, and TCE from any aerosol or liquid brake cleaner, carburetor cleaner, engine degreaser, or general purpose degreaser manufactured after December 31, 2002. Manufacturers would be provided an additional sell-through period of 18 months for chlorinated products manufactured prior to this date.

Facility owners and operators would be provided an additional year from the end of the sell-through period (June 30, 2004) to deplete their inventories of chlorinated products. The proposed control measure would prohibit facility owners and operators from using chlorinated automotive consumer products in their facilities after June 30, 2005.

To determine effective dates under the proposed ATCM, staff established dates consistent with some of the effective dates listed under the Consumer Products Regulation, as amended in October 1999 (ARB,1999b). For example, effective dates for brake cleaners and carburetor cleaners under the Consumer Products Regulation coincide with the December 31, 2002, effective date in the proposed ATCM. The effective date for aerosol general purpose degreasers is January 1, 2002, which is a year sooner that what is required by the proposed ATCM. For these categories, automotive consumer products manufactures would most likely conduct a one-time reformulation to comply with both the proposed ATCM and the Consumer Products Regulation. Although the December 31, 2002, effective dates in the proposed ATCM for engine degreasers and non-aerosol general purpose degreasers do not coincide with the Consumer Products Regulation, staff believes automotive consumer products manufactures will have sufficient time to reformulate to meet the December 31, 2002, effective date under the proposed ATCM. Additionally, most manufacturers already market products that comply with the proposed ATCM.

Additionally, the 18-month sell-through period under the proposed ATCM would provide sufficient time for businesses to sell automotive consumer products, based on data provided in the Proposed Amendments to the Statewide Regulation to Reduce Volatile Organic Compound Emissions from Consumer Products, Phase II, Technical Support Document, October 1991 (Phase II TSD). In surveys conducted under the Phase II TSD, the majority of businesses responded that most automotive consumer products are sold within one year (ARB, 1991b). Therefore, we have determined that an 18-month sell-through period is sufficient.

B. Basis For The Proposed Regulation

California Health and Safety Code (HSC) section 39665(b) requires the Board to address the technological feasibility of proposed ATCMs. HSC section 39665(b) also requires the Board to address the "availability, suitability and relative efficacy" of substitute products of a less hazardous nature when proposing an ATCM. To evaluate the technological feasibility and availability of the proposed ATCM, staff determined the market share of substitute or alternative products. Staff determined suitability and efficacy by reviewing product labels and interviewing users of both the products for which the limit is proposed and the alternative products.

1. Best Available Control Technology

In addition to the issues to be addressed under HSC section 39665(b), HSC section 39666 requires that any control measure for a TAC without a Board-specified threshold level be designed to reduce emissions to the lowest level achievable through the application of best available control technology (BACT) or a more effective control method. To determine BACT for automotive maintenance and repair activities for each of the four product categories under the proposed regulation, staff identified whether alternatives existed for a given product category, and then evaluated the availability, suitability, and effectiveness of the alternatives.

In evaluating BACT, staff evaluated three options. The first scenario addressed removing Perc from brake cleaning products. In consideration of interchangeability of brake cleaning compounds, the second scenario would additionally remove MeCl and TCE from brake cleaners. Finally, in consideration of the interchangeability of automotive consumer products, the third scenario would remove Perc, MeCl, and TCE from not only brake cleaning products, but the three additional product categories: carburetor cleaners, engine degreasers, and general purpose degreasers. The following discussion addresses the HSC section 39665(b) requirements for each of the three scenarios.

2. <u>Scenario 1 - Remove Perc from Brake Cleaning Products</u>

Information from the Manufacturer and Facility Surveys indicates that approximately two-thirds of brake cleaning products do not contain Perc. Additionally, the Facility Survey indicates that more than 60 percent of the facilities that use brake cleaning products use non-chlorinated brake cleaning products (see Table VII-1). Thus, non-chlorinated products are considered to be technically feasible and available. We also found that, in almost all instances, manufacturers of Perc brake cleaning products also market a non-chlorinated product and make similar claims as to suitability on the product label (see Appendix H for examples of manufacturer efficacy claims). Finally, facility operators contacted during staff site visits and representatives of brake parts manufacturers (Raybestos and Federal-Mogul) indicated that non-chlorinated aerosols and water-based brake washers, respectively, were effective brake cleaning products (Raybestos, 1999; Federal-Mogul, 1999).

Table VII-1. Facility Survey Summary of Chlorinated and Non-chlorinated Product Usage

Product Category	Total Number of Shops Using Product Category	Number and (Percent) of Shops using Selected Products			
		Non-chlorinated	Other Chlorinated [1]	Perc Only	Unknown Formulations
Brake [2,3]	3676	2256 (61)	8 (~0)	1364 (37)	48 (<1)
Carb and Fuel Injection [4]	3508	3162 (90)	291 (8)	0 (0)	55 (<1)
Engine Degreaser [4]	496	443 (89)	8 (2)	27 (5)	18 (4)
General Purpose Degreaser [4]	171	163 (95)	0 (0)	0 (0)	8 (5)

1. These products contain Perc, MeCl, or TCE, either alone or in combination.
2. Information is compiled for both bulk and aerosol brake cleaner usage.
3. Number of shops that reported using a brake cleaner, whether they reported doing brakes or not.
4. The survey requested only aerosol product usage for these categories.
5. Numbers have been rounded and may not add to 100 percent.

We also learned through our survey that almost 25 percent of facilities performing brake work did not use automotive consumer products. Instead they used water or petroleum washers, or in some cases, nothing at all. Additionally, almost 50 percent of the Facility Survey respondents already use a water-based portable brake cleaning unit in conjunction with other products, and 12 percent use a water-based portable brake cleaning unit alone.

3. Scenario 2 - Remove Perc, MeCl and TCE from Brake Cleaning Products

Facility Survey respondents also reported using brake cleaning products which were determined to contain MeCl and TCE, usually in conjunction with Perc. Scenario 2 assumes that Perc is no longer available for brake cleaning product formulations and evaluates the effect of brake cleaning products reformulated to contain a large proportion of MeCl or TCE. Based on available formulation data, MeCl and TCE, when used alone would not likely exceed 60 and 45 percent, respectively, and in combination, would not likely exceed 90 percent of the content of a product.

The unit risk factor for MeCl is approximately one-sixth that of Perc. Thus, the potential health risk for a product containing 60 percent MeCl (formulations containing 60 percent MeCl were observed during the site visits) would be one-tenth that of a 94 percent Perc product. Similarly, TCE has a unit risk approximately one-third that of Perc, so the potential health risk for a product containing 45 percent TCE (TCE is a VOC and would be limited to 45 percent by the Midterm Measures II Consumer Products Regulation) would be about one-seventh that of a 94 percent Perc product. The potential health risk for a product composed of 45 percent MeCl and 45 percent TCE would be slightly less than one-fourth that of a 94 percent Perc product.

While the potential risk for a product containing MeCl, TCE, or both is lower than for Perc, it could still be significant in some instances. For example, generic facility G2 would still exceed a 10 in a million risk level at 20 meters for both the MeCl and TCE products. As such, and in recognition of the statutory requirement for BACT and the availability of suitable and effective alternatives, staff believe that brake cleaning products should not contain MeCl and TCE.

4. Scenario 3 - Also Remove Perc, MeCl and TCE from Carburetor Cleaners, Engine Degreasers, and General Purpose Degreasers

Information from the Facility Survey, as well as discussions with AMR facility operators and the Institute for Research and Technical Assistance (IRTA), indicate that many operators use various automotive consumer products interchangeably (IRTA, 1999). For example, a mechanic may use a brake cleaner for engine and/or tool degreasing, or may use an engine degreaser or carburetor cleaner for brake cleaning. While automotive consumer products manufacturers have adamantly stated that they do not condone this activity and believe that each product is best formulated for its intended purpose, many mechanics indicated that these products are used for, and work equally well in, a variety of tasks. Therefore, it is necessary to address the potential risk posed by product interchangeability.

The practice of mechanics substituting, on an equal basis, carburetor cleaner, engine degreaser, or general purpose degreaser reformulated to contain Perc, MeCl or TCE for brake cleaning products that would no longer contain Perc, MeCl or TCE would result in potential health risks to the public analogous to those identified in section B.3. above. Again, staff evaluated the availability, suitability, and effectiveness of alternatives in the three product categories.

Table VII-1 shows the relative proportion and percent of facilities using non-chlorinated carburetor cleaning, engine degreasing and general purpose degreasing products. From the table, it can be seen that the overwhelming majority of facilities (approximately 90 percent) use non-chlorinated carburetor cleaner, engine degreaser, and general purpose degreaser. Additionally, carburetor cleaners are subject to United States Environmental Protection Agency (U.S. EPA) regulations for fuel additives (ARB, 1999b). These regulations require manufacturers to register their formulations and collectively fund a literature search on the potential health effects of the use of their products. Currently, manufacturers can only register formulations with compounds containing five elements: carbon, hydrogen, oxygen, nitrogen, and sulfur. However, formulations containing other elements were registered prior to the 1990 Clean Air Act Amendments. These formulations have been essentially "grandfathered" from the requirement that they contain only compounds with the five elements mentioned (ARB, 1999b). Some of these grandfathered products contain MeCl and Perc. Since non-chlorinated products in the three categories of interest appear to predominate, staff concluded that alternative products are technically feasibility and available. Additionally, product label claims and discussions with facility operators indicate that the alternative products are both suitable and effective.

The number of products in the carburetor cleaner, engine degreaser, and general purpose degreaser categories that contain Perc, MeCl and TCE, either in combination or alone, is small and the products themselves generally only contain a small percentage of the chlorinated compounds. As such, staff conclude that the additional requirement to remove these three compounds from carburetor cleaner, engine degreaser, and general purpose degreaser would not be an overly burdensome requirement and would reduce exposure to these compounds.

Based on this evaluation, staff believes that it is appropriate to eliminate the use of Perc, MeCl and TCE in automotive consumer products used in AMR activities, and we established the limits presented in Table VII-2.

Table VII-2. BACT Product Content Limits

Evaluation Level	Product Categories and Compounds	Chlorinated Content Limit (percent)
Scenario 1	Perc-containing brake cleaning products	<1[1]
Scenario 2	Perc, MeCl, and TCE-containing brake cleaning products	<1[1]
Scenario 3	Perc, MeCl and TCE-containing brake cleaners, carburetor cleaners, engine degreasers, and general purpose degreasers	<1[1]

1. As previously mentioned, the language of the proposed ATCM provides that a product is considered to contain Perc, MeCl, or TCE if it contains one percent or more by weight of any one of the three compounds.

C. Alternatives to The Proposed Control Measure

Alternatives to the proposed control measure, other than taking no action, include workplace practices and two product modification options. We evaluated each of the three alternatives and determined that they would not be as effective at reducing emissions of Perc, MeCl, and TCE from AMR activities as the proposed control measure. We also determined that the three alternatives did not meet the objective of HSC section 39666 to reduce emissions to the lowest level achievable through the application of BACT or a more effective control method in consideration of cost, risk, and environmental impacts.

This section discusses each of the three alternatives and provides the reasons they were considered to be less effective than the proposed regulation. For each of the three alternatives evaluated, other than the "No Action" alternative, staff addressed four issues: applicability, effectiveness, enforceability, and cost/resource requirements.

1. Alternative One - No Action

The "no action" alternative would not address the potential risk posed by the use of automotive consumer products containing Perc, MeCl, and TCE in AMR activities. As evidenced by the potential health impacts discussed in Chapter VI, this alternative would not be protective of public health.

2. Alternative Two - Workplace Practices

The workplace practices alternative would require that AMR facility operators implement process controls including: (1) the use of a reservoir to capture any runoff from the use of brake cleaning products, and (2) the disposal of the runoff as a hazardous waste. This alternative would apply only to the brake cleaning product category.

a. Applicability

This alternative would not address the capture of brake cleaning products used for applications other than brake cleaning. It additionally would not address the capture of carburetor cleaner, engine degreaser, or general purpose degreaser unless they were being used for brake cleaning. Finally, it would not address the use of these products in other industrial, institutional, and residential settings.

b. Effectiveness

Information from the manufacturing industry indicates that workplace standards could achieve capture efficiencies of approximately 43 percent for disk brakes and 68 percent for drum brakes (CRC, 1998). Staff estimated that an average facility performs 25 percent of its brake jobs on drum brakes and 75 percent on disk brakes, and would therefore expect to observe an average capture efficiency of 50 percent. Thus, a facility (with a 50 percent capture efficiency) that currently exceeds a 22 chances in a million risk level from automotive maintenance and repair activities would still exceed the10 chances in a million "Hot Spots" notification level established by most air pollution control and air quality management districts (districts) after implementing the workplace standards outlined in this control alternative. Additionally, residual risk posed by these facilities would still have to be addressed. In light of the availability of alternative products that contain no chlorinated compounds, a measure that only addressed 50 percent of emissions would not be considered BACT.

c. Enforceability

As part of this alternative, the manufacturing industry indicated that they would participate in an education program by including workplace standard information in their labeling. We believe that, even with an education program, many facilities would not use capture reservoirs in the absence of district inspectors. Discussions with several operators indicate that they would not be inclined to capture runoff unless they were being watched. It is unlikely that this alternative could be adequately enforced by the State's districts and the Board.

d. Cost and Resource Requirements

Currently, many facility operators have either water washers or parts washers in their facilities. The trend in the automotive repair industry appears to be toward a mobile parts washer that could be wheeled under vehicles for performing brake services. The proposed concept would require facility operators to procure another reservoir specifically for brake service operations to avoid contamination of the fluids used in their water washers or parts washers. This is necessary because the hazardous waste companies that collect spent baths set strict limits on the level of contamination by chlorinated solvents. This separate waste stream would result in increased disposal costs and might require modifications to the facility's DTSC permit for on-site hazardous waste storage.

As enforcement would be conducted predominantly by the districts, the burden of enforcement costs would fall to them. However, several larger districts already inspect AMR facilities, generally in connection with degreasing rules, and the incremental cost of this alternative would likely be minimal. Cost estimates for district inspectors to enforce the proposed ATCM are addressed in Chapter IX.

3. Alternative Three - Product Modification / Risk-based Content Limits

This alternative falls into the product modification category and would require that automotive consumer products manufacturers establish chlorinated compound content limits that would result in the potential risk of a product falling below a prescribed risk level.

a. Applicability

This alternative could be applied to the brake cleaner product category alone, or to all four product categories. In either case, this alternative would address both institutional/industrial and residential use. In other words, it provides emissions reductions from both "hot spots" (AMR facilities) and non-"hot spot" area sources (residential usage). It additionally addresses use outside the automotive maintenance and repair activities arena.

b. Effectiveness

This alternative would require the establishment of a product content cap based on a corresponding acceptable risk level (an acceptable number of chances in a million), and ignores the requirement for best available control technology. In addition to not addressing the requirement for BACT, this alternative is dependent upon the meteorological data set chosen for modeling. Thus the product content cap necessary to avoid exceeding a set risk level in one geographic location in the State would not be sufficient to avoid exceeding the same risk level in another location.

If this alternative addressed Scenario 1, it could lead to increased MeCl and TCE use in brake cleaners. If this alternative addressed Scenario 2, it could lead to increased Perc, MeCl and TCE use in carburetor cleaners, engine degreasers, and general purpose degreasers.

Regardless of whether this alternative addressed Scenario 1, Scenario 2, or Scenario 3, it would likely result in increased VOC use and emissions. Each subsequent scenario would have greater potential VOC usage and emissions. If manufacturers could market chlorinated automotive consumer products meeting the risk-based content limits prescribed by this alternative, then the continued use of chlorinated compounds would be greater than with Alternative Four or the proposed control measure. Thus, this alternative would likely result in lower VOC use and emissions than Alternative Four or the proposed control measure.

c. Enforceability

Primary responsibility for enforcement of this alternative, as with all ATCMs, would be with the districts. However, HSC section 39669 also grants ARB enforcement authority. As many districts do not have the inherent capability to analyze consumer products, it is possible that the ARB might have to provide laboratory and compliance assistance. This alternative is more enforceable than Alternative Two (workplace standards) because it regulates fewer sources - manufacturers instead of facilities. There is also a clear cut test method for determining compliance versus having to observe facility operators using or not using capture reservoirs.

d. Cost and Resource Requirements

This alternative would have a fiscal impact on the State and air districts, as well as an economic impact on business. The impact on AMR facilities would be minimal. The impact on the districts would be dependent upon how heavily they had to rely upon the ARB's laboratory and compliance resources. If districts elected to establish a memorandum of understanding with the ARB authorizing the ARB's Compliance Division to enforce the ATCM, then enforcement could be conducted in conjunction with enforcement of the Consumer Products Regulations. In other words, the division of fiscal impacts between state and district entities would depend largely upon where the split in agreed upon enforcement responsibility lies.

4. Alternative Four - Product Modification / Chlorinated Compound Phase Out

This alternative also falls into the product modification category and would require that automotive consumer products manufacturers remove chlorinated compounds from the four product categories in discrete steps.

a. Applicability

This alternative could be applied to the brake cleaner product category alone, or to all four product categories. In either case, this alternative would address both institutional/industrial and residential use.

b. Effectiveness

This alternative would require the removal of one or more of the compounds Perc, MeCl, or TCE from up to four automotive consumer products categories depending upon the control scenario selected, but would accomplish the removal through a series of sequential reductions. As such, it would eventually represent BACT. However, it would not be as effective in reducing chlorinated emissions as the proposed control measure because it would not remove the chlorinated compounds as quickly.

If this alternative addressed Scenario 1, it could lead to increased MeCl and TCE use in brake cleaners. If this alternative addressed Scenario 2, it could lead to increased Perc, MeCl and TCE use in carburetor cleaners, engine degreasers, and general purpose degreasers.

Regardless of whether this alternative addressed Scenario 1, Scenario 2, or Scenario 3, it would likely result in increased VOC use and emissions. Each subsequent scenario would have greater potential VOC usage and emissions. This alternative, regardless of scenario, would result in lower VOC use and emissions than the proposed control measure because it would not remove the chlorinated compounds as quickly.

c. Enforceability

Primary responsibility for enforcement of this alternative, as with all ATCMs, would be with the districts. However, HSC section 39669 also grants ARB enforcement authority. As many districts do not have the inherent capability to analyze consumer products, it is possible that the ARB might have to provide laboratory and compliance assistance. This alternative is more enforceable than Alternative Two (workplace standards) because it regulates fewer sources - manufacturers instead of facilities. There is also a clear cut test method for determining compliance versus having to observe facility operators using or not using capture reservoirs. This alternative would be more difficult to enforce than the proposed control measure because there could be several intermediate content limits which could have an impact on laboratory testing and the need to re-educate compliance personnel as each new limit became effective.

d. Cost and Resource Requirements

This alternative would have a fiscal impact on the State and air districts, as well as an economic impact on business. The impact on AMR facilities would be minimal. The impact on the districts would be dependent upon how heavily they had to rely upon the ARB's laboratory and compliance resources. If districts elected to establish a memorandum of understanding with the ARB authorizing the ARB's Compliance Division to enforce the ATCM, then enforcement could be conducted in conjunction with Compliance Division enforcement of the Consumer Products Regulations. In other words, the division of fiscal impacts between state and district entities would depend largely upon where the split in agreed upon enforcement responsibility lies.

D. Evaluation of the Proposed Control Measure

In Part B., staff discussed selecting Scenario 3 as the basis for the proposed control measure. Staff addressed the same four issues of applicability, effectiveness, enforceability, and cost/resource requirements when considering the proposed control measure.

1. Applicability

The proposed control measure could be applied to the brake cleaner product category alone, or to all four product categories. In either case, this alternative would address both institutional/industrial and residential use.

2. Effectiveness

The proposed control measure would require the removal of Perc, MeCl, and TCE from all four automotive consumer products categories without the use of sequential reductions. As with Alternative Four (phase out), it would represent BACT; however, it would achieve greater emissions reductions because BACT would be achieved much sooner.

Again, the proposed control measure could lead to increased MeCl and TCE use in brake cleaners if it addressed Scenario 1. The proposed control measure could lead to increased Perc, MeCl and TCE use in carburetor cleaners, engine degreasers, and general purpose degreasers if it addressed Scenario 2. Thus, the proposed control measure addresses Scenario 3.

Regardless of whether the proposed control measure addressed Scenario 1, Scenario 2, or Scenario 3, it would likely result in increased VOC use and emissions. Each subsequent scenario would have greater potential VOC usage and emissions. The proposed control measure, regardless of scenario, would result in higher VOC use and emissions than Alternatives Three or Four because it requires that the chlorinated content not exceed one percent, and does not provide for sequential reductions.

3. Enforceability

Primary responsibility for enforcement of the proposed control measure, as with all ATCMs, would be with the districts. However, HSC section 39669 also grants ARB enforcement authority. As many districts do not have the inherent capability to analyze consumer products, it is possible that the ARB might have to provide laboratory and compliance assistance. The proposed control measure is more enforceable than Alternative Two (workplace standards) because it regulates fewer sources - manufacturers instead of facilities. There is also a clear cut test method for determining compliance versus having to observe facility operators using or not using capture reservoirs. The proposed control measure would be the easiest to enforce.

4. Cost and Resource Requirements

The proposed control measure would have a fiscal impact on the State and air districts, as well as an economic impact on business. The impact on AMR facilities would be minimal. The impact on the districts would be dependent upon how heavily they had to rely upon the ARB's laboratory and compliance resources. If districts elected to establish a memorandum of understanding with the ARB authorizing the ARB's Compliance Division to enforce the ATCM, then enforcement could be conducted in conjunction with enforcement of the Consumer Products Regulations. In other words, the division of fiscal impacts between state and district entities would depend largely upon where the split in agreed upon enforcement responsibility lies.

VIII. POTENTIAL HEALTH IMPACTS OF THE PROPOSED AIRBORNE TOXIC CONTROL MEASURE

This chapter discusses the potential health impacts of this proposed Airborne Toxic Control Measure (ATCM). The topics addressed below include the benefits of the proposed ATCM toward statewide emissions and potential health impacts, a general assessment of the potential health impacts that could result from the remaining chemical ingredients used in the four product categories, and a general discussion of workplace exposure.

A. Statewide Emissions and Risk Reduction Benefits of the Airborne Toxic Control Measure

Since the proposed ATCM would result in the removal of Perc, MeCl, and TCE in the four product categories, the emission and health impact (i.e., potential cancer risk) reduction benefits are 100 percent. A total reduction of 5.17 tons per day of Perc, MeCl, and TCE could be achieved as a result of the proposed ATCM. As presented in Chapter VI, an additional benefit of the proposed ATCM is a reduction in ambient levels of Perc, MeCl, and TCE. Overall we estimated a reduction in ambient levels of Perc by 26 percent, MeCl by 5 percent, and TCE by 37 percent. By reducing ambient levels of these compounds, overall statewide risk reduction benefits can be achieved.

In determining the potential reduction in ambient levels from the proposed ATCM, we assumed that a proportionality of emissions can be used to calculate ambient levels of Perc, MeCl, and TCE. In addition, we compiled inventory data to determine the percentage of emissions from the four product categories. This percentage was then applied to the total ambient concentration to determine the percentage of each compound attributed to the four product categories. Note, however that some sources of Perc, MeCl, and TCE emissions may not be accounted for in the inventory data used and therefore the reduction in ambient levels may be slightly overestimated. See Chapter VI, Section 5 for a complete discussion on potential reduction in ambient levels of Perc, MeCl, and TCE.

B. Potential Adverse Health Effects from Use of Volatile Organic Compounds

The intent of this exercise was to determine what the potential health impacts could be from the remaining chemical constituents currently used in these four product categories if Perc, MeCl, and TCE are removed and secondly, if only Perc is removed. To perform this evaluation, Material Safety Data Sheets (MSDS) were used to obtain chemical ingredient information for products that AMR facilities reported using in the Facility Survey. The MSDS information was obtained by calling the manufacturers or distributers directly, or if available, from a manufacturer’s web site. In addition, a list of ingredients for these four product categories was obtained from the 1997 Consumer and Commercial Products Survey. A complete list of the chemical ingredients for the four product categories can be found in Appendix G. The listing of chemical ingredients in Appendix G identifies whether these compounds are regulatory defined as volatile organic compounds (VOCs), are identified or candidate toxic air contaminants (TACs) under California's Air Toxics Program, and whether the substance has approved cancer and non-cancer health effects values.

In addition to those currently used in the four automotive consumer product categories, staff intends to monitor the usage of other identified TACs and will propose amendments to the ATCM if appropriate. Additionally, product manufacturers will be advised to not use identified TACs in their product formulations.

For this exercise, we assumed that any of the chemical ingredients meeting this criteria could have a maximum content of 45 percent. The 45 percent VOC limit is used because that was the limit established for brake cleaners in the October 1999 Amendments to the Consumer Products Regulation approved by the ARB in October 1999. The VOC content limit for the four product categories range from 35 to 50 percent in the October 1999 amendments.

1. <u>VOCs that are Candidate or Identified TACs</u>

a. <u>Scenario One: Removal of Perc, TCE, and MeCl</u>

Under this scenario, we used the information in Appendix G to see what the potential individual health impacts could be for chemical ingredients that are regulatory defined as both volatile organic compounds (VOCs) and candidate or identified TACs if Perc, MeCl, and TCE are removed.

As a screen to determine the worst-case scenario, we identified the individual ingredients from Appendix G that have the highest cancer potency and/or lowest non-cancer chronic or acute reference exposure levels (RELs). Benzene is the only ingredient in Appendix G that has a cancer potency factor. Eight ingredients have acute and/or chronic RELs. Of those eight, naphthalene had the lowest chronic REL and benzene had the lowest acute REL.

No adverse health impacts from the compounds on this list (other than Perc, MeCl, and TCE) are expected. The apparent use of benzene (which is a TAC as well as a VOC) was a concern for staff; however, upon further investigation, staff learned that it was only used by one manufacturer (in one product) at concentrations less than two percent (a second manufacturer indicated they had one product in which benzene was a contaminant). Staff intends to monitor the usage of other TACs and will propose amendments to the ATCM if appropriate. Additionally, manufacturers will be advised to not use identified TACs in their product formulations.

b. Scenario Two: Removal of Perc

The removal of Perc from the four product categories leaves TCE, a TAC and VOC, as an ingredient with the potential for expanded use in these products. Additionally, MeCl may also be used to further increase the chlorinated content of a reformulated product. Looking specifically at aerosol brake cleaners as an example, TCE (a VOC) is subject to a 45 percent VOC limit as specified in the ARB's consumer product regulations. While there are no such restrictions for MeCl, however, the total chlorinated content for this exercise is being capped at 90 percent. A 90 percent cap allows for the inclusion of other compounds as well as propellants. Table VIII-1 summarizes the impact of Perc replacement in brake cleaners compared to current emissions.

Table VIII-1. Potential TCE and MeCl Emissions After Removal of Perc from Aerosol Brake Cleaners

Compound	Current Emissions from Brake Cleaners [lbs/yr][1]	Emissions With Replacement of Perc [lbs/yr]	
		45% TCE	45% TCE/45% MeCl
Perc	2,978,400	0	0
MeCl	211,700	0	1,340,280
TCE	58,400	1,340,280	1,340,280

1. Based on ARB surveys.

From a risk standpoint, the individual potential cancer risk would decrease by approximately 84 percent when compared to the potential individual health risk for AMR facilities using Perc-containing products. An 84 percent decrease would result in a potential cancer risk of approximately 21 chances per million at the near-source (20 meter) location for the generic facilities using default meteorological data. Regarding non-cancer health impacts, the chronic hazard indices for TCE at a 45 percent content level is less than 0.1 for the generic facilities using default meteorological data. Generally, hazard indices less than one are not considered to be a concern to public health.

The use of a TCE/MeCl product at a 90 percent combination content level (45 percent each) would result in approximately a 75 percent decrease in the individual potential cancer risk when compared to the potential individual health risk for AMR facilities using Perc-containing products. While this decrease may sound significant, this still could pose a potential cancer risk of approximately 31 chances per million at the near-source (20 meter) location for the generic facilities using default meteorological data. Regarding non-cancer health impacts, the chronic hazard indices for TCE/MeCl product at a 90 percent content level is less than 0.1 for the generic facilities using default meteorological data. Generally, hazard indices less than one are not considered to be a concern to public health.

2. VOCs that are Not Candidate or Identified TACs

The second group of ingredients that were evaluated included those that are VOCs but that are not a candidate or identified TAC. None of the ingredients in Appendix G that meet this criteria have cancer potency factors. One of the ingredients (2-butoxyethanol) listed in Appendix G has both an acute and chronic REL. The acute and chronic hazard indices for this ingredient at the 45 percent content level are less than 0.5 for the generic facilities using default meteorological data. Generally, hazard indices less than one are not considered to be a concern to public health.

C. Replacement With Other Toxic Air Contaminants that are Not Volatile Organic Compounds

1. Scenario One: Removal of Perc, TCE, and MeCl

For this portion of the evaluation, we reviewed the ingredients listed in Appendix G to determine if any are candidate or identified TACs that are not classified as VOCs. There are no ingredients which satisfy this criteria and have an approved cancer potency factor. Two ingredients, have an acute and/or chronic RELs. Of those, ammonia had both the lowest chronic and acute RELs. The acute and chronic hazard indices for this ingredient at the 45 percent content level are less than 0.2 for the generic facilities using default meteorological data. Generally, hazard indices less than one are not considered to be a concern to public health.

In addition to those currently used in the four automotive consumer product categories, staff intends to monitor the usage of other identified TACs and will propose amendments to the ATCM if appropriate. Additionally, product manufacturers will be advised to not use identified TACs in their product formulations.

2. Scenario Two: Removal of Perc

The removal of Perc from the four product categories leaves MeCl, a TAC that is not a VOC, as an ingredient with the potential for expanded use in these products. During the site visits, products were observed with MeCl content as high as 60 percent. Additionally, TCE may be used to further increase the chlorinated content of a reformulated product, subject to the 35 to 50 percent VOC limit specified in the ARB's consumer product regulations (TCE is a VOC). Again, in order allow for the inclusion of other compounds and propellants for aerosol products, the total chlorinated content for this exercise is being capped at 90 percent. Table VIII-2 summarizes the impact of Perc replacement compared to current emissions for aerosol brake cleaners as an example.

From a risk standpoint, the individual potential cancer risk would decrease by approximately 89 percent when compared to the potential individual health risk for AMR facilities using Perc-containing products. An 89 percent decrease would result in a potential cancer risk of approximately 14 chances per million at the near-source (20 meter) location for the generic facilities using default meteorological data. Regarding non-cancer health impacts, the acute and chronic hazard indices for MeCl at a 60 percent content level are less than 0.1. Generally, hazard indices less than one are not considered to be a concern to public health.

Table VIII-2. Potential MeCl and TCE Emissions After Removal of Perc from Aerosol Brake Cleaners

Compound	Current Emissions from Brake Cleaners [lbs/yr][1]	Emissions With Replacement of Perc [lbs/yr]	
		60% MeCl	45% MeCl/45% TCE
Perc	2,978,400	0	0
MeCl	211,700	1,787,040	1,340,280
TCE	58,400	0	1,340,280

1. Based on ARB surveys.

As mentioned above, the use of a TCE/MeCl product at a 90 percent combination content level (45 percent each) would result in approximately 75 percent decrease in the individual potential cancer risk when compared to the potential individual health risk for AMR facilities using Perc-containing products. While this decrease may sound significant, this still could pose a potential cancer risk of approximately 31 chances per million at the near-source (20 meter) location for the generic facilities using default meteorological data. Regarding non-cancer health impacts, the chronic hazard indices for TCE/MeCl product at a 90 percent content level is less than 0.1 for the generic facilities using default meteorological data. Generally, hazard indices less than one are not considered to be a concern to public health.

D. Replacement With Compounds that are Not Toxic Air Contaminants or Volatile Organic Compounds

None of the compounds listed in Appendix G of the TSD meet this criteria.

E. Workplace Exposure

Perc, TCE and MeCl are probable human carcinogens. The California Department of Industrial Relations-Division of Occupational Safety and Health Administration (Cal/OSHA) regulates Perc, TCE and MeCl in the workplace environment. To protect worker safety, Cal/OSHA has established a permissible exposure limit (PEL) for the compounds. The PEL is the maximum, eight-hour, time-weighted average concentration for occupational exposure and is 25 ppmv for Perc, TCE and MeCl. Since the proposed ATCM will remove these compounds from automotive consumer products, worker exposure to Perc, MeCl, and TCE from automotive consumer product use will be eliminated.

IX. ECONOMIC IMPACTS OF THE PROPOSED AIRBORNE TOXIC CONTROL MEASURE

A. Summary of Economic Impacts

No significant economic impacts are expected from the proposed Airborne Toxic Control Measure (ATCM). Automotive consumer products are manufactured or marketed by 60 companies nationwide, with ten based in California. Most manufacturers already have at least one non-chlorinated volatile organic compound (VOC) product on the market that meets the requirements of the proposed ATCM, and therefore, are not expected to incur additional costs. Those companies that do not currently have VOC products and choose to formulate one are expected to be able to absorb the cost of reformulation with no adverse impacts on their profitability.

The analysis showed that raw materials costs for chlorinated Toxic Air Contaminant (TAC) products are greater than the raw materials costs for VOC products. As a result, it should be less costly to manufacture non-chlorinated VOC products as opposed to products that contain perchloroethylene (Perc), methylene chloride (MeCl), or trichloroethylene (TCE). However, there are no noticeable differences between the market prices for chlorinated TAC and VOC products. Therefore, there should be no economic impact on the consumer.

The economic analysis focused on worse case assumptions. It was assumed that the costs to comply with this ATCM would be the same costs that a company would incur if they were reformulating a product to meet a new VOC limit under the Consumer Products Program. Essentially, each manufacturer and marketer is assumed to "reinvent the same wheel" and directly conduct all reformulation, and research and development efforts. By doing this, we were very conservative in an effort to estimate costs.

Overall, most affected businesses will be able to absorb the costs of the proposed ATCM with no significant adverse impacts on their profitability. This finding is indicated by the staff's analysis of the estimated change in "return on owner's equity" (ROE). The analysis found that the overall change in ROE ranges from negligible to a decline in ROE of about six percent, with an average decline in ROE of about two percent. However, the proposed ATCM may impose economic hardship on some businesses with small or no margin of profitability. If necessary, these businesses can seek relief under the variance provision of the proposed ATCM. A variance may provide sufficient time to minimize the cost impacts to these businesses. Because the proposed ATCM 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.

Our analysis shows that the cost-effectiveness of the proposed requirements is similar to the cost-effectiveness of previously approved ATCMs (Perc Dry Cleaning Operations ATCM, Ethylene Oxide ATCM, Non-Ferrous Metal Melting ATCM). The estimated cost-effectiveness of the proposed ATCM for reducing a pound of TAC, specifically Perc, MeCl, and TCE, range from no cost (net savings or no cost) to about $0.23 per pound of TAC reduced (in 1999 dollars). The cost-effectiveness that considers the emission and health impact reduction benefits ranges from approximately $1,400 to $111,000 per cancer case avoided. These ranges are significantly less than previously approved ATCMs, which generally have fallen within an overall range of $0.64 to $1.77 (adjusted to 1999 dollars) per pound of Perc reduced (1993 Perchloroethylene Dry Cleaning Operations ATCM) and $6,600 to $18.6 million (adjusted to 1999 dollars) per cancer case avoided (1992 Non-Ferrous Metal Melting ATCM).

While determining the maximum and minimum cost-effectiveness values is useful for establishing boundaries, it is also useful to determine the average cost-effectiveness of the proposed ATCM. 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 ATCM 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 the ATCM. Overall, the emission reductions-weighted average (ERWA) cost-effectiveness for the proposed ATCM is about $0.03 per pound of TAC reduced. That is, the average cost to reduce one pound of TAC averaged across all the categories subject to the proposed ATCM is less than five cents. 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 costs, which generally have the biggest influence in product costs for most consumer product categories. Our analysis indicates that raw material costs for chlorinated TAC products are greater than for VOC products which comply with the proposed ATCM. Therefore, raw material cost changes should be negligible (net savings or no cost). Again, this compares favorably to the change in per unit cost projected for the existing 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 or higher at the actual compliance dates. To the extent that the projected cost savings or increases are ultimately passed on to the consumer, the actual retail price of products after the proposed limits become effective may be higher or lower than suggested by this analysis.

Even if all annualized nonrecurring costs (research and development, capital equipment purchases, etc.) and recurring raw material cost increases are factored into the affected products manufacturing costs, the potential increase in production per-unit costs are comparable to existing ARB consumer product regulations. The estimated per-unit cost increases from both annualized nonrecurring and annual recurring costs range from negligible cost (net savings or no cost) to about $0.09 per unit. When averaged over the total number of unit sales in California of regulated products, the unit sales-weighted average cost increase is about $0.02 per unit. As noted before, these per unit cost increases compare favorably to the change in per unit cost projected for existing ARB consumer product regulations.

B. Economic Impacts Analysis on California Businesses as Required by The California Administrative Procedure Act (APA)

1. 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.

Health and Safety Code section 57005 requires the ARB to perform an economic impact analysis of submitted alternatives to a proposed regulation before adopting any major regulation. A major regulation is defined as a regulation that will have a potential cost to California business enterprises in an amount exceeding ten million dollars in any single year. The proposed ATCM is not a major regulation.

2. Potential Impact on California Businesses

Overall, most affected businesses will be able to absorb the costs of the proposed ATCM 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. If necessary, these businesses can seek relief under the variance provision of the proposed ATCM for extensions to their compliance dates. Such extensions may provide sufficient time to minimize the cost impacts to these businesses. Because the proposed ATCM 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.

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 requirements. The data used in this analysis are obtained from publicly available sources, the ARB's 1997 Consumer and Commercial Products Survey, and the staff's cost-effectiveness analysis discussed later in this chapter.

3. Affected Businesses

Any business which manufactures or markets chlorinated automotive consumer products would potentially be affected by the proposed ATCM. Also potentially affected are businesses which supply raw materials to these manufacturers or marketers, distribute or retail, and use chlorinated automotive consumer products. The focus of this analysis, however, is on manufacturers or marketers because these businesses are directly affected by the proposed ATCM.

Automotive consumer products are manufactured or marketed by 60 companies nationwide, of which ten (mostly medium- or small-sized firms) are based in California according to the ARB's Consumer Products Registration Database. These companies manufacture and market an estimated total of 186 VOC and 66 chlorinated TAC products. California companies accounted for nine percent of chlorinated TAC and VOC products manufactured or marketed in California as shown in Table IX-1.

Table IX-1. Number of Chlorinated TAC and VOC Products Marketed in California

Product Type	California Firms		Non-California Firms		Total	
Chlorinated TAC Products	6	9%	60	91%	66	100%
VOC Products	16	9%	170	91%	186	100%
Total	22		230		252	
Firms	10		50		60	

All affected products are classified under Standard Industrial Classification (SIC) 2842 or the new North American Industry Classification System (NAICS) 325612. A list of these products is provided in Table IX-2. The product category with the most chlorinated TAC products is automotive brake cleaners (2202), followed by general purpose degreasers (5203c), carburetor cleaners (2203), and engine degreasers (2204a).

Table IX-2. Affected Product Categories

Code	Category	Products	
		VOC	Chlorinated TAC
2202	Automotive Brake Cleaners	61	37
2203	Carburetor Cleaners	45	11
2204a	Engine Degreasers	56	6
5203c	General Purpose Degreasers (including aerosol Solvent Parts Cleaners)	24	12

a. Study Approach

This study covers one industry with 60 affected businesses. The approach used in evaluating the potential economic impact of the proposed ATCM on these businesses is outlined as follows:

- A sample of three representative businesses of different sizes was selected from the list of 60 affected businesses based on the size of their sales and number of noncompliant products they manufacture or market;
- Compliance cost was estimated for each of these businesses;
- Estimated cost was adjusted for federal and state taxes; and,
- The three-year average ROE was calculated, where data was available, for each of these businesses by averaging their ROEs for 1996 through 1998. 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 10 percent in profitability is considered to indicate a potential for significant adverse economic impacts.

The threshold value of 10 percent has been used consistently by the ARB staff to determine impact severity (ARB, 1990b; ARB, 1991b; ARB, 1995; ARB, 1999b). This threshold is consistent with the thresholds used by the United States Environmental Protection Agency and others.

b. Assumptions

The ROEs before and after the subtraction of the adjusted compliance costs were calculated for each size business using financial data for 1996 through 1998. The calculations were based on the following assumptions:

- Selected businesses are representative of affected businesses;
- All affected businesses were subject to the highest federal and state corporate tax rates of 35 percent and 8.8 percent respectively; and,
- 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; however, they may not be applicable to all businesses.

c. Results

Typical California businesses are affected by the proposed ATCM to the extent that the additional costs imposed by the proposed requirements would change their profitability. A detailed analysis of these costs is provided in the cost-effectiveness section of this report. The cost analysis shows that the estimated annualized costs of reformulating a noncompliant product will range from $1,392 to $17,840, with an average of $9,616 (see Table IX-4).

Using ROE to measure profitability, we found that the average ROE of sample businesses in the automotive consumer products industry declined by about 2.04 percent as shown in Table IX-3. This represents a minor change in the average profitability of sample businesses.

Table IX-3. Changes in Return on Owner's Equity (ROEs) for Typical Businesses in Automotive Consumer Products Industry

Size	Change in ROE
Small	6.01%
Medium	0.07%
Large	0.04%
Average	**2.04%**

Note: all "change in ROEs" shown are negative (i.e., shows a decline in profitability)

The projected change in profitability of typical businesses in the automotive consumer products industry varied widely. The predicted decline in profitability of sample businesses ranged from a high of about 6.01 percent for a small business to a low of 0.04 percent for a large business, as shown in Table IX-3. This variation in the impact of the proposed ATCM can be attributed mainly to two factors. First, large businesses incur higher costs due to the number of noncompliant (chlorinated TAC) products they manufacture or market. For example, the estimated annualized costs for sample businesses ranged from a high of about $67,300 to a low of about $28,800. Second, the performance of businesses may differ from year to year. Hence, the average 1996 through 1998 financial data used may not be representative of an average-year performance for some businesses.

The estimated changes to 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 in the long run. 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.

4. Potential Impact on Consumers

The potential impact of the proposed ATCM on consumers depends upon how it would change the price and performance attributes of chlorinated TAC products. Currently, there are no noticeable differences between the market prices for chlorinated TAC and VOC products. These products are basically interchangeable. According to the industry sources, both chlorinated TAC and VOC products have basically the same performance attributes, except that many chlorinated TAC products are nonflammable while VOC products are typically flammable. (For a discussion of flammability, see Chapter X, Section F). Given the availability of good substitute products, it is unlikely that affected businesses will be able to pass on the cost increases to consumers. Thus, we estimated that the cost increase per unit will range from no change to $0.09, with an average of about $0.02.

The proposed ATCM, however, may limit the product choices available to consumers by requiring manufacturers not to sell chlorinated TAC products in California. This may not be a major problem because there is more demand for VOC products than for chlorinated TAC products in the market. According to the ARB 1997 Consumer Products Survey, there are three VOC products in the market for every one chlorinated TAC product. Presently, the market sales for these products is split approximately 60 and 40 percent between VOC and chlorinated TAC products. According to the industry sources, about 90% of these products are used for non-residential applications. Automotive repair facilities may have an incentive to reduce their uses of chlorinated TAC products because it would reduce the amount of hazardous waste generated, thus reducing their disposal costs.

5. Potential Impact on Employment

The proposed ATCM is not expected to cause a noticeable change in California employment and payroll because the contribution of the affected industry to the California economy is marginal. California accounts for a small share of manufacturing employment for automotive consumer products. According to the 1997 Economic Census, California employment in the industry (NAICS 325612/SIC 2842, which includes establishments engaged in manufacturing and packaging polishes and speciality cleaning preparations) was 1,669 in 1997, or about 7.6 percent of the national employment in the industry. This also represents only about 0.09 percent of the total manufacturing jobs in California. These employees working in 83 establishments generated about $51 million in payroll, accounting for less than 0.02 percent of total California manufacturing payroll in 1997. Twenty-three establishments had over 20 employees; the rest had less than 20 employees each.

The employment in the speciality cleaning preparations industry is unlikely to change significantly as a result of the proposed ATCM. This is because, as shown above, affected manufacturers or marketers are able to absorb the reformulation costs with no significant impact on their profitability. The bulk of brake cleaning products, however, are used by brake repair shops. In 1997, California automotive speciality repair shops (SIC 7539), which included brake repair shops, employed 6,128 persons with a payroll of about $144 million. The employment in these shops is unlikely to be affected adversely by the proposed ATCM. This is because we do not expect a noticeable change in the prices of reformulated products. The availability of good substitute products in the market is likely to prevent affected manufacturers or marketers from passing along the reformulation costs to their consumers in the form of higher prices.

6. Potential Impact on Business Creation, Elimination or Expansion

The proposed ATCM 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 of the proposed ATCM may be warranted.

While some individual businesses may be affected adversely, the proposed ATCM may provide business opportunities for existing California businesses or result in the creation of new businesses. California businesses which supply raw materials or provide consulting services to affected industries may benefit from increased industry spending on reformulation.

7. Potential Impact on Business Competitiveness

The proposed ATCM should have no significant impact on the ability of California businesses to compete with businesses in other states. Because the proposed ATCM would apply to all businesses that manufacture or market automotive consumer products for sale in California regardless of their location, the staff’s proposal should not present any economic disadvantages specific to California businesses. Of a total of 60 companies involved in manufacturing or marketing automotive consumer products, ten were located in California. Only three of ten California companies manufactured or marketed chlorinated TAC products subject to the proposed ATCM. These companies manufactured or marketed only 6 out of 66 noncompliant TAC products.

Nonetheless, the proposed ATCM 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. As stated above, such impacts can be mitigated to a degree with a justifiable compliance extension under the variance provision of the proposed ATCM.

C. Analysis of Potential Impacts to California State or Local Agencies

The proposed ATCM should have no economic impact on State agencies. There are no State agencies that manufacture or market automotive consumer products which are subject to the proposed ATCM. However, the Air Resources Board (ARB or Board) may incur additional implementation or enforcement costs at some future time.

The proposed ATCM should have minimal economic impacts on the local air pollution control and air quality management districts (districts). Health and Safety Code section 39666 requires that after the adoption of the proposed ATCM by the Board, the districts must enforce the ATCM or adopt and enforce an equal or more stringent regulation. Beginning in 2005, the districts, during their normal course of business, will be responsible for determining if automotive maintenance and repair (AMR) facilities are using complying automotive consumer products as defined by the proposed ATCM. The inspection for complying automotive consumer products should add very little time to the total time it takes to conduct an inspection. Because AMR facilities are currently not required to be permitted by the districts, we are unable to estimate how many AMR facilities a district will visit during the course of a year. Therefore, the total economic impact on the districts cannot be quantified. However, the cost for a district inspector to perform an AMR facility inspection is estimated to range from $50 to $83 per hour (AQMD, 2000).

D. Analysis of the Cost-Effectiveness of the Proposed ATCM

This is the first ATCM to address consumer products. Therefore, to evaluate the cost-effectiveness for this ATCM, we used methods that have been used in the past for both the Toxic Air Contaminant Control Program and the Consumer Products Program. For a VOC or criteria pollutant regulation, the cost effectiveness is usually assessed on the basis of the cost per pound of pollutant controlled. This type of evaluation allows us to compare the efficiency of the proposed regulation in reducing a pound of pollutant relative to existing regulations. For an air toxics control regulation, we use a method that considers both the quantity and toxicity of the emissions reduced. This measure of cost-effectiveness is based on the calculation of the cost per potential cancer case avoided.

1. 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 annualized cost) to the mass reduction of the pollutant(s) to be achieved by complying with that standard (in annual pounds). Annual costs include annualized non-recurring fixed costs (e.g., total research and development, product and consumer testing, equipment purchases/modifications, etc.) and annual recurring costs (e.g., raw materials, labeling, packaging, etc.).

As in the past Consumer Products regulations, ARB staff analyzed each product category independently of the others as if it was a separate regulation. By evaluating each product category separately, we can examine the impact that the proposed regulation may have on manufacturers in each category. This is a conservative assumption since we know there will be a sharing of technology between departments of a company that makes products for several product categories.

In this analysis, we annualized the non-recurring 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 reformulate a product 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 that sum by the annual emission reductions to calculate the cost-effectiveness for the estimated mass of pollutant(s) reduced. Equation 1 presents the methodology for calculating cost-effectiveness.

(1) $$\text{Cost-Effectiveness} = \frac{(\text{Annualized Fixed Costs})^{\text{Pre-Reg}}_{\text{ATCM}} + (\text{Annual Recurring Costs})^{\text{Pre-Reg}}_{\text{ATCM}}}{(\text{Annual Mass Reduction in TAC})^{\text{Pre-Reg}}_{\text{ATCM}}}$$

where:

(2) $$\text{Annualized Fixed Costs} = (\text{Fixed Costs}) \times \frac{i(1+i)^n}{(1+i)^n - 1}$$

$i(1+i)^n/((1+i)^n-1)$	=	Capital Recovery Factor (CRF)
i	=	discount interest rate over project horizon, in percent
n	=	number of years in project horizon
Fixed Costs	=	total nonrecurring cost per product category
	i.e.	(Nonrecurring Cost per Product) x (Total Noncompliant Products in the Category)

A convenient method for estimating the annual recurring cost component 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 cost-effectiveness fraction for recurring costs can be simplified and calculated as follows:

(3) Annual Recurring Costs (Emissions) = $\frac{\text{(Compliant Materials Cost) - (Baseline Materials Cost)}}{\text{(Baseline TAC Emissions) - (Compliant Emissions of TACs)}}$

where,

Baseline Materials Cost	=	cost of raw materials for each pound of product ($/lb), based on product formulations prior to ATCM implementation
Baseline TAC Emissions	=	Emission of TACs prior to ATCM implementation
Compliant Materials Cost	=	cost of raw materials for each pound of product ($/lb), based on product formulations that meet the proposed ATCM
Compliant TAC Emissions	=	Emission of TACs after full implementation of ATCM

To use Equation 3, we determined the sales-weighted average VOC and chlorinated TAC contents of products in each of the four product categories, based on sales data and the speciated formulations as reported by manufacturers in the ARB's 1997 Consumer and Commercial Products Survey. To the extent feasible, we then determined the detailed formulations which most closely reflect the "typical" (i.e., sales-weighted average) VOC and chlorinated TAC products. These formulations, in turn, were designated as compliant and baseline formulations, respectively.

For most ingredients, we used the most recent, distributor-level bulk prices from the *Chemical Market Reporter* (November 29, 1999), or from information gathered during the October 1999 Amendments to the Consumer Products Regulation, to calculate the baseline and compliant material costs based on these designated formulations. These analyses are shown in Table IX-5 (pages 17 & 18) and discussed in more detail in "Annual Recurring Cost (Impacts to Raw Materials Cost)" later in Section D-4.

2. Assumptions

In this analysis, we made an assumption that the costs to comply with this ATCM would be the same costs that a company would incur if they were reformulating a product to meet a new VOC limit under the Consumer Products Program. For fixed nonrecurring costs, 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 research and development 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 category is unknown. However, to the extent contract fillers are used by companies to make complying products, the actual cost to comply with the ATCM for the entire industry is likely to be less than predicted, resulting in more cost-effective emission reductions than indicated in this analysis.

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, including previous consumer product rulemakings. Based on these assumptions, the Capital Recovery Factor is 0.16274.

In the 1997 and 1999 amendments to the Consumer Products Regulation, the Consumer Products staff assumed products reformulated to meet the proposed limits would be marketed throughout the United States by national marketers. Except for the aerosol coatings regulation (title 17, CCR, sections 94520-94528), the Consumer Products staff found that businesses generally formulated products compliant with the Phase I (1990) and Phase II (1991) Consumer Products Regulations 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 proposed ATCM. 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 the proposed ATCM (ARB, 1999b).

For the annual recurring costs, we assumed that to make compliant VOC reformulations would result in cost changes 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. This assumption is based on previous consumer product regulatory experiences. To illustrate, ARB staff conducted a comprehensive technical assessment of the 55 percent VOC hairspray limit, which required extensive reformulations and revolutionary changes to existing products. The hairspray limit is generally considered to be among the most challenging of the consumer product limits; it likely resulted in more changes to the regulated product, relative to pre-regulatory products, than any other VOC limit. However, the staff's assessment found that changes to recurring costs other than hairspray raw material costs were expected to be negligible (ARB, 1997d). Based on this finding and because there are compliant VOC products currently available, we believe our assumptions regarding the recurring costs are reasonable.

In the 1999 Consumer Products amendments, the definition for "general purpose degreaser" was modified to include products that are designed to clean miscellaneous metallic parts. These products are currently sold and labeled as "solvent parts cleaner" or "metallic parts cleaner." These products have functions similar to general purpose degreasers in that they are designed to remove or dissolve grease, dirt, grime, and other contaminants (ARB, 1999b). In the 1997 Consumer and Commercial Products Survey the general purpose degreaser category was grouped under "household care products." For the cost analysis, the general purpose degreaser/solvent parts cleaner category was analyzed as a "household" product. For this ATCM, most of the products in the general purpose degreaser/solvent parts cleaner category are for automotive use and were therefore analyzed as automotive products. The difference in the analysis is that the initial "estimated annualized fixed cost to reformulate" is different for the household care and automotive categories.

3. Non-Recurring Fixed Costs

In the past, reviews of relevant technical literature and industry trade journals provided little information that could be used to estimate costs directly. This is not surprising, because the consumer products industry is very competitive, and production cost data specific to a company are closely-guarded trade secrets. In addition, ARB staff have had very limited success with cost surveys in the past and did not expect one to provide much useful information in this rulemaking (e.g., during the 1991 consumer products Phase II rulemaking, cost survey responses from only three manufacturers were received out of several hundred that were mailed; ARB, 1991b). Therefore, ARB staff developed estimates for nonrecurring cost based on analogous costs reported by ARB staff for the Phase II Consumer Products rulemaking (ARB,1991b; Appendix D1). The Phase II nonrecurring costs are applicable for this analysis since they were based on staff's detailed estimates of labor, research and development, equipment purchase, and other costs involved in product reformulations for four generic product categories which included automotive consumer products. This is the same approach that was used for the 1997 and 1999 consumer products amendments.

The Phase II nonrecurring investment costs, reported in 1991 dollars, were adjusted to 1999 dollars using a well-established method of ratioing chemical engineering plant cost indices as follows (Peters and Timmerhaus, 1980):

(4) $$\text{Non-Recurring Costs (in 1999 dollars)} = \text{Non-Recurring Costs (in 1991 dollars)} \times \frac{\text{C.E. 1999 index}}{\text{C.E. 1991 index}}$$

where,

C.E. 1999 index = 1999 Chemical Engineering Plant Cost Index = 392.0
C.E. 1991 index = 1991 Chemical Engineering Plant Cost Index = 357.6
(*Chemical Engineering*, November 1999)

ARB Consumer Product staff believe the original Phase II cost estimates were beneficial at the time of rulemaking for predicting the costs to comply with those limits. However, in 1997, the ARB Consumer Products staff completed a detailed technical assessment of the hairspray second-tier limit. They 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 limit ($20 to $50 million total cost divided by an estimated 350 noncompliant hairspray products; ARB, 1997c). Because the hairspray category arguably represents a worst-case scenario, with its two-tier limits requiring extensive reformulations, research and development, and consumer/safety testing, they 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 most of the proposed new limits. We therefore estimated the nonrecurring costs for the ATCM by adjusting the Phase II estimates to be consistent (same order of magnitude) as the $100,000 per product real-world average expenditures for hairsprays (ARB, 1999b).

The number of noncomplying products used for the calculations came from the 1997 Consumer and Commercial Products Survey. This survey was mailed to over 3,000 companies nationwide at the end of February 1998. The survey requested data on about 100 categories of consumer products. Extensive outreach efforts were made to maximize the market coverage of the survey. The Consumer Products staff found that the survey and extensive outreach resulted in an estimated 90 percent market coverage for most categories (ARB, 1999b). It is not possible for a survey of this magnitude to reach the entirety of the consumer products industry. Therefore, as a conservative estimate, the number of noncomplying products have been multiplied by a factor of 1.2 to adjust for 80% market coverage.

Table IX-4 shows our estimates for per-product and total annualized nonrecurring costs for each of the four product categories subject to the proposed ATCM. As shown, we project a per-product annualized nonrecurring cost ranging from a low of about $8,550 to a high of about $110,000. With approximately 80 noncompliant (chlorinated TAC) products that would need to be reformulated, the overall total annualized fixed cost to industry is projected to range from about $110,000 to $1.4 million dollars per year, with a general breakdown of this range as follows: automotive brake cleaners (56 percent), carburetor or fuel-injection air intake cleaners (17 percent), engine degreasers (9 percent), and general purpose degreasers/solvent parts cleaners (18 percent).

4. Annual Recurring Cost (Impacts to Raw Materials Cost)

In this analysis, we evaluated the anticipated cost impacts that the proposed ATCM may have on raw material costs. An evaluation of the impacts to raw material costs provides an indicator of possible impacts to the retail prices of the affected products (assuming the cost impacts are passed on partially or fully to consumers). Because of unpredictable factors such as the highly competitive nature of the consumer products market, it is not possible to accurately predict the final retail price of products that will comply with the proposed ATCM when it become effective. To the extent the cost impacts are passed on to consumers, the final retail prices may be lower or higher than suggested by this analysis.

Table IX-4. Estimated Total Annualized Non-Recurring Fixed Cost to Comply with Proposed ATCM

			Estimated # of	Estimated Total One-Time Cost		Estimated Annualized Cost		Estimated Annualized Fixed Cost to	

1999 Chemical Engineering Plant Cost Index =	392.0	(Prelim 8/99)	Market Adjustment =	1.2		Grand Annual Total (dollars per year)	$110,209	$1,412,936	
1991 Chemical Engineering Plant Cost Index =	357.6	(Final 1991)	(used to estimate total number of chlorinated TAC products in CA)						
			Discount Rate	10.00%					
			Project Horizon, in years	10					
			Capital Recovery Factor (CRF)	0.16275					

Notes: (1) # Chorinated TAC Products = (Market Adj.) x (# Chlorinated TAC Products in Survey)
(Survey is 1997 Consumer and Commerical Products Survey)
(2) Estimated Total One-Time Cost to Reformulate from 1991 Consumer Products Report. (See Section IX-C.3)

a. Methodology

As discussed previously, we determined the detailed formulations which most closely reflect the “typical” (sales-weighted average) VOC and chlorinated TAC contents. These formulations, in turn, were designated as compliant and baseline formulations, respectively. The average unit size used for these calculations, are the same as the ones used for the VOC products in the 1999 Consumer Products cost calculations. These unit sizes differ from the ones used for the chlorinated TAC products in the risk assessment modeling.

As part of the analysis, we compared the chlorinated TAC formulations with both the complying and non-complying VOC formulations that were used for the 1999 Consumer Products cost calculations. The difference in cost was very small, and did not change the final results mentioned below. VOC formulations listed in the tables reflect the formulations that are compliant with the 1999 Consumer Products amendments.

Distributor-level ingredient prices from the *Chemical Market Reporter* (November 29, 1999) or from information gathered during the 1999 Consumer Products regulation were used to calculate the baseline and compliant material costs for these formulations. As noted previously, we assumed changes in packaging, labeling, distribution and other recurring costs to be negligible relative to baseline levels of these costs (ARB, 1997c).

The analyses and the detailed formulations evaluated (with individual weight fractions and unit prices per pound) are shown as cost spreadsheets in Table IX-5. 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 this analysis.

b. Results

As shown in Table IX-6, the raw materials cost for chlorinated TAC products are greater than for VOC products. Table IX-7 shows a comparison of the impacts to raw materials cost under the proposed ATCM relative to those of the ARB consumer product regulations. As shown, the raw materials cost impacts under the proposed limits are comparable to those of other ARB regulations.

5. Analysis of the Combined Impacts on Per-Unit Cost from Recurring and Nonrecurring Costs

In this analysis, we evaluated the combined impacts of both recurring (i.e., raw materials costs) and nonrecurring costs from the proposed ATCM on per-unit costs. Although the raw material costs usually constitute the major portion of the compliance costs, the nonrecurring (fixed) cost was the major contributor in this analysis. In performing this analysis, we used the fixed costs, raw material costs, assumptions, and other facts discussed previously.

Table IX-5. Annual Recurring Cost Calculations for Raw Materials

Formulation: 2202
Category: Automotive Brake Cleaners

Formulation and Cost Comparison

Component (A)	Unit Cost $/lb (B)	Typical Chlorinated TAC Formulation wt% (C)	Cost (B)x(C)/100	45.00% VOC Tier-1 Compliant wt% (D)	Cost (B)x(D)/100
acetone	0.140			50.0	0.070
toluene	0.120			20.0	0.024
methanol	0.058			15.0	0.009
heptane	0.120			10.0	0.012
carbon dioxide	0.100	10.00	0.010	5.0	0.005
perchloroethylene	0.350	40.00	0.140		
methylene chloride	0.450	30.00	0.135		
trichloroethylene	0.650	20.00	0.130		
	SUM	100.00%		100.00%	

	Typical Chlorinated TAC	45.00% VOC Tier-1 Compliant
Total Cost , $/Pound	0.415	0.120
% Cost Diff. Relative to Current Product		-71.2%
Total Cost , $/Unit	0.34	0.10
Annual Recurring Costs C.E., $/lb TAC Reduced		-$0.00

Assume: (1) 1997 Statewide Emissions of Perc, MeCl, & TCE from Automotive Brake Cleaners: 4.45 tons/day

(2) Average unit size = **13.00** ounce

(**) Cost-effectiveness values in "( )" are negative (i.e., indicates potential cost savings)

Formulation: 2203
Category: Carburetor, Fuel-Injection Cleaners

Formulation and Cost Comparison

Component (A)	Unit Cost $/lb (B)	Typical Chlorinated TAC Formulation wt% (C)	Cost (B)x(C)/100	45.00% VOC Tier-1 Compliant wt% (D)	Cost (B)x(D)/100
acetone	0.140			50.0	0.070
toluene	0.120			20.0	0.024
methanol	0.058	10.0	0.006	5.0	0.003
xylene	0.140	30.0	0.042	20.0	0.028
carbon dioxide	0.100	3.0	0.003	5.0	0.005
methylene chloride	0.450	57.00	0.257		
	SUM	100.00%		100.00%	

	Typical Chlorinated TAC	45.00% VOC Tier-1 Compliant
Total Cost , $/Pound	0.307	0.130
% Cost Diff. Relative to Current Product		-57.7%
Total Cost , $/Unit	0.25	0.11
Annual Recurring Costs C.E., $/lb TAC Reduced		-$0.00

Assume: (1) Statewide 1997 Emissions of Perc, MeCl, & TCE from Carburetor, Choke Cleaners: 0.31 tons/day

(2) Average unit size = **13.00** ounce

(**) Cost-effectiveness values in "( )" are negative (i.e., indicates potential cost savings)

Table IX-5 (continued). Annual Recurring Cost Calculations for Raw Materials

Formulation: 2204a
Category: Engine Degreasers

Formulation and Cost Comparison

Component (A)	Unit Cost $/lb (B)	Typical Chlorinated TAC Formulation wt% (C)	Cost (B)x(C)/100	35.00% VOC Tier-1 Compliant wt% (D)	Cost (B)x(D)/100
HC propellant	0.250			10.0	0.025
d-limonene	1.100			10.0	0.110
glycol ether	0.460			5.0	0.023
LVP glycol ether	0.700			15.0	0.105
aromatic solvent	0.106			10.0	0.011
water	0.002			39.0	0.001
ammonia	0.098			1.0	0.001
surfactant	1.900			10.0	0.190
trichloroethylene	0.650	99.0	0.644		
carbon dioxide	0.100	1.0	0.001		
	SUM	100.00%		100.00%	

	Typical	Tier-1 Compliant
Total Cost , $/Pound	0.645	0.465
% Cost Diff. Relative to Current Product		-27.8%
Total Cost , $/Unit	0.52	0.38
Annual Recurring Costs C.E., $/lb TAC Reduced		-$0.00

Assume: (1) 1997 Statewide Emissions of Perc, MeCl, & TCE from Engine Degreasers (Aerosols): 0.1 tons/day

(2) Average unit size = **13.00** ounce

(**) Cost-effectiveness values in "( )" are negative (i.e., indicates potential cost savings)

Formulation: 5203c
Category: G.P. Degreaser/Solvent Parts Cleaner (Aerosol)

Formulation and Cost Comparison

Component (A)	Unit Cost $/lb (B)	Typical Chlorinated TAC Formulation wt% (C)	Cost (B)x(C)/100	50.00% VOC Tier-1 Compliant wt% (D)	Cost (B)x(D)/100
carbon dioxide	0.100			5.0	0.005
water	0.002			42.0	0.001
isopropanol	0.340			10.0	0.034
surfactant/emuls	1.900			3.0	0.057
glycol ether	0.700			20.0	0.140
d-limonene	1.100			20.0	0.220
perchloroethylene	0.350	24	0.084		
111-trichloroethane	1.030	72	0.742		
carbon dioxide	0.100	4	0.004		
	SUM	100.00%		100.00%	

	Typical	Tier-1 Compliant
Total Cost , $/Pound	0.830	0.457
% Cost Diff. Relative to Current Product		-44.9%
Total Cost , $/Unit	0.78	0.43
Annual Recurring Costs C.E., $/lb TAC Reduced		-$0.00

Assume: (1) 1997 Statewide Emissions of Perc, MeCl, & TCE from G.P. Degreaser/Solvent Parts Cleaner (Aerosol): 0.31 tons/day

(2) Average unit size = **15.00** ounce

(**) Cost-effectiveness values in "( )" are negative (i.e., indicates potential cost savings)

Table IX-6. Estimated Impacts to Raw Materials Cost Per Unit

		Estimated Raw Materials costs, $/Unit of Product		
		Chlorinated TAC Formulation (Baseline)	**VOC Formulation (Compliant)**	**Cost Difference Between Compliant and Baseline Formulations**
Code	**Category**	**(B1)**	**(A1)**	**(A1)-(B1)**
2202	Automotive Brake Cleaners	$0.34	$0.10	$0.00
2203	Carburetor, Fuel-Injection Cleaners	$0.25	$0.11	$0.00
2204a	Engine Degreasers	$0.52	$0.38	$0.00
5203c	General Purpose/Solvent Parts Cleaner (aerosol)	$0.78	$0.43	$0.00
			Max Increase	$0.00

Table IX-7. Comparison of Raw Materials Cost Impacts for the Proposed ATCM and ARB Consumer Product Regulations (unadjusted dollars)

Regulation	**Cost Impacts (Dollars per Unit of Product)**
Proposed Chlorinated TAC ATCM	$0.00
Mid-Term Measures II, 1999	$0.00 to $0.25
Phase III (Mid-Term Measures 1) Consumer Products Regulation, 1997	$0.00 to $0.60
Hairsprays, 1997[1]	($0.10) to $0.45
Phase II Consumer Products Regulation, 1991	<$0.01 to $0.60

1. $0.45/unit reported as a worst-case scenario using high-level of HFC-152a as propellant in “premium” products.

a. Methodology

This method differs from the raw materials cost-only analysis in the previous section in that the nonrecurring cost in this analysis is assumed to be "spread out" (i.e., recouped) through the entire California sales volume of each product category. Thus, the total annual recurring and annualized nonrecurring costs reported previously is divided by the number of units sold in California per year to estimate the per-unit cost increase. The California sales volume for a product category is estimated by dividing the total TAC emissions (pounds of TAC per year) for that category by the category's sales-weighted average TAC content (pounds of TAC per pound of product).

d. Results

As shown in Table IX-8, the combined fixed and raw material cost changes to per-unit production costs ranged from no cost increase (net savings or no cost for various categories) to about $0.09 per unit (engine degreaser). Averaged over the sales volume for each category, the unit sales-weighted average cost increase is about $0.02 per unit. For comparison purposes, this is the same unit sales-weighted average cost increase that was estimated for the 1999 Consumer Products amendments.

6. Cost-Effectiveness

a. Cost Per Pound of Emissions Reduced

Table IX-9 shows the overall results of our cost-effectiveness analysis, with separate cost-effectiveness fractions representing the annualized nonrecurring and annual recurring costs (see equations 1 and 3). In general, Table IX-9 shows that the annualized recurring costs (i.e., raw materials, labeling, packaging, etc.) have a small impact on overall cost-effectiveness for the affected categories. For the most part, the raw materials cost (i.e., annual recurring cost) for both VOC and chlorinated TAC products are relatively the same. The most significant impact on overall cost-effectiveness is from the annualized nonrecurring fixed costs (i.e., research and development, product testing, etc.). Table IX-9 shows that the estimated cost-effectiveness ranges from a low of $0.00 (net savings or no cost for several categories) to a high of about $0.23 per pound of TAC reduced for the general purpose degreaser/solvent parts cleaner category.

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 product category and its associated cost-effectiveness, divided by the sum of the total emission reductions for all the product categories. 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 the proposed ATCM 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 the proposed ATCM. As shown in Table IX-9, the ERWA cost-effectiveness is about $0.03 per pound of TAC reduced.

Table IX-8. Estimated Per-Unit Cost Increases from Both Annualized Non-Recurring and Annual Recurring Costs

		Estimated Annualized Fixed Cost to Reformulate All Chlorinated TAC Products (dollars per year)		Sales-Wtd Average TAC Content	Estimated TAC Emissions,	Typical Unit Weight	Estimated Unit Sales per Day in Calif.	Estimated Per Unit Production Cost Increase: Annualized Nonrecurring Cost	Annualized Nonrecurring Cost	Annual Recurring Cost Difference	Total Cost Increase	Total Cost Increase	Total Cost Increase
Code	Category	Low (D1)	High (D2)	% (E)	tons/day (F)	Ounces (G)	(H)	Low Cost/Unit (I1=D1*CNF/H)	High Cost/Unit (I2=D2*CNF/H)	Cost/Unit (J)	Low/Unit K1=(I1+J)	High/Unit K2=(I2+J)	Mid/Unit (K1+K2)/2
2202	Automotive Brake Cleaners	$61,784	$792,100	90.0%	4.45	13	12,171	$0.00	$0.02	$0.00	$0.00	$0.02	$0.01
2203	Carburetor, Fuel-Injection Cleaners	$18,368	$235,489	57.0%	0.31	13	1,339	$0.00	$0.06	$0.00	$0.00	$0.06	$0.03
2204a	Engine Degreasers	$10,019	$128,449	47.0%	0.10	13	524	$0.01	$0.09	$0.00	$0.01	$0.09	$0.05
5203c	G.P. Degreaser/Solvent Parts Cleaner (Aerosol)	$20,038	$256,897	24.0%	0.31	15	2,756	$0.00	$0.03	$0.00	$0.00	$0.03	$0.02
	SUM	$110,209	$1,412,936		5.170		16,789				MIN UNIT COST INCREASE		**$0.00**
											MAX UNIT COST INCREASE		**$0.09**
											SWA-UNIT COST INCREASE		**$0.02**

Notes:

(1) (H) = (Estimated TAC Emissions/Sales-Wtd Ave TAC Content)*2000*16/Typical Unit Weight

(2) (I) = Total Annualized Non-recurring Cost / [(H) * 365]

(3) (J) = Raw material cost difference between compliant and baseline formulations from Table IX-6

(4) Figures in "( )" are negative (i.e., indicates potential cost savings)

(5) California-to-National Cost Adjustment Factor (CNF)= 0.13

(6) Annual Recurring Cost Difference from Table IX-3

Table IX-9. Estimated Cost-Effectiveness for Proposed ATCM (Cost per Pound of Pollutants Reduced)

Code	Category	Estimated Annualized Fixed Cost to Reformulate All Chlorinated TAC Products (dollars per year) Low (D1)	High (D2)	1997 Emission Reduc. tons/day (L)	Estimated Reformulation Costs (in 1999 dollars): Annualized Non-Recurring Cost $/lb TAC Reduced Low M1 = D1*(CNF)/L	High M2 = D1*(CNF)/L	Annual Recurring Cost $/lb TAC Reduced (N)	Estimated Cost-Effectiveness $/lb TAC reduced (in 1999 dollars) Low O1=(M1+N)	High O2=(M2+N)	Ave (O1+O2)/2
2202	Automotive Brake Cleaners	$61,784	$792,100	4.450	$0.00	$0.03	-$0.00	$0.00	$0.03	$0.02
2203	Carburetor, Fuel-Injection Cleaners	$18,368	$235,489	0.310	$0.01	$0.14	-$0.00	$0.01	$0.14	$0.07
2204a	Engine Degreasers	$10,019	$128,449	0.100	$0.02	$0.23	-$0.00	$0.02	$0.23	$0.12
5203c	G.P. Degreaser/Solvent Parts Cleaner (Aerosol)	$20,038	$256,897	0.310	$0.01	$0.15	-$0.00	$0.01	$0.15	$0.08
	Grand Total	$110,209	$1,412,936	5.170					MIN G(1)	$0.00
									MAX G(2)	$0.23
									ERWA-AVG	$0.03

Notes:

(1) Avg. Cost-Effectiveness shown as "$0.00" means the average of the low and high cost-effectiveness for the category was either 0 or negative.
(2) ERWA = emission reduction-weighted average
(3) Cost-effectiveness values in "( )" are negative (i.e., indicates potential cost savings)
(4) Non-recurring fixed costs annualized by multiplying with the Cost Recovery Factor (CRF)
(5) "Emission Reductions" (Column L) reflect 1997 Consumer and Commercial Products Survey results adjusted for market coverage of the survey.
(6) For non-recurring costs, "low" and "high" refer to range of estimated fixed costs discussed in Section IX-D.3.

Total industry-wide annual compliance costs = $99,003
[(ERWA-AVG)*(L)*(365 days/year)*(2000 lbs/ton)]

California-to-National Cost Adjustment Factor (CNF)= 0.13

Thus, the average cost to reduce one pound of chlorinated TACs under the proposed ATCM is less than five cents, indicating that total industry-wide annual compliance costs to achieve a reduction of 5.17 tons per day of chlorinated TACs statewide in 1997 should be approximately $99,000 per year.

Table IX-10 shows a comparison of the cost-effectiveness for the proposed ATCM relative to the Perchloroethylene Dry Cleaning Operations ATCM. Of the nine ATCMs adopted by the Board, this is the only one which controls one of the TACs addressed in the proposed ATCM.

Table IX-10. Comparison of Cost-Effectiveness (Pound of Pollutant Reduced)

Airborne Toxic Control Measure	Cost-Effectiveness
Proposed Chlorinated TAC ATCM	$0.00 to $0.23 ($0.03 avg.) (Cost per pound of Perc, MeCl, and TCE reduced)
Perchloroethylene Dry Cleaning Operations ATCM, 1993	$0.64-1.77 ($1.29 avg.) (Cost per pound of Perc reduced) (adjusted to 1999 dollars)[1]

1. Cost-effectiveness values for Dry Cleaning ATCM adjusted to 1999 dollars using the following Chemical Engineering Plant Cost indices: 359.2 (1993), 392.0 (Preliminary August 1999) from *Chemical Engineering, November 1999*.

b. Cost Per Potential Cancer Case Avoided

By removing Perc, MeCl, and TCE from the four automotive consumer product categories, the emission and health impact (i.e., potential cancer risk) reduction benefits are 100 percent. This correlates to a total of 5.17 tons per day emissions reduction of chlorinated TACs. Additionally, based on a 70 year exposure duration, a reduction of approximately 65 total potential excess cancer cases statewide could be achieved by removal of Perc, MeCl, and TCE from the four automotive product categories.

To determine the reduction of 65 potential excess cancer cases statewide, we used ambient concentrations and emissions data as presented in Chapter VI. We then determined the individual potential cancer risk for each compound based on its ambient concentration and multiplied this by the percentage of emissions from the four automotive product categories. Finally, we multiplied this number by California's 1997 population of 33 million. Of the 65 potential cancer cases avoided, approximately 57 are attributed to Perc, 4 to TCE, and 4 to MeCl.

To evaluate the relative impact and effectiveness of the proposed control measure, we calculated the cost per cancer case avoided. We again use Equation (1) to calculate cost effectiveness, but instead of using "annual mass reduction in TACs" in the denominator, we use

Table IX-11. Estimated Cost-Effectiveness for Proposed ATCM (Cost per Cancer Case Avoided)

Code	Category	Estimated Annualized Fixed Cost to Reformulate All Non-Compliant Products (dollars per year) Low (D1)	High (D2)	Total Annualized Recurring Cost (Raw Materials Cost) ($/Pound of Product) (P)	Total Regulation Cost ($/year) (Q1=(D1*CNF)+P)	(Q2=(D2*CNF)+P)	Estimated Cost-Effectiveness $/Cancer Cases Avoided Low R1=(Q1*70 yrs/cases)	High R2=(Q2*70 yrs/cases)	Ave (R1+R2)/2
2202	Automotive Brake Cleaners	$61,784	$792,100	$0.00	$8,032	$102,973	$8,676.43	$111,236.32	$59,956.38
2203	Carburetor, Fuel-Injection Cleaners	$18,368	$235,489	$0.00	$2,388	$30,614	$2,579.48	$33,070.26	$17,824.87
2204a	Engine Degreasers	$10,019	$128,449	$0.00	$1,302	$16,698	$1,406.99	$18,038.32	$9,722.66
5203c	G.P. Degreaser/Solvent Parts Cleaner (Aerosol)	$20,038	$256,897	$0.00	$2,605	$33,397	$2,813.98	$36,076.65	$19,445.31
	Grand Total	$110,209	$1,412,936	$0.00	$14,327	$183,682	$15,477	$198,422	$106,949
								MIN Q(1)	$1,406.99
								MAX Q(2)	$111,236.32
								AVERAGE	$25,927.08

Notes:
(1) Cost-effectiveness values in "( )" are negative (i.e., indicates potential cost savings)
(2) Non-recurring fixed costs annualized by multiplying with the Cost Recovery Factor (CRF)
(3) For non-recurring costs, "low" and "high" refer to range of estimated fixed costs discussed in Section IX-E.
(4) Total Annual Recurring Cost = [raw material cost difference ($/pound) multiplied by the number of non-complying products] multiplied by 10 years, which is the project horizon

California-to-National Cost Adjustment Factor (CNF)=	0.13
Total Potential Excess Cancer Cases Avoided (cases) =	64.8

the "number of cancer cases avoided." Table IX-11 shows the average cost per cancer case avoided is about $26,000 with a range of approximately $1,400 to $111,000.

Table IX-12 shows a comparison of the cost-effectiveness for the proposed ATCM relative to other ARB control measures. As shown, the staff's proposal is significantly less than previously approved ARB control measures.

Table IX-12. Comparison of Cost-Effectiveness (Cancer Case Avoided) for Proposed ATCM and other ARB Control Measures (adjusted to 1999 dollars)

Airborne Toxic Control Measure	Cost-Effectiveness[1,2] (Dollars per Cancer Case Avoided)
Proposed Chlorinated TAC ATCM	$1,400-111,000
Perchloroethylene Dry Cleaning Operations ATCM, 1993	$1.9-4.8 million
Ethylene Oxide ATCM for Sterilizers and Aerators, 1990	$2.1-3.2 million
Emissions of Toxic Metals from Non-Ferrous Metal Melting, 1992	$6,600-$18.6 million

1. Cost-effectiveness values for ATCMs are based on size of the facility, amount and type of equipment required to meet the control limits, and which control limit is to be met.
2. All cost-effectiveness values have been adjusted to 1999 dollars using the following Chemical Engineering Plant Cost indices: 357.6 (1990), 358.2 (1992), 359.2 (1993), 392.0 (Preliminary August 1999).

X. ENVIRONMENTAL IMPACTS OF THE PROPOSED AIRBORNE TOXIC CONTROL MEASURE

The intent of the proposed airborne toxic control measure (ATCM) is to protect the public health by reducing the public's exposure to potentially harmful emissions of TACs. An additional consideration is the impact that the proposed ATCM may have on other areas of the environment. Based on available information, the ARB has determined that no significant adverse environmental impacts should occur. This chapter describes the potential impacts that the proposed ATCM may have on waste water treatment, hazardous waste disposal, and air pollution.

A. 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. Since 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 Initial Statement of Reasons for a rulemaking in lieu of preparing an environmental impact report or negative declaration. In addition, the ARB will respond in writing to all significant environmental issues 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 ATCM.

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 ATCM. Regarding reasonably foreseeable mitigation measures, CEQA requires an agency to identify and adopt feasible mitigation measures that would minimize any significant adverse environmental impacts described in the environmental analysis.

B. Potential Waste Water Impacts

Sanitation districts have been concerned about the amount of chlorinated compounds found in the waste effluent at treatment plants. Currently, many treatment plants do not have the equipment necessary to process industrial wastes such as chlorinated solvents and these solvents have been detected at elevated levels at some facilities. Over the last several years, increased influent concentrations of Perc were observed at four wastewater treatment plants (Pomona Water Reclamation Plant, City of Los Angeles' Donald C. Tillman Water Reclamation Plant, Joint Water Pollution Control Plant, and East Bay Municipal Utilities District). The influent concentrations of Perc have been high enough to potentially cause violations of the plants' discharge limit of 5 micrograms per liter (µg/L). The data collected from the wastewater treatment plants for 1999 showed median influent levels of 17 µg/L, 78 µg/L, 8 µg/L, and 4 µg/L, respectively (CSDLA, 1999a; CSDLA 1999b).

The number of stationary and mobile parts washers being used in AMR facilities has increased over the years to meet federal, state, and local regulations adopted to address environmental and health concerns. Publicly-owned treatment works (POTWs) have been concerned about the disposal practices of the spent baths, which are usually classified as hazardous waste and cannot be disposed in the sewer system. In some cases, unused cleaners are also considered hazardous waste. A study conducted in Southern California showed that about three-quarters of spent water baths were classified as hazardous waste. None of these spent baths met discharge standards set by local POTWs or sanitary sewerage districts (DTSC, 1999a).

The removal of Perc, MeCl, and TCE from the four automotive consumer products categories should lead to a reduction in the amount of chlorinated solvents reaching the storm drains and the waste water treatment plants.

C. Potential Hazardous Waste Impacts

Hazardous waste is regulated in California by both federal and state programs. In California, all hazardous waste must be disposed of at a facility that is registered with the California Department of Toxic Substances Control (DTSC). Under these programs, chlorinated automotive consumer products are generally classified as hazardous waste because they contain substances which are listed as toxic substances.

An AMR facility will generate spent chlorinated solvent from stationary and portable parts washers and from liquid solvent that is used to wash parts over a collection drum. A hazardous waste hauler is usually contracted to remove the spent solvent from the facility. For a monthly fee, waste haulers will pick-up the spent solvent, clean and maintain the solvent cleaning unit, and refill the unit with clean solvent. Depending on the arrangement, solvent cleaning units may be owned by the shop or leased from a solvent service company. The waste hauler will then recycle the spent solvent to reclaim the chlorinated substances which can then be resold. Based on information collected during site visits, spent baths (as well as other waste disposal containers) contaminated with chlorinated compounds are typically more costly to have removed from the facility.

It is expected that the proposed ATCM may increase the usage of stationary and portable parts washers. The removal of Perc, MeCl, and TCE from automotive consumer products will minimize the possibility of chlorinated solvents contaminating aqueous baths, waste oil containers, and hazardous waste disposal drums thereby significantly reducing hazardous waste contamination and disposal costs.

D. Potential Air Pollution Impacts

1. Potential Increase in VOC Emissions

The Consumer Products Regulation reduces the formation of tropospheric, or ground-level, ozone by reducing VOC emissions from consumer products. Tropospheric ozone formation requires a mix of VOCs, nitrogen oxides, oxygen, and sunlight. Therefore, a reduction in VOC emissions is expected to provide a beneficial environmental impact on air quality and public health by reducing tropospheric ozone formation. Based on the results of the 1997 Consumer and Commercial Products Survey, the products from the four automotive consumer product categories emitted approximately 14.6 tons per day (tpd) of VOCs in California (ARB, 1999b).

The October 1999 amendments to the Consumer Products Regulation are expected to obtain a reduction of 3.3 tpd in VOC emissions from automotive consumer products (ARB, 1999b). However, the removal of Perc, MeCl, and TCE as formulation options in the proposed ATCM will adversely impact the reduction in VOC emissions that otherwise would have been realized. Chlorinated automotive consumer products account for approximately 38 percent of the market and their removal will reduce emissions of Perc, MeCl, and TCE by approximately 5.2 tpd (approximately 3.8 million pounds per year) as shown in Table X-1.

Table X-1. Statewide Emissions of Perc, MeCl, and TCE from Automotive Consumer Products

Perc Emissions [tons/day]	MeCl Emissions [tons/day]	TCE Emissions [tons/day]	Total Chlorinated [tons/day]
4.2	0.7	0.3	5.2

If we assume a worse case scenario where all current users of chlorinated products switch to non-chlorinated, VOC-based products with Perc, MeCl, and TCE replaced with VOC compounds (irrespective of any current VOC-based formulation limits), then the theoretical increase in statewide VOC emissions would be approximately 5.2 tpd. However, beginning January 1, 2002, the VOC-content of automotive consumer products is subject to VOC-content limits as specified in the October 1999 amendments to the Consumer Products Regulation. As a result of these technically-feasible limits, post-ATCM VOC emissions would increase by no more than 2.3 tpd statewide. Table X-2 summarizes the potential increase in VOC emissions.

Table X-2. Potential Maximum Increase in VOC Emissions from a Switch to VOC-Based Non-Chlorinated Products

Product Category	VOC Limit [%]	Potential VOC Emissions [tons/day]
Brake Cleaners	45	2.00
Carburetor Cleaners	45	0.14
Engine Degreasers	35	0.04
General Purpose Degreasers	50	0.16
	Total (approx.)	2.3

ARB staff expects, however, that some users of chlorinated automotive consumer products will choose to consider other non-chlorinated alternatives (such as aqueous-based portable brake cleaning units and parts washers) and not switch exclusively to non-chlorinated VOC products. If this occurs, the increase in VOC emissions related to the proposed ATCM would be less than 2.3 tpd statewide. When total VOC emission reductions from both the October 1999 amendments to the Consumer Products Regulation and the proposed ATCM are considered, statewide VOC emissions from the four automotive consumer products categories are reduced by at least one ton per day. These reductions are summarized in Table X-3.

Table X-3. Approximate Emission Reductions from Proposed ATCM and October 1999 Consumer Products Amendments[1]

Chlorinated TAC Reductions [tons/day]	VOC Reductions [tons/day]
5.2	1.0

1. Total combined emission reductions from the October 1999 Consumer Products Amendments and the proposed ATCM.

2. Impacts on the State Implementation Plan for Ozone

The Federal Clean Air Act amendments of 1990 require an ozone attainment plan from every state unable to meet the national ambient air quality standard for ozone. California's 1994 State Implementation Plan (SIP) for ozone fulfills this requirement (ARB, 1994). State law provides the legal authority to ARB to develop regulations affecting a variety of mobile sources, fuels, and consumer products. The regulations that have already been 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.

As previously mentioned, the proposed ATCM decreases the potential VOC reductions that will be obtained by the October 1999 amendments to the Consumer Products Regulation while achieving substantial reductions in emissions of chlorinated TACs. Perc was considered a VOC in the 1994 ozone SIP inventory; therefore, substituting non-chlorinated VOC-based products to replace Perc will have no impact on the 1994 SIP (which covers Ventura County, the Sacramento Metropolitan area, the San Joaquin Valley, San Diego County, and the Southeast Desert). In the context of the 1994 SIP, substituting VOC-based products for MeCl will increase VOC emissions by approximately 0.1 tpd in all the 1994 SIP areas combined.

The South Coast Air Quality Management District (SCAQMD) revised their federal ozone plan in 1999, and the U.S. EPA has proposed to approve this plan. In the 1999 revision, Perc is not considered a VOC. In the context of the 1999 revision, if VOC-based products are substituted for all the Perc and MeCl currently used in chlorinated products, we expect an increase of approximately one ton per day of VOC in the South Coast Air Basin. The ARB and the SCAQMD will address this shortfall in the next comprehensive revision of the South Coast ozone SIP.

3. Potential Environmental Impacts on Global Warming and Stratospheric Ozone Depletion

Greenhouse gases, which alter the amount of heat, or infrared radiation, that can escape the Earth's surface, have been linked to a gradual warming of the Earth's surface and lower atmosphere. While carbon dioxide (CO_2) has been the traditional focus of greenhouse gas concerns, other greenhouse gases include methane, nitrous oxide, and chlorofluorocarbons (U.S. EPA, 1998a). In the United States, the largest source of greenhouse gas emissions is from fossil fuel combustion, which accounted for approximately 81 percent of greenhouse gas emissions in 1996 (U.S. EPA, 1998a).

Carbon dioxide is used as a propellant in both chlorinated and non-chlorinated aerosol automotive consumer products. Based on data from the 1997 Consumer and Commercial Products Survey, non-chlorinated products typically contain a greater amount of carbon dioxide than their chlorinated counterparts. Since the proposed ATCM does not require a reduction of the amount of aerosol products sold, many users of chlorinated products may switch to non-chlorinated products thereby increasing the amount of carbon dioxide released. However, the use of carbon dioxide as a propellant in automotive consumer products typically results from a recycled by-product of existing processes and, therefore, does not contribute to global warming (ARB, 1995a). Additionally, non-chlorinated aerosols account for nearly 62 percent of the market. As a result, the proposed ATCM is expected to have a negligible impact on global warming.

4. South Coast Air Quality Management District Air Toxics Control Plan

The South Coast Air Quality Management District (South Coast AQMD) is currently in the process of developing a comprehensive control plan designed to obtain significant reduction of toxic emissions in the South Coast Air Basin (SCAB). The plan will address current air toxic levels, control strategies, and projected future air toxic emission levels. The removal of Perc, MeCl, and TCE from automotive consumer products will greatly assist the efforts of the South Coast AQMD in their efforts to reduce toxic emissions. It is expected that the proposed ATCM will reduce toxic emissions in the SCAB by approximately 2.6 tpd. Additionally, combined with the October 1999 amendments to the Consumer Products Regulation, VOC emissions should be reduced by almost 0.5 tpd.

5. Workplace Exposure

The California Department of Industrial Relations-Division of Occupational Safety and Health Administration (Cal/OSHA) regulates the concentration of many TACs and VOCs in the workplace environment. To protect worker safety, Cal/OSHA has established a permissible exposure limit (PEL) for many of these compounds (the PEL is the maximum, eight-hour, time-weighted average concentration for occupational exposure). The combined effect of both the proposed ATCM and the October 1999 amendments to the Consumer Products Regulation is a reduction in VOC emissions. As a result, an increase in workplace exposure from TAC emissions and VOC emissions is not expected.

E. Formation of Phosgene

Phosgene is a toxic, colorless, gas or volatile liquid with a suffocating odor that is similar to decaying fruit or moldy hay. It is slightly soluble in water and freely soluble in benzene, toluene, glacial acetic acid, chloroform, and most liquid hydrocarbons. Phosgene is noncombustible but can decompose into hydrochloric acid (HCl) and CO_2 when wetted. As a result, wet phosgene is corrosive and poses an additional hazard from pressure buildup in closed containers. The density of phosgene is more than three times that of air, which means that its concentrated emission plumes tend to settle to the ground and collect in low areas (ARB, 1997b). Phosgene is listed as a TAC and a federal HAP.

Phosgene, also known as carbonyl chloride, is not a normal component of welding gases, can be formed by the thermal decomposition of chlorinated hydrocarbons (e.g., Perc, TCE, and TCA) when welding is carried out in the presence of solvent vapors. These solvent vapors may be escaping from a nearby degreasing tank, a recently expelled aerosol product, or when solvent is left behind after degreasing (NOHSC, 1999a). Phosgene formation is promoted by ultraviolet radiation, hot metal surfaces, flame, and cigarette smoking (NOHSC, 1999a). The gas-shielded arc welding processes and plasma processes provide greater ultraviolet light intensity than the flux-shielded arc welding processes. Additionally, heat and ultraviolet radiation from the welding arc may react with solvent vapor to produce irritant gases such as acetylchloride and acetylchloride derivatives such as dichloroacetylchloride. There is also evidence of phosgene formation from the photooxidation of chloroethylenes in air such as Perc and TCE (U.S. EPA, 1985).

Acute non-cancer affects are of the most concern. Phosgene is extremely irritating to the lungs, and can cause severe respiratory effects, including pulmonary edema. Symptoms of acute exposure include choking, chest constriction, coughing, painful breathing, and bloody sputum. Acute phosgene poisoning may affect the heart, brain, and blood. Symptoms may be delayed up to 24 hours after exposure. Chronic inhalation exposure has been shown to result in some tolerance to acute effects noted in humans, but irreversible emphysema and pulmonary fibrosis may occur (ARB, 1997b). The National Institute for Occupational Safety and Health (NIOSH) lists a recommended exposure limit of 0.1 parts per million for phosgene. The U.S. Occupational Safety and Health Administration (OSHA) also lists a PEL of 0.1 parts per million (NIOSH, 1994).

Recognizing these health and safety concerns, both OSHA and Cal/OSHA have taken steps to limit worker exposure to phosgene. OSHA Regulations state that degreasing and cleaning operations that involve chlorinated hydrocarbons shall be located so that vapors from these operations will not reach or be drawn into the area that surrounds any welding operation (Standards-29 CFR, General requirements, Section 1910.252). In addition, compounds such as Perc and TCE should be kept out of areas penetrated by ultraviolet radiation of gas-shielded welding operations. Cal/OSHA regulations for electric welding state that chlorinated solvents shall not be used within 200 feet (61 meters) of the exposed arc. Furthermore, surfaces prepared with chlorinated solvents should be thoroughly dry before welding is performed on them (California Code of Regulations, Subchapter 7, Group 11, Article 90, Section 4853).

The removal of Perc, MeCl, and TCE from automotive consumer products in the proposed ATCM will minimize the potential for phosgene formation in the presence of flame or heat sources thereby extending a greater level of worker and public health protection and safety.

F. Potential Flammability of Products that Contain VOCs

The June 1997 Status Report, based on the limited data available at the time, considered the flammability of many non-chlorinated aerosols to be a disadvantage when compared to chlorinated aerosols which are typically non-flammable (ARB, 1997a). Industry groups representing product manufacturers have also underscored this concern stating their belief that AMR facilities need to continue their usage of the more toxic chlorinated aerosols, especially in areas where use may occur near flame, heat, or other ignition sources. Since the release of the Status Report, however, more data regarding flammability has become available. A search of statewide and national databases as well as inquiries to fire departments and associations across the state were unable to locate any reports of fires, injuries, or other incidents related to the use of non-chlorinated products in AMR facilities. Additionally, the California State Fire Marshal's office indicated that the combustion of gasoline, such as from a leaking fuel line, poses a significantly greater flammability concern than the use of aerosols.

During the 137 site visits, ARB staff observed brake service operations at one facility using a flammable, non-chlorinated aerosol product occurring in one service bay and welding operations occurring in another service bay. ARB staff also observed chlorinated products that were listed as flammable on the product label, which indicates that chlorinated products can also be flammable.

Sixteen additional site visits were conducted to specifically investigate flammability issues. Of these facilities, all 16 used flammable products (non-chlorinated and chlorinated) but only 14 had an ignition source. The types of ignition sources observed included: welding (e.g. arc) equipment, torch (e.g. acetylene) equipment, cigarettes, and space heaters (natural gas and propane, portable, and overhead). Usage of flammable products occurred from approximately 20 to 30 feet from the ignition source with most usage occurring in adjacent service bays. Only one facility reported an incident (non-injury) associated with the use of a flammable product. This facility, however, attributed the incident to a vehicle malfunction and continues to use flammable products almost exclusively. Additionally, none of the facilities visited indicated that flammability concerns were a factor when making decisions on which products to buy (cost was the major factor). Instead, discussions with facility operators indicated that most facilities consider all aerosol products flammable and use common safety precautions when using these products Therefore, flammability is sufficiently addressed by the use of good operating practices on the part of facility owners, mechanics, and technicians. This belief is supported by the fact that most facilities already use a host of flammable products and that non-flammable alternatives such as aqueous-based portable brake cleaning units and water-based aerosol products are readily available and in use.

G. Reasonably Foreseeable Feasible Mitigation Measures

As previously discussed, ARB is required to do an analysis of reasonably foreseeable feasible mitigation measures. ARB staff has concluded that no significant adverse environmental impacts should occur from implementation of the proposed ATCM. As a result, no mitigation measures would be necessary.

H. Reasonably Foreseeable Alternative Means of Compliance with the ATCM

The ARB is required to do an analysis of reasonably foreseeable alternative means of compliance with the ATCM. Alternatives to the proposed ATCM are discussed in Chapter VII. Based on the discussion in Chapter VII, ARB staff has concluded that the removal of MeCl and TCE from automotive consumer products is appropriate and necessary because of the potential increased use and, therefore, potential increased risk if the use of these two compounds was not so limited. For the same reasons, staff has concluded that the removal of Perc, MeCl, and TCE from carburetor cleaners, engine degreasers, and general purpose degreasers, as well as from brake cleaners, is appropriate and necessary.

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