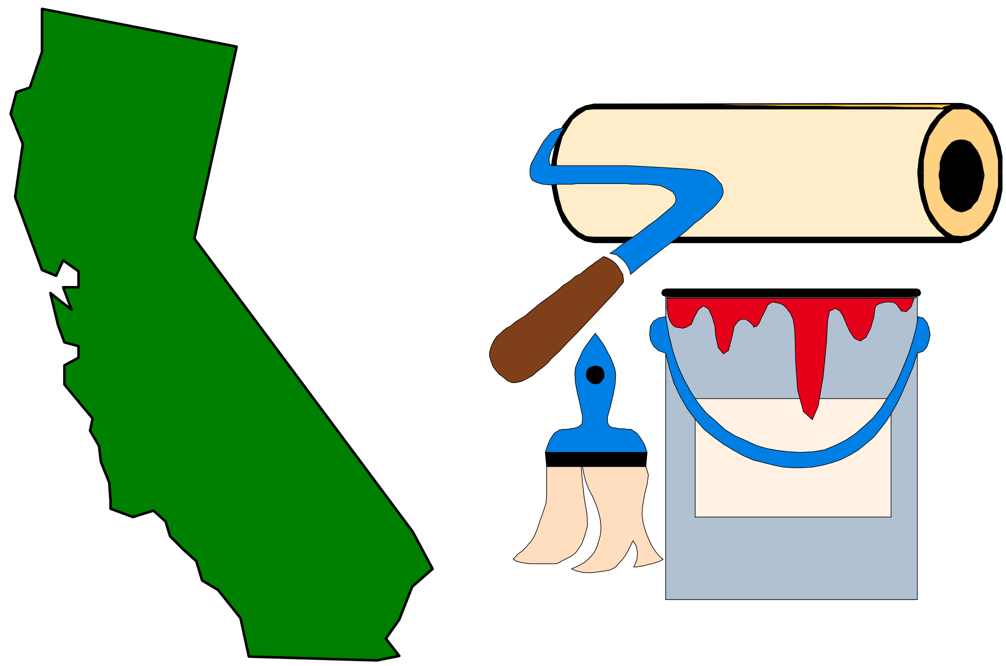
STAFF REPORT

for the Proposed

Suggested Control Measure for Architectural Coatings



June 2000

California Environmental Protection Agency

Air Resources Board

CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC MEETING TO CONSIDER APPROVAL OF A SUGGESTED CONTROL MEASURE FOR EMISSIONS OF VOLATILE ORGANIC COMPOUNDS FROM THE APPLICATION OF ARCHITECTURAL COATINGS

The Air Resources Board (ARB or Board) will conduct a public meeting at the time and place noted below to consider approval of a Suggested Control Measure for emissions of volatile organic compounds from the application of architectural coatings.

DATE: June 22, 2000

TIME: 9:30 a.m.

PLACE: Air Resources Board
Board Hearing Room, Lower Level
2020 L Street
Sacramento, California

This item will be considered at a two-day meeting of the ARB, which will commence at 9:30 a.m., June 22, 2000, and may continue at 8:30 a.m., June 23, 2000. This item may not be considered until June 23, 2000. Please consult the agenda for the meeting, which will be available at least 10 days before June 22, 2000, to determine the time when this item will be considered.

This facility is accessible to persons with disabilities. If accommodation is needed, please contact ARB's Clerk of the Board by June 12, 2000, at (916) 322-5594, or TDD (916) 324-9531, or (800) 700-8326 for TDD calls from outside the Sacramento area, to ensure accommodation.

Background

Architectural coatings are basically paints and other coatings applied to stationary structures and their appurtenances. The use of architectural coatings in California results in approximately 130 tons per day of volatile organic compound (VOC) emissions, which contribute to the formation of ozone and particulate matter (PM). These two pollutants pose California's most serious air quality problems.

Under California law, the primary authority for controlling emissions from architectural coatings is vested in the local air pollution control districts and air quality management districts ("districts", see Health and Safety Code, sections 39002, 40000, and 40001). However, the ARB often provides guidance and other assistance to the districts, including the development of model rules, such as the Suggested Control Measure (SCM) for architectural coatings. The ARB's authority to do this is provided by sections 39001, 39003, 39500, 39600, 39602, 39605, 40916 and 41500 of the Health and Safety Code.

Widespread regulation of architectural coatings began in 1977, when the ARB approved a SCM for architectural coatings. A number of districts adopted architectural coatings rules based on this SCM and on revisions to the SCM in 1985 and 1989. Currently, 17 of California's 35 districts have adopted architectural coatings rules. Given advances in coatings technologies over the past 10 years, and given the need for further emission reductions to attain health-based air quality standards in many districts, the ARB, in cooperation with the districts, has evaluated the VOC content limits in the 1989 SCM and current district rules. This two year effort included the following activities: 1) a comprehensive survey of architectural coatings; 2) regular meetings with districts, U.S. Environmental Protection Agency (U.S. EPA), and industry representatives; 3) an evaluation of durability and performance testing in various coating categories; 4) an evaluation of U.S. EPA's national architectural coatings rule; 5) technical analyses of all the coating categories proposed in the SCM; 6) an evaluation of alternatives to the SCM in a draft program environmental impact report; and 7) an analysis of the cost impacts. ARB staff also conducted eight public workshops and meetings with individual manufacturers and other interested parties from May 1998 through March 2000. The outcome of this review is the proposed new SCM.

The approval of the proposed SCM by the ARB will not impose binding requirements on any person. Binding requirements will only be imposed if one or more districts decide to adopt the SCM as a district rule. Upon adoption, a district rule would then apply to affected persons within the jurisdiction of the district. In addition, approval of the SCM by the ARB will not impose an obligation on any district to subsequently adopt the SCM. It will be up to each district to decide if adoption of the SCM as a district rule is needed to attain the state and federal ambient air quality standards within the district. Architectural coatings rules now in place in the districts will remain in effect, unchanged, until district adoption of the SCM.

Description of the Proposed SCM

The proposed new SCM specifies VOC limits for 47categories of architectural coatings. However, the SCM lowers limits for only 11 of these 47 categories, relative to typical district limits currently in effect in California. The categories include general use flat and nonflat (glossy) coatings, and a wide variety of specialty coatings, such as industrial maintenance coatings, lacquers, floor coatings, roof coatings, rust preventive coatings, stains, and primers, sealers, and undercoaters. Implementation of the proposed SCM would reduce VOC emissions by 10.3 tons per day statewide (excluding the South Coast Air Quality Management District, since they adopted Rule 1113 amendments in May 1999). The proposed effective date for the VOC limits is January 1, 2003, for all categories except industrial maintenance coatings. The proposed effective date for the VOC limit for industrial maintenance coatings is January 1, 2004.

The SCM also contains a three year "sell through" provision (for coatings manufactured before the applicable effective dates), definitions, test methods, standards for painting practices and thinning of coatings, container labeling requirements, and reporting requirements.

Although the current version of the proposed SCM does not contain an averaging provision, we are continuing to work with all interested parties to develop a voluntary averaging provision. The voluntary averaging provision will provide manufacturers with additional flexibility in complying with the proposed VOC limits. ARB staff plans to propose an averaging provision for the SCM at the June 22, 2000, public meeting.

AVAILABILITY OF DOCUMENTS AND AGENCY CONTACT PERSON

The ARB staff has prepared a Staff Report on the proposed SCM. The Staff Report contains the full text of the proposed SCM, and discusses the background, necessity for, technical basis, and economic impacts of the proposed SCM. Pursuant to CEQA (Public Resources Code sections 21000 et seq.), the ARB has also prepared a Draft Program Environmental Impact Report (EIR) for the proposed SCM. The Draft Program EIR concludes that no significant adverse environmental effects would result from the proposed SCM. The Draft Program EIR was made available for a 45-day public review and comment period from February 22, 2000, to April 7, 2000. All comments received on the Draft Program EIR and the ARB's responses to those comments will be incorporated into the Final Program EIR for the SCM, which will be made publicly available prior to the June 22, 2000, Board meeting.

Copies of the Staff Report, the Draft Program EIR, and the Final Program EIR (when it is completed) may be obtained from the ARB's Public Information Office, 2020 L Street, Sacramento, California 95814, (916) 322-2990. In addition, this notice, the Staff Report, the Draft Program EIR, and the Final Program EIR will be available on the ARB Internet site at **http://www.arb.ca.gov/arch/recent.htm**. To obtain these documents in an alternative format, please contact the Air Resources Board ADA Coordinator at (916) 323-4916, TDD (916) 324-9531, or (800) 700-8326 for TDD calls from outside the Sacramento area.

Further inquiries regarding this matter should be directed to Mr. Jim Nyarady, Manager, Strategy Evaluation Section, Stationary Source Division, at (916) 322-8273.

SUBMITTAL OF COMMENTS

At the June 22, 2000, public meeting, staff will recommend that the Board approve the proposed SCM, and certify the Final Program EIR for the SCM. The public may present comments relating to this matter orally or in writing at the meeting, and in writing or by e-mail before the meeting. To be considered by the ARB, written submissions must be addressed to and received by the Clerk of the Board, Air Resources Board, P.O. Box 2815, Sacramento, CA 95812, or 2020 L Street, 4th Floor, Sacramento, CA 95814, no later than 12:00 noon, June 21, 2000, or received by the Clerk of the Board at the meeting. To be considered by the ARB, e-mail submissions must be addressed to **archscm@listserv.arb.ca.gov** and received at the ARB no later than 12:00 noon June 21, 2000.

The ARB requests, but does not require, that 30 copies of any written statement be submitted. The ARB encourages members of the public to bring any suggestions for modification of the proposed SCM to the attention of staff in advance of the meeting.

CALIFORNIA AIR RESOURCES BOARD

MICHAEL P. KENNY
EXECUTIVE OFFICER

Date: June 5, 2000

California Environmental Protection Agency

Air Resources Board

STAFF REPORT
FOR THE PROPOSED
SUGGESTED CONTROL MEASURE FOR
ARCHITECTURAL COATINGS

Release Date:
June 6, 2000

State of California
AIR RESOURCES BOARD

STAFF REPORT
FOR THE PROPOSED SUGGESTED CONTROL MEASURE
FOR ARCHITECTURAL COATINGS

Public Meeting to Consider

THE PROPOSED
SUGGESTED CONTROL MEASURE
FOR ARCHITECTURAL COATINGS

To be considered by the Air Resources Board on June 22, 2000

Air Resources Board
Board Hearing Room, Lower Level
2020 L Street
Sacramento, California

Air Resources Board
P.O. Box 2815
Sacramento, CA 95812

State of California
AIR RESOURCES BOARD

THE PROPOSED SUGGESTED CONTROL MEASURE FOR ARCHITECTURAL COATINGS

Prepared by:

Stationary Source Division
Air Resources Board

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June 2000

ACKNOWLEDGMENTS

This report and the proposed California architectural coating suggested control measure were developed by the following Air Resources Board staff:

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We would like to extend our appreciation to the California Air Pollution Control Officers Association (CAPCOA), the CAPCOA Architectural Coatings Working Group, Jack Broadbent, Laki Tisopulos, Naveen Berry, and Darren Stroud of the South Coast Air Quality Management District, the National Paint and Coatings Association (NPCA), the Roof Coatings Manufacturers Association (RCMA), the Society for Protective Coatings, and the Paint and Decorating Contractors of America for facilitating discussion among industry and governmental representatives. We also would like to thank those coating manufacturers that met with ARB staff to share specific technical information regarding their products.

We would also like to express our appreciation, in memoriam, to Johnny Gordon, for providing his expertise over the years, especially as Chairman of the Air Resources Board's Architectural Coatings Task Force (1981-1988).

Staff Report for the Proposed Suggested Control Measure for Architectural Coatings

Introduction and Executive Summary
and
Technical Support Document

Air Resources Board
P. O. Box 2815
Sacramento, CA 95812

Staff Report for the Proposed Suggested Control Measure for Architectural Coatings

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Volume I:
Introduction and Executive Summary

I.

INTRODUCTION

A. HISTORY AND BACKGROUND

Architectural coatings are coatings applied to stationary structures and their appurtenances, and include such coatings as house paints, stains, industrial maintenance coatings, and traffic coatings. When applied, the solvents in architectural coatings evaporate into the atmosphere and contribute to volatile organic compound (VOC) emissions. The annual average VOC emissions from architectural coatings are estimated to be about 130 tons per day (TPD), in California in 1995. This represents about eight percent of the total stationary source VOC emissions, and about four percent of all VOC emissions statewide.

VOC emissions are precursors to the formation of ozone and particulate matter (PM), California's most serious air quality problems. VOCs react photochemically with oxides of nitrogen (NO_x) to form ozone. Ozone is a strong oxidizer and irritates the human respiratory system and damages plant life and property. VOCs also react in the atmosphere to form PM_{10} (particulate matter with an aerodynamic diameter less than 10 microns in size). PM_{10} is inhaled deep into the lungs and reduces human pulmonary function. PM_{10} may also contain toxic compounds. In the atmosphere, PM_{10} reduces visibility.

Control of emissions from architectural coatings is primarily the responsibility of the local Air Pollution Control Districts (APCD) and Air Quality Management Districts (AQMD). However, the Air Resources Board (ARB) has approved suggested control measures (SCMs) for architectural coatings beginning in 1977. The SCMs act as model rules for districts when adopting and amending their local architectural coatings rules. The proposed SCM described in this staff report reflects advances in coating technologies since the last SCM was approved in 1989. The proposed SCM, in part, relies upon the technical efforts by the South Coast AQMD staff to establish the interim limits in South Coast AQMD Rule 1113, which was adopted in May, 1999. Also, the proposed SCM reflects nearly two years of study of architectural coatings, and was developed in cooperation with the local air districts, the United States Environmental Protection Agency, and the affected industry.

II.

EXECUTIVE SUMMARY

A. INTRODUCTION

In this executive summary, we provide an abbreviated version of the information covered in the staff report. The executive summary is written in "question and answer" format and covers the following topics:

- Summary of the proposed suggested control measure (SCM)
- SCM development process and evaluation of alternatives
- Compliance with the proposed SCM
- Environmental Impacts
- Economic Impacts
- Future Plans

B. SUMMARY OF PROPOSED SUGGESTED CONTROL MEASURE (SCM)

What are architectural coatings?

Architectural coatings, as defined in the SCM, are coatings that are applied to stationary structures and their appurtenances at the site of installation, to portable buildings at the site of installation, to pavements, or to curbs. To be classified as an architectural coating, a coating must be applied in the field, at the site of installation, rather than in a shop or factory where pollution control equipment may be installed. The "appurtenances" included in the definition range from pipes to downspouts.

Architectural coatings include, but are not limited to paints, varnishes, stains, industrial maintenance coatings, and traffic coatings. General use flat and non-flat (eggshell, satin, semi-gloss, gloss) coatings account for about 61 percent of the sales of architectural coatings. The remaining sales consist of a variety of specialty coating categories. Architectural coatings, as defined in this SCM, do not include aerosol coatings (e.g., spray paint).

Why are we proposing the SCM?

We are proposing the SCM to help districts meet state implementation plan (SIP) and California Clean Air Act (CCAA) plan requirements. The SIP is California's master plan for achieving federal air quality standards. It includes the individual local air districts' air quality programs, the ARB's mobile source, fuels, and consumer products control programs, California's vehicle inspection and maintenance programs, and federal measures. The CCAA plans are districts' plans designed to achieve the State ozone standard.

The SCM is also necessary to help fulfill the conditions of a SIP lawsuit settlement agreement. Specifically, on September 18, 1997, three environmental groups (Communities for a Better Environment, the Coalition for Clean Air, and the Natural Resources Defense Council) filed a lawsuit in the United States District Court for the Central District of California. The lawsuit was filed against the ARB, the South Coast Air Quality Management District, and the United States Environmental Protection Agency, and was related to California's progress in achieving the 1994 SIP commitments. However, a settlement agreement was reached with these groups, under which the ARB staff committed, among other things, to proposing a number of control measures for the Board's consideration, including the SCM for architectural coatings.

We are also proposing the SCM to update the last SCM for architectural coatings, which was approved in 1989. Since that time, technological advances in resin technology have made it possible to meet lower VOC limits. The proposed SCM reflects these advances in technology, consistent with the South Coast AQMD's May 14, 1999, amendments to Rule 1113.

As with all SCMs and model rules, we are also proposing the SCM to promote consistency and uniformity among district rules. This is desirable because it makes it easier for manufacturers and painting contractors to comply with district rules.

Finally, we are proposing the SCM and the associated Program Environmental Impact Report (EIR) to provide assistance to the districts. When the 1989 SCM was approved, several districts that attempted to adopt and implement rules based on it were delayed by legal actions brought by some representatives of the architectural coatings industry. A central issue in these lawsuits was whether the districts had adequately analyzed the potential environmental impacts of their proposed rules, as required by the California Environmental Quality Act (CEQA). The proposed SCM is supported by a comprehensive Program EIR prepared by the ARB, that can be used by each district preparing whatever CEQA document a district chooses to prepare for its own architectural coatings rules. The ARB is committed to assisting the districts in adopting architectural coatings rules based on the proposed SCM.

How are emissions from architectural coatings controlled in the SCM?

Architectural coatings contain solvents, which evaporate when they are applied. Most of the solvents used in architectural coatings are volatile organic compounds (VOCs) that contribute to California's air quality problems. The SCM controls VOC emissions by establishing limits on the VOC content of architectural coatings. These VOC limits are expressed in grams of VOC per liter of coating (or pounds of VOC per gallon), less water and exempt compounds, and vary with each coating category. In general, manufacturers will meet the VOC limits by replacing some of the solvents in architectural coatings with water or other exempt compounds, or by increasing the amount of solids, such as resins and pigments.

What architectural coating categories are in the proposed SCM?

As shown in Table 1 below, the proposed SCM (see Appendix A) will establish VOC content limits for 47 categories (including subcategories) of architectural coatings. These coating categories are very similar to those in existing district rules in California. This is a full update of the 1989 SCM, establishing standards for 47 categories of coatings. However, this SCM lowers limits for only 11 of these 47 categories, relative to typical limits currently in effect in California. These 11 categories account for about 80 percent of the total emissions from the categories in the proposed SCM, and are noted in Table 1 with a double asterisk.

Table 1
Architectural Coatings Categories in Proposed Suggested Control Measure

Coating Category	Proposed VOC Limit*	Effective Date
Flat Coatings	100**	1/1/2003
Non-flat Coatings		
- All Others	150**	1/1/2003
- High Gloss	250	1/1/2003
Specialty Coatings:		
Antenna Coatings	530	1/1/2003
Antifouling Coatings	400	1/1/2003
Bituminous Roof Coatings	300	1/1/2003
Bituminous Roof Primer Coatings	350	1/1/2003
Bond Breakers	350	1/1/2003
Clear Wood Coatings		
- Clear Brushing Lacquers	680	1/1/2003
- Lacquers (including lacquer sanding sealers)	550**	1/1/2003
- Sanding Sealers (other than lacquer sanding sealers)	350	1/1/2003
- Varnishes	350	1/1/2003
Concrete Curing Compounds	350	1/1/2003
Dry Fog Coatings	400	1/1/2003
Faux Finishing Coatings	350	1/1/2003
Fire-Resistive Coatings	350	1/1/2003
Fire-Retardant Coatings		
- Clear	650	1/1/2003
- Opaque	350	1/1/2003
Floor Coatings	250	1/1/2003
Flow Coatings	420	1/1/2003
Form-Release Compounds	250	1/1/2003
Graphic Arts Coatings (sign paints)	500	1/1/2003
High-Temperature Coatings	420	1/1/2003
Industrial Maintenance Coatings	250**	1/1/2004
Low Solids Coatings	120	1/1/2003
Magnesite Cement Coatings	450	1/1/2003
Mastic Texture Coatings	300	1/1/2003
Metallic Pigmented Coatings	500	1/1/2003

Table 1 (continued) Architectural Coatings Categories in Proposed Suggested Control Measure		
Coating Category	**Proposed VOC Limit***	**Effective Date**
Multi-Color Coatings	250**	1/1/2003
Pre-Treatment Wash Primers	420	1/1/2003
Primers, Sealers, and Undercoaters	200**	1/1/2003
Quick-Dry Enamels	250**	1/1/2003
Quick-Dry Primers, Sealers, and Undercoaters	200**	1/1/2003
Recycled Coatings	250	1/1/2003
Roof Coatings	250	1/1/2003
Rust Preventative Coatings	400	1/1/2003
Shellacs - Clear - Opaque	 730 550	 1/1/2003 1/1/2003
Specialty Primers, Sealers, and Undercoaters	350	1/1/2003
Stains	250**	1/1/2003
Swimming Pool Coatings	340	1/1/2003
Swimming Pool Repair and Maintenance Coatings	340**	1/1/2003
Temperature-Indicator Safety Coatings	550	1/1/2003
Traffic Marking Coatings	150	1/1/2003
Waterproofing Sealers - Concrete/Masonry - Wood	 400 250**	 1/1/2003 1/1/2003
Wood Preservatives	350	1/1/2003

* VOC limits expressed in grams VOC per liter of coating, less water and exempt compounds, except for low solids coatings (which are expressed in grams VOC per liter of coating, *including* water and exempt compounds).

** VOC limit lower than typical limits currently in effect in California.

How does the proposed SCM compare to the National Rule and South Coast Air Quality Management District's Rule 1113?

Comparison to National Rule:

There are many differences between the proposed SCM and the U.S. Environmental Protection Agency's (U.S. EPA) National Rule, which became effective on September 13, 1999. The National Rule applies only to manufacturers and importers of architectural coatings while the proposed SCM applies to manufacturers, distributors, retailers, and users of architectural coatings. The National Rule also has generally higher (less restrictive) VOC limits than current district rules and the proposed SCM. For example, the proposed VOC limits in the National Rule for the three largest coating categories (flat, non-flat, and industrial maintenance coatings) are 250, 380, and 450 grams per liter, respectively. This compares with VOC limits of 100, 150 (excluding high gloss non-flat), and 250 grams per liter, respectively, for the same categories in the SCM. The National Rule also includes 16 additional specialty categories that are not included in the proposed SCM. These "national" categories are covered under one of the existing coating categories in the SCM. As discussed in detail in Chapter VI, ARB staff analyzed these additional national categories and found that it was not necessary to add them to the proposed SCM because: they are subject to other coating categories in existing district rules; are not architectural coatings; or, are not sold in California.

Comparison to South Coast AQMD Rule 1113:

The proposed SCM is very similar to the interim limits in the South Coast AQMD's Rule 1113 adopted in May, 1999. However, there are some differences in the coating categories and VOC limits. The proposed SCM contains the following eight coating categories not included in Rule 1113: antenna, antifouling, high gloss non-flat, bituminous roof primers, clear brushing lacquer, flow, form release compounds, and temperature-indicator safety coatings. In another five categories (bituminous roof, floor, high-temperature, pre-treatment wash primer, and swimming pool repair and maintenance), the VOC limits differ. The differences between the proposed SCM and Rule 1113 reflect that the SCM is designed to be implemented throughout California, with varied climatic conditions. The differences also reflect the need to simplify enforcement for districts with limited resources. Specifically, the proposed limits will allow closely related coatings categories to be subject to the same VOC limit.

What is the difference between the proposed SCM and a district rule?

Control of emissions from architectural coatings is primarily the role of the local air pollution control districts and air quality management districts ("air pollution control agencies") in California. As such, the local air pollution control agencies adopt and enforce their own architectural coatings rules. Suggested control measures (SCMs) are developed by the ARB in conjunction with the districts, and serve as model rules for use by the districts when they adopt or amend their architectural coatings rules. Widespread regulation of architectural coatings began in 1977, when the Air Resources Board approved the first SCM for architectural coatings. Many districts adopted architectural coatings rules based on this SCM and on revisions to the SCM in 1989. Currently, 17 of California's 35 districts have adopted architectural coatings rules.

Does the SCM include an averaging provision?

No. Although the proposed SCM does not currently include an averaging provision, we are currently working with interested parties to develop such a provision. An averaging provision would provide manufacturers with some additional flexibility to meet the regulation. Under such an approach, a coating manufacturer would be able to meet the regulation by averaging emissions of overcomplying products with emissions of noncomplying products. The South Coast AQMD Rule 1113 contains such a provision, and we are considering the use of the Rule 1113 averaging approach for the SCM, but with the inclusion of a sunset date. We are proposing to include a sunset date to ensure that districts meet their SIP commitments. The sunset date is not necessary for the South Coast AQMD averaging provision because their architectural coatings rule contains future effective limits more stringent than those proposed in the SCM. We plan to propose an averaging provision for the SCM when it is presented to the Board at the June 22, 2000, Board meeting.

Does the SCM include any other provisions to provide flexibility to industry?

Yes. The proposed SCM contains a special provision for certain industrial maintenance coatings sold and used in the San Francisco Bay Area, North Central Coast, and North Coast Air Basins. This provision would allow limited use of industrial maintenance coatings with VOC contents up to 340 g/l. This provision is designed to address the need that public services and industrial facilities have for higher VOC coatings in areas with persistent fog and cold temperatures. Under this provision, the maximum loss in emission reductions from industrial maintenance coatings in these areas would be five percent. We are proposing a quantifiable cap on the loss in emission reductions from this provision to maximize the emission reductions achieved from the industrial maintenance category. We worked closely with the affected agencies in determining the total annual volume at 340 g/l needed to meet their demand under these adverse climatic conditions.

What other requirements are included in the proposed SCM?

The proposed SCM includes several other requirements, which are similar to those found in existing district architectural coatings rules in California. These requirements include the following:

(1) container labeling requirements regarding the date of manufacture, VOC content, thinning recommendations, and labeling specific to selected coating categories;
(2) reporting requirements specific to clear brushing lacquers, rust preventative coatings, bituminous roof coatings; bituminous roof primers; specialty primers, sealers, and undercoaters; coatings containing methylene chloride or perchloroethylene; and recycled coatings;
(3) a "painting practices" provision designed to limit VOC emissions from open paint containers;
(4) a thinning provision specifying allowable thinning practices;
(5) a "sell-through" provision allowing three years to sell products manufactured prior to the effective date of a VOC limit; and
(6) provisions specific to industrial maintenance and rust preventative coatings.

Are any products exempt from the SCM?

Yes. Architectural coatings sold in containers with a volume of one liter or less are exempt from the SCM. This is consistent with district architectural coatings rules in California and the U.S. EPA's national architectural coatings rule. Aerosol coating products are also exempt. However, they are subject to the ARB's statewide aerosol coatings regulation. Finally, products manufactured for use outside of the applicable district, or for shipment to other manufacturers for reformulation or repackaging are also exempt.

Who would be affected by the proposed SCM amendments?

If adopted by the districts, the proposed SCM would apply to anyone who sells, supplies, offers for sale, or manufactures any architectural coating for use within the applicable district, as well as any person who applies or solicits the application of any architectural coating within the district. The primary impact would be on manufacturers and marketers of architectural coatings, which will have to reformulate some of their products. Manufacturers will need to devote research and development resources to develop lower VOC products, and may also need to use more expensive resins, exempt solvents, or other ingredients in their lower VOC formulations. There may also be a slight impact on distributors and retailers, who must ensure that they are selling or supplying products that comply with the new VOC limits. Suppliers of resins, solvents, and other ingredients may be impacted, depending on whether there is an increased or decreased demand for their products. Some industrial, institutional, or governmental users may need to test the new products and adjust manuals and specifications to account for the new lower VOC formulations. Finally, consumers, contractors, and other paint users may have to pay more for some architectural coatings, or may have to make some adjustments in their use of the reformulated products.

What are the district SIP commitments for architectural coatings?

Five local air districts in four federal ozone nonattainment areas included control measure commitments in the 1994 Ozone SIP to achieve additional VOC emission reductions from architectural coatings. These districts are the South Coast AQMD, Ventura County APCD, Yolo-Solano AQMD, Placer County APCD, and San Joaquin Valley Unified APCD. Yolo-Solano AQMD and Placer County APCD are part of the same federal ozone nonattainment area referred to as the Sacramento Metropolitan nonattainment area. The staff report, Chapter I, provides information on the emission reduction commitments for architectural coatings in the 1994 Ozone SIP by district and by attainment year.

Which districts are expected to adopt the proposed SCM?

At a minimum, we expect the 17 districts with current architectural coatings rules in California to amend their rules based on the SCM (with the exception of the South Coast AQMD, since the SCM was based on the interim limits in their rule). These districts are listed in Table 2 below. We also note that there are five districts that are nonattainment for the State ozone standard that do not have an architectural coatings rule: Glenn, San Luis Obispo, Shasta, and Tehama County Districts, and the Yolo-Solano AQMD. The SCM will be available for adoption by these districts in order to reduce VOC emissions and attain or maintain the State ozone standard.

We have worked closely with the districts in developing the SCM. As a result, the California Air Pollution Control Officers Association issued a position paper urging districts to adopt the SCM within 12 to 18 months of ARB approval. Architectural coatings used in districts without architectural coatings rules will be subject to the VOC limits in the U.S. EPA's National Rule.

Table 2 Districts That Have Architectural Coatings Rules	
Antelope Valley APCD	Monterey Bay Unified APCD
Bay Area AQMD	Placer County APCD
Butte County APCD	Sacramento Metropolitan AQMD
Colusa County APCD	San Diego County APCD
El Dorado County APCD	San Joaquin Valley Unified APCD
Feather River AQMD	Santa Barbara County APCD
Imperial County APCD	South Coast AQMD
Kern County APCD	Ventura County APCD
Mojave Desert AQMD	

C. SCM DEVELOPMENT PROCESS AND EVALUATION OF ALTERNATIVES

How did ARB staff develop the proposed architectural coatings SCM?

The architectural coatings SCM was developed in cooperation with local air pollution control agencies, the architectural coatings industry, the U.S. EPA, and other interested parties. The development process included the following activities: (1) a comprehensive survey of architectural coatings; (2) regular meetings with district and U.S. EPA Region IX, and industry representatives; (3) an evaluation of durability and performance testing in several coating categories; (4) an evaluation of the U.S. EPA's national architectural coatings rule; (5) technical analyses of all the coating categories proposed in the SCM; (6) an evaluation of alternatives to the SCM in a draft program environmental impact report; and (7) an analysis of the cost impacts. ARB staff also conducted eight public workshops and meetings with individual manufacturers and other interested parties from May 1998 through March 2000. A chronology of the public meetings held is shown in the table below.

Table 3
Chronology of Architectural Coatings Suggested Control Measure

Date	Meeting	Location
May 27, 1998	1st Public Workshop	Sacramento, CA
August 20, 1998	2nd Public Workshop	Sacramento, CA
March 30, 1999	3rd Public Workshop	Diamond Bar, CA
June 3, 1999	4th Public Workshop	Sacramento, CA
July 1, 1999	5th Public Workshop	Sacramento, CA
September 8, 1999	6th Public Workshop	Diamond Bar, CA
December 14, 1999	7th Public Workshop	Diamond Bar, CA
March 16, 2000	8th Public Workshop	Sacramento, CA

To solicit additional information and comments, staff also held numerous individual meetings and teleconferences with the districts, industry representatives, and the U.S. EPA.

Who has been most active in the process?

The local air pollution control agencies, architectural coatings manufacturers and marketers, trade associations, and representatives of essential public services agencies have been active in the development of the proposed SCM. The air pollution control agencies most involved in the process are members of the Architectural Coatings Working Group of the California Air Pollution Control Officers Association. The Working Group is composed of the following air pollution control agencies:

- Bay Area Air Quality Management District
- Monterey Bay Unified Air Pollution Control District
- Sacramento Metropolitan Air Quality Management District
- San Diego County Air Pollution Control District
- San Joaquin Valley Unified Air Pollution Control District
- South Coast Air Quality Management District
- Ventura County Air Pollution Control District
- Yolo-Solano Air Pollution Control District

The manufacturers, marketers and users of architectural coatings that have been involved in the process are too numerous to list, and include a broad cross-section of the industry. The essential public services agencies and the trade associations representing architectural coatings manufacturers or users include the following:

- California Department of Transportation
- California Department of Water Resources
- National Paints and Coatings Association (NPCA)
- Paint and Decorating Contractors of America (PDCA)
- Roof Coatings Manufacturers Association (RCMA)
- Society for Protective Coatings (SSPC)

What information was gathered in the ARB's 1998 Architectural Coatings Survey?

The ARB's 1998 Architectural Coatings Survey collected detailed sales and formulation information from over 150 manufacturers of architectural coatings for coatings sold in California in 1996. This information was collected for 58 different coating categories and was collected either on a product specific basis, or collectively from product groups that met certain criteria (e.g. the products must be within a 50 gram VOC per liter content range). Specifically, for each product or group of products, the survey requested the following information:

- Coating category code
- Number of products grouped
- Interior or exterior use, or dual use
- Carrier technology
- Percent by weight volume solids
- Density

- VOC actual
- VOC regulatory
- Thinning information
- California sales (in gallons)

The survey also requested for each product, or group of products, either: (1) the complete formulation; or (2) the speciation of the VOC ingredients (and exempt VOCs). Manufacturers were given either option to complete the survey.

ARB used the data collected in the survey to develop an updated emissions inventory for 1996. The technical information gathered in the survey was also used, along with other information, to develop the proposed SCM.

Did ARB staff evaluate alternatives to the proposed SCM?

Yes. Under the California Environmental Quality Act (CEQA), project alternatives should be identified in the Draft Program Environmental Impact Report (EIR). Alternatives include measures for attaining the objectives of the proposed project, and provide a means for evaluating the comparative merits of each alternative. An alternative evaluating the merits of not having the project must also be included. The alternatives considered feasible are then evaluated for potential environmental impacts that may result from their implementation.

The alternatives rejected as being infeasible in the Program EIR include:

(1) Performance-based standards, i.e., emission standards based on coating performance;
(2) Seasonal regulation, i.e., VOC limits for "high ozone season" only;
(3) Regional regulation, i.e., exemption from VOC limits for regions that may not have an ozone problem;
(4) Exceedance fees, i.e., allowing manufacturers to "pay to pollute;"
(5) Low vapor pressure exemption, i.e., exempting VOCs with low vapor pressures in determining the overall VOC content of a coating; and
(6) Reactivity-based VOC limits, i.e., VOC limits based on the ozone impacts of the VOCs in a coating.

The following alternatives were considered feasible in the Program EIR, but were rejected in favor of the proposed SCM:

(1) No project, i.e., assuming that the SCM will not be adopted;
(2) Extended compliance deadlines, i.e., extending all of the effective dates of the VOC limits to January 1, 2004;
(3) Further reduction of VOC content limits, i.e., adopting the "final" limits of the May, 1999, SCAQMD Rule 1113 amendments (those with effective dates of 2005-2008); and

(4) Product line averaging, i.e., allowing manufacturers to make products that have VOC contents higher than the proposed VOC limits in the SCM, if they compensate with other products that are below the proposed VOC limits.

After further evaluation of the feasible alternatives, we are developing an averaging provision that we plan to include in the proposed SCM presented to the Board at the June 22, 2000, Board meeting. These alternatives are discussed in detail in Chapter V of the Draft Program EIR.

How were the proposed VOC limits in the SCM established?

Although the VOC limits in the proposed SCM are similar to those in the South Coast AQMD's Rule 1113, ARB staff performed an independent analysis of each of the proposed limits. These analyses are included in Chapter VI of the staff report. In proposing each of the VOC limits, ARB staff considered: (1) the results of the ARB's 1998 Architectural Coatings Survey; (2) the number of complying products currently on the market; (3) trade journals and other literature related to the product category; and (4) discussions with paint and resin manufacturers. As mentioned previously, the proposed VOC limits are the product of extensive interaction with the affected coatings industry, including discussions during eight public workshops and numerous meetings and conference calls. Although each of the proposed limits is based on factors unique to each individual coating category, the following guiding principles were applied:

- Technological and commercial feasibility - assuring that reformulation technologies will be available by the effective date for each proposed limit, and that the overall performance of complying products will be similar to that of noncomplying products.

- Emission reductions achieved - assuring that our overall proposal will achieve the maximum feasible reduction in emissions.

- Minimize the potential for the use of Toxic Air Contaminants (TAC) - assuring that the proposal can be met without an increased used of TACs.

D. COMPLIANCE WITH THE SCM PROPOSAL

How will manufacturers reformulate their products to comply with the VOC limits?

Manufacturers of coatings above the proposed VOC limits will need to reformulate their products to meet the applicable VOC limits. Manufacturers have the flexibility to choose any formulation that meets the applicable VOC limits, and the reformulation options vary with each coating category (see Chapter VI of the staff report). In general, VOC solvents will need to be reduced, by increasing the amount of water, exempt solvents, or coating solids. In water-based products, VOC solvents may be partially replaced with water. This may require the use of different resin systems that require less VOC solvents. In solvent-based products, VOC solvents may be partially replaced with paint solids or exempt solvents such as acetone. These changes may also require the use of different resin systems. For example, a higher solids formulation may need to use a less viscous resin system to improve flow and leveling. Solvent-based products may also be reformulated to a water-based system. As mentioned previously, ARB staff has proposed VOC limits that can be met without an increase in the use of Toxic Air Contaminants.

Are the VOC limits proposed in the SCM technologically and commercially feasible?

Yes. As explained in detail in Chapters IV and VI of the staff report, staff believes all of the VOC limits proposed in the SCM are technologically and commercially feasible by the effective dates in the SCM. The proposed VOC limits are targeted towards the lowest VOC content technology within a coating category that will adequately perform the intended function. Although we believe that all of the proposed VOC limits are technologically and commercially feasible, ARB staff will conduct technology reviews of the proposed VOC limits in the SCM that are lower than current limits, prior to their implementation. This is a standard practice for consumer products regulations and is intended to identify any unanticipated problems prior to implementation of the proposed VOC limits.

Our survey results demonstrate that for nearly all the coating categories, products are currently available that comply with the proposed limits. For the 11 categories for which we are proposing lower limits than the predominant limits in existing district rules, the complying marketshares range from 13 to 74 percent, with the exception of swimming pool repair and maintenance coatings. For this category, the survey indicated no complying products, but staff identified technologies in Chapter VI of the staff report that can be used by manufacturers to meet the proposed VOC limit. The complying marketshares vary widely with each coating category because the proposed limits were developed after considering a variety of factors unique to each category. These factors include the availability of reformulation options that may not be used in current products, the variety of product types in a given coating category, patents that may restrict some reformulation options, and economic issues.

Will the reformulated products perform similar to existing products?

Yes. ARB staff concludes that the overall performance of the reformulated products will be similar to the performance of their higher VOC counterparts. This conclusion is based on: (1) the current availability of complying products in the marketplace; (2) ARB staff's analyses of each product category, as detailed in Chapter VI; and (3) the results of performance studies conducted by independent laboratories (the "National Technical Systems (NTS) Study" and the "Harlan Associates Study"). The NTS study showed that when compared to conventional coatings, currently compliant, low-VOC coatings available today have similar application and performance characteristics, including blocking resistance, mar resistance, adhesion, abrasion resistance, and corrosion protection. The raw data from the Harlan Associates study was published in 1995. Although somewhat dated, the information generally supports the results of the NTS study. These studies are discussed in detail in Chapter IV of the staff report.

What are the emission reduction benefits from the architectural coatings SCM proposal?

The total emission reductions from full implementation of the proposed VOC limits is estimated to be about 10 tons per day in California, excluding the South Coast AQMD. This equates to about a 20 percent reduction in the total emissions from the coating categories in the SCM. We are not counting any emission reductions in the South Coast AQMD, because the interim limits in their rule, as amended on May 14, 1999, are similar to those in the proposed SCM. The emission reductions are calculated based on the predominant limit in existing district rules. Many of the proposed limits will not achieve significant reductions because the proposed limit is the same as the predominant limit in current district rules.

E. ENVIRONMENTAL IMPACTS

Why did we develop a Program EIR?

Both the California Environmental Quality Act (CEQA) and ARB policy require the ARB to evaluate the potential adverse environmental impacts of proposed projects. As explained in the Draft Program EIR, the ARB is authorized to prepare a plan or other written document (such as an environmental analysis chapter in the staff report) in lieu of an environmental impact report. However, the ARB chose to develop a formal "Program EIR" to assist the districts in the adoption of the SCM. State law allows a lead agency to prepare a Program EIR for a series of actions that can be characterized as one large project (subject to certain requirements as explained in the Program EIR). The ARB intends that each district may rely on the Program EIR by incorporating it by reference in whatever CEQA documents a district chooses to prepare for its own architectural coatings rule.

What are the expected environmental benefits of the architectural coatings SCM?

The primary environmental benefit of the SCM amendments will be a reduction in the formation of tropospheric (ground level) ozone and PM_{10} (minute particulate matter of 10 microns or less equivalent aerodynamic diameter). It has long been known that exposure to ground level ozone and PM_{10} have adverse impacts on public health. Research has shown that, when inhaled, ozone and PM_{10} can cause respiratory problems, aggravate asthma, and impair the immune system.

In the presence of sunlight, the VOCs from architectural coatings and other sources react with oxides of nitrogen (NO_x) to form ozone. In addition, VOCs have been found to be a source of PM_{10}, either through condensation of the VOCs or complex reactions of VOCs with other compounds in the atmosphere. Therefore, districts that adopt the SCM will reduce their VOC emissions and experience a positive impact on air quality and public health. The exact reductions in ozone and PM_{10} cannot be accurately predicted due to the wide variety of factors that impact the formation of ozone and PM_{10}. These factors include atmospheric conditions, the ratio of VOCs to NO_x in the atmosphere, and the reactivity (ozone formation potential) of the individual

VOCs emitted. However, numerous scientific studies have shown that by reducing VOC emissions, ozone and PM_{10} concentrations are reduced. Therefore, by reducing ozone and PM_{10} concentrations, this SCM would reduce the health risks posed by exposure to these pollutants.

Are there any potential negative environmental impacts?

No. In the Draft Program EIR, we examined the potential effect of the proposed SCM on air quality, water demand, water quality, public services (public facility maintenance, fire protection), transportation and circulation, solid waste/hazardous waste, and hazards to the public or the environment. Based on our analysis, we do not expect any significant adverse environmental impacts to result from the implementation of the proposed SCM.

F. ECONOMIC IMPACTS

How did ARB staff evaluate the potential economic impacts of the proposed SCM?

ARB staff evaluated the economic impacts of the proposed SCM by: (1) conducting a cost survey sent to manufacturers; (2) comparing the ingredient costs of typical low VOC formulations with higher VOC formulations; and (3) comparing the retail prices of complying formulations with higher VOC formulations. The analysis assumes that the SCM is implemented statewide by districts (excluding the South Coast AQMD which has already adopted a rule with similar interim limits). As detailed below, this information was used to perform a business impacts analysis and a cost-effectiveness analysis for the 11 coating categories where the VOC limits in the proposed SCM are different from most current district VOC limits. The analysis does not consider the economic benefit to manufacturers that choose to participate in the averaging program that is under development.

How was the business impacts analysis conducted and what are the results?

In our economic impact analysis, we evaluated the potential impact of the proposed VOC limits on profitability and other aspects of businesses subject to the limits. To conduct our analysis, we relied on the estimated costs of compliance from our industry cost survey, ingredient costs for typical complying and noncomplying formulations, and retail price surveys. We then evaluated the impact of these costs on typical businesses using a combination of publicly available financial databases *(Dun and Bradstreet, Ward's Business Directory of U.S. Manufacturing Industries*), the ARB's 1998 Architectural Coatings Survey, industry journals/literature such as the *Chemical Market Reporter*, and discussions with industry representatives.

We utilized the change in "return-on-owners equity" (ROE) as an indicator of the limits' potential impacts on business profitability. The cost to comply with the proposed SCM, through increased research and development, equipment purchases, and increased ingredients costs, is presumed to impact a business' ROE and therefore its profitability. The cost to reformulate noncomplying products for a typical company was used to determine total annual reformulation costs. Our analysis indicates the estimated change in ROE can vary from essentially no change to 2 percent change. The average change in ROE is about 1 percent, relative to the ROE before the proposed SCM would take effect. This estimated change in ROE is well within the change in ROE estimated for other ARB and district rules.

Our ROE analysis for the proposed limits may overestimate the impact on businesses because it assumes that all of the costs of the proposed limits will be absorbed by manufacturers. In reality, we expect that at least some of the investment costs to comply with the proposed limits will be passed on to consumers. The analysis also does not quantify the extent of cost mitigation due to “technology-transfer” between product lines and from contract manufacturers who make essentially equivalent products for a number of competing businesses.

While we expect that most businesses will be able to absorb the costs of the proposed limits without significant adverse impacts on their profitability, there is the possibility that some individual businesses will be adversely affected when districts adopt the proposed SCM. Therefore, it is possible that the proposed SCM may have a significant adverse impact on some businesses that are not in a market position to invest monies to develop new low VOC products, or to absorb the increased cost resulting from their compliance with the proposed SCM.

Based on our analysis, we do not expect the proposed limits in the SCM to have a significant impact on employment, or business creation, elimination, or expansion. We also do not expect the proposed SCM to have a significant impact on the competitiveness of California businesses compared with those outside of California. This is because all companies that sell these products in California would have to meet the proposed requirements, whether located in California or outside of California.

The VOC limits in the proposed SCM will primarily impact architectural coatings manufacturers, and marketers (companies which contract out the manufacturing of their products). However, we recognize that other industries could also be impacted to a lesser amount, which is difficult to quantify. These industries include distributors, retailers, and “upstream” suppliers who supply solvents and other chemicals used in architectural coatings.

Distributors and retailers could be impacted because they need to ensure that noncomplying products are not sold past the “sell-through period.” However, based on retail sell-through data obtained during the development of ARB’s existing consumer products regulations, we believe the existing three year sell-through period should provide ample time to allow for the sale of noncomplying architectural coatings.

Upstream suppliers could be impacted because manufacturers will be purchasing some different solvents, and other materials for their reformulated products. However, we do not expect these changes to result in a major impact on the affected industries because chemical companies generally supply many different industries, and because many of the upstream suppliers also provide the alternative products which will be used in the reformulated products. In fact, we expect some upstream suppliers will benefit since the proposed limits are likely to create new or increased demand for materials to be used in compliant formulations.

Will the proposed SCM be cost-effective?

Yes. Cost-effectiveness is one measure of the SCM's efficiency in reducing a given amount of pollutant (often reported in "dollars (to be) spent per pound of VOC reduced"). The methodology used to determine cost-effectiveness is well established and often used to compare a proposed regulation's cost-efficiency with those of other regulations. To calculate the cost effectiveness of the SCM, we divided the estimated total annual cost to reformulate all noncomplying products in a given category by the total emission reduction for the category. We estimated the cost-effectiveness of each of the categories in the SCM where reductions will occur. To conduct our analysis, we relied on specific formulation data from the "1998 ARB Architectural Coatings Survey," industry journals/literature such as the Chemical Market Reporter for ingredient unit prices, and discussions with industry representatives. Based on our analyses, we estimate that the cost-effectiveness of the individual VOC limits ranges from essentially no cost to about $7.70 per pound of VOC reduced. We estimate the average cost-effectiveness weighted by emissions reductions across all the proposed limits to be about $3.20 per pound of VOC reduced. These estimated cost-effectiveness values are within the typical range of costs of existing ARB control measures and district rules.

Will consumers have to pay more for architectural coating products subject to the proposed SCM?

Maybe. Consumers will have to pay more for some products subject to the architectural coatings SCM, depending on the extent to which manufacturers are able to pass along their costs to consumers. As explained in Chapter VIII of the staff report, assuming that all the costs of the proposed SCM are passed along to consumers, the change in cost per unit would range from no cost to a cost increase of $7.90 per gallon, depending on the coating category. The average cost increase per unit, is estimated to be about $1.40 per gallon.

G. FUTURE PLANS

Are there any plans for further emissions reductions from architectural coatings?

Yes. If the Board approves the proposed SCM, staff will begin investigating the final (2005-2008) VOC limits in the South Coast AQMD's Rule 1113. These limits are lower than the limits proposed in the SCM, and affect the following categories in the SCM: floor coatings; high-temperature coatings; industrial maintenance coatings; flats; non-flats; lacquers; primers, sealers, and undercoaters; quick-dry enamels; quick-dry primers, sealers, and undercoaters; recycled coatings; rust preventative coatings; and specialty primers, sealers, and undercoaters. We will also consider developing mandatory "reactivity-based" limits which account for differences in individual VOC's potential to form ozone. However, this approach would first require a detailed survey with VOC speciation information on a product specific basis. It is staff's intent to continue our working relationships with the districts, U.S. EPA, and industry as we investigate these potential future limits.

Will ARB staff track industry's progress toward the proposed VOC limits?

Yes. Staff plans to conduct technology assessments for each coatings category with lower proposed future limits at least one year prior to their effective date. We are convinced that the proposed limits are feasible, based on all the evidence available to us. However, it is standard practice for the ARB to conduct these reviews to ensure that unanticipated problems do not arise. We will also track essential public services test programs and the National Technical Systems (NTS) test program. Industry has also expressed interest in initiating a new test program.

Will there be additional architectural coatings surveys?

Yes. Staff currently anticipates beginning another architectural coatings survey in 2001 to 2002. It is expected that the survey would collect speciated VOC information on a product specific basis. This information is needed to determine the feasibility of reactivity-based control strategies, as described in the response to the next question.

How will the "reactivity" of individual VOC's be considered in future architectural coating rules?

Every VOC reacts differently under ambient conditions to form ozone. This tendency is called the VOC's "reactivity." Individual VOCs vary both in their rate of ozone formation and in the quantity of ozone formed. A relative reactivity scale (the maximum incremental reactivity scale) was developed by Dr. William Carter to rank VOCs based on their tendency to form ozone. Each VOC in this scale is assigned an "ozone formation potential" value based on smog chamber studies or by comparison with similar VOCs. Such a relative reactivity scale is used in the ARB's existing Low Emissions Vehicle (LEV) program. This regulation first used the MIR scale to determine the ozone forming potential of vehicle exhaust by utilizing reactivity adjustment factors. By making a reactivity adjustment to the emissions, an alternatively fueled vehicle is able to emit more mass emissions, as long as they are less reactive than those from a gasoline fueled vehicle.

Traditional mass-based VOC limits have treated all VOCs equally, with no consideration for the reactivity of individual compounds (other than exempting negligibly-reactive compounds). However, the ARB staff recently proposed mandatory reactivity-based limits for aerosol coatings, and intends to investigate the feasibility of incorporating mandatory reactivity-based limits into the architectural coatings SCM.

III.

RECOMMENDATION

We recommend that the Board approve the proposed architectural coatings suggested control measure and certify the Program Environmental Impact Report.

State of California
AIR RESOURCES BOARD

Staff Report for the Proposed Suggested Control Measure for Architectural Coatings

Volume II: Technical Support Document

I.

INTRODUCTION

A. OVERVIEW

Architectural coatings are coatings applied to stationary structures and their accessories, and include such coatings as house paints, stains, industrial maintenance coatings, and traffic coatings. Emissions from architectural coatings in California are estimated to be about 130 tons per day (TPD), on an annual average, of volatile organic compounds (VOC) in 1995. This represents about eight percent of the total stationary source VOC emissions, and about four percent of all VOC emissions statewide. This 130 TPD is more than all the VOC emissions from petroleum refining and marketing combined, and is comparable in size to the VOC emissions from the emission categories of pesticides, degreasing operations, and all other coatings.

VOC emissions are precursors to the formation of ozone and particulate matter (PM), two of the most serious air pollutants in California, for which the State and national ambient air quality standards are exceeded in much of the state. VOCs react photochemically with oxides of nitrogen (NO_x) to form ozone. Ozone is a strong oxidizer and irritates the human respiratory system and damages plant life and property. VOCs also react in the atmosphere to form PM_{10} (particulate matter with an aerodynamic diameter less than 10 microns in size). PM_{10} is inhaled deep into the lungs and reduces human pulmonary function and increases inhalation of toxic compounds. In the atmosphere, PM_{10} limits visibility.

Control of emissions from architectural coatings is primarily the responsibility of the local Air Pollution Control Districts (APCD) and Air Quality Management Districts (AQMD). The Air Resources Board (ARB or Board), in part through its oversight responsibilities, approved a Suggested Control Measure (SCM) for architectural coatings in 1977, and amended it in 1985 and 1989. The 1989 amendments (Appendix B) were undertaken in cooperation with the California Air Pollution Control Officers Association (CAPCOA). The SCM has been used as a model for districts when adopting and amending their local architectural coatings rules. The traditional approach used to reduce emissions through architectural coatings rules is by setting VOC content limits for various coating categories. In this way, high-VOC coatings are either replaced by existing low-VOC coatings, or the high-VOC coatings are reformulated to meet the VOC limits.

Given the advances in coating technologies over the past ten years, and given the need for further emission reductions to attain health-based air quality standards in many districts, the ARB, in cooperation with the districts, has undertaken several projects in the last few years to evaluate the technology of architectural coatings. The ultimate goal of these projects was to determine if the 1989 SCM could be updated so that further emission reductions can be achieved from architectural coatings when districts adopt or amend architectural coatings rules.

In this staff report, we present the results of nearly two years of study of architectural coatings, which ultimately led to our proposal to update the SCM. Our evaluation included a survey of architectural coatings sold in California, an evaluation of United States Environmental Protection Agency's (U.S. EPA) National Rule for Architectural Coatings (National Rule), an examination of several compliance flexibility options, and technology assessments. We also present several proposed long-term efforts that can ultimately improve the effectiveness of the SCM and district architectural coatings rules.

B. ARCHITECTURAL COATINGS INDUSTRY

Architectural coatings, as defined in the SCM, are coatings that are applied to permanent structures or portable buildings, to pavements and curbs, and to any accessories to stationary structures. To be classified as an architectural coating, a coating must be applied in the field, at the site of installation, rather than in a shop or factory where pollution control equipment may be installed. Encompassed in the architectural coatings category are coatings applied to homes, schools, factories and processing plants, public utilities, and structures. The accessories included in the definition range from pipes to downspouts.

Coatings are used primarily for beautification and protection. Architectural coatings are designed specifically to be applied to a variety of surfaces, including metal, wood, plastic, concrete, bricks, and plaster. Some coatings are designed to be on the surface, while others are meant to be on the substrate with other coatings adhering to them. Some coatings are designed to impregnate the surface, while others are transparent and allow the substrate to be visible. Some of the specialty coatings in the architectural coatings category are formulated to withstand traffic, electrical energy, chemicals, caustics, and abrasion. Architectural coatings are applied by a variety of methods including brush, roller, spray gun, or specialized equipment. Architectural coatings must also meet the application and performance expectations of do-it-yourselfers, professional painting contractors, and maintenance personnel.

Architectural coatings are formulated using four main categories of ingredients:

- Resins (polymers or binders) that bind the pigments and additives together and form a film upon drying. Sometimes copolymers are used to modify the properties of the primary resin. Some resins used in architectural coatings include alkyds, latex, oils, vinyls, acrylics, cellulosics, epoxies, urethanes, and polyurethanes.

- Pigments, finely ground powders dispersed in the paint, provide its color, ability to hide the underlying surface, and other properties.

- Solvents are the volatile carriers used to control the viscosity of the paint and provide application properties. Some solvents used are water, alcohols, glycols, glycol ethers, ketones, esters, and aromatic or aliphatic hydrocarbons.

- Additives or specialty chemicals, which assist in manufacture and application, may improve the properties of the finished film. Some examples of additives include preservatives, wetting agents, coalescing agents, freeze-thaw stabilizers, anti-foam agents, and thickeners.

In addition, extenders such as limestone, clay, gypsum, talc, and silica are sometimes added for performance characteristics or to control cost, but extenders generally are detrimental to application, gloss, and overall durability of coatings. Therefore, the highest performing paints consist of a balanced formulation of pigments and binders. They are available in a wide range of colors, gloss, and performance characteristics.

One important criterion for selecting coatings is durability. Exterior paints must be able to stand up to sunlight, humidity, water, heat, cold, ice, snow, and air pollution. Interior paints are chosen for their color, gloss, and ability to withstand scrubbing.

Architectural coatings are usually purchased ready-to-use, although some come in two components that must be mixed prior to application. Coatings are sometimes thinned when they are too thick to spray or brush, or when low temperature or high humidity hamper application properties. Water-based coatings are thinned with water only, whereas solvent-based coatings can only be thinned with organic solvents. Solvents are also used with water-based coatings following soap and water cleanup of spray guns to prevent deterioration of the equipment.

Table I-1 shows the top ten architectural coatings manufacturers, by volume, in California in 1996, listed alphabetically.

Table I-1 **Top Ten Architectural Coatings Manufacturers** **(in California in 1996)**
Behr Process Corporation
Conco Paint Company
Dunn-Edwards Corporation
Frazee Industries
ICI Paints
Kelly-Moore Paint Company
Sherwin-Williams Company
Smiland Paint Company
Vista Paint Corporation
Western Colloid Products

C. BACKGROUND

Before discussing the proposed SCM, it is important to first review a brief history of the regulation of architectural coatings in California, including recent federal activities, as well as the State Implementation Plan commitments, for architectural coatings.

1. History of the Regulation of Architectural Coatings in California

Widespread regulation of emissions from architectural coatings in California began with the approval of the SCM for architectural coatings by the ARB in 1977. Subsequently, many of the local air districts adopted rules based on this SCM. ARB's SCM was amended in 1985, and most recently in 1989. Again, many districts adopted or amended their architectural coatings rules after these revisions to the SCM. Districts have also revised their rules independent of changes to the SCM.

Currently, 17 of California's 35 local air districts have an architectural coatings rule. These 17 districts encompass about 95 percent of California's population and are listed in Table I-2. Appendix C lists the current VOC limits for the coating categories contained in these 17 districts' rules. Appendix C also lists the limits in ARB's 1989 SCM and U.S. EPA's National Rule.

Table I-2
Districts That Have Architectural Coatings Rules

Antelope Valley APCD	Monterey Bay Unified APCD
Bay Area AQMD	Placer County APCD
Butte County APCD	Sacramento Metropolitan AQMD
Colusa County APCD	San Diego County APCD
El Dorado County APCD	San Joaquin Valley Unified APCD
Feather River AQMD	Santa Barbara County APCD
Imperial County APCD	South Coast AQMD
Kern County APCD	Ventura County APCD
Mojave Desert AQMD	

In 1990, several districts amended their architectural coatings rules based on the 1989 SCM, lowering many VOC limits, which were to go into effect a few years later. Shortly after the adoption of these limits, however, a group of coatings manufacturers filed a lawsuit against the ARB and these districts claiming, among other things, that the 1990 amendments did not comply with the California Environmental Quality Act (CEQA). The lawsuit alleged that the districts' CEQA analyses did not adequately address potentially significant air quality impacts related to seven alleged impacts arising from the implementation of the lower VOC limits. As a result of these lawsuits, the courts invalidated the rules adopted by the South Coast AQMD, the Bay Area AQMD, and Ventura County APCD, on the grounds that these districts did not prepare adequate environmental analyses under CEQA. Accordingly, these districts were prevented from going forward with the lower VOC limits for industrial maintenance coatings, lacquers, quick-dry enamels, and quick-dry primers, sealers, and undercoaters. However, Santa Barbara County APCD was not sued within the prescribed time period and retained the VOC limits of their amended rule.

Regarding the environmental analysis prepared by the South Coast AQMD, the District prevailed on six of the seven alleged impacts. The court suggested that further study be undertaken to determine whether or not illegal thinning of coatings in the field results in a negative air quality impact before the 1990 amendments could be re-adopted. An appellate court has rejected the manufacturers' appeals of the original ruling on the other six alleged impacts.

In response to the court's decision, the South Coast AQMD conducted unannounced site visits in 1996 to determine the impact of thinning within the district. This field study determined that although some thinning was occurring, it was not in excess of the district limits. The South Coast AQMD continued to augment their 1996 field study through 1999. Again they concluded that the coating applicators do not engage in widespread thinning, and even when thinning occurs, the coatings' VOC content limits are not exceeded. (South Coast AQMD, 1996, South Coast AQMD, 1999)

The South Coast AQMD amended its rule in November 1996 to lower the VOC limits for some coating categories based on the concept of reformulation of existing coatings. The South Coast AQMD also increased the VOC limit for other coating categories and reinstated higher VOC limits pursuant to the court order. These amendments implemented Phase I of the District's plan for reducing VOC emissions from architectural coatings.

There have been several other lawsuits brought by coatings manufacturers against districts and the ARB since 1990, including lawsuits filed against the South Coast AQMD, the ARB, and the U.S. EPA regarding the South Coast AQMD's adoption of its 1996 rule amendments. The lower courts have ruled in favor of the air quality agencies on essentially all issues, although several issues are still before the courts and have not yet been decided.

The Bay Area AQMD made a minor amendment to its architectural coatings rule in November 1998 to address low solids coatings. The South Coast AQMD again amended its rule on May 14, 1999, to implement Phase II of the District's plan for reducing VOC emissions from architectural coatings, and to readopt limits negated in 1990. Several industry groups filed lawsuits challenging the 1999 amendments based on various legal theories. These lawsuits are still pending before the Orange County Superior Court. While a few preliminary matters have been resolved, the court has not yet issued a decision on the major issues involved in the lawsuits.

Except for the South Coast AQMD, most districts have the same VOC limits as the 1989 SCM for most categories. The most notable exceptions are the industrial maintenance, quick-dry enamels, and quick-dry primer, sealer, and undercoater categories, all of which frequently have higher (less restrictive) VOC limits in district rules than in the 1989 SCM.

Santa Barbara County APCD had the most stringent architectural coatings rule in California during the early 1990s. The current VOC limit of 350 grams per liter (g/l) for lacquers is lower than the South Coast AQMD's 550 g/l current VOC limit for this category. Santa Barbara County APCD has a 340 g/l VOC limit for industrial maintenance (IM) including anti-graffiti coatings, and their current VOC limit for the industrial maintenance high-temperature coatings is 420 g/l. These limits are all lower than the South Coast AQMD's current limits. The quick-dry enamel category has a VOC limit of 250 g/l, which is the limit scheduled to go into effect in the South Coast AQMD in 2002.

San Joaquin Valley Unified APCD and Sacramento Metropolitan AQMD both have current VOC limits of 340 g/l for IM coatings. Placer County APCD, San Joaquin Valley Unified APCD, and Sacramento Metropolitan AQMD have a VOC limit of 340 g/l for industrial maintenance anti-graffiti coatings. For industrial maintenance high-temperature coatings, Placer County APCD, San Joaquin Valley Unified APCD, Sacramento Metropolitan AQMD, and Bay Area AQMD all have a VOC limit of 420 g/l.

2. U.S. EPA and the National Architectural Coatings Rule

In the 1990 Clean Air Act Amendments, the U.S. Congress enacted section 183(e), which established a new regulatory program for controlling VOC emissions from consumer and commercial products. Section 183(e) directs the U.S. EPA Administrator to determine the ozone-forming potential of these products, and to prioritize the need for regulation of these products. Architectural coatings were in the first group of products to be regulated.

In 1992, the U.S. EPA initiated a regulatory negotiation (Reg-Neg) process to assist in fulfilling its obligation for a national architectural coatings rule, as required by section 183(e) of the federal Clean Air Act. The Reg-Neg process is an alternative to the traditional approach to rulemaking in which stakeholders from industry, consumers, air pollution control agencies, environmental groups, and labor organizations attempt to reach consensus on key regulatory issues for developing a rule. In 1992, the U.S. EPA conducted a survey of national sales of architectural coatings and emissions. After two years of negotiations and the proposal of a draft rule, consensus could not be reached, and in September 1994, the Reg-Neg process concluded. The U.S. EPA then initiated development of a national architectural coatings rule through conventional rule development.

The U.S. EPA proposed a draft rule in June 1996 that established specific VOC limits for various categories of architectural coatings. The national architectural coatings rule was finalized in September 1998. The National Rule went into effect throughout the country, including all California districts, on September 13, 1999.

The National Rule contains over 20 categories that are not typically included in district rules. In addition, for many of the categories that are in both the district rules and the National Rule, the National Rule has definitions that differ significantly from those of the district rules. All but two of the VOC limits in U.S. EPA's National Rule are equal to or less stringent than existing district rules. Roof coatings and traffic paints are the two categories that have lower VOC limits in the National Rule than most district rules. The applicable VOC limits in the National Rule are also listed in Appendix C and are compared to the proposed SCM. Further discussion of the National Rule is contained in Chapter III.

3. State Implementation Plan Commitments

In November 1994, the Board adopted California's 1994 State Implementation Plan (SIP) for ozone to comply with the federal Clean Air Act. The SIP is California's master plan for achieving the federal air quality standards. It includes the individual local air districts' air quality programs, the ARB's mobile source, fuels, and consumer products control programs, California's vehicle inspection and maintenance programs, and federal measures. California's 1994 Ozone SIP was approved by the U.S. EPA in September 1996.

Five local air districts in four federal ozone nonattainment areas included control measure commitments in the 1994 Ozone SIP to achieve additional VOC emission reductions from architectural coatings. These districts are the South Coast AQMD, Ventura County APCD, Yolo-Solano AQMD, Placer County APCD, and San Joaquin Valley Unified APCD. Yolo-Solano AQMD and Placer County APCD are part of the same federal ozone nonattainment area referred to as the Sacramento Metropolitan nonattainment area. Table I-3 lists the emission reduction commitments for architectural coatings in the 1994 Ozone SIP by district and by attainment year.

Table I-3
1994 Ozone SIP Commitments For VOC Emission Reductions From Architectural Coating Measures

District	Attainment Year	Committed Emission Reductions in Attainment Year		Status of Rulemaking
		TPD	Percentage	
San Joaquin Valley	1999 *	1.5	7	In progress
Placer County **Yolo-Solano**	2005	1.6	9	Adopted 1997 In progress
Ventura County	2005	0.9	15	In progress
South Coast	2010	62.3	75	Adopted Phases I & II

* The U.S. EPA is in the process of reclassifying San Joaquin Valley as severe nonattainment with an attainment date of 2005.

As mentioned earlier, the South Coast AQMD adopted the first phase of its architectural coatings rule in November 1996, and the second phase in May 1999. The Placer County APCD also adopted revisions to its architectural coatings rule in August 1997, fulfilling its 1994 Ozone SIP commitment.

Both the South Coast AQMD and Ventura County APCD have adopted revisions to their 1994 Ozone SIP plans. In 1996, the South Coast AQMD adopted a major revision to their 1994 Ozone SIP plan. This plan revision is the 1997 Air Quality Management Plan (AQMP). The South Coast AQMD's architectural coating commitment changed in the 1997 AQMP, dropping the percent emission reduction commitment from near-term (by the year 2000) rule revisions, from 75 to 50 percent. The remaining 25 percent reduction is to come from long-term (post-2000) commitments. Overall, the South Coast AQMD's commitment remains unchanged. The ARB approved the 1997 AQMP as a SIP revision in January 1997, and transmitted the revision to the U.S. EPA in February 1997. On January 12, 1999, the U.S. EPA proposed to partially approve and partially disapprove this SIP revision. The U.S. EPA proposed to approve procedural requirements, and baseline and projected emission inventories, but proposed to disapprove VOC and NO_x control measures, the attainment demonstration, and quantitative milestones and reasonable further progress provisions. The architectural coatings plan commitment was among the ones that was lessened in the 1997 AQMP, and the U.S. EPA has proposed to disapprove this commitment. Because the U.S. EPA did not finalize this proposed ruling, the 1994 Ozone SIP was until recently still the applicable SIP for the South Coast AQMD.

In December 1999, the South Coast AQMD adopted an amendment to its 1997 AQMP, which revises the local ozone control strategy of the 1997 AQMP. The ARB approved this amendment in January 2000 as a revision to the ozone SIP and forwarded it to the U.S. EPA. The U.S. EPA approved this 1999 AQMP amendment on April 10, 2000, and it became effective May 10, 2000. Thus, the 1999 amendment to the South Coast AQMD's 1997 AQMP now replaces the 1994 plan as the applicable SIP for the South Coast AQMD. This 1999 amendment includes a proposed third phase revision to Rule 1113 to achieve the remaining emission reductions from architectural coatings committed to in the 1994 Ozone SIP.

In October 1997, the Ventura County APCD likewise adopted revisions to its SIP commitments, including minor revisions to its architectural coatings commitment. These revisions included amending the proposed adoption date and revising the emission reduction commitment. The ARB transmitted these revisions to the U.S. EPA in November 1997. The U.S. EPA finalized approval of this SIP revision on April 21, 1998.

The South Coast AQMD and the San Joaquin Valley Unified APCD are planning to update their SIPs in the year 2001. The emission reduction commitments for architectural coatings will be reviewed as part of this activity. These SIP revisions will also incorporate new statewide emission reduction strategies which ARB staff expects to present to our Board in early 2001.

Table I-4 below shows that staff believes that the proposed SCM will achieve sufficient reductions when compared to the percentage emission reductions claimed by the San Joaquin Valley Unified, Ventura County, and Yolo-Solano districts in their 1994 ozone SIPs. In fact, the proposed SCM is expected to achieve about a 20 percent emission reduction, which is greater than any of the SIP commitments of these three districts. The mass emission reductions in some cases are less than those claimed in the 1994 ozone SIP (see Table I-3), primarily because the architectural coatings emissions inventory used in the 1994 ozone SIP is larger than the 1998 survey data used to calculate emission reductions from this proposed SCM. The official ARB emission inventory for architectural coatings is in the process of being updated to reflect these new data. The values in Table I-4 assume that the emissions from architectural coatings are approximately 100 TPD, on an annual average, statewide, not including emissions from thinning and clean-up (ARB, 1999). The emission reductions from the SCM are estimated to be 10 TPD, in the non-South Coast AQMD portion of the State.

Table I-4
Comparison of Estimated Emission Reductions From the Proposed SCM and the 1994 Ozone SIP Commitments

District	District's percent of California's population (A)	District's architectural coatings inventory (100 TPD * A) = (B)	1994 SIP commitment reduction (C)	Recalculated 1994 SIP commitment reduction (B*C)	District's percent of SCM reductions (A/55%)(100) (D)	District's reduction from SCM (D* 10.3 TPD)
San Joaquin Valley	9.3%	9.3 TPD	7%	0.7 TPD	16.9%	1.7 TPD
Ventura	2.2%	2.2 TPD	15%	0.3 TPD	4.0%	0.4 TPD
Yolo-Solano	0.8%	0.8 TPD	9%	0.1 TPD	1.5%	0.2 TPD

In 1997, the U.S. EPA promulgated a new national 8-hour ozone standard, and new national standards for particulate matter (PM_{10} and $PM_{2.5}$). On May 14, 1999, the U.S. Court of Appeals for the District of Columbia put implementation of the new standards on hold. The Court ruled that the agency had overstepped its constitutional authority in setting the new standards because, among other things, it did not clearly articulate the rationale used in selecting specific levels for the standards. The court remanded all of the standards to the U.S. EPA for further consideration. During remand, the status of the standards is as follows: (1) the Court vacated the new PM_{10} standard, (2) the Court left the new eight-hour ozone standard in place, but held that the standard "cannot be enforced," and (3) the Court will decide in the future whether the $PM_{2.5}$ standard should be vacated outright, or remain in place while the case is remanded to the U.S. EPA. The U.S. EPA appealed the court's decision to the full U.S. Court of Appeals; however, a narrowly divided Court let the decision stand. U.S. EPA asked the Supreme Court to review the decision and is awaiting their response.

The court decision has no immediate impact on California's air quality programs, because most of California continues to violate the pre-existing national and State one-hour ozone and PM_{10} standards, and the court decision did not affect the applicability of these standards. In general terms, California's one-hour ozone standard is similar in its impact to the new federal eight-hour standard. Regardless of the ultimate legal fate of the new federal standards, ARB and the districts will need to pursue new emission reduction measures to attain the existing standards.

4. California Clean Air Act

In addition to the federal planning requirements, the California Clean Air Act (CCAA) imposes a separate set of planning requirements on local air districts. The CCAA was enacted in 1988, and has the fundamental goal that all areas of California are to attain the State ambient air quality standard for ozone by the earliest practicable date. The State one-hour ozone standard is set by the ARB, and is more stringent than the federal one-hour ozone standard. As specified in the CCAA, the ARB has designated areas of California to be in "attainment" or "nonattainment" for the State ozone standard. Local districts that are nonattainment for the State ozone standard are required by the CCAA to prepare plans, which must be designed to achieve and maintain the standard by the earliest practicable date. In developing their plans each district determines which measures are necessary to include, as well as the specific details of each included measure.

Of the 35 districts in California, 22 are nonattainment for the State one-hour ozone standard and have air quality planning responsibilities. Of the 22 ozone nonattainment districts, all but five already have an architectural coatings rule. These five districts are the Glenn, San Luis Obispo, Shasta, and Tehama County Districts, and the Yolo-Solano AQMD.

In many of the nonattainment districts, substantial additional emission reductions will be necessary in order to achieve and maintain the State ozone standard. If needed, the SCM will be available for adoption by the above five districts in order to reduce VOC emissions and attain or maintain the State ozone standard. The Yolo-Solano AQMD needs the SCM as part of its federal SIP commitment. The remaining 16 districts (not counting the South Coast AQMD, which has already adopted a rule that will achieve greater emission reductions than the proposed SCM) could also revise their existing rules to be consistent with the SCM, in order to achieve greater emission reductions from the SCM's more stringent VOC limits.

REFERENCES

Air Resources Board. 1998 Architectural Coatings Survey Results Final Report. September 1999. (ARB, 1999)

South Coast Air Quality Management District. Draft Staff Report for: Proposed Amendments to Rule 1113 - Architectural Coatings. September 26, 1996. (SCAQMD, 1996)

South Coast Air Quality Management District. Staff Report for: Proposed Amendments to Rule 1113 - Architectural Coatings. May 14, 1999. (SCAQMD, 1999)

II.

PROPOSED SUGGESTED CONTROL MEASURE

In this chapter, we provide a plain English discussion of the staff's proposed suggested control measure (SCM) for architectural coatings, which is contained in Appendix A. All sections of the proposed SCM are discussed below. Where applicable, key terms or concepts of the proposed SCM are discussed.

This is the first updating of this SCM since 1989. Where applicable, we discuss where the proposed SCM's provisions differ from those of the 1989 SCM. However, it is important to point out that in developing the proposed SCM, staff approached this as a new SCM, not as amendments to the 1989 SCM. Accordingly, staff evaluated the technical and commercial feasibility of the proposed VOC limits for all of the categories, not just those that differ from the 1989 SCM. For the reader's information, the 1989 SCM is contained in Appendix B.

Control of emissions from architectural coatings is primarily the responsibility of the local air pollution control districts and air quality management districts, collectively referred to as districts. The proposed SCM may be used as a model by the districts when adopting and amending their local architectural coatings rules. Accordingly, throughout the staff report references are made to the most common or most restrictive district VOC limits, since the district rules are the enforceable regulations.

Although the proposed SCM does not currently contain an averaging provision, we are continuing to work with all interested parties to develop such a provision. We plan to include an averaging provision in the SCM that is presented to the Board at the June 22, 2000, public meeting.

A. APPLICABILITY

The proposed SCM, like the 1989 SCM, applies to manufacturers, distributors, and users of architectural coatings, and minor wording changes have been made to clarify applicability. Aerosol coatings are not considered architectural coatings and the aerosol coating exemption was reworded to emphasize this fact. The exemption for architectural coatings sold in containers of less than one liter has been further clarified by indicating that the exemption is based on volume. The 1989 SCM contains an exemption for emulsion-type bituminous pavement sealers, and that exemption has been deleted in the proposed SCM, to be consistent with U.S. EPA's national architectural coatings rule, and because those are very-low VOC products.

B. DEFINITIONS

To help clarify and enforce the proposed SCM, Section 2 of the proposed SCM provides new or revised definitions for terms used which are not self-explanatory. Forty-one architectural coatings categories are contained in the proposed SCM, some of which are further subcategorized. For example, the shellacs category is further subcategorized into clear and opaque products, as is the fire-retardant coatings category. Due to the subcategorization of some categories, the proposed SCM defines 47 categories or subcategories of architectural coatings for which limits are proposed. These definitions are largely consistent with those in the South Coast AQMD's architectural coating rule (Rule 1113) and the National Rule, with a few exceptions.

While some of the product categories in the existing SCM are not found in the proposed SCM, no product categories have been eliminated. For example, products included in the below ground wood preservatives category in the 1989 SCM would be included in the wood preservatives category under the proposed SCM.

We are proposing to add definitions for 20 architectural coatings product categories that were not included in the 1989 SCM: antenna coatings; antifouling coatings; bituminous roof coatings; bituminous roof primers; clear brushing lacquers; faux finishing coatings; fire-resistive coatings; flat coatings; floor coatings; flow coatings; low solids coatings; non-flat coatings; non-flat high gloss; quick-dry enamels; quick-dry primers, sealers, and undercoaters; recycled coatings; rust preventative coatings; specialty primers, sealers, and undercoaters; temperature-indicator safety coatings; and waterproofing concrete/masonry sealers.

C. STANDARDS

The proposed SCM differs from the 1989 SCM by adding new product category definitions, VOC limits, and by adding more stringent VOC limits for some existing categories. A total of 47 VOC limits are proposed, most of which are consistent with the interim limits in South Coast AQMD's Rule 1113. The new or modified VOC limits, with the exception of the VOC limit for industrial maintenance coatings, would become effective on January 1, 2003. The VOC content limit for industrial maintenance coatings has a proposed effective date of January 1, 2004.

The table of standards in the proposed SCM, reprinted below as Table II-1, contains the proposed limits for maximum VOC content in each category of architectural coatings, and the proposed effective date. If the coating is represented in any way that indicates it can be used in more than one of the coating categories listed in Table II-1, then the lowest, or most restrictive, VOC content limit will apply. The most restrictive VOC content limit applies to all architectural coatings listed in Table II-1, with the exception of the following: lacquer coatings (including lacquer sanding sealers); metallic pigmented coatings; shellacs; fire-retardant coatings; pre-treatment wash primers; industrial maintenance coatings; low-solids coatings; wood preservatives; high - temperature coatings; temperature-indicator safety coatings; antenna coatings; antifouling coatings; flow coatings; and bituminous roof primers. Eleven of the 47 proposed VOC limits are more stringent than the most predominant existing district limits.

If a coating does not meet any of the definitions for the categories listed in Table II-1, that coating will be classified as either a flat or a non-flat coating, depending upon its gloss, and the corresponding VOC content limit will apply. In the 1989 SCM, all coatings not contained in the table of standards would have to meet a default VOC limit of 250 g/l.

Table II-1
VOC CONTENT LIMITS FOR ARCHITECTURAL COATINGS

Limits are expressed in grams of VOC per liter[a] of coating thinned to the manufacturer's maximum recommendation, excluding the volume of any water, exempt compounds, or colorant added to tint bases. "Manufacturer's maximum recommendation" means the maximum recommendation for thinning that is indicated on the label or lid of the coating container.

Coating Category	Effective 1/1/2003	Effective 1/1/2004
Flat Coatings	100	
Non-flat Coatings	150	
Non-flat Coatings High Gloss	250	
Specialty Coatings:		
Antenna Coatings	530	
Antifouling Coatings	400	
Bituminous Roof Coatings	300	
Bituminous Roof Primers	350	
Bond Breakers	350	
Clear Wood Coatings • Clear Brushing Lacquers • Lacquers (including lacquer sanding sealers) • Sanding Sealers (other than lacquer sanding sealers) • Varnishes	 680 550 350 350	
Concrete Curing Compounds	350	
Dry Fog Coatings	400	
Faux Finishing Coatings	350	
Fire-Resistive Coatings	350	
Fire-Retardant Coatings: • Clear • Opaque	 650 350	
Floor Coatings	250	

Coating Category	Effective 1/1/2003	Effective 1/1/2004
Flow Coatings	420	
Form-Release Compounds	250	
Graphic Arts Coatings (Sign Paints)	500	
High-Temperature Coatings	420	
Industrial Maintenance Coatings		250
Low Solids Coatings [b]	120	
Magnesite Cement Coatings	450	
Mastic Texture Coatings	300	
Metallic Pigmented Coatings	500	
Multi-Color Coatings	250	
Pre-Treatment Wash Primers	420	
Primers, Sealers, and Undercoaters	200	
Quick-Dry Enamels	250	
Quick-Dry Primers, Sealers, and Undercoaters	200	
Recycled Coatings	250	
Roof Coatings	250	
Rust Preventative Coatings	400	
Shellacs: • Clear • Opaque	 730 550	
Specialty Primers, Sealers, and Undercoaters	350	
Stains	250	
Swimming Pool Coatings	340	
Swimming Pool Repair and Maintenance Coatings	340	
Temperature-Indicator Safety Coatings	550	

Coating Category	Effective 1/1/2003	Effective 1/1/2004
Traffic Marking Coatings	150	
Waterproofing Sealers: • Concrete/Masonry • Wood	 400 250	
Wood Preservatives	350	

[a] Conversion factor: one pound VOC per gallon (U.S.) = 119.95 grams VOC per liter.
[b] Units are grams of VOC per liter (pounds of VOC per gallon) of coating, including water and exempt compounds.

Under the proposed SCM, an architectural coating listed in Table II-1 and manufactured prior to the effective date of the VOC content limit for that coating category may be sold, supplied, or offered for sale for up to three years after the effective date. This three-year time period is referred to as the "sell-through" period. The sell-through provision allows unlimited use of coatings manufactured prior to the effective dates of the proposed limits.

The Standards section of the proposed SCM also specifies that coating containers and any VOC-containing products used for cleaning or thinning are to be closed when not in use, and that coatings are not to be thinned to exceed the applicable VOC limit.

Special provisions regarding rust preventative coatings and industrial maintenance coatings are defined in the Standards section of the proposed SCM. For the industrial maintenance coatings, we are removing the residential restriction for their usage. This allows coatings such as permanent anti-grafitti coatings to be subject to the industrial maintenance limit instead of the more restrictive limits for flats or non-flats. Rust preventative coatings are not to be used in an industrial setting unless they comply with the VOC limit for industrial maintenance coatings.

Section 3.8 of the proposed SCM contains a special provision for certain industrial maintenance coatings used in the San Francisco Bay Area, the North Central Coast, or the North Coast Air Basins. This provision would allow limited use of industrial maintenance coatings with VOC contents up to 340 g/l. This provision is designed to address the need for higher VOC industrial maintenance coatings in areas with persistent fog and cold temperatures. This provision is primarily needed by essential public services agencies and industrial facilities located near the coast from Big Sur north. The maximum allowable loss in reductions from this provision would be five percent of the available reductions from strict compliance with the proposed 250 g/l VOC limit.

We are proposing a quantifiable cap on the loss in emission reductions from this provision to maximize the emission reductions achieved from the industrial maintenance category. We worked closely with the essential public services agencies in determining the total annual volume of 340 g/l coatings needed to meet their demand under these adverse conditions.

We then set a proposed cap which would allow for the use of over five times the coatings volume needed by the Department of Transportation in the San Francisco Bay Area Air Basin. This cap will ensure that sufficient volumes of 340 g/l coatings will be available via the petition process for all industrial users that need to use industrial maintenance coatings during persistent fog and cold temperature conditions.

D. CONTAINER LABELING REQUIREMENTS

In the 1989 SCM this section was titled Administrative Requirements. Many of the container labeling requirements in the proposed SCM are similar to those in the 1989 SCM. The proposed SCM, like the 1989 SCM, requires each manufacturer to label their coatings with a date code, thinning recommendations, VOC content, and, in the case of industrial maintenance coatings, conditions for use.

Minor wording changes have been made to the date code and thinning recommendations labeling requirements to indicate where on the container the information should be placed. The VOC content labeling requirement has been modified to pertain to the VOC content of the coating as supplied, rather than as applied. Language has been added to the VOC content labeling requirement to reflect the various methods that can be used to calculate VOC content, and to specify that the VOC content is to be displayed in grams of VOC per liter of coating.

The labeling requirement for industrial maintenance coatings has been revised. Industrial maintenance coatings, like all architectural coatings, must be labeled with date code, thinning recommendations, and VOC content. In addition, industrial maintenance coatings must be labeled in terms of use. The 1989 SCM requires that industrial maintenance coatings be labeled "Not for Residential Use" or "Not for Residential Use in California." The proposed SCM gives manufacturers greater flexibility by providing more allowable options for meeting the industrial maintenance labeling requirements. In addition, the restriction on residential use has been deleted.

Labeling requirements were added to the proposed SCM for the following coating categories: high-gloss non-flats; clear brushing lacquers; quick-dry enamels; rust preventative coatings; and specialty primers, sealers, and undercoaters. Clear brushing lacquers must bear the statements "For brushing application only" and "This product must not be thinned or sprayed." Quick-dry enamels must bear the words "Quick-Dry" and indicate the recoat time. Rust preventative coatings must bear the statement "For Metal Substrates Only." Non-flat high gloss coatings must include the words "High Gloss." The labels of specialty primers, sealers, and undercoaters must bear one or more descriptive statements indicating specific use conditions.

For the exact wording to be used to meet container labeling requirements, please refer to section 4.1 of the proposed SCM.

E. REPORTING REQUIREMENTS

Reporting requirements were added to the proposed SCM for the following coatings: clear brushing lacquers, rust preventative coatings, specialty primers, sealers, and undercoaters, recycled coatings, bituminous roof coatings, bituminous roof primers, and all coatings containing the toxic exempt compounds perchloroethylene or methylene chloride, regardless of the coating category. Manufacturers who sell coatings subject to reporting requirements must file a report with the Executive Officer of the ARB by April 1 of each year. This reporting will allow us to track the usage of products in categories with higher VOC limits broken out from a more general category and track usage of toxic exempt compounds. Future revisions to the SCM may be needed if we find that volumes of the reported coating categories significantly increase or there is an increase in the use of methylene chloride and perchloroethylene.

For all coating categories subject to reporting requirements, the annual report must include the number of gallons of product sold in California in the previous calendar year and an explanation of how the sales were calculated.

The annual report for coatings containing perchloroethylene or methylene chloride must include the number of gallons of product sold in California in the previous calendar year, in addition to the following: product brand name and product label with usage instructions; identification of product category; and the volume percent of perchloroethylene and/or methylene chloride in the coating.

F. COMPLIANCE PROVISIONS AND TEST METHODS

This section of the proposed SCM includes formulas for calculating the VOC content of architectural coatings. There are two formulas provided, one for calculating the VOC content of all architectural coatings other than low solids coatings, and one for calculating the VOC content of low solids coatings.

In addition to using the formulas provided for calculating the VOC content of coatings, manufacturers may use U.S. EPA Method 24, or an alternative test method, for all coatings except multicomponent methacrylate traffic marking coatings. If opting to use an alternative test method, the manufacturer must receive written approval from the district, the ARB, and the U.S. EPA. If there are discrepancies between the results of a Method 24 test and any other means of determining VOC content, Method 24 test results will prevail.

Manufacturers of multicomponent methacrylate traffic marking coatings shall use a modification of U.S. EPA Method 24 if they do not wish to use the formula provided in the proposed SCM to calculate VOC content.

Test methods for architectural coatings subject to the proposed SCM are also provided in this section. These include tests for flame spread, fire resistance, gloss, metal content, acid content, drying times, surface chalkiness, several tests for the determination of various exempt compounds, and methods for determining VOC content.

III.

PROCESS FOR DEVELOPING PROPOSED SUGGESTED CONTROL MEASURE

Staff initiated activities relating to the update of the suggested control measure (SCM) in late 1997. These activities included: (1) a survey of architectural coatings; (2) regular meetings with district and U.S. EPA Region IX representatives; (3) an evaluation of durability and performance research for several coating categories; (4) an evaluation of the U.S. EPA's National Architectural Coatings Rule; (5) public workshops and meetings with individual manufacturers and other interested parties; (6) technology assessments on the coating categories; (7) an evaluation of alternatives in a draft program environmental impact report; and (8) a cost analysis.

A. 1998 ARCHITECTURAL COATINGS SURVEY

In late 1997, ARB staff began working with manufacturers and industry groups to develop a new survey of architectural and industrial maintenance coatings sold in California. The last such ARB survey was undertaken in 1993 (ARB, 1994) and surveyed sales and VOC contents of coatings sold in 1990. In February 1998, the ARB sent out the latest survey seeking 1996 sales data. Unlike previous surveys, this survey asked for information on the speciation of VOCs in an effort to identify what VOCs and non-VOC solvents are being used in architectural coatings.

Data entry and quality assurance checking were completed in February 1999, and a draft survey report was issued to all survey respondents and other interested parties. The draft survey report did not include speciation data, however, since staff was still evaluating this information. A workshop was held in March 1999 to receive comments on the survey results. The draft speciation data was completed in June 1999 and industry reviewed it. The final survey report was issued in September 1999 (ARB, 1999b). The final report included, overall, solvent-based, and water-based speciated data ranked by descending mass.

A discussion of the survey results and the estimated emissions from architectural coatings is found in Chapter V.

B. WORKING WITH DISTRICT AND U.S. EPA REPRESENTATIVES

In February 1998, staff began meeting with representatives of some of the districts that will use the SCM as the basis for their district architectural coating rules. The U.S. EPA has also been involved in these meetings to provide insight on harmonization with the National Rule and to increase the likelihood that the district rules based on the SCM will be approvable as State Implementation Plan revisions. The purpose of these meetings was to discuss: district needs and emission reductions needed from architectural coatings; findings of the 1998 architectural coatings survey; ongoing research and future research needs; specific SCM language; the scope and content of a statewide environmental assessment; and flexibility options for manufacturers to comply with coatings regulations. To date, 18 meetings and conference calls have been held.

C. PUBLIC PROCESS

In developing the proposed SCM, ARB held eight public meetings attended by representatives from industry (coatings manufacturers, ingredient manufacturers, coatings contractors, user groups, and trade associations), local districts, the U.S. EPA, and other interested parties. These public meetings were held on May 27 and August 20, 1998, on March 30, June 3, July 1, September 8, and December 14, 1999, and March 16, 2000. The two meetings in 1998 focused on general discussions of issues and flexibility options, while the March 30, 1999, workshop focused specifically on the draft survey report. The July 1, 1999, meeting was also a Scoping Meeting held to solicit input on the Initial Study for the environmental impacts analysis. The remaining workshops focused on the SCM and/or the averaging compliance option. A chronology of the public meetings held is shown in the following table.

Table III-2
Chronology of Architectural Coatings Suggested Control Measure

Date	Meeting	Location
May 27, 1998	1st Public Workshop	Sacramento, CA
August 20, 1998	2nd Public Workshop	Sacramento, CA
March 30, 1999	3rd Public Workshop	Diamond Bar, CA
June 3, 1999	4th Public Workshop	Sacramento, CA
July 1, 1999	5th Public Workshop	Sacramento, CA
September 8, 1999	6th Public Workshop	Diamond Bar, CA
December 14, 1999	7th Public Workshop	Diamond Bar, CA
March 16, 2000	8th Public Workshop	Sacramento, CA

Workshop announcements, SCM revisions, reports, surveys, workshop summaries, workshop slide presentations, and lists of workshop attendees were regularly posted on the ARB's Internet site. Copies of workshop announcements are contained in Appendix D.

In addition to the public workshops, manufacturers held meetings with ARB staff to share individual concerns and data. About 40 such meetings with manufacturers or trade groups have occurred.

D. EVALUATION OF THE NATIONAL RULE

On August 14, 1998, the U.S. EPA promulgated the final version of their National Volatile Organic Compound Emission Standards for Architectural Coatings (National Rule) (see 63 *Federal Register* No. 176, September 11, 1998). The National Rule took effect on September 13, 1999.

Staff's analysis of the impacts of incorporating the National Rule into the SCM focused primarily on: technical assessment of the limits; a careful evaluation of the differences in definitions; and the impacts of the flexibility provisions. Our goal was to achieve the maximum feasible reduction in VOC emissions while aligning the SCM with the National Rule.

The National Rule applies only to manufacturers and importers of architectural coatings, while the SCM applies to manufacturers, distributors, and users of architectural coatings. The National Rule contains 61 categories, including more than 20 categories that are not included in most district rules.

It is important to point out that, for the most part, California districts will not see additional emission reductions from the National Rule, since the majority of the national limits are equal to or higher than districts' existing limits. Accordingly, districts need to adopt lower limits in their rules, to improve air quality and achieve the State and federal ozone standards. In fact, the National Rule specifically allows states or local governments to adopt more stringent emission limits.

The National Rule contains flexibility provisions that are not in the SCM: (1) an exceedance fee provision; (2) a tonnage exemption; and (3) a recycled coatings compliance option. For compliance with these provisions, manufacturers and importers must keep specified records and submit annual reports to the appropriate regional U.S. EPA office.

The exceedance fee provision allows manufacturers and importers to comply with the rule by paying a fee in lieu of meeting the VOC content limits. The tonnage exemption allows manufacturers and importers to sell or distribute limited quantities of architectural coatings that do not comply with the VOC content limits and for which no exceedance fee is paid.

The recycled coatings compliance option allows calculation of an adjusted-VOC content for coatings that contain a certain percentage of post-consumer coating. Containers of recycled architectural coatings, in addition to the labeling requirements, must include on the label or lid a statement of the percentage, by volume, of post-consumer coating content.

The National Rule's flexibility options were designed primarily for states to administer. We did not include an exceedance fee or tonnage exemption in the proposed SCM because we wanted to maximize emission reductions. Chapter V of the Final Program EIR contains more detail about our reasons for considering the exceedance fee to be an infeasible alternative as the basis for the SCM project. The description of recycled coatings in Chapter VI of the staff report contains more information on why the National Rule's recycled coating option was not included in the proposed SCM.

E. TECHNOLOGY ASSESSMENT

A technology assessment was conducted for all the coating categories included in the SCM. In addition, the National Rule categories that were not included in the proposed SCM were also studied. Some of the sources of information utilized in the technology assessment included: the ARB 1998 survey data; manufacturers' brochures, product data sheets, product labels, and material safety data sheets; Internet websites; books and trade magazines; technical reports; training manuals; test results and specifications; U.S. EPA's Background Information Document (U.S. EPA, 1998); South Coast AQMD staff reports from Rule 1113 amendments (South Coast AQMD, 1996; South Coast AQMD, 1999); interviews with manufacturers and users of coatings; district rules and discussions with district staff; the 1989 SCM technical support document (ARB, 1989); and information from trade associations.

For eleven categories represented in the proposed SCM, staff reviewed detailed information from manufacturers pertaining to numerous compliant and non-compliant coatings. These are the categories for which we are proposing limits that are more stringent than found in most district rules. Staff compared technical data provided by the manufacturers for coatings in each category to assess coverage, dry times, durability (adhesion, abrasion resistance, chemical resistance, impact resistance, scrubability, etc.), solids content by volume, and other characteristics. These data are summarized in Appendix E of the Draft Program EIR.

In addition, staff viewed test panels and evaluated laboratory data from the NTS study to better assess performance of compliant coatings compared to non-compliant coatings. Some manufacturers have also forwarded actual laboratory test data and third party testing data, which were utilized in the technical evaluation of the categories. The results of the Harlan study (ARB, 1995) were also considered.

During November 1999, ARB staff met with representatives of seven resin manufacturers. These meetings provided staff an opportunity to become familiar with the latest developments in resin technology, and to discuss applicability of a variety of resin systems to specific types of coatings.

The technical basis for the SCM is discussed in Chapter IV, and the detailed results of the technology assessments by category are reported in Chapter VI.

F. EVALUATION OF ALTERNATIVES IN THE DRAFT PROGRAM ENVIRONMENTAL IMPACT REPORT (EIR)

Under the California Environmental Quality Act (CEQA), project alternatives that are determined to be feasible and infeasible should be identified. Alternatives include measures for attaining the objectives of the proposed project and provide a means for evaluating the comparative merits of each alternative. An alternative evaluating the merits of not having the project must also be included. The alternatives considered feasible are then evaluated for potential environmental impacts that may result from their implementation.

The alternatives rejected as being infeasible include:

1. Performance-based standards, i.e., emission standards based on performance of the coating;
2. Seasonal regulation, i.e., VOC limits for "high ozone season" only;
3. Regional regulation, i.e., exemption from VOC limits for certain districts;

4. Exceedance fees, i.e., allowing manufacturers to pay a fee in lieu of meeting VOC limits;
5. Low vapor pressure exemption, i.e., exempting VOCs with low vapor pressures in determining the overall VOC content of a coating; and
6. Reactivity-based VOC limits, i.e., VOC limits based on the ozone formation potential.

The alternatives considered feasible include:

1. No project, i.e., assuming that the SCM will not be adopted;
2. Extended compliance deadlines, i.e., extending all the effective dates of the VOC limits to January 1, 2004;
3. Further reduction of VOC content limits, i.e., adopting the "final" limits of the May 1999, South Coast AQMD Rule 1113 amendments (those with effective dates of 2005-2008); and
4. Product line averaging, i.e., allowing manufacturers to make products that have VOC contents higher than the proposed VOC limits in the SCM, if they compensate with other products that are below the proposed VOC limits.

G. COST ANALYSIS

Although it is not required under CEQA, the economic impact of the SCM on affected businesses and consumers was evaluated and quantified. In December 1999, the ARB sent a cost survey to manufacturers who responded to the 1998 architectural coatings survey (ARB, 1999b). The data received from this survey was one of the sources of information used to perform a cost-effectiveness analysis and a business impacts analysis. The cost-effectiveness analysis measures how cost-efficient the proposed SCM will be in reducing VOCs relative to other regulatory programs. The business impacts analysis evaluates the impacts on profitability, employment, and competitiveness to California businesses, consumers, and government agencies.

Staff also performed research to identify typical non-complying and complying formulations for 11 coating categories, and costs were identified for these formulations. The categories selected were those for which we are proposing VOC limits that are more stringent than the predominant limit in existing district rules. Examples of sources of information for the cost analysis were: the December 1999 cost survey; the 1998 architectural coatings survey; product data sheets; material safety data sheets; example formulations provided by manufacturers or resin suppliers; district staff; trade magazines; Internet searches; and patents. In addition, staff performed shelf cost surveys to determine retail prices of a variety of complying and non-complying products.

Results of the cost analysis are reported in Chapter VIII.

REFERENCES

Air Resources Board. Technical Support Document. “ARB-CAPCOA SCM for Architectural Coatings.” July, 1989. (ARB, 1989)

Air Resources Board. “Survey of Emissions from Solvent Use, Volume II: Architectural Coatings.” Final Report for Contract No. A132-086. September, 1994. (ARB, 1994)

Air Resources Board. “Testing of Architectural and Industrial Maintenance Coatings.” Final Report for Contract No. 92-339. February 1995. (ARB, 1995)

Air Resources Board. Letter to Air Pollution Control Officers from Peter D. Venturini, with attachments. May 5, 1999. (ARB, 1999a)

Air Resources Board. “1998 Architectural Coatings Survey Results, Final Report.” September 1999. (ARB, 1999b).

Air Resources Board. “Draft Program Environmental Impact Report, Suggested Control Measure for Architectural Coatings.” February 2000. (ARB, 2000).

South Coast Air Quality Management District. Draft Staff Report, “Proposed Amendments to Rule 1113 - Architectural Coatings.” September 26, 1996. (South Coast AQMD, 1996)

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United States Environmental Protection Agency. “National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards.” EPA-453/R-98-0006b. August 1998. (U.S. EPA, 1998)

United States Environmental Protection Agency. “National Volatile Organic Compound Emission Standards for Architectural Coatings.” 63 *Federal Register* No. 176, September 11, 1998.

IV.

TECHNICAL BASIS FOR THE PROPOSED SCM

To ensure that the proposed SCM is technologically and commercially feasible, we considered the following: 1) the results of our comprehensive survey of architectural coatings; 2) information from coating manufacturers, resins suppliers, and other industry groups; 3) the results of durability and performance testing in several coating categories; 4) the existing VOC limits for architectural coatings; and 5) the results of our technical analyses of all the coating categories proposed in the SCM (see Chapter VI). Based on our technical analyses, we have concluded that the overall performance of the reformulated products in each category will be similar to the performance of their higher VOC counterparts. However, we will conduct technology reviews for the proposed VOC limits that are lower than current limits prior to their effective dates.

A. SALES DATA FROM ARB SURVEY

To determine the extent that current coating products already comply with the proposed VOC limits, staff reviewed sales data from the ARB's 1998 Architectural Coatings Survey. In particular, the percent of marketshare by coatings already in compliance, and the number of complying products in each category were reviewed. Table IV-1 contains these data.

It should be noted that although "swimming pool repair and maintenance coatings" shows a zero complying marketshare, this coating category has only existed to allow chlorinated rubber technology coatings to phase out over time, as evidenced by several district rules having a 340 g/l limit for this category already. The proposed limit of 340 g/l still allows the existing epoxy technology coatings to remain, which are included in the "swimming pool coatings" category. Epoxy coatings can be used to repair epoxy coatings, so there will be repair and maintenance coatings available. Although marked "PD" (protected data) in Table IV-1 due to less than three companies reporting, "swimming pool coatings" have a relatively high complying marketshare.

Similarly, "quick-dry enamels", although marked "PD" in Table IV-1, have a low complying marketshare; however, many complying coatings in the "non-flats - high gloss" category can meet this coating need. As discussed in Chapter VI, we recommend districts eliminate the "swimming pool repair and maintenance" and the "quick-dry enamel" categories (as well as the quick-dry primer, sealer, and undercoater category) over time.

For each SCM category, the technical assessment discusses the specific sales data in Chapter VI of this staff report.

B. INFORMATION FROM COATING MANUFACTURERS, RESIN SUPPLIERS, AND OTHER INDUSTRY GROUPS

As part of our technical assessment of currently available coatings, we reviewed available information from industry, including coating manufacturers, resin suppliers, industry groups, trade groups, and trade journals. The information for each SCM category characterized the complying and non-complying coatings, including features such as recommended coating uses, types of resins and formulations, VOC levels, coating application and surface preparation requirements, expected performance characteristics, and issues associated with each category. For non-complying coatings, we gathered information on the types of technology available to achieve compliance.

For non-complying coatings, we identified several technologies that may be options to achieve lower VOC contents. These options, available singly or in combination, are briefly described below. Discussions of compliance options by coating category are included in Chapter VI, under the subsections entitled “Proposed VOC Limit and Basis for Recommendation.”

1. Change to High Solids Formulations

The VOC content of traditional solvent-based formulations may be lowered by increasing the solids content and thus decreasing the solvent content. Generally, the resin needs to be modified, by decreasing its molecular weight, to avoid higher viscosity, which would otherwise impair the application characteristics of the coating when less solvent is available. Pigment fillers may also be used to increase the solids content. The resin and coating formulations are generally developed to achieve higher solids content while, at the same time, retaining many of the desirable performance characteristics of the traditional coating.

2. Solvent Substitution with Exempt Solvents

The VOC content of solvent-based formulations may be decreased by substituting appropriate amounts of exempt solvents to replace traditional solvents. The exempt solvent to be used should have similar solvent characteristics as the traditional solvent (or combination of solvents) used, to minimize changes to the coating application and performance characteristics. Exempt solvents such as Oxsol 100® (parachlorobenzotrifluoride) or acetone are available for reformulation.

3. Use of Reactive Diluents

For some solvent-based, two-component formulations, the use of reactive diluents may decrease the VOC content. Reactive diluents initially act as solvents and then form part of the coating, instead of evaporating away, thus reducing VOC emissions.

4. Change From Solvent-Based To Water-Based Formulations

When a solvent-based formulation is well above the VOC limit, changing to a water-based formulation may be a practical option. Currently, there are solvent-based and water-based versions of several types of basic formulations, such as acrylic, epoxy, and polyurethane formulations. The manufacturers of some of the newer, water-based, low VOC coatings believe that the performance characteristics of the new coatings are comparable to that of the traditional, solvent-based, high-VOC coatings. Coatings may also be reformulated by changing the resin type and formulation altogether. For example, a current alkyd formulation (solvent-based) may be changed to an acrylic formulation (water-based) or to a low VOC, two-component epoxy or polyurethane formulation, depending on the performance characteristics needed.

The current alkyd coatings are essentially all solvent-based, high VOC formulations. There are indications that new technologies are emerging for water-based alkyds that may meet the proposed VOC limits in the SCM.

5. Change to Hybrid Resin Systems

Changing current high-VOC formulations, such as alkyds, by developing new hybrid resins may be an option to lower VOC contents. This option may be desirable since hybrid resins and formulations may provide new or enhanced performance characteristics, and thus may provide more types of formulations and flexibility for the coating users.

6. Decrease Level of Coalescent Solvents and/or Glycols

For non-complying water-based formulations, the coalescent solvents and freeze/thaw additives (glycols) are generally the main sources of VOCs. To lower the VOC content, the resins may need to be modified to enable lower amounts of coalescent solvents and/or glycols to be used.

Overall, the staff made an effort wherever possible to ensure that multiple reformulation options are available for products to comply with the proposed VOC limits. Multiple reformulation options allow flexibility in the formulation of compliant coatings, ensuring that effective, reliable, and cost-effective coatings will be brought to the marketplace. The proposed limits were developed at VOC levels that staff determined could be met without the increased use of Toxic Air Contaminants or ozone-depleting compounds.

C. TEST RESULTS

We also reviewed available test results comparing the application and durability performance characteristics of certain low and high VOC coatings. The tests include results from the Harlan Associates Study and the National Technical Systems (NTS) Study.

1. Harlan Associates Study

In February 1995, the ARB published the results of performance testing of architectural coatings by Harlan Associates, Inc. The purpose of the study was to determine the physical properties and performance of representative products in eight coating categories. A total of 110 coating products, purchased during late 1993 and throughout 1994, were tested in the following categories:

- Industrial Maintenance Primers and Topcoats
- High-Temperature Industrial Maintenance Coatings
- Lacquers
- Varnishes
- Non-flats (including Quick-Dry Enamels)
- Primers/Sealers (including Quick-Dry Primers/Sealers)
- Sanding Sealers
- Waterproofing Sealers (Wood and Concrete)

While the raw data from this study were published in 1995, an analysis of the overall comparison of the coatings' test performance was not published. In developing the proposed SCM, ARB and district staffs analyzed and summarized the raw data. This performance study, although somewhat dated, is used to supplement the newer NTS study.

2. NTS Study

In support of the 1999 amendments to its architectural coatings rule (Rule 1113), the South Coast AQMD contracted with NTS to test performance characteristics of six significant architectural coating categories. The ARB staff has participated on the contract's technical advisory committee, which was established to oversee contractor selection, coating selection, testing protocol development, and analysis of results. Most of the members in the technical advisory committee are from the coating industry. The study was initiated in May 1998, and an interim report was released in April 1999. ARB staff analyzed the data from the laboratory portion of the NTS Study, and the results of the study are an important part of our technical assessment of these eight coating categories. ARB's analysis is found in Appendix E. In addition to the laboratory results, accelerated exposure, real time exposure, and application characteristics studies are continuing. ARB staff are continuing to track these portions of the NTS study, and we will include any results in our future technology assessments.

The purpose of the NTS study was to test the application and durability performance of very low-VOC, low-VOC, and just-compliant coatings for the following six coating categories:

- Industrial Maintenance Coatings
- Non-flat Coatings
- Primers, Sealers, and Undercoaters
- Quick-Dry Enamels
- Quick-Dry Primers, Sealers, and Undercoaters

- Waterproofing Sealers

Results from the Harlan Associates Study and the NTS Study are discussed in the technical assessment for these categories (See Chapter VI). Overall, the complying coatings performed similarly to the non-complying coatings.

D. EXISTING REGULATORY LIMITS

We also considered the regulatory limits currently in effect in the air pollution control and air quality management districts (air districts) in California, and the national limits promulgated in the U.S. EPA's rule. In particular, we considered the regulatory limits adopted by the South Coast AQMD on May 14, 1999, and the South Coast AQMD's technical assessment associated with those limits. Because of the lead efforts taken by the South Coast AQMD, their interim limits served as the starting points in developing many of the limits in the SCM, with differences as discussed in the technical assessment for each of the SCM categories (see Chapter VI). One notable difference is that the South Coast AQMD rule includes certain final limits to be effective during the 2005-2008 time frame, while the SCM includes only near term limits, to be effective during the 2003-2004 time frame.

The national limits apply as minimal requirements. In most cases, the SCM included limits more stringent than the national limits, because of the greater need for VOC emission reductions in California compared to other parts of the nation, or because the SCM limits have been in effect for many years already in many California districts.

The districts with adopted architectural coatings rules (other than the South Coast AQMD) are anticipated to be updating their rules. Also, other districts that are nonattainment for the State or federal ozone or PM_{10} standards may decide to adopt architectural coatings rules. The purpose of this SCM is to serve as a model rule for these districts. Our technical assessment considers the current common district limits by category, and the extent of changes if the SCM limits are to be implemented by the districts. Some of the current district limits are based on the ARB's 1989 SCM for architectural coatings, the predecessor document to this proposed SCM.

E. COMMENTS RECEIVED

As described above, we received comments and considered VOC limits suggested by coating manufacturers, air districts, other government agencies, other industry groups, and trade groups. Various workshops and meetings were held, and many revisions to the draft SCM have been made. This coordinated effort was an important approach for developing the VOC limits, compliance dates, category definitions, and related wording as currently proposed in the SCM.

Table IV-1 lists the proposed VOC limits for each coating category, the emission reductions, and the number and marketshare of coatings that currently comply with the proposed limits. The total emission reductions from the proposed limits is about 10 tons per day (excluding the South Coast AQMD). The variation in complying marketshare reflects the fact that each limit is developed independently, based on individual technical assessments and on the available reformulation options.

Table IV-2 summarizes the emission reductions that will be realized in the non-South Coast AQMD portion of the State from the few National Rule limits that are more stringent than most current district rules. These emission reductions cannot be claimed as being due to the proposed SCM, but can be claimed by districts toward their SIP commitments, assuming a district did not take credit for the National Rule in their applicable SIP. See also Chapter VI category discussions.

Table IV-1
Summary of Complying Products

Coating Category	Proposed VOC Limit (g/l)	Number of Complying Products/ Total[1]	VOC Emission Reduction (TPD) and Percent Reduction	Complying Marketshare[2] (%)
Flat Coatings	100	1,097/2,355	1.39/17	48.5
Non-flat Coatings				
- Low Gloss	150	472/851	0.11/6	75.7
- Medium Gloss	150	805/2139	1.06/16	57.3
- High Gloss	250	333/796	0/0	79.5
Specialty Coatings:				
Antenna Coatings	530	None reported	0/0	~100[3]
Antifouling Coatings	400	PD	0/0	100
Bituminous Roof Coatings	300	110/151	0/0	98
Bituminous Roof Primers	350	Not surveyed	0/0	Unknown[4]
Bond Breakers	350	PD	0/0	PD
Clear Wood Coatings				
- Clear Brushing Lacquers	680	Not surveyed	0/0	Unknown[4]
- Lacquers (including lacquer sanding sealers)	550	138/403	1.03/41	13.8
- Sanding Sealers (other than lacquer sanding sealers)	350	5/31	0/0	4.5
- Varnishes			0/0	
- Clear	350	146/341		47.6
- Semitransparent	350	28/90		51.5
Concrete Curing Compounds	350	36/47	0/0	95.1
Dry Fog Coatings	400	46/51	0/0	96.9
Faux Finishing Coatings	350	Not surveyed	0/0	~100[3]
Fire-Resistive Coatings	350	Not Surveyed	0/0	Unknown[4]
Fire-Retardant Coatings				
- Clear	650	PD	0/0	100
- Opaque	350	53/57	0/0	99.8
Floor Coatings	250	373/578	0/0	84.8

Table IV-1 (continued)
Summary of Complying Products

Coating Category	Proposed VOC Limit (g/l)	Number of Complying Products/ Total[1]	VOC Emission Reduction (TPD) and Percent Reduction	Complying Marketshare[2] (%)
Flow Coatings	420	None reported	0/0	~100[3]
Form-Release Compounds	250	PD/13	0/0	PD
Graphic Arts Coatings (sign paints)	500	18/108	0/0	81.2
High-Temperature Coatings	420	54/93	0/0	52.5
Industrial Maintenance Coatings[5]	250	941/2,759	2.95/38	28.0
Low Solids Coatings	120	PD	0/0	PD
Magnesite Cement Coatings	450	PD/5	0/0	PD
Mastic Texture Coatings	300	56/56	0/0	100
Metallic Pigmented Coatings	500	98/125	0/0	98.3
Multi-Color Coatings	250	13/22	0.01/29	65.8
Pre-Treatment Wash Primers	420	PD/30	0/0	PD
Primers, Sealers, and Undercoaters	200	445/891	0.64/14	73.6
Quick-Dry Enamels[6]	250	PD/154	0.99/44	PD
Quick-Dry Primers, Sealers, and Undercoaters[7]	200	19/150	1.00/31	34.6
Roof Coatings	250	125/174	0/0	97.4
Rust Preventative Coatings[8]	400	16/25	0/0	63.5
Shellacs - Clear - Opaque	 730 550	 2/2 10/10	 0/0 0/0	 100 100
Specialty Primers, Sealers, and Undercoaters	350	Not surveyed	0/0	Unknown[4]
Stains	250	337/1323	0.64/17	52.8
Swimming Pool Coatings	340	PD/18	0/0	PD
Swimming Pool Repair and Maintenance Coatings[9]	340	0/6	0.03/70	0
Temperature-Indicator Safety Coatings	550	Not Surveyed	0/0	High[3]
Traffic Marking Coatings	150	107/161	0/0	53.4
Waterproofing Sealers - Concrete/Masonry - Wood	 400 250	 Not surveyed[10] Not surveyed[10]	0.39/36	 95.2[10] 12.8[10]
Wood Preservatives Below Ground - Clear - Semitransparent - Opaque	 350 350 350 350	 PD 16/20 20/25 PD	 0/0 0/0 0/0 0/0	 PD 94.7 74.1 PD

1. Information based on ARB's 1998 Architectural Coatings Survey.
2. Information based on ARB's 1998 Architectural Coatings Survey. Complying marketshare is based on sales volumes reported in survey.
3. Complying marketshare estimated (not based on ARB survey).
4. Complying marketshare unknown, but estimated to be significant because many district rules currently have the same VOC limit specified in the SCM.
5. A 340 g/l limit is available by a petition process in coastal regions north of Point Sur. However, data reflects all industrial maintenance coatings at 250 g/l.
6. There may be additional coatings in the "non-flat-high gloss" category that meet the definition of "quick-dry enamel."
7. There may be additional coatings in the "primer, sealer, and undercoater" category that meet the definition of "quick-dry primer, sealer, and undercoater."
8. These include products specifically listed as rust preventative in the ARB study.
9. Although the survey shows a zero complying marketshare, several district rules currently specify a 340 g/l VOC limit for swimming pool repair and maintenance coatings. In addition, "swimming pool repair and maintenance coatings" are a specific technology that has been signaled to be phased out for the past ten years (as evidenced by district rules). Current 340 g/l swimming pool coatings will meet this need.
10. Waterproofing sealers were surveyed in the ARB's 1998 Architectural Coatings Survey, but the survey did not distinguish between products for wood and concrete. The complying marketshares are based on all waterproofing sealers.

PD = Protected data, less than three companies reporting.

Table IV-2
VOC Emission Reductions Credited to U.S. EPA's National Rule

Coating Category	VOC Emission Reductions (excluding South Coast AQMD) (tons/day)
Quick-dry Primers, Sealers, and Undercoaters	0.27
Roof Coatings	0.01
Rust Preventatives	0.01
Traffic Coatings	0.36
Total	**0.65**

V.

EMISSIONS

California's extreme air quality problems require unique strategies for meeting federal and State ambient air quality standards. In this chapter, we provide an overview of these air quality problems and the need for significant emission reductions from all sources of air pollution. We also describe the need for the regulation of architectural coatings and provide a detailed summary of the emissions from the categories proposed for regulation.

A. AMBIENT AIR QUALITY AND THE NEED FOR EMISSIONS REDUCTIONS

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

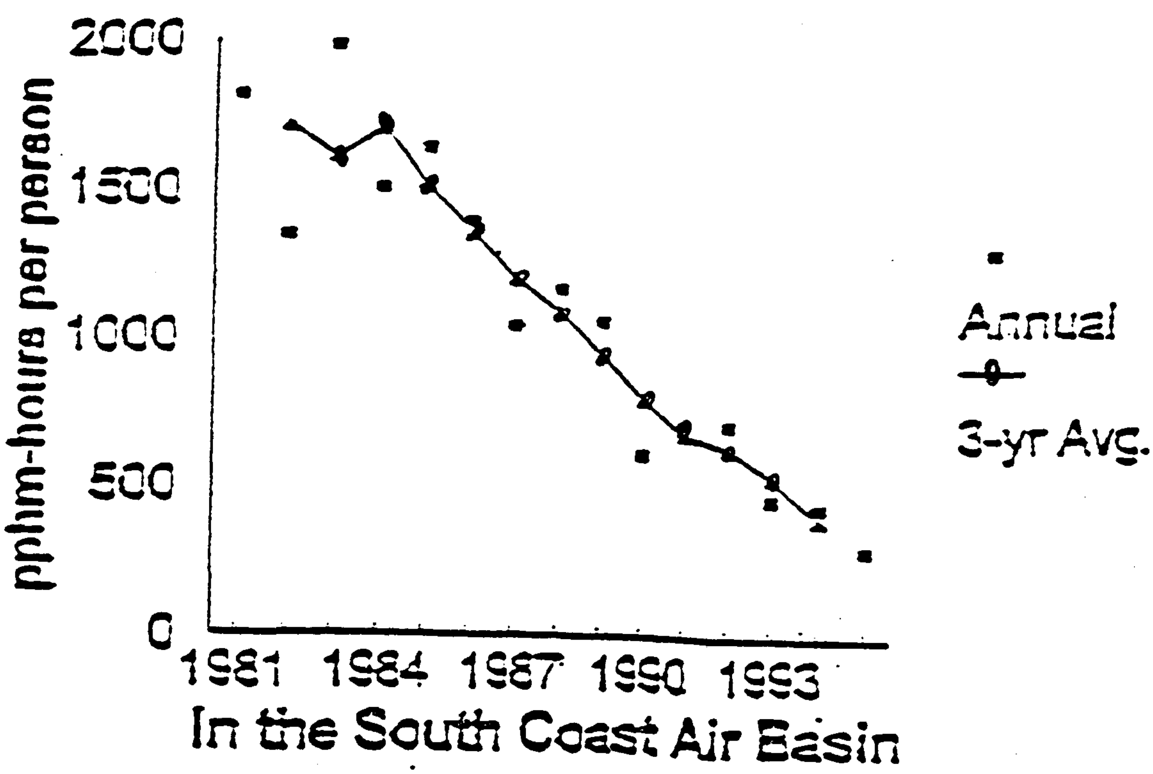
Ozone

VOCs and nitrogen oxides (NO_x) react in the presence of sunlight to form ozone. The rate of ozone generation is related closely to the rate of VOC production (in the form of reactive organic gases, or ROG) as well as the availability of NO_x in the atmosphere (U.S. EPA, 1996; Seinfeld and Pandis, 1998). At low ambient concentrations, ozone is a colorless, odorless gas, and the chief component of urban smog. It is one of the State's more persistent air quality problems. Air quality data have revealed that 75 percent of the nation's exposure to ozone occurs in California (ARB, 1994a). As shown in Figure V-1, the population-weighted average exposure to ozone concentrations above the State ambient air quality standard of nine parts per hundred million in the South Coast Air Basin has been declining. However, despite this decline and nearly 25 years of regulatory efforts, ozone continues to be an important environmental and health concern.

It has been well documented that ozone adversely affects the respiratory functions of humans and animals. Human health studies show that short-term exposure to even very low levels of ozone injures the lung (ARB, 1997; U.S. EPA, 1996). Ozone is a strong irritant that can cause constriction of the airways, forcing the respiratory system to work harder in order to provide oxygen to the body. Besides shortness of breath, it can aggravate or worsen existing respiratory diseases such as emphysema, bronchitis, and asthma (U.S. EPA, 1996).

Chronic exposure to ozone may cause permanent damage in deep portions of the lung. In some animal studies, permanent structural changes due to long-term ozone exposure were noted. These changes remained even after periods of exposure to clean air (U.S. EPA, 1996). The ARB is currently conducting a study to determine the effects of ozone on lung development. The is currently conducting a study to determine the effects of ozone on lung development. The "Epidemiologic Investigation to Identify Chronic Health Effects of Ambient Air Pollutants in Southern California" is a long-term study which is documenting the lung development of children in 12 cities in California. The air quality in these 12 communities varies from good to moderate and poor, so any trends in lung development may be determined. Preliminary results of this on-going study do indicate that chronic ozone exposure slows lung development, although no conclusions specific to ozone have been drawn.

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



Not only does ozone adversely affect human and animal health, but it also affects vegetation throughout most of California resulting in reduced yield and quality in agricultural ozone levels are often highest in the urban centers in Southern California, the San Joaquin Valley, and Sacramento Valley, which are adjacent to the principal production areas in California's multibillion-dollar agricultural industry. ARB studies indicate that ozone pollution damage to crops is estimated to cost agriculture over 300 million dollars annually (ARB, 1987). Similarly, the U.S. EPA estimates national agricultural losses to exceed 1 billion dollars annually (U.S. EPA, 1996).

PM_{10}

Airborne particulate matter (PM_{10}) is a solid or liquid substance with less than (<) 10 microns determined as the equivalent aerodynamic diameter. PM_{10} can be directly emitted into the atmosphere as the result of anthropogenic actions such as fuel combustion or natural causes such as wind erosion. Indirect PM_{10} is formed via a complex reaction involving a gas-to-particulate matter conversion process in which VOCs can participate (Seinfeld and Pandis, 1998). The focus of this discussion will be on the indirect aerosol formation of $PM_{10.}$

PM_{10} is composed of up to 35 percent aerosols which may be the result of atmospheric chemical reactions of sulfate, nitrates, ammonium, trace metals, carbonaceous material (VOCs), and water. The products of the gas-phase reactions may combine to form new particles (either single or two or more vapor phase species) or increase existing particle growth by condensation of VOCs (Seinfeld and Pandis, 1998). Furthermore, although the contribution from VOCs is not known, carbonaceous aerosols generally account for a significant fraction of the fine (<2 micron equivalent aerodynamic diameter) urban particulate matter. In Los Angeles, for example, aerosol carbon alone accounts for about 40 percent of the total fine particulate mass (Seinfeld, 1989).

PM_{10}, and specifically, its smaller fraction, $PM_{2.5}$, are inhaled deep into the lungs, causing significant adverse health effects. The particulate matter irritates the respiratory tract, and may contain toxic as well as carcinogenic compounds (Godish, 1991). Epidemiologic evidence indicates that certain populations are particularly sensitive to PM_{10}, including the elderly, persons suffering from lung or cardiopulmonary disease, infants and children, and asthma sufferers. These populations suffer a range of health effects. Among children, decrements in lung function occur, leading to increased school absences, and asthmatic individuals may suffer from increased respiratory symptoms. Among the elderly and in individuals suffering from cardiopulmonary disease, exacerbations of chronic disease leading to increased hospital admissions are seen (U.S. EPA, 1997). PM_{10} also contributes to reduced visibility.

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

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

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

In 1997, the U.S. EPA promulgated a new national eight-hour ozone standard, and new national standards for particulate matter (PM_{10} and $PM_{2.5}$). On May 14, 1999, the U.S. Court of Appeals for the District of Columbia put implementation of the new standards on hold. The Court ruled that the agency had overstepped its constitutional authority in setting the new standards because, among other things, it did not clearly articulate the rationale used in selecting specific levels for the standards. The Court remanded all of the standards to the U.S. EPA for further consideration. During remand, the status of the standards is as follows: (1) the Court vacated the new PM_{10} standard; (2) the Court left the new eight-hour ozone standard in place, but held that the standard "cannot be enforced"; and (3) the Court will decide in the future whether the $PM_{2.5}$ standard should be vacated outright, or remain in place while the case is remanded to the U.S. EPA. The U.S. EPA appealed the court's decision to the full U.S. Court of Appeals; however, a narrowly divided Court let the decision stand. U.S. EPA asked the Supreme Court to review the decision and is awaiting their response.

The court decision has no immediate impact on California's air quality programs, because most of California continues to violate the pre-existing national and State one-hour ozone and PM_{10} standards, and the court decision did not affect the applicability of these standards. The pre-existing national one-hour ozone and PM_{10} standards continue to apply. Also, California's State standards continue to apply. (In general terms, California's one-hour ozone standard is similar in its impact to the new federal eight-hour ozone standard.) Regardless of the ultimate legal fate of the new federal standards, ARB and the districts will need to pursue new emission reduction measures to attain the existing standards.

The vast majority of California's population who live in urban areas breathe unhealthy air for much of the year, as clearly shown in Figure V-2 (ARB, 1998). Lastly, Figures V-3 and V-4 show that unhealthy levels of ozone and PM_{10}, respectively, are not limited to just urban areas, but can be found in nearly every county in California. As shown in these maps, 46 counties and portions of counties are currently designated as nonattainment for the State ozone standard, while 54 counties are designated as nonattainment for the State PM_{10} standard (ARB, 1999). These counties contain over 97 and 99 percent, respectively, of California's population, a clear indication of the extent and magnitude of the ozone and PM_{10} problems in California.

The California Clean Air Act requires districts that have been designated nonattainment for the State ambient air quality standards for ozone, carbon monoxide, sulfur dioxide, or nitrogen dioxide to prepare and submit plans for attaining and maintaining the standards (see Health and Safety Code §40910 *et seq.*). In addition, the federal Clean Air Act requires that districts designated nonattainment for the federal ambient air quality standards prepare State Implementation Plans to demonstrate attainment with the federal standards. In some of these districts, substantial additional emission reductions will be necessary if attainment is to be achieved. In developing their plans, each district determines which measures are necessary to include, as well as the specific details of each included measure.

The plans from various districts underscore the increasing role of pollution from areawide sources, including consumer products and architectural coatings. As emissions from facilities and vehicles are reduced, the widespread areawide sources become a larger part of the inventory, and are included as a more significant area for potential reductions of VOC emissions. It is estimated that without additional architectural coatings regulations, the inventory for architectural coatings emissions will increase due to population growth.

Figure V-2
California Exceedences of
State Ambient Air Quality Standards During 1997

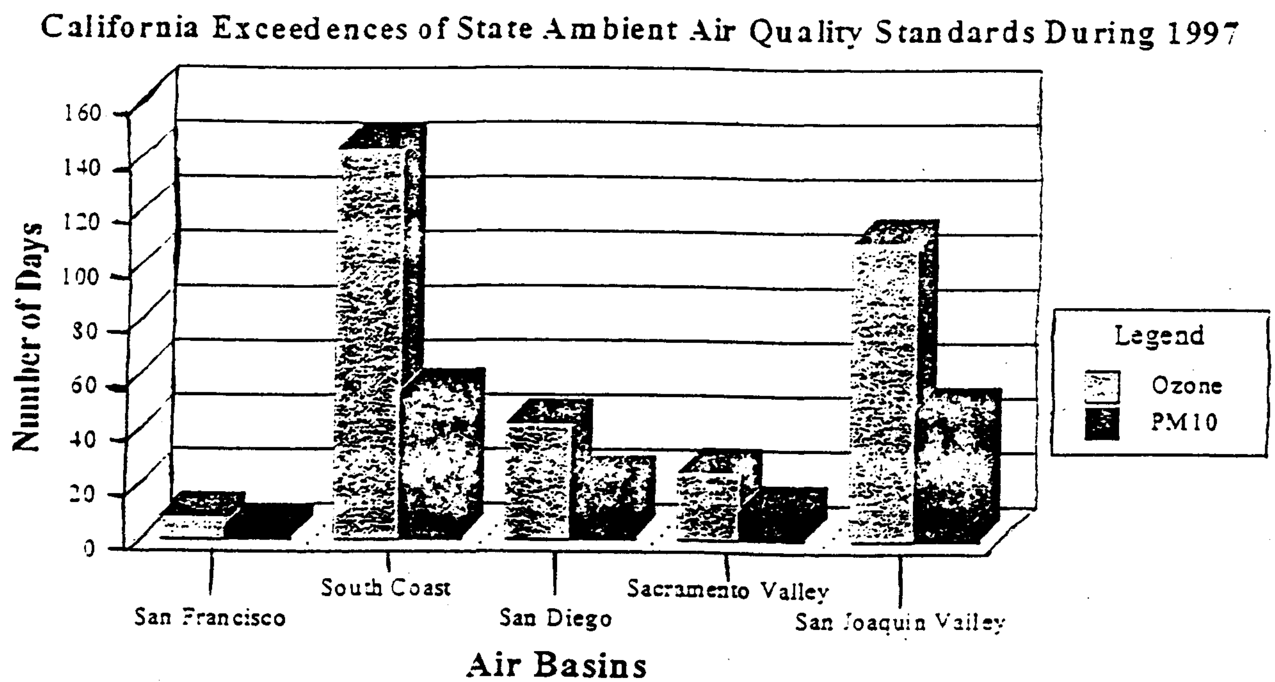
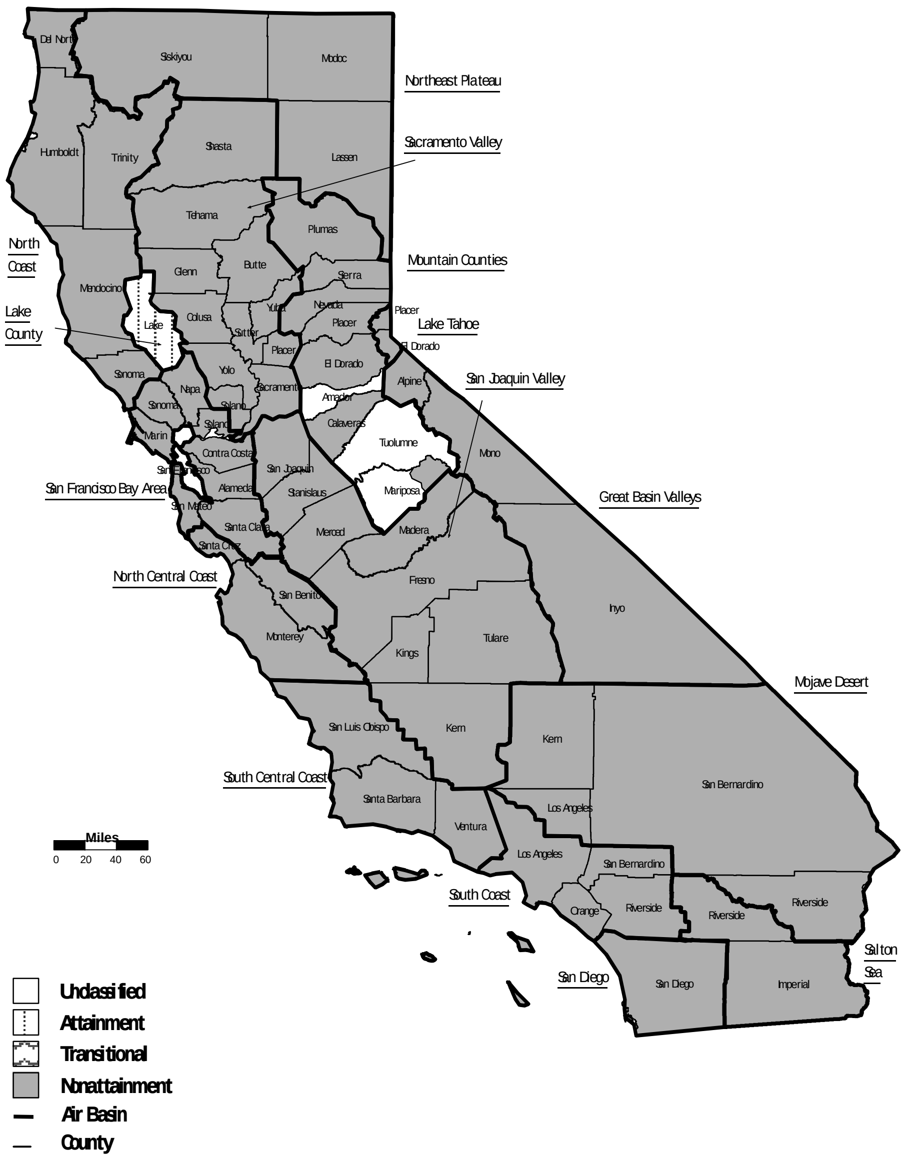


Figure V-3
Area Designations for State Ambient Air Quality Standard for Ozone

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



B. WHY REGULATE ARCHITECTURAL COATINGS?

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

Architectural coatings comprise an important source of emissions in California because they are widely distributed, emit VOCs when used, and contribute to the air pollution problem in California. Although each container of paint may seem to be a small source of emissions, when the total number of users in California is aggregated, the total VOC emissions become significant. As the population in California continues to grow, the VOC emissions from architectural coatings will also grow.

Recognizing the importance of the potential impact of VOC emissions from architectural coatings, the local districts began regulating the VOC content of architectural coatings in 1977. Because each district was free to adopt its own architectural coatings rule, the rules varied by district, raising compliance issues for companies which manufacture and distribute products nationally or statewide. To attempt to resolve these issues, the Air Resources Board amended its existing suggested control measure for architectural coatings in 1989 to act as a model rule for districts. The goal was to bring statewide uniformity to the various architectural coatings rules.

In its attainment demonstration in the 1994 Air Quality Management Plan (AQMP), the South Coast AQMD projected that, if left unchecked, architectural coatings emissions would account for 26 percent of the allowable VOC emissions by the year 2010. The 1994 AQMP thus contains a control measure that would reduce architectural coating emissions by 75 percent, or 62 tons per day, by 2010 (South Coast AQMD, 1996). The South Coast AQMD Rule 1113 amendments of November 8, 1996, will reduce VOC emissions by 18 percent (South Coast AQMD, 1996), while the May 14, 1999, Rule 1113 amendments will achieve a 38 percent emission reduction compared to the current emission inventory, on an annual average basis (South Coast AQMD, 1999). Large VOC reductions are also needed to attain the federal ozone standard in other districts such as Ventura County and San Joaquin Valley APCDs, and the Yolo-Solano AQMD. All of these VOC reductions were committed to in California's 1994 Ozone SIP.

Achieving significant VOC reductions from architectural coatings is a key element of the California Ozone SIP (ARB, 1994b). The SIP was adopted by the ARB on November 15, 1994, and serves as California's overall long-term plan for the attainment of the federal ambient air quality standard for ozone by early in the 21st century. Together with significant reductions from stationary industrial facilities, mobile sources (e.g., cars, trains, boats), and other area sources (e.g., consumer products), the architectural coatings reductions in the SIP are an essential part of California's effort to attain the air quality standards for ozone. Through the implementation of the proposed SCM, we will continue to make progress toward meeting California's SIP commitment for ozone attainment.

The 1994 Ozone SIP only addresses commitments to achieve the federal 1-hour air quality standard for ozone. Both the federal 8-hour ozone standard (if promulgated) and the State ozone standard are more stringent than the federal 1-hour standard, and will require even greater emission reductions to achieve attainment.

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

C. ESTIMATED EMISSIONS FROM ARCHITECTURAL COATINGS

Emissions from architectural coatings are estimated from surveys of architectural coatings sales in California that the ARB has conducted over the past 20 years. The four most recent surveys collected sales and emissions data for coatings sold in California in 1984, 1988, 1990, and 1996.

The 1998 ARB survey, which collected data for coatings sold in 1996, was sent to over 700 companies that potentially sold architectural coatings in California. Unlike previous surveys, this survey asked for information on the speciation of VOCs. We received responses from 340 companies, 152 of which submitted survey data. This compares favorably to the previous three ARB surveys, in which an average of 149 companies responded with data. A workshop was held in March 1999 to receive comments on the draft survey results. The draft speciation data was reviewed by industry in June 1999. The final survey report was published in September 1999 (ARB, 1999).

Table V-2 compares the ARB survey results for architectural coatings sold in 1990 and 1996. This table shows that the estimated annual emissions were reduced from 126 TPD in 1990 to 117 TPD in 1996. These data also show that architectural coatings in California are continuing to shift toward water-based, low-VOC coatings. In 1990, the split between water-based and solvent-based coatings was roughly 75 percent and 25 percent, respectively. The 1996 survey data show closer to an 80 percent/20 percent water-based/solvent-based split, respectively. The per capita use of coatings was relatively constant between 1990 and 1996. These trends seem to indicate that emissions from architectural coatings are declining, assuming that the growth in population and housing does not offset any trend in reductions. Also, because the increase in volume from 1990 to 1996 was roughly equal to what would be predicted based on growth alone (i.e., two percent per year), we did not adjust the inventory to account for incomplete market coverage from the survey process. We believe we captured about 98 percent of the California coatings market with the 1998 ARB survey.

Table V-2
1990/1996 Survey Comparison

	1990	**1996**
Total volume, gallons	77.1 million	87.5 million
Water-based/solvent-based split, %	76/24	82/18
Estimated emissions (TPD), annual average day	126	117
Gallons per capita	2.6	2.7
Emissions per capita (pounds)	3.1	2.6

The ARB and district staff use survey data, coupled with information on the growth of coating use and the level of emissions control from local district rules, to estimate emissions from architectural coatings in the future. The data in Tables V-2 and V-3 are presented in 1996 values, as annual average emissions. The values used in ozone attainment plans are usually presented as average summer emissions, since the peak ozone season in California is typically the summer. The estimated emissions on an average summer day are greater than on an average annual day because more painting is done in May through October than the rest of the year, due to weather conditions. Annual average daily emissions spread out these higher summer emissions evenly throughout the year.

The 1995 ARB emissions inventory estimates the emissions from all stationary sources to be about 1600 tons per day, with architectural coatings contributing about eight percent of the stationary source emissions, or about 130 tons per day. This estimate was based on the 1990 architectural coatings survey data. These estimates have not yet been officially updated based on the 1996 survey data.

Table V-3 shows the estimated emissions from the architectural coatings categories included in the proposed SCM are about 54 tons per day (excluding South Coast AQMD) based on the 1998 ARB survey. The statewide emissions estimate for all the categories surveyed is about 100 tons per day. After estimates from thinning and cleanup emissions are included, the architectural coatings emissions estimate is about 117 tons per day. The table also shows that the emissions from the eleven coating categories, for which emission reductions will be achieved from the proposed SCM, account for almost 80 percent of the total emissions from all of the coating categories in the SCM. These eleven categories are shown in bold in Table V-3.

Table V-3 VOC Emissions By Product Category	
Coating Category	**VOC Emissions (excluding South Coast AQMD) (tons/day)**
Flat[1]	**8.00**
Non-flat - High Gloss - **Medium Gloss** - **Low Gloss**	 2.17 **6.75** **1.73**
Specialty Coatings:	
Antenna Coatings	*
Antifouling Coatings	*
Bituminous Roof Coatings	1.42
Bituminous Roof Primer Coatings	Not surveyed
Bond Breakers	0.02
Clear Wood Coatings - Clear Brushing Lacquers - **Lacquers (incl. Lacquer sanding sealers)** - Sanding Sealers (other than lacquer sanding sealers) - Varnishes	 Not surveyed **2.50** 0.46 1.74
Concrete Curing Compounds	0.24
Dry Fog Coatings	0.26
Faux Finishing Coatings	Not surveyed
Fire-Resistive Coatings	Not surveyed
Fire-Retardant Coatings - Clear - Opaque	 * 0.03
Floor Coatings	0.79
Flow Coatings	*
Form-Release Compounds	0.02
Graphic Arts Coatings (sign paints)	0.03
High-Temperature Coatings	0.05
Industrial Maintenance Coatings	**7.84**
Low Solids Coatings	*
Magnesite Cement Coatings	0.14
Mastic Texture Coatings	0.15
Metallic Pigmented Coatings	0.81
Multi-Color Coatings	**0.04**
Pre-Treatment Wash Primers	0.04
Primers, Sealers, and Undercoaters	**4.59**
Quick-Dry Enamels	**2.24**
Quick-Dry Primers, Sealers, and Undercoaters	**3.27**

Table V-3 (continued) VOC Emissions By Product Category	
Coating Category	**VOC Emissions excluding South Coast AQMD (tons/day)**
Recycled Coatings	Not surveyed
Roof	0.30
Rust Preventative Coatings	0.14
Shellacs - Clear - Opaque	 0.11 0.41
Specialty Primers, Sealers, and Undercoaters	Not surveyed
Stains	**3.89**
Swimming Pool Coatings	0.01
Swimming Pool Repair and Maintenance Coatings	**0.05**
Temperature-Indicator Safety Coatings	Not surveyed
Traffic Marking Coatings	2.02
Waterproofing Sealers[2] - Concrete **- Wood**	 0.46 **1.08**
Wood Preservatives	0.51
Total	**54.3**

1 Bold indicates categories that account for the majority of the emission reductions in the proposed SCM.

2 Emissions based on the South Coast AQMD's estimate that 30 percent of the emissions for waterproofing sealers are contributed by coatings for concrete, and the remaining 70 percent by coatings for wood.

* Emissions are less than 0.01 tons per day.

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VI.

DESCRIPTION AND TECHNICAL ASSESSMENT OF THE COATING CATEGORIES

Note: This chapter previously appeared as Appendix D in the Draft Program Environmental Impact Report. Most of the category descriptions now contained in this chapter remain unchanged from those of Appendix D. However, where category descriptions have been revised, text that has been deleted is indicated by ~~strikeout~~, and text that has been added is indicated by underline:

In addition, the following category descriptions have been added, or due to the nature of the revisions, have been replaced in their entirety for clarity:

(1) flats;
(2) non-flats;
(3) non-flat high gloss;
(4) bituminous roof coatings;
(5) bituminous roof primers;
(6) floor coatings;
(7) quick-dry enamels;
(8) waterproofing concrete/masonry sealers; and
(9) waterproofing wood sealers.

Finally, in this chapter specialty primers, sealers, and undercoaters are referred to as specialty primers throughout.

In this chapter, we provide a discussion of the 47 architectural coatings categories (including subcategories) included in the proposed SCM, as well as 16 categories that are included in the United States Environmental Protection Agency's (U.S. EPA's) national architectural coatings rule, but not in the SCM. This chapter is divided into three sections. Section A, "Coating Categories for Which We Are Proposing New VOC Limits," discusses the 31 coating categories in the SCM where we are proposing new VOC limits or VOC limits that are generally lower than those in existing district rules (excluding the South Coast AQMD). These discussions provide more background and technical analysis than those in Sections B and C. Section B, "Coating Categories for Which the Proposed VOC Limits are Generally Consistent with District Rules," discusses the 16 coating categories in the SCM where we are proposing VOC limits that are generally consistent with the VOC limits in existing district rules. The discussions in this section explain why we believe the existing VOC limits in district rules are appropriate for the proposed SCM. Finally, Section C, "Categories Not Proposed for Inclusion in the Suggested Control Measure," discusses the coating categories that are not included in the proposed SCM, but are included in the U.S. EPA's national architectural coatings rule. These discussions explain why we believe it is unnecessary to include a separate category for these products in the proposed SCM.

In general, the VOC limits in the proposed SCM are modeled after the interim limits in the South Coast Air Quality Management District (South Coast AQMD's) Rule 1113, except that they have an effective date of January 1, 2003 (except for industrial maintenance coatings which have an effective date of January 1, 2004). The effective dates are later than those in Rule 1113, because we wanted to provide roughly the same three-year reformulation time provided by the South Coast AQMD. Also, consistent with Rule 1113 and most other district architectural coatings rules, coating products sold in containers of one liter or less are exempt from the proposed VOC limits in the SCM.

The discussions of the proposed VOC limits for each of the coating categories explain why we believe that they are technologically and commercially feasible by the proposed effective date. Our analysis of each coating category relies on information from many sources, including trade journals, the ARB's 1998 Architectural Coatings Survey, discussions with manufacturers and resin suppliers, and the results of laboratory tests of both complying and noncomplying products. However, we will also monitor industry's progress toward achieving the proposed VOC limits in the SCM, to ensure that manufacturers are able to satisfy the overall market demand for these products.

A. COATING CATEGORIES FOR WHICH WE ARE PROPOSING NEW VOC LIMITS

We are proposing new VOC limits for the following 31 coating categories that are generally consistent with the interim VOC limits adopted in recent amendments to the South Coast AQMD's Rule 1113 (with the exception of antenna coatings, antifouling coatings, bituminous roof coatings, clear brushing lacquers, floor coatings, flow coatings, high-temperature coatings, non-flat high gloss coatings, pre-treatment wash primers, swimming pool repair and maintenance coatings, and waterproofing sealers). However, in many cases, the proposed limits are lower than the existing VOC limits in other district rules in California. Therefore, the discussions of these coating categories are more detailed than those for the other categories. The discussions for each of these coating categories include: 1) product category description; 2) information on product use and marketing; 3) information on the existing product formulations; 4) discussion of the proposed VOC limit, our rationale for the proposed limit, and the options for compliance; and 5) if applicable, a discussion of the issues associated with the proposed VOC limit, as raised by the affected industry. After the Flat and Non-flat categories, the product categories are in alphabetical order.

1. Flat Coatings

Product Category Description:

Flat coatings are widely used on both interior and exterior surfaces of residential and commercial buildings. Flat coatings leave a matte finish, with no gloss or shine. They are defined as having a gloss of less than 15 on an 85^{o} meter or less than 5 on a 60^{o} meter. The flat finish tends to minimize surface irregularities and imperfections.

Table VI-1 below summarizes our estimate of sales and VOC emissions from the flat coatings category based on ARB survey results. The ARB survey (ARB, 1999) shows that flat coatings represent the largest coating category with regard to both sales volume and VOC emission levels. In 1996 (the year surveyed), approximately 32 million gallons of flat coatings were used in California. This represents about 36 percent of the total California sales volume of architectural coatings in 1996. The VOC emissions from flat coatings in California, excluding those emissions that occur in the South Coast AQMD, are about 8.0 tons per day (TPD). VOC emissions from flat coatings represent approximately 15 percent of the total emissions from architectural coatings. Because most of the products sold are water-based, most of the emissions are from water-based products, even though these products have a lower sales-weighted average VOC content than solvent-based products.

Table VI-1
Flat Coatings*

	Number of Products	Category Sales (gallons/year)	Sales-Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	56	27,873	373	0.06
Water-Based	2,299	31,800,868	98	7.94
Total	2,355	31,828,705	98	8.00

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

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

Typically, flat coatings can be brushed, rolled, or sprayed on the surface to be painted. Flat coatings make up approximately 80 to 90 percent of the total coatings used for residential applications (South Coast AQMD, 1996). "Do-it-yourselfers" and paint contractors can purchase flat coatings at outlets including hardware stores, home supply stores, and retail paint stores. Flat coatings are used on interior walls and ceilings, and are typically used to paint living rooms, dining rooms, bedrooms, and halls. Flat coatings are also used on exterior walls and overhangs. With proper surface cleaning and priming (if necessary), flat coatings can be used on a large variety of interior and exterior substrates including drywall, plaster, wallpaper, brick, concrete block, wood siding, vinyl siding, aluminum siding, and stucco. Because most flat coatings are water-based, soap-and-water cleanup is typical. Most flat coatings (about 97 percent) are sold in size units greater than one liter (ARB, 1999).

The 1998 ARB survey showed that about 41 percent of the flat coatings sold in 1996 were formulated for interior applications, 30 percent for exterior applications, and 29 percent were formulated for both interior and exterior applications (ARB, 1999).

For marketing their products, some manufacturers of "zero VOC" flat coatings emphasize the health benefits of using such coatings versus conventional coatings. The benefits include the low-to-minimal odor of zero VOC coatings and the reduced chemical exposures from the use of such coatings. Because of those features, manufacturers of zero VOC coatings emphasize the coatings' suitability for use in enclosed centrally-ventilated buildings (e.g. schools, office buildings, and hospitals), rooms that need to be occupied soon after painting (e.g. restaurants, hotel rooms), and residences.

Product Formulation:

As discussed earlier, most flat coatings are water-based. The 1998 ARB survey (which represents 1996 sales as reported) shows that water-based flat coatings represent over 99 percent of the flat coatings market. Solvent-based flat coatings represent 0.1 percent of the market and generally have VOC levels greater than 250 g/l, the VOC limit for flat coatings currently in effect for those California air pollution control districts that have architectural coatings rules. The volume of solvent-based flat coatings sold has decreased approximately 54 percent since the 1993 ARB survey of architectural coatings (which reflected 1990 sales), while overall sales of flat coatings has remained about the same. The overall sales-weighted average VOC level for flat coatings has decreased 7 percent since the 1993 ARB survey (ARB, 1999).

Generally, the type of binder used in a formulation has a large influence on the amount of VOC needed. Binders serve to hold the paint together in a film and to provide adhesion to the substrate. The binder in water-based flat coatings, which comprise the majority of flat coatings, is typically a dispersion of synthetic resin particles, called latex. Thus, these types of coatings are commonly called latex coatings. A wide variety of synthetic polymers are used as binders in latex coatings. Two common latex binders are acrylic and vinyl-acrylic resins. The solvent-based coatings in this category are commonly formulated using alkyd resins as binders.

The VOCs in water-based coatings perform one or more of the following functions: binder coalescing aid, polymer plasticizer, freeze/thaw stabilizer, defoamer, and carriers for other additives such as colorants, thickening agents, surfactants, and biocides. The largest contributors of VOCs in latex coatings are glycols, added mainly to provide freeze/thaw resistance, and coalescing solvents such as 2,2,4-trimethyl-1,3-pentanediol isobutyrate (Texanol®), to allow the latex particles to come together to form a film (Klein, 1993). Generally, so called "zero VOC" coatings contain very small amounts of VOCs. Lower-VOC coatings tend to be formulated using binders that require less coalescing solvent and/or are formulated using less VOCs for freeze/thaw stabilization (Klein, 1993; Currie, 1993).

Proposed VOC Limit and Basis for Recommendation:

We recommend a 100 g/l VOC limit for flat coatings, effective January 1, 2003. The proposed VOC limit is technologically and commercially feasible by January 1, 2003, based on our review of ARB survey data on marketshares, product information from manufacturers, and other information as discussed below. The proposed VOC limit is lower than the national limit recently promulgated by the United States Environmental Protection Agency (U.S. EPA) for this category. The U.S. EPA divides flat coatings into interior and exterior categories, but the same VOC limit, 250 g/l, applies to both (U.S. EPA, 1998). In California, the 1989 SCM for architectural coatings recommended a 250 g/l VOC limit for flat coatings (ARB, 1989); this is the most common limit currently in effect for those California air pollution control districts that have architectural coatings rules. In 1996, the South Coast AQMD adopted a 100 g/l limit for flat coatings that will become effective July 1, 2001, and also adopted a 50 g/l limit that will become effective July 1, 2008. Our recommended limit is consistent with the interim limit adopted by the South Coast AQMD.

As shown in Table VI-2, the 1998 ARB survey found that about half of the marketshare of flat coatings complies with the proposed VOC limit. Nearly 1,100 products of the approximately 2,400 products reported already comply with the proposed limit. Of the 45 companies that reported in this category, 36 offered flat coatings that comply with the proposed limit. Products with a VOC content equal to or lower than 50 g/l represent about 18 percent of the market, and products with a VOC content equal to or lower than 150 g/l represent 88 percent of the market. (ARB, 1999).

The table below also shows that VOC emission reductions in the non-South Coast AQMD portion of California would be approximately 1.4 TPD, on an annual average basis, from implementing the proposed limit of 100 g/l.

Table VI-2
Flat Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
100	1,097	48.5	1.39

***** Based on ARB's 1998 Architectural and Industrial Maintenance Coatings Survey (ARB, 1999).

Considering flat coatings formulated for interior and exterior use separately, the 1998 ARB survey indicates that 69 percent (550 products) of the volume of interior flat coatings sold comply with the proposed limit, 42 percent (276 products) of the volume of exterior flat coatings sold comply, and 27 percent (143 products) of the volume of coatings sold for both interior and exterior use comply (ARB, 1999).

The high marketshares that already comply with the proposed limit demonstrate widespread use of existing low-VOC technology for formulating flat coatings. While almost all flat coatings are currently water-based latex coatings, the proposed limit would require more water-based products to be formulated using lower-VOC technology. As discussed above, the primary sources of VOCs in latex coatings are coalescing solvents and VOCs (glycols) added mainly to provide freeze/thaw resistance. We expect that product reformulation to meet the proposed limit would involve switching to a binder (or blend of binders) that requires less coalescing solvent and/or reducing the amount of glycol that is added to provide freeze/thaw stability (Klein, 1993; Currie, 1993).

Of note is that most solvent-based flat coatings used in districts without architectural coatings rules do not meet the 250 g/l limit currently in place in district architectural coatings rules. Such solvent-based coatings will at a minimum have to be reformulated (likely to water-based) to meet the national rule limit of 250 g/l in those California districts that do not adopt architectural coatings rules.

Independent Product Tests

Consumers Union, an independent, nonprofit organization, recently reported on tests it performed on interior and exterior paints. Tests were performed on 14 brands of interior flat paints marketed as higher-grade paints. For each brand, three colors that represent the basic tint bases were tested. Several flat paints with VOC levels below 100 g/l were included in the tests. The paints were tested for hiding ability and resistance to scrubbing, staining, blocking, fading, and mildew. All the interior flat paints tested performed well, rating “good” or better in overall scores. One complying flat paint, Pittsburgh Manor Hall, was included as one of the five paints recommended as “best of the flats” and received the second highest overall score (Consumer Reports, 2000).

Consumers Union also tested 16 brands of exterior latex flat paints (three colors for each brand) purchased mostly from the northeastern United States. ARB staff was able to ascertain that one flat paint tested complies with the proposed 100 g/l limit. The paints were applied to Southern yellow pine, a type of wood prone to cracking, and were exposed to the weather in New York and Florida for nearly two years. Periodic assessments were made for signs of cracking, color change, dirt buildup, mildew growth, and other problems. The investigators also tested how well the paints adhered to a chalky surface. Based on the test results, four flat paints received a recommendation from Consumers Union. Those recommended paints included Glidden Dulux Endurance flat, which, with the exception of its accent tint base, complies with the proposed VOC limit (Consumer Reports, 1999).

Product information from manufacturers

Product information sheets published by coatings manufacturers indicate that a wide variety of flat coatings that meet the proposed VOC limit are available that possess performance characteristics similar to higher-VOC coatings. At the end of the discussion of this category are tables of information about specific products that meet the proposed VOC limit and, for comparison, products that exceed the proposed limit. We identified specific products with a VOC content of 100 g/l or less offered by Behr, Devoe, Dunn Edwards, Frazee, ICI-Dulux, Rodda Paint, Sherwin Williams, and Tru-Test. A list of performance characteristics compiled from product information sheets for interior and exterior flat coatings with VOC levels of 100 g/l or less is presented below. Please note that not all flat coatings with VOC levels at or below 100 g/l possess all of the characteristics listed below:

Interior flat coatings
good quality, high quality, premium quality, top of the line quality
good to excellent hiding qualities, good dry hiding
durable crack-resistant long-lasting finish
excellent adhesion
excellent color and sheen uniformity
non-yellowing
good to excellent touch-up properties
good stain resistance
washable to extremely washable, durable, long-lasting protection
easy application
excellent freeze-thaw resistance
high film build without sags or runs

Exterior flat coatings
quality product, top of the line, premium quality
long-lasting durability, durable and tough
exceptional coverage
excellent adhesion
low temperature application to 35^{o} F
maximum protection against UV color fade, efflorescence, water intrusion, and film failure, fade and chalk resistant
resists blistering, peeling, and flaking
easy application
very good to excellent touch-up
good hide
exceptional mildew resistance

Issues:

1. Issue: The flat coatings category covers a broad range of products. The ARB should consider subcategorizing the flat coatings category to allow for a higher VOC limit for special use, high performance products. A specific suggestion is to split the flat coatings category into interior and exterior subcategories with different VOC limits for each.

Response: The information we reviewed does not substantiate the need to subcategorize the flat coatings category. Our survey of product information published by coating manufacturers indicates that a wide variety of product types in the flat coatings category already comply with the proposed limit. This includes coatings formulated specifically for acoustic ceilings, coatings formulated for contractors (which emphasize features such as ease and speed of application, hiding properties, and touch-up properties), texture coatings, high-build coatings, coatings designed for low temperature application, and premium quality coatings.

As discussed above, information on marketshares obtained from the 1999 ARB survey indicates that a considerable portion of interior and exterior flat coatings already comply with the proposed limit. Our survey of product information and independent test results show that a variety of performance characteristics comparable to those of higher VOC products have been achieved for both interior and exterior flat coatings with VOC levels at or below 100 g/l.

2. Issue: The 100 g/l limit for flat coatings will allow the sale of medium quality coatings, but consumers will not be able to purchase high quality flats that will stand up to repeated washings or have good exterior durability. Application properties at lower temperatures will be compromised, as will freeze-thaw resistance.

Response: Product information from coating manufacturers and independent test results indicate that a variety of manufacturers have been able to use available technology to achieve desirable properties for flat coatings with VOC levels at or below 100 g/l. Our survey of product information indicates that there are a number of existing interior and exterior coatings that meet the proposed limit that are marketed as premium quality coatings. Further, the product information and test results indicate that there are complying coatings with excellent scrub resistance and durability. Also, there are complying products that allow for low temperature application and products with good freeze-thaw resistance.

3. Issue: It is premature to adopt South Coast AQMD's interim flat limit when the District committed in Rule 1113 to do a technical assessment prior to its 2001 implementation date.

Response: South Coast AQMD Rule 1113 requires the District to perform the first technology assessment on flat coatings by July 1, 2000, a year before the 100 g/l limit is to take effect in that district. We expect that the South Coast AQMD's assessment will largely consider the same types of information that we considered in our assessment, i.e. information obtained in ARB's 1998 survey, information on product tests, and product information from coating manufacturers. We will monitor the South Coast AQMD's work in this area, and if their assessment indicates a need to reconsider the 100 g/l limit for flat coatings, there will be sufficient time for the other California districts to make any necessary rule changes before the recommended effective date.

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FLAT COATINGS

Less than or Equal to 100 g/l

Product Name and Brand	VOC Content g/l	Type[1]	Information from Manufacturer's Product Sheets
Behr Premium Plus Interior Flat Smooth Wall Texture Paint	25	I	Durable, crack resistant, long lasting finish, excellent adhesion
Benjamin Moore Pristine Eco Spec Interior Latex Flat 219	0	I	Washable, spatter-resistant, high hiding, excellent touch-up, uniform finish
DeVoe Paint DE-VO-KO Flat Interior Latex Wall Paint #378XX	61	I	Good quality, economy and speed of application, excellent color & sheen uniformity, good dry hiding, non-yellowing
DeVoe Paint DE-VO-PRO Flat Interior Latex Wall Paint #534XX	31	I	Good hiding, low odor, good touch-up
DeVoe Paint Wonder-Hide Flat Interior Latex Wall Paint #519XX	33	I	High quality, good hiding, good touch-up, non-yellowing, good washability, good scrubability, easy application, excellent color & sheen uniformity, excellent freeze-thaw resistance, excellent adhesion
DeVoe Paint SPRA-MAX 40 Flat Interior High Build Latex Coating #45XX	90	I	High quality, high film build for all types of interior surfaces, film thickness to 20 mils dry are easily obtained without sags or runs, durable, washable surface
Dunn Edwards Acoustikote Interior Acoustic Paint	0	I	High-hiding, sprays easily, finish does not affect sound-deadening qualities of acoustical surfaces
Dunn Edwards Decovel Interior Velvet Flat Wall Paint W 401	65	I	Premium flat wall paint, exceptional hide, good stain resistance & washability, easy to apply, designed to provide long lasting protection for interior walls, ceilings & other properly prepared & primed surfaces
Dunn Edwards Interior Maintenance Latex Flat Paint	65	I	Heavy-bodied, superior hiding power, applies very easily, touches-up well
Dunn Edwards Quik-Wall Interior Latex Flat Wall Finish	65	I	Heavy-bodied, excellent hide, touches up very well
Dunn Edwards Sierra Low Odor/Zero VOC Flat Wall Finish W 501	0	I	Exceptional hide & applies easily
Dunn Edwards Tuffwall Interior Latex Flat Enamel	95	I	Tough, durable finish that is extremely washable, excellent touch-up qualities, very good hiding power
Dunn Edwards Walltone Interior Flat Wall Paint	45	I	Durable, easy touch-up, good hide
Dunn Edwards Arizona Exterior Latex Flat Finish	65	I/E	Good hide, very good touch-up
Dunn Edwards Prokote Plus Exterior Flat Paint for New Construction	70	E	Excellent touch-up qualities, durable, good hide

[1] I = Interior, E = Exterior, I/E = Interior and Exterior

FLAT COATINGS
Less than or Equal to 100 g/l (continued)

Product Name and Brand	VOC Content g/l	Type[1]	Information from Manufacturer's Product Sheets
Dunn Edwards Evershield 100% Acrylic Wood & Masonry Flat W 701	85	E	Top of the line, advanced technology & premium ingredients provide unparalleled performance, long-lasting durability, exceptional coverage & excellent adhesion, provides maximum protection against UV color fade efflorescence, water intrusion & film failure (grain crack, peeling & blistering)
Frazee Majestic Interior Acrylic Copolymer Velvet Flat Finish	89	I	Top of the line quality, test results: resistance to abrasion – Pass, resistance to blocking - pass, resistance to washing - pass, resistance to yellowing – pass, resistance to 1500-2000 scrub cycles – pass
Frazee Acoustic Ceiling Paint Interior Acoustic Flat Latex Finish	93	I	Top of the line quality, high hide, doesn't affect sound deadening properties of substrate
Frazee Speedwall Plus Interior Vinyl-Acrylic Flat Finish	89	I	Top of the line commercial quality, ease of application, test results: resistance to abrasion - pass, resistance to blocking – pass, resistance to washing - pass, resistance to yellowing - pass, resistance to 1500 - 2000 scrub cycles – pass
Frazee Speedwall Interior Vinyl-Acrylic Flat Finish	72	I	Top of the line commercial quality, maximum hiding
Frazee Craftsman Heavy Duty Interior Vinyl Flat Finish	77	I	Top of the line commercial quality, excellent hiding qualities
Frazee Envirokote Interior Low Odor Zero VOC Flat Finish	0	I	Top of the line quality, test results: - resistance to abrasion - pass, resistance to blocking - pass, resistance to washing - pass, resistance to yellowing - pass, resistance to 500 - 600 scrub cycles – pass
ICI-Dulux Decra-Shield Exterior 100% Acrylic Finish	0	E	Premium quality, exceptional mildew resistance, low temperature application to 35°F, good resistance to early moisture exposure, durable & tough, fade & chalk resistant, excellent adhesion, resists blistering, peeling & flaking, easy application
ICI-Dulux Lifemaster 2000 Interior Flat Finish LM 9100	0	I	Professional best, exceptional hiding, excellent touch-up properties, washable, durable
ICI-Dulux Professional Velvet Matte Interior Flat Latex Wall & Trim Finish	85	I	Premium quality, excellent touch-up, coverage & application properties, durable & washable
ICI-Dulux Ultra Velvet Sheen Interior Flat Latex Wall & Trim Finish	92	I	Excellent hiding, highest quality premium flat latex, excellent coverage & application properties, good burnish resistance, durable, wear resistant, very good touch-up, excellent scrub resistance, very good washability

[1] I = Interior, E = Exterior, I/E = Interior and Exterior

FLAT COATINGS
Less than or Equal to 100 g/l (continued)

Product Name and Brand	VOC Content g/l	Type[1]	Information from Manufacturer's Product Sheets
ICI-Dulux Ultra-Wall Latex Flat Interior Wall Paint	50	I	Professional quality, high hiding, excellent touch-up, uniform flat finish, non-yellowing
ICI-Dulux Speed-Wall Latex Matte Flat Interior Wall Paint	33	I	Excellent dry hide, uniform flat finish, excellent touch-up properties
ICI-Dulux Speed-Wall Latex Flat Interior Wall Paint	18	I	Excellent dry hide, uniform flat finish, good touch-up properties
ICI-Dulux Ultra-Hide Latex Flat Interior Wall Paint "The Workhorse"	98	I	Professional best "workhorse," high hiding, excellent touch-up, uniform finish, washable, non-yellowing, easy application, excellent hiding & flexibility
ICI-Dulux Ultra-Hide High-Build Latex Flat Interior Primer/Finish	46	I	High-build, excellent touch-up properties,
ICI-Dulux Ultra-Hide Build-Dur Spray Latex Flat Interior Primer/Finish	83	I	High-build without running or sagging
ICI-Dulux Speed-Cote Exterior Latex Flat Masonry Finish	22	E	Uniform flat finish, easy application
ICI-Dulux Ultra Hide, Interior/Exterior High-Build Acrylic Latex Texture Coating	88	I/E	Premium quality, provides a uniform texture on rough or irregular surfaces
Rodda Paint AC-911 Exterior Latex House Paint	96	E	Uniform finish, smooth even finish, very good resistance to moisture
Rodda Paint Krillicon Exterior Flat Paint	85	E	Very good resistance to moisture – masonry paint
Rodda Paint Ezee Coat Flat Wall Paint	67	I	High hiding, economical, excellent touch-up characteristics, good resistance to moisture
Rodda Paint Horizon Clean Air Select	0	I	Washable, uniform, durable, easy application properties, excellent resistance to moisture
Rodda Terra Solid Color Latex Flat	76	E	For rough wood surfaces where the ultimate in color retention & durability is desired, excellent resistance to moisture
Sherwin Williams Health Spec Low Odor Latex Interior Flat	2.4-6	I	Provides the durability expected from a flat wall paint without the odor associated with typical latex paints; 1300 scrubs
Sherwin Williams Style Perfect Interior Flat Latex Ceiling Paint	51	I	No specific performance information provided
Sherwin Williams Style Perfect Interior Latex Flat	36-48	I	Fade resistant, easy to apply, resists yellowing, easy clean-up
Sherwin Williams ProMar 700 Interior Latex Flat Wall Paint	48-60	I	No specific performance information provided

[1] I = Interior, E = Exterior, I/E = Interior and Exterior

FLAT COATINGS
Less than or Equal to 100 g/l (continued)

Product Name and Brand	VOC Content g/l	Type[1]	Information from Manufacturer's Product Sheets
Sherwin Willaims ProMar 400 Interior Latex Flat	48-84	I	Durable, quality vinyl acrylic paint
Sherwin Williams ProMar 200 Interior Latex Flat	48-84	I	Finest quality product designed for the professional
Tru-Test Contractor's Latex Flat Wall Paint GF-Line	<100	E	No specific performance information provided

[1] I = Interior, E = Exterior, I/E = Interior and Exterior

FLAT COATINGS
Greater than 100 g/l

Product Name and Brand	VOC Content g/l	Type[1]	Information from Manufacturer's Product Sheets
ACE Quality Paints 7* Flat Latex Wall Paint	198	I	15 year durability, scrubbable, low spatter, non-yellowing, colorfast, stain resistant
ACE Quality Paints 7* Flat Latex Ceiling White	213	I	Low spatter, non-yellowing, colorfast, stain resistant, finish reduces reflection and glare
ACE Quality Paints 5* Flat Latex Wall Paint	215	I	Washable, easy application, non-yellowing, colorfast, spot resistant
ACE Quality Paints 5* Flat Latex Ceiling Paint	175	I	Washable, easy application, non-yellowing, colorfast, spot resistant
ACE Quality Paints 7* Acrylic Latex House Paint	143	E	15 year durability, no chalk washdown, mildew resistant, non-yellowing, washable, stain resistant
ACE Quality Paints 5* Acrylic Latex House Paint	143	E	Stain resistant, no chalk washdown, non-yellowing, washable
ACE Quality Paints Pro High Hiding Flat Latex Wall Paint	141	I	Good touch up
AFM Safecoat Interior Flat	102	I	Premium quality, superior hiding properties, durable finish
Devoe Paint Velour Flat Interior Alkyd Wall Paint	372	I	Easy application, excellent hiding, excellent durability, good washability
Devoe Paint Wonder Tones Flat Interior Latex Wall Paint	203	I	Premium quality, durable, excellent hiding, non-yellowing, resists staining, highly washable, excellent touch-up, excellent spatter resistance
Devoe Paint Ceiling White Flat Interior Latex Paint	125	I	Good hiding, easy application, excellent spatter resistance, non-yellowing
Devoe Paint SPRA-MAX-12 Flat Interior Medium Build Latex Coating	158	I	Excellent hiding, fast application, excellent washability
Devoe Paint Wonder-Speed Flat Interior Latex Wall Paint	219	I	Professional best, good hiding, excellent tuoch-up, non-yellowing, washable, easy application
Dunn Edwards Acri-Flat 100% Acrylic Exterior Wood Stain & Masonry Flat Paint	120	E	Easy to apply, excellent color retention, good crack resistance, long-term exterior durability
Dunn Edwards Endurawall Elastomeric Wall Coating Smooth	110	E	Exceptional flexibility, provides superior protection against wind-driven rain and moisture by bridging cracks, outstanding elastic recovery and resilience even under conditions of extreme cold or heat, outstanding resistance to UV light and dirt pick up, easy touch-up
Dunn Edwards Suprema Interior Low Sheen Wall Paint	135	I	Premium quality, tough washable finish, outstanding stain resistance, durability and hide
Frazee Velvin Interior Acrylic Copolymer Flat Finish	112	I	Top of the line quality, test results: resistance to abrasion – pass, resistance to blocking – pass, resistance to washing – pass, resistance to yellowing – pass, resistance to 600-800 scrub cycles – pass
Frazee Luxwall Heavy-Duty Interior Vinyl-Acrylic Flat Finish	165	I	Top of the line commercial quality, outstanding hiding power

[1] I = Interior, E = Exterior, I/E = Interior and Exterior

FLAT COATINGS
Greater than 100 g/l (continued)

Product Name and Brand	VOC Content g/l	Type[1]	Information from Manufacturer's Product Sheets
Frazee Luxwall Ready-To-Use Interior Vinyl-Acrylic Flat Finish	165	I	Top of the line commercial quality, outstanding hiding power
Frazee Versa-Tex Interior/Exterior Acrylic Copolymer Flat Finish	126	I/E	Fine quality, tough, blister resistant, good adhesion and weather resistance
Frazee Duratec II 100% Acrylic Exterior Flat	102	E	Excellent quality, excellent adhesion and weather resistance
Frazee Acri-Tec Exterior Acrylic Copolymer Flat Finish	105	E	Commercial quality, assures good fade/weather resistance, test results: resistance to blocking – pass, resistance to chalking – pass, resistance to fading – pass, resistance to grain cracking – pass, resistance to UV rays – pass
Frazee Acri-Kote Exterior 100% Acrylic Finish	131	E	Commercial quality
Frazee Royal Supreme Exterior 100% Acrylic Low Luster Finish	110	E	Top of the line quality, washable, fade resistant, superior adhesion
ICI Dulux Professional Exterior 100% Acrylic Flat Finish	156	E	Premium quality, exceptional mildew resistance, low temperature application to 35°F, good resistance to early moisture exposure, durable and tough, fade and chalk resistant, excellent adhesion, resists blistering, peeling and flaking, easy application
ICI Dulux Exterior Latex Flat Finish	106	E	Highest quality premium, exceptional weathering resistance, easy application, durable and tough, fade and chalk resistant, exceptional mildew resistance, moisture resistant, excellent adhesion, resists blistering, peeling and flaking
ICI Dulux Ultra-Hide Durus Exterior Acrylic Flat Finish	241	E	Professional best, excellent mildew resistance, easy application, fade and chalk resistant, moisture resistant, durable and tough, excellent adhesion, resists blistering, peeling and flaking, excellent touch-up
ICI-Dulux Uitra-Hide Durus Exterior Acrylic Flat Masonry Finish	143	E	Professional best, excellent mildew resistance, easy application, excellent color retention, chalk resistant, durable and tough, resists blistering, mildew, and staining, excellent touch-up, resists erosive effects of coastal salt air
ICI Dulux Speed-Cote Exterior Acrylic Flat Finish	128	E	Fade and chalk resistant, easy application, mildew resistant
Rodda Paint Hi Hide Velvet Flat Latex House Paint	112	E	Premium quality, one coat coverage, mildew resistant, excellent resistance to peeling, fading, blistering, chalking, sun and water fumes
Rodda Paint Ext Alkyd Flat House Paint	362	E	Highly durable, fume resistant, excellent resistance to moisture

[1] I = Interior, E = Exterior, I/E = Interior and Exterior

FLAT COATINGS
Greater than 100 g/l (continued)

Product Name and Brand	VOC Content g/l	Type[1]	Information from Manufacturer's Product Sheets
Rodda Paint Lasyn Velvet Flat Wall Paint	120	I	Dries within 15 minutes, minimizing dirt pick-up, flows and levels well, excellent color retention and adhasion, will not blister, withstands an alkaline atmosphere
Rodda Paint Master Painter Latex Flat Wall Paint	120	I	Good resistance to moisture
Sherwin Williams Everclean Interior Latex Flat	152-215	I	Provides the washability and durability usually found in glossy enamel finishes. Allows most household stains to be removed without the need for scrubbing
Sherwin Williams Classic 99 Interior Latex Flat Ceiling Paint	158	I	No specific performance information provided
Sherwin Williams Classic 99 Interior Latex Flat	72-180	I	Provides one coat hiding over many colors on smooth surfaces and will provide a durable, scrubbable, washable finish
Sherwin Williams Duration Exterior Latex Flat Coating	89-113	E	Provides the most durable and longest lasting coating available, one coat protection, self-priming, easy application, superior hiding, thicker, more flexible, resists blistering and peeling
Sherwin Williams LowTemp 35 Exterior Latex Flat	101-135	E	Quality product recommended for use down to a surface and air temperature of 35^{o} F
Sherwin Williams SuperPaint Exterior Flat Latex	96-144	E	Finest quality exterior flat finish

[1] I = Interior, E = Exterior, I/E = Interior and Exterior

2. Non-Flat Coatings – Low and Medium Gloss

Product Category Description:

Non-flat coatings are low to high gloss coatings that are widely used on both interior and exterior surfaces of residential and commercial buildings. They are defined as having a gloss of 15 or greater on an 85^{o} meter and 5 or greater on a 60^{o} meter. Non-flat coatings are often described using terms such as "eggshell," "satin," "semi-gloss," and "enamel." Non-flat coatings tend to resist stains better than flat coatings and tend to be more washable. The greater shine of non-flat coatings may show surface flaws more than flat coatings.

For the purposes of the 1998 ARB Architectural Coatings Survey, the non-flat category has been divided into three subcategories: low, medium, and high gloss. High gloss coatings, which are defined as having a dried film gloss of 70 or above on a 60^{o} meter, have been broken into a separate subcategory for which we are proposing a higher VOC limit than that for low and medium gloss coatings. The distinction between the low and medium gloss subcategories is continued here only for the purpose of presenting information. The same VOC limit is proposed for low and medium gloss non-flat coatings.

Tables VI-3a-b below summarize our estimates of sales and VOC emissions from low and medium gloss non-flat coatings category based on the ARB survey results. The 1998 ARB survey shows that the low and medium gloss subcategories have a large California sales volume. Medium gloss coatings, with 18 percent of the sales volume, is the second largest coating subcategory behind flat coatings. Low gloss coatings is the fifth largest subcategory, with 5 percent of the sales volume (ARB, 1999).

With regard to VOC emissions, low and medium gloss non-flat coatings emit over 8 tons per day in California, excluding emissions in the South Coast AQMD. The 1998 ARB survey found that the medium gloss subcategory has the third highest emissions of all the coatings categories, representing 12 percent of the total VOC emissions from architectural coatings. Low gloss coatings represent three percent of architectural coatings emissions. Most of the emissions from low and medium gloss coatings are from water-based products, in spite of the relatively lower VOC content of those products, because the great majority of the products sold are water-based (ARB, 1999).

Table VI-3a
Non-Flat Coatings – Low Gloss*

	Number of Products	Category Sales (gallons/year)	Sales-Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	30	34,373	341	0.07
Water-Based	821	4,440,720	133	1.65
Total	851	4,475,094	134	1.73

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Table VI-3b
Non-Flat Coatings – Medium Gloss*

	Number of Products	Category Sales (gallons/year)	Sales-Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	246	522,186	287	0.94
Water-Based	1,893	15,107,606	151	5.80
Total	2,139	15,629,792	155	6.75

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Product Use and Marketing:

Typically, non-flat coatings can be brushed, rolled, or sprayed on the surface to be painted. "Do-it-yourselfers" and paint contractors can purchase non-flat coatings at outlets including hardware stores, home supply stores, and retail paint stores. Non-flat coatings are commonly used on surfaces where frequent cleaning is necessary and in rooms where moisture is present. Kitchens, bathrooms, hallways, and children's rooms are often painted with non-flat coatings. Commercial buildings and institutions commonly use non-flat coatings on surfaces such as walls, corridors, and stairwells. Doors, window frames, shutters, and wood trim are typically painted with non-flat coatings, especially higher gloss coatings. With proper surface preparation and priming (if necessary), non-flat coatings can be used on a large variety of interior and exterior substrates including drywall, plaster, concrete block, wood, and metal. Most low and medium gloss coatings (94 percent for each subcategory) are sold in size units greater than one liter. (ARB, 1999).

The 1998 ARB survey showed that about 44 percent of the low gloss coatings sold in 1996 were formulated for interior applications, 23 percent for exterior applications, and

32 percent were formulated for both interior and exterior applications. For medium gloss coatings, about 48 percent were formulated for interior applications, 12 percent for exterior applications, and 40 percent were formulated for both interior and exterior applications (ARB, 1999).

For marketing their products, some manufacturers of "zero VOC" non-flat coatings emphasize the health benefits of using such coatings versus conventional coatings. The benefits include the low-to-minimal odor of zero VOC coatings and the reduced chemical exposures from the use of such coatings. Because of those features, manufacturers of zero VOC coatings emphasize the coatings' suitability for use in enclosed centrally-ventilated buildings (e.g. schools, office buildings, and hospitals), rooms that need to be occupied soon after painting (e.g. restaurants, hotel rooms), and residences.

Product Formulation:

As mentioned above, most low gloss coatings are water-based. The 1998 ARB survey (which reflected 1996 sales) shows that water-based low-gloss coatings represent about 99 percent of the market for that subcategory. Solvent-based low gloss coatings represent about one percent of the market. The sales volume of solvent-based low gloss coatings has decreased approximately 60 percent since the 1993 ARB survey of architectural coatings (which reflected 1990 sales), while overall sales of low gloss coatings increased 7 percent over the same period. The overall sales-weighted average VOC content of low gloss coatings decreased 18 percent between 1990 and 1996 (ARB, 1999).

Similarly, most medium gloss coatings are water-based, but the proportion of solvent-based sales is somewhat greater than that of low gloss coatings. The 1998 ARB survey shows that water-based medium gloss coatings represent about 97 percent of the market for that subcategory. Solvent-based medium gloss coatings represent about three percent of the market. The amount of solvent-based medium gloss coatings sold has decreased approximately 65 percent since the 1993 ARB survey, while overall sales of medium gloss coatings has increased 11 percent over the same period. The overall sales-weighted average VOC content of medium gloss coatings decreased 12 percent between 1990 and 1996 (ARB, 1999).

As discussed for flat coatings, the type of binder used in a formulation generally has a large influence on the amount of VOC needed. Binders serve to hold the paint together in a film and to provide adhesion to the substrate. As the gloss level of paint increases, the relative amount of binder as compared to other solid ingredients (i.e. pigment) also tends to increase. The binder in water-based non-flat coatings, which comprise the majority of non-flat coatings, is typically a dispersion of synthetic resin particles, called latex. Thus, these types of coatings are commonly called latex coatings. A wide variety of synthetic polymers are used as binders in latex coatings. Two common latex binders are acrylic and vinyl-acrylic resins. The solvent-based coatings in this category are commonly formulated using alkyd resins as binders. Such solvent-based coatings generally exceed the 250 g/l VOC limit currently in effect in California districts that have architectural coatings rules.

The VOCs in water-based coatings perform one or more of the following functions: binder coalescing aid, polymer plasticizer, freeze/thaw stabilizer, defoamer, and carriers for other additives such as colorants, thickening agents, surfactants, and biocides. The largest contributors of VOCs in latex coatings are glycols, added mainly to provide freeze/thaw resistance, and coalescing solvents such as 2,2,4-trimethyl-1,3-pentanediol isobutyrate (Texanol®), to allow the latex particles to come together to form a film (Klein, 1993). Generally, so called "zero VOC" coatings contain very small amounts of VOCs. Lower-VOC coatings tend to be formulated using binders that require less coalescing solvent and/or are formulated using less VOCs for freeze/thaw stabilization (Klein, 1993; Currie, 1993).

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 150 g/l VOC limit for low and medium gloss non-flat coatings, effective January 1, 2003. The proposed VOC limit is technologically and commercially feasible by January 1, 2003, based on our review of ARB survey data on marketshares, product information from manufacturers, laboratory performance tests, and information on available resin technology as discussed below.

The proposed limit is lower than the national limit recently promulgated by the U.S. EPA for the non-flats category. The U.S. EPA divides non-flat coatings into interior and exterior categories, but the same VOC limit, 380 g/l, applies to both (U.S. EPA, 1998). In California, the 1989 SCM for architectural coatings recommended a 250 g/l VOC limit for non-flat coatings (ARB, 1989); this is the most common limit currently in effect for those California air pollution control districts that have architectural coatings rules. In 1999, the South Coast AQMD adopted a 150 g/l limit for non-flat coatings that will become effective July 1, 2002, and also adopted a 50 g/l limit that will become effective July 1, 2006. Our proposed 150 g/l limit for low and medium gloss coatings is consistent with the interim limit for non-flat coatings adopted by the South Coast AQMD.

As shown in Table VI-4a, the 1998 ARB survey found that about 76 percent of the marketshare of low gloss coatings comply with the proposed VOC limit. About 470 of the 850 products reported comply with the proposed limit. Of the 29 companies that reported for this subcategory, 22 offered low gloss coatings that comply with the proposed limit. A number of low gloss products have a VOC content lower than the proposed limit. Products with a VOC content equal to or lower than 100 g/l represent about 19 percent of the market. Products with a VOC content equal to or lower than 50 g/l represent about 4 percent of the market (ARB, 1999).

As shown in Table VI-4b, the 1998 ARB survey found that about 57 percent of the marketshare of medium gloss coatings comply with the proposed VOC limit. About 810 of the 2,100 products reported comply with the proposed limit. Of the 50 companies that reported for this subcategory, 28 offered medium gloss coatings that comply with the proposed limit. A number of medium gloss products have a lower VOC content than the proposed limit. Products with a VOC content equal to or lower than 100 g/l represent about 23 percent of the market. Products with a VOC content equal to or lower than 50 g/l represent about 2 percent of the market (ARB, 1999).

Tables VI-4a-b also show that VOC emission reductions in the non-South Coast AQMD portion of California would be approximately 0.1 and 1.1 tons per day for low and medium gloss coatings, respectively, (about 1.2 tons per day total) on an annual average basis, from implementing the proposed 150 g/l limit.

Table VI-4a
Low Gloss Non-Flat Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
150	472	75.7	0.11

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

Table VI-4b
Medium Gloss Non-Flat Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
150	805	57.3	1.06

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

The following discussion distinguishes between products formulated for interior versus exterior use. The 1998 ARB survey indicates that 62 percent of the volume of interior low gloss coatings sold comply with the proposed limit, 94 percent of exterior low gloss coatings comply, and 83 percent of low gloss coatings sold for both interior and exterior use already comply. Those marketshares represent 167 products, 196 products, and 56 products, respectively (ARB, 1999).

Similarly, 58 percent of the volume of interior medium gloss coatings sold comply with the proposed limit, 70 percent of the exterior medium gloss coatings comply, and 53 percent of the medium gloss coatings sold for both interior and exterior use already comply. Those marketshares represent 383 products, 268 products, and 112 products, respectively (ARB, 1999).

The high marketshares that comply with the proposed VOC limit demonstrate widespread use of existing low VOC technology for low and medium gloss coatings. Most of the existing non-flat coatings with a VOC level of 250 g/l or less (the most common current limit for those districts that have architectural coatings rules) are water-based latex products, although some solvent-based products are at or below that limit (ARB, 1999). To meet the proposed 150 g/l VOC limit, it is likely that noncomplying water-based products would need to be reformulated using lower VOC technology. As discussed above, the primary sources of VOCs in latex coatings are coalescing solvents and VOCs (glycols) added mainly to provide freeze/thaw resistance. We expect that product reformulation of water-based latex products to meet the proposed limit would involve switching to a binder (or blend of binders) that requires less coalescing solvent and/or reducing the amount of glycol that is added to provide freeze/thaw stability (Klein, 1993, Currie, 1993). It is also likely that most solvent-based coatings would need to be reformulated to be water-based or to use low-VOC alkyd core-shell technology (e.g., Vianova Resins, 1999).

Laboratory performance tests

National Technical Systems. Independent laboratory performance tests of a number of coatings were recently conducted by National Technical Systems (NTS) under contract with the South Coast AQMD. Included in those tests were 14 interior and 13 exterior non-flat coatings. Of those coatings, 9 had a VOC content below 150 g/l (range: 0 to 135 g/l), 10 had a VOC content at or below 250 g/l (range: 170 to 250 g/l) and the remaining 8 had VOC levels that ranged from 400 to 420 g/l. The coatings with VOC levels of 400 g/l or greater were mostly "quick-dry enamels," and the test results for those coatings are discussed in the quick-dry enamel category description. For this discussion, those coatings that comply with the proposed 150 g/l limit ("lower VOC coatings") are compared with those coatings with a VOC content above 150 g/l that comply with the most common current limit of 250 g/l ("higher VOC coatings"). Similar performance was seen in tests of brushing properties, sag resistance, and hiding. Dry-to-touch times were also similar, but dry hard times tended to be somewhat shorter for lower VOC coatings. The lower VOC coatings tended to have slightly less leveling performance than the higher VOC coatings, but this difference was mostly seen with the 0 VOC coatings. Dry film thickness tended to be slightly higher in the lower VOC coatings. Resistance to blocking was similar for the interior coatings, while resistance to blocking for the exterior coatings tended to be better in the lower VOC product group. Interior coatings were also tested for dirt removal ability and scrub abrasion resistance, where the higher VOC coatings tended to perform somewhat better (NTS, 1999).

NTS also tested primer/topcoat systems with non-flat coatings as topcoats. Included in those tests were 14 interior and 12 exterior systems with non-flat topcoats. Of those topcoats, 11 had a VOC content below 150 g/l (range: 0 to 135 g/l), 9 had a VOC content at or below 250 g/l (range: 220 to 250 g/l) and the remaining 6 had a VOC level of 400 g/l. ARB staff compared the results for those topcoats that comply with the proposed 150 g/l VOC limit with those topcoats with VOC levels greater than 150 g/l but less than or equal to 250 g/l. Our comparison indicates that lower and higher VOC interior systems had comparable performance with regard to adhesion tests and resistance to household chemicals. However, the lower VOC topcoat systems tended to show slightly more softening in response to chemical exposure. The exterior systems showed similar performance with regard to dry film thickness and water resistance (NTS, 1999).

Harlan Associates. In 1995, Harlan Associates, Inc., under contract with ARB, conducted performance tests on 10 interior and 10 exterior non-flat coatings. Those coatings were selected in 1994 from commercially available coatings. The VOC levels of the twenty coatings ranged from 15 g/l to 459 g/l. Thirteen were high gloss coatings, six were medium gloss, and one was low gloss. Four of those coatings, 3 interior (medium gloss) and 1 exterior (low gloss), had VOC levels below 150 g/l. The low VOC non-flat coatings were similar to higher VOC coatings with regard to stability, hardness, application, and appearance. Results of tests for adhesion showed that two low VOC coatings had good to excellent adhesion, while two had poor to mediocre adhesion. In comparison, many of the higher VOC coatings had good to excellent adhesion, while two of those coatings rated “poor” to “fail” on the adhesion test. One low-VOC coating failed the block resistance test (the resistance of two painted surfaces to stick to each other), two rated “good” to “very good”, and one rated “excellent.” In comparison, the higher VOC coatings rated “fail” to “excellent” in block resistance. One low VOC coating failed the flexibility test, while all the other coatings passed. Two low VOC coatings (only interior coatings tested) passed the scrub resistance test, while one wore through at 400 cycles. In comparison, five of the higher VOC coatings passed the scrub resistance test, while two wore through sooner than 400 cycles (ARB, 1995; Cowen, 1999).

Consumers Union. Consumers Union, an independent, nonprofit organization, recently reported on tests it performed on interior and exterior paints. Tests were performed on 15 brands of interior low-luster paints marketed as higher-grade paints. For each brand, three colors that represent the basic tint bases were tested. A number of satin and eggshell paints with VOC levels below 150 g/l were included in the tests, including four “zero VOC” paints. The paints were tested for hiding ability and resistance to scrubbing, staining, blocking, fading, and mildew. All the paints tested performed well, rating “good” or better in overall scores. Sears Best Easy Living Satin, which complies with the proposed VOC limit, was recommended as one of the four best low-luster paints and received the highest overall score. The second-highest rated paint, House Beautiful Satin, with a VOC content that ranges from 117 to 156 g/l depending on the tint base, comes close to complying with the proposed limit (Consumer Reports, 2000).

Consumers Union also tested 17 brands of exterior latex non-flat paints (three colors for each brand) purchased mostly from the northeastern United States. A number of paints tested comply with the proposed 150 g/l limit. The paints were applied to Southern yellow pine, a type of wood prone to cracking, and were exposed to the weather in New York and Florida for nearly two years. Periodic assessments were made for signs of cracking, color change, dirt buildup, mildew growth, and other problems. The investigators also tested how well the paints adhered to a chalky surface. Based on the test results, four low-luster and four semi-gloss paints received a recommendation from Consumers Union. Three of the four recommended low-luster paints comply with the proposed limit. Those three paints are Glidden Dulux Endurance Satin, Sears Best Weatherbeater Satin, and Sears Weatherbeater Satin. One of the four recommended semi-gloss paints, Sears Best Weatherbeater Semi-Gloss, complies with the proposed VOC limit (Consumer Reports, 1999).

Product information from manufacturers

Product information sheets published by coatings manufacturers indicate that a variety of low to medium gloss coatings that meet the proposed VOC limit are available that possess performance characteristics similar to higher VOC coatings. At the end of the discussion of this category are tables of information about specific products that meet the proposed VOC limit and, for comparison, products that exceed the proposed limit. We were able to identify specific products with a VOC content of 150 g/l or less from AFM, Con-Lux, Dunn Edwards, Evr-Gard, Flex Bon, Griggs Paint, ICI Dulux, Kelly-Moore, Sherwin Williams, and Spectra-Tone.

A list of performance characteristics compiled from product information sheets for low and medium gloss non-flat coatings (often described as satin, eggshell, or semi-gloss finishes) with VOC levels of 150 g/l or less is presented below. The compilation distinguishes between interior and exterior products; characteristics of coatings formulated for dual interior/exterior use are included under both categories. Please note that not all low and medium gloss coatings with VOC levels at or below 150 g/l possess all of the characteristics listed below.

Low and medium gloss interior coatings

professional best, premium quality, highest quality premium
good to excellent adhesion
excellent moisture resistance
excellent one coat coverage
very good block resistance
easy application, high speed application
durable, highly durable finish, extremely abrasion resistant
excellent color retention
stain resistant
excellent washability
bonds to glossy surfaces
very good touch-up properties
good dry hide, excellent hide
mildew resistant
resists yellowing
high build

Low and medium gloss exterior coatings

professional best, best quality, premium quality, highest quality premium
the most durable and longest lasting coating available, superior durability, durable and tough, outstanding exterior durability
extremely abrasion resistant
extremely washable
superior color retention, excellent color and gloss retention
superior to exceptional mildew resistance
flexible
exceptionally smooth finish
superior hiding
shields the surface from the elements that cause film failure (grain crack, peeling, blistering), resists blistering, peeling and flaking
exceptional weathering resistance
fade and chalk resistant
moisture resistant
excellent adhesion
easy application
long lasting uniform finish
recommended for use down to a surface and air temperature of 35^{o} F

one coat protection
self-priming

Available resin technology

The South Coast AQMD recently surveyed current and emerging technology available for formulating non-flat coatings. ARB staff concurs with the findings of the South Coast AQMD based on our own discussions with resin manufacturers. The South Coast AQMD identified a number of resin manufacturers that have developed technologies for use in developing non-flat coatings that comply with the proposed 150 g/l limit. Technologies identified by the South Coast AQMD include those offered by Rohm and Haas, BASF, Conlux, Air Products and Chemicals, and Vianova Resins (South Coast AQMD, 1999; BASF, 1999; Vianova Resins, 1999).

Issues:

1. Issue: The non-flat coatings category covers a broad range of products. The ARB should consider subcategorizing the non-flat coatings category to allow for a higher VOC limit for special use, high performance products. Two specific suggestions are to split the non-flat coatings category into interior and exterior subcategories, and to further split these subcategories into a high-gloss subcategory and another subcategory for the remaining non-flat coatings. A VOC limit of 250 g/l was suggested for the high gloss subcategory.

Response: Our survey of product information published by paint manufacturers indicates that a wide variety of interior and exterior low and medium gloss coatings comply with the proposed limit. This includes coatings formulated for contractors (which emphasize features such as ease and speed of application, hiding properties, and touch-up properties), high-build coatings, coatings designed for low temperature application, and premium quality coatings.

We distinguished between interior and exterior coatings in our evaluation, and also distinguished between low, medium, and high gloss coatings. As discussed above, information on marketshares obtained from the ARB survey indicates that a considerable portion of existing interior and exterior low and medium gloss coatings already comply with the proposed 150 g/l limit. Our survey of product information sheets for complying low and medium gloss coatings shows that a variety of performance characteristics comparable to those of higher VOC products have been achieved for both interior and exterior coatings. Thus, available information does not support subdividing low and medium gloss coatings into interior and exterior subcategories.

As discussed in the high gloss non-flat coatings subcategory, we have modified the proposed SCM to include a separate subcategory with a VOC limit of 250 g/l for high gloss coatings, primarily due to enforcement concerns because of the overlap between non-flat high gloss and quick-dry enamels.

2. Issue: The 150 g/l limit for non-flat coatings will adversely affect a number of performance characteristics of those coatings. Characteristics that will be compromised include film durability, scrub resistance, stain removal properties, low temperature application properties, freeze-thaw resistance, and block resistance. Also, the coatings with the best performance characteristics (durability and resistance to the following: deterioration by water; corrosion, physical contact; loss of adhesion; erosion; film cracking; discoloration; household chemical attack; and the effects of sunlight) require "hard" resins that must be formulated with VOC levels above 200 g/l to achieve maximum performance. The NTS study shows that flow and leveling characteristics are superior for alkyd paints (>350 g/l VOC) when compared to the water based products (150-250 g/l VOC) and the 150 g/l paints tested did not show the highest performance levels achievable.

Response: A subcategory for high gloss non-flat coatings has been created with a 250 g/l VOC limit, primarily due to enforcement concerns. (See the high gloss non-flat coatings subcategory for more detailed information.) We disagree with the comment that high quality low and medium gloss coatings cannot be formulated at 150 g/l with current technology. Our conclusion is based on laboratory performance tests viewed in conjunction with information published by coatings manufacturers.

Specifically, the laboratory tests conducted by NTS show comparable performance for lower VOC non-flat coatings when compared to higher VOC non-flat coatings in many performance areas listed in the above comment. For the purposes of staff's evaluation of non-flat coatings, it was appropriate to compare coatings that comply with the proposed 150 g/l limit with higher VOC coatings that comply with the most common current California district limit of 250 g/l. The high VOC coatings (> 350 g/l) mentioned in the above comment would not be allowed under current district rules for non-flat coatings, and were thus excluded from that comparison. Moreover, most of those high VOC coatings (> 350 g/l) tested were "quick-dry enamels." Such coatings must meet specific gloss and dry time criteria, and are classified in a separate category from non-flat coatings. It only appropriate to use the NTS results for those coatings in the context of evaluating the proposed VOC limit for the quick-dry enamel category, as was done by ARB staff.

Our survey of product information sheets indicates that there are a number of complying interior and exterior low and medium gloss coatings that are identified by their manufacturers as premium quality coatings. Further, the product information indicates that there are complying coatings that are described as having superior durability and that have excellent performance in the other areas listed in the above comment. Also, there are complying products that allow for low temperature application and products with very good block resistance. Available information also suggests that the 150 g/l limit allows for the formulation of non-flat coatings with sufficient freeze-thaw resistance. Thus, our survey of product information indicates that a variety of manufacturers have been able to use available technology to achieve a balance in desirable properties for low and medium gloss coatings with VOC levels at or below 150 g/l.

3. **Issue**: The qualities claimed by manufacturers for their products are marketing terms that de-emphasize compromises made necessary by excessively stringent VOC content limits and do not indicate a guarantee of the ultimate of performance.

Response: We believe it is appropriate to use product data sheets published by coating manufacturers in conjunction with test results and other information in our assessment of non-flat coatings. Coating manufacturers publish the product data sheets to provide customers with information regarding important characteristics of their coatings. The information contained in the product data sheets is typically based on laboratory tests and may also be based on field studies. The above comment states that the product information sheets are simply marketing tools and do not guarantee performance. We believe that customers rely on the information contained in the sheets to assist them in choosing products, and that providing inaccurate information as a marketing tool does not make good business sense as it would alienate customers. Also, more credence is given to the information contained in product data sheets when similar performance claims are made for complying and non-complying products, and when different manufacturers make similar performance claims for complying products.

4. **Issue:** Low VOC interior paints may cause an indoor air quality problem, especially with the elimination of mercury as an additive. Glycols act as preservatives, and if you reduce the glycol concentrations in paints, you might see increased health hazards due to microbial growth inside buildings.

Response: Microbial growth on paint after it is applied to the substrate is primarily caused by moisture in the environment and to a lesser degree by warm temperatures. Thus, mildew growth on paint is fairly common in tropical climates. There are numerous non-mercury additives in common use in the coatings industry, including the pigment zinc oxide, that suppress the growth of mildew. Moreover, glycols evaporate after the paint is applied to the substrate and would thus not be retained in the paint over the long term. Further, the South Coast AQMD reports that independent testing by NTS shows no difference in mildew resistance in the high VOC vs. the low-to-zero-VOC non-flat coatings tested (Berry, 2000).

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NON-FLAT COATINGS

Less Than or Equal to 150 g/l

Product Name and Brand	VOC Content g/l	Type[1]	Information from Manufacturer's Product Sheets
AFM Safecoat CemBond Masonry Paint	83	I/E	Premium quality, satin sheen, superior hiding, superior durable finish, concrete & masonry surfaces
Con-Lux Enviro-Plex Acrylic Latex Eggshell Enamel-12000	0	I	No specific performance information provided
Con-Lux Enviro-Plex Acrylic Latex Semi-Gloss Enamel-11000	0	I	No specific performance information provided
Con-Lux Enviro-Plex 100% Acrylic Gloss Enamel-13000	0	I, H	No specific performance information provided
Dunn Edwards Enduracryl Low Sheen Finish W 705	140	E	Premium quality, superior durability, color retention & mildew resistance, flexible, exceptionally smooth finish, shields the surface from the elements that cause film failure (grain crack, peeling & blistering)
Dunn Edwards Sierra, Low Odor/Zero VOC Interior Acrylic Eggshell Enamel W 540	0	I	Excellent hide, good adhesion
Dunn Edwards Sierra Low Odor/Zero VOC, Interior Acrylic Semi-Gloss W 550	0	I	Excellent hide, good adhesion
Evr-Gard Aqua-Sheen Acrylic Satin Enamel	136	I/E	Fine quality, good durability
Evr-Gard Latex Semi-Gloss Paint	88	I/E	Good performance
Evr-Gard Acry-Namel Acrylic Semi-Gloss Enamel	138	I/E	Professional quality, ease of application, non-yellowing, color retention, washability, superb hiding, free flowing
Flex Bon Classic Interior-Exterior Low Sheen Acrylic Latex Wall & Trim Paint	80	I/E	No specific performance information provided
Flex Bon Premium Exterior Low Sheen 100% Acrylic Latex House & Trim Paint	60	E	Mildew resistant, chalk & fade resistant
Flex Bon Premium Interior Low Sheen Acrylic Latex Wall & Trim Paint	130	I	Non-yellowing, washable, spatter resistant
Griggs Paint, Acrylic Emulsion Satin	0	I/E	Outstanding exterior durability, extremely abrasion resistant, extremely washable
Griggs Paint, Acrylic Emulsion Semi-Gloss	0	I/E	Outstanding exterior durability, extremely abrasion resistant, extremely washable
Griggs Paint, Acrylic Emulsion Gloss	0	I/E, H	Outstanding exterior durability, extremely abrasion resistant, extremely washable

[1] I = Interior, E = Exterior, I/E = Interior and Exterior, H = High Gloss

NON-FLAT COATINGS
Less Than or Equal to 150 g/l (continued)

Product Name and Brand	VOC Content g/l	Type[1]	Information from Manufacturer's Product Sheets
ICI-Dulux Decra Shield Exterior 100% Acrylic Satin Finish	0	E	Premium quality, exceptional mildew resistance, low temperature application to 35°F, durable & tough, fade & chalk resistant, moisture resistant, excellent adhesion, resists blistering, peeling & flaking, easy application
ICI Dulux Decra-Tones Exterior Acrylic Low Sheen Accent Base	50	E	High quality, durable finish, mildew resistant, fade and chalk resistant, burnish resistant, easy application
ICI-Dulux Dulux Ultra Eggshell Interior Acrylic Wall & Trim Enamel	112	I	Highest quality premium eggshell, highly durable, excellent washability, excellent moisture resistance, excellent adhesion, excellent one coat coverage, very good block resistance, bonds to glossy surfaces, very good touch-up properties, easy application, alkyd-like flow & leveling
ICI-Dulux Dulux Exterior Latex Satin Finish	105	E	Highest quality premium exterior, exceptional weathering resistance, easy application, long lasting uniform finish, durable & tough, fade & chalk resistant, exceptional mildew resistance, moisture resistant, excellent adhesion, resists blistering, peeling & flaking
ICI-Dulux Lifemaster 2000 Interior Semi-Gloss	0	I	Professional best, durable, excellent washability, excellent stain resistance, very good block resistance, easy application, bonds to glossy surfaces
ICI-Dulux 2000 (Interior Eggshell)	0	I	Professional best, durable, excellent washability & hiding, block resistant, bonds to glossy surfaces, very good touch-up properties, easy application
ICI-Dulux Professional Acrylic Eggshell Interior Wall & Trim Paint	125	I	Premium quality, excellent adhesion & moisture resistance, excellent one coat coverage, very good block resistance, alkyd like flow & leveling, highly durable finish, easy application, excellent washability
ICI-Dulux Speed-Wall Latex Eggshell Interior Wall & Trim Enamel	84	I	Easy application, good dry hide & application properties, durable & washable
ICI-Dulux Speed-Wall Latex Semi-Gloss Interior Wall & Trim Enamel	88	I	Good dry hide, hard, tough & durable, easy application
ICI-Dulux Ultra-Hide Build Dur Spray Latex Eggshell Interior Primer/Finish	77	I	Heavily bodied thixotropic latex eggshell, high build, uniform finish, high speed application, application of 10-20 mils without running or sagging

[1] I = Interior, E = Exterior, I/E = Interior and Exterior, H= High Gloss

NON-FLAT COATINGS
Less Than or Equal to 150 g/l (continued)

Product Name and Brand	VOC Content g/l	Type[1]	Information from Manufacturer's Product Sheets
ICI-Dulux Ultra-Hide Durus Exterior Acrylic Semi-Gloss Finish	79	E	Professional best, excellent color & gloss retention, excellent mildew resistance, durable & tough, moisture resistant, excellent adhesion, resists blistering, peeling & flaking, easy application
Kelly-Moore Enviro-Cote Interior Acrylic Satin and Semi-Gloss Enamels	0	I	No specific performance information provided
Kelly-Moore Sat-N-Sheen Latex Wall and Trim Finish	143	I	Durable
Pittsburgh Paints Brilliant Reflections Interior/Exterior Latex Gloss Enamel 51 Line	117-135	I/E, H	Brilliant, durable gloss finish, fast drying, outstanding washability, long lasting weatherability, excellent adhesion, easy application
Sherwin Williams HealthSpec Low Odor Interior Eg-Shel	0	I	Provides the durability expected from an eg-shel enamel without the odor associated with typical latex paints: 1600 scrubs
Sherwin Williams HealthSpec Low Odor Interior Semi-Gloss	0	I	Provides the durability expected from a semi-gloss enamel without the odor associated with typical latex paints: 2000 scrubs
Sherwin Williams Low Temp 35 Exterior Satin House Paint	101	E	Quality product recommended for use down to a surface & air temperature of 35°F
Sherwin Williams A-100 Exterior Gloss Latex	133-157	E	Our best quality exterior gloss finish
Sherwin Williams A-100 Exterior Latex Satin	90-115	E	Our best quality exterior satin finish
Sherwin Williams Duration Exterior Latex Satin Coating	66-119	E	Provides the most durable and longest lasting coating available, one coat protection, self-priming, easy application, superior hiding, thicker, more flexible, resists blistering and peeling
Sherwin Williams Classic 99 Interior Latex Semi-Gloss	84-108	I	Provides one coat hiding over many colors on smooth surfaces and will provide a durable, scrubbable, and washable finish
Sherwin Wil0liams Classic 99 Interior Latex Satin	120-144	I	Provides one coat hiding over many colors on smooth surfaces and will provide a durable, scrubbable, and washable finish
Sherwin Williams Pro-Mar 400 Interior Latex Eg-Shel Enamel	121	I	Durable, quality interior vinyl acrylic finish
Sherwin Williams ProMar 200 Interior Latex Semi-Gloss Enamel	84-144	I	Our finest quality product designed for the professional
Sherwin Williams ProMar 400 Interior Latex Semi-Gloss	84-96	I	Durable, quality interior vinyl acrylic paint
Sherwin Williams ProMar 400 Interior Latex Eg-Shel	132-144	I	Durable, quality, interior vinyl acrylic finish

[1] I = Interior, E = Exterior, I/E = Interior and Exterior, H = High Gloss

NON-FLAT COATINGS
Less Than or Equal to 150 g/l (continued)

Product Name and Brand	VOC Content g/l	Type[1]	Information from Manufacturer's Product Sheets
Sherwin Williams ProMar 700 Interior Latex Semi-Gloss Enamel	60	I	No specific performance information provided
Sherwin Williams Style Perfect Interior Latex Semi-Gloss	101	I	Fade resistant, easy to apply, resists yellowing, easy clean-up
Sherwin Williams Style Perfect Interior Latex Satin	48-120	I	Fade resistant, easy to apply, resists yellowing, easy clean-up
Sherwin Williams Super Paint Exterior Gloss Latex	120-156	E	Our finest quality exterior gloss finish. 20 year guarantee
Sherwin Williams Super Paint Interior Latex Satin	108-144	I	20 year guarantee
Sherwin Williams Super Paint Exterior High Gloss Latex Enamel	105-130	E, H	Superior performance in block resistance, moisture resistance, gloss retention, flow & leveling
Spectra-Tone Paint Enviro Interior Eggshell Enamel	0	I	Easy to handle, excellent durability & color retention, excellent hiding, blister, alkali, fume & fade resistant, washable after one week curing time, good touch-up characteristics, resistant to mildew, good leveling, positive adhesion
Spectra-Tone Paint Enviro Interior Semi-Gloss	0	I	Easy to handle, excellent durability & color retention, excellent hiding, blister, alkali, fume & fade resistant, washable after one week curing time, good touch-up characteristics, resistant to mildew, good leveling, positive adhesion

[1] I = Interior, E = Exterior, I/E = Interior and Exterior, H = High Gloss

NON-FLAT COATINGS
Greater Than 150 g/l

Product Name and Brand	VOC Content g/l	Type[1]	Information from Manufacturer's Product Sheets
Dunn Edwards Permasheen Acrylic Semi-Gloss Enamel	215	I/E	Excellent adhesion to aged alkyd enamels, very good non-blocking characteristics, excellent color retention, very good flow and leveling
Dunn Edwards Permashell Acrylic Eggshell Enamel	235	I/E	Excellent adhesion to aged alkyd enamels, very good non-blocking characteristics, excellent color retention, very good flow and leveling
Dunn Edwards Decoglo Acrylic Semi-Gloss Enamel	240	I	Premium, excellent adhesion and durability, good flow and leveling, brushes out better than many waterborne enamels, non-yellowing
Dunn Edwards Decosheen Interior Acrylic Eggshell Enamel	215	I	Excellent adhesion, very good flow and leveling, durable and washable
Dunn Edwards Permagloss Acrylic Gloss Enamel	220	I/E	Excellent adhesion to aged alkyd enamels, very good non-blocking characteristics, excellent color retention, very good flow and leveling
Evr-Gard Aqua-Sheen Acrylic Semi-Gloss Enamel	179	I/E	Production quality, designed for wear resistance and gloss retention
Evr-Gard 7000 Acry-Sheen 100% Acrylic Enamel	245	I/E	Premium quality, unsurpassed color and gloss retention, superb hiding and flow characteristics, non-yellowing extremely tough and washable surface
Evr-Gard 7200 Acry-Sheen 100% Acrylic Enamel	214	I/E	Premium quality, unsurpassed color and gloss retention, superb hiding and flow characteristics, non-yellowing extremely tough and washable surface
Evr-Gard 8000 Evr-Gloss Enamel	226	I/E	Premium quality, excellent durability, excellent adhesion
Evr-Gard 8100 Evr-Gloss Enamel	245	I/E	Premium quality, excellent durability, excellent adhesion
Evr-Gard Elast-A-Trim Semi-Gloss Enamel	239	I/E	Professional quality, washable, easily applied, high hiding, free flowing, non-sagging
Evr-Gard Goldseal Satin Enamel	254	I/E	Professional quality, easily applied, excellent color retention, durability and washability
Flex Bon Paints Premium Interior-Exterior Gloss Acrylic Latex Enamel	185	I/E, H	Mildew resistant, durable for use on doors, handrails, cabinets, and furniture, chalk and fade resistant, non-yellowing, spatter resistant
Flex Bon Paints Classic Interior-Exterior Semi-Gloss Acrylic Latex Wall and Trim Paint	170	I/E	No specific performance information provided
Flex Bon Paints Premium Interior-Exterior Semi-Gloss Acrylic Latex Enamel	185	I/E	Mildew resistant, durable for use on doors, handrails, cabinets, and furniture, chalk and fade resistant, non-yellowing, spatter resistant

[1] I = Interior, E = Exterior, I/E = Interior and Exterior, H = High Gloss

NON-FLAT COATINGS - Greater Than 150 g/l (continued)

Product Name and Brand	VOC Content g/l	Type [1]	Information from Manufacturer's Product Sheets
Flex Bon Premium Interior Semi-Gloss Acrylic Latex Wall and Trim Paint	155	I	Spatter resistant, non-yellowing, washable
Flex Bon Paints Premium Exterior Semi-Gloss 100% Acrylic Latex House and Trim Paint	170	E	Mildew resistant, chalk and fade resistant
ICI Dulux Ultra-Wall Latex Semi-Gloss Interior Wall and Trim Enamel	187	I	Professional quality very good coverage, high hiding, durable and washable, block resistant, easy application
ICI Dulux Ultra-Hide Durus Interior/Exterior Acrylic Gloss Enamel	225	I,E	Professional best, excellent coverage, durable gloss finish, high hiding, easy application
ICI Dulux Glidden Spred Supreme Interior Eggshell	187	I	Premium quality, excellent coverage, spatter-free application, durable, washable, scrubbable, good burnish resistance, easy application
ICI Dulux Glidden Spred Supreme Interior Semi-Gloss	164	I	Premium quality, excellent coverage, excellent moisture resistance, spatter-free application, durable, scrubbable, washable, good block resistance
ICI Dulux Traditional Semi-Gloss Interior Alkyd Wall and Trim Enamel	380	I	Highest quality premium, excellent coverage, excellent hardness, toughness and block resistance, highly durable, burnish resistant, excellent moisture resistance, high hiding, washable, excellent flow and leveling, cleans easily, tough hard film
ICI Dulux Dulux Ultra Semi-Gloss Interior Acrylic Wall and Trim Enamel	191	I	Highest quality premium, excellent adhesion, excellent moisture resistance, alkyd-like flow and leveling, spatter-free application, durable, excellent one coat coverage, very good block resistance, easy application
ICI Dulux Dulux Professional Acrylic Semi-Gloss Interior Wall and Trim Enamel	154	I	Premium quality, excellent adhesion, alkyd-like flow and leveling, spatter-free application, durable, excellent moisture resistance, excellent washability, excellent one coat coverage, easy application
ICI Dulux Dulux Professional Interior Semi-Gloss AA White/Tint	199	I	Premium quality, excellent adhesion, alkyd-like flow and leveling, spatter-free application, durable, excellent moisture resistance, excellent washability, excellent one coat coverage, easy application
ICI Dulux Dulux Professional Exterior 100% Acrylic Satin Finish	168	E	Premium quality, durable and tough, fade and chalk resistant, exceptional mildew resistance, moisture resistant, excellent adhesion, resists blistering, peeling, and flaking, easy application, low temperature application to 35°F

[1] I = Interior, E = Exterior, I/E = Interior and Exterior, H= High Gloss

NON-FLAT COATINGS
Greater Than 150 g/l (continued)

Product Name and Brand	VOC Content g/l	Type [1]	Information from Manufacturer's Product Sheets
ICI Dulux Dulux Professional Exterior 100% Acrylic Semi-Gloss Finish	187	E	Premium quality, durable and tough, fade and chalk resistant, exceptional mildew resistance, excellent gloss retention, moisture resistant, excellent adhesion, resists blistering, peeling, and flaking, easy application, low temperature application to 35^{o}F
ICI Dulux Dulux Interior/Exterior Acrylic Gloss Finish	237	I/E, H	Highest quality premium, exceptional toughness and durability, easy application, durable gloss finish, alkyd-like hardness and durability, excellent gloss and color retention, excellent flow and leveling, high hiding, non-yellowing, moisture resistant, resists blistering, peeling, and flaking
ICI Dulux Dulux Exterior Latex Semi-Gloss Finish	229	E	Highest quality premium, durable and tough, fade and chalk resistant, exceptional mildew resistance, excellent gloss retention, moisture resistant, excellent adhesion, resists blistering, peeling and flaking, easy application
ICI Dulux Dulux Accents Interior/Exterior Acrylic Latex Semi-Gloss	185	I/E	Durable, scrubbable, washable, spatter-free easy application
ICI Dulux Decra-Tones Exterior Acrylic Semi-Gloss Accent Base	175	E	High quality, excellent gloss and color retention, durable, mildew resistant, excellent block resistance, excellent adhesion, fade and chalk resistance, burnish resistant, easy application
ICI Dulux Ultra Hide Durus Interior/Exterior Acrylic Gloss Enamel	225	I/E	Professional best, excellent coverage, durable, high hiding, easy application
Kelly-Moore 1250 Acry-Lustre Acrylic Semi-Gloss	240	E	Premium quality, long-lasting weather protection, excellent color and gloss retention
Kelly-Moore 1260 Acry-Lustre Acrylic Gloss Enamel	240	I/E, H	Premium quality, tough wear-resistant and weather-resistant finish, excellent color and gloss retention
Kelly-Moore Kel-Cote Alkyd Semi-Gloss Enamel	249	I	Premium quality, smooth flow, sag resistance, good leveling qualities, durable, extremely washable and protective
Kelly-Moore Acry-Plex Latex Eggshell Enamel	170	I	High quality, durable, long-lasting, excellent for use in areas where repeated washing is necessary
Kelly-Moore Master Painter's Satin Sheen Semi-Gloss Stiple	249	I	Heavy-bodied designed to produce a stiple pattern, scuff-resistant, washable
Kelly-Moore Acry-Plex Latex Semi-Gloss Enamel	202	I	Premium quality, durable, highly washable, block-resistant
Kelly-Moore Kel-Guard Acrylic Gloss Enamel	249	I/E, H	Premium quality, durable protection, tough, glossy film withstands the elements, abrasion resistant and stands up to harsh use

[1] I = Interior, E = Exterior, I/E = Interior and Exterior, H = High Gloss

NON-FLAT COATINGS
Greater Than 150 g/l (continued)

Product Name and Brand	VOC Content g/l	Type [1]	Information from Manufacturer's Product Sheets
Sherwin Williams Super Paint Interior Latex Semi-Gloss	144-180	I	20 year guarantee
Sherwin Williams ProClassic Waterborne Interior Acrylic Gloss Enamel	157	I,H	A high quality water based enamel designed to provide service performance equal to high quality alkyd enamels
Sherwin Williams ProClassic Waterborne Interior Acrylic Semi-Gloss Enamel	157	I	Durable, non-yellowing finish equal to an alkyd enamel. The superior flow and leveling characteristics result in a smooth, rich finish
Sherwin Williams Everclean Interior Latex Semi-Gloss	157	I	Provides a finish that most stains cannot penetrate, allowing them to be washed off easily
Sherwin Williams Everclean Interior Latex Satin	186-220	I	Provides the washability and durability usually found in glossy enamel finishes. It allows most household stains to be removed without the need for scrubbing.
Sherwin Williams ProMar Salon Interior Alkyd Semi-Gloss	235	I	Best quality product designed for use in VOC restricted areas
Sherwin Williams ProMar Salon Interior Alkyd Eg-Shel	238	I	Our best quality product designed for the professional for use in VOC restricted areas
Sherwin Williams ProMar 200 Interior Latex Gloss Enamel	155-195	I,H	Our finest quality product designed for the professional

[1] I = Interior, E = Exterior, I/E = Interior and Exterior, H = High Gloss

3. Non-Flat Coatings – High Gloss

Product Category Description:

Non-flat coatings are described in the previous section on low and medium gloss non-flat coatings. For the purposes of the 1998 ARB Architectural Coatings Survey, the non-flat category has been divided into three subcategories: low, medium, and high gloss. High gloss coatings, which are defined as having a dried film gloss of 70 or above on a 60^{o} meter, have been broken into a separate subcategory for which we are proposing a higher VOC limit than that for low and medium gloss coatings. Many high gloss coatings meet the gloss and dry-time criteria of quick-dry enamel coatings, a separate category in the proposed SCM with the same proposed VOC limit as the high gloss non-flat subcategory. Please see the quick-dry enamel category description for more detailed information on that coating classification.

Table VI-5 below summarizes our estimates of sales and VOC emissions from high gloss non-flat coatings based on the ARB survey results. The 1998 ARB survey shows that the high gloss non-flat subcategory, with two percent of the California sales volume, is the ninth largest subcategory with regard to sales. With regard to VOC emissions, high gloss non-flat coatings emit approximately two tons per day in California, excluding emissions in the South Coast AQMD. The 1998 ARB survey found that the high gloss non-flat subcategory contributes 4 percent of the architectural coatings emissions and is the eighth highest subcategory. In contrast to low and medium gloss non-flat coatings, where emissions are due predominantly to water-based products, emissions from high gloss coatings are more evenly split among solvent-based and water-based products, with emissions from solvent-based products somewhat greater than those from water-based products (ARB, 1999).

Table VI-5
Non-Flat Coatings – High Gloss*

	Number of Products	Category Sales (gallons/year)	Sales-Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	463	532,033	366	1.23
Water-Based	333	1,618,786	209	0.94
Total	796	2,105,818	248	2.17

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Product Use and Marketing:

The previous section on low and medium gloss non-flat coatings describes how non-flat coatings are used and marketed. High gloss coatings are frequently used on surfaces such as doors, window frames, shutters, and wood trim. The 1998 ARB survey showed that most high gloss coatings (88 percent) are sold in size units greater than one liter. The survey also showed that about 36 percent of the high gloss coatings sold in 1996 were formulated for interior applications, 15 percent for exterior applications, and 48 percent were formulated for both interior and exterior applications (ARB, 1999).

Product Formulation:

The formulation of non-flat coatings is described in the previous section on low and medium gloss non-flat coatings. Most high gloss coatings are water-based. Water-based products represent about 75 percent of the market and solvent-based products represent about 25 percent of the market for this subcategory. The amount of solvent-based high gloss coatings sold has decreased approximately 64 percent since the 1993 ARB survey of architectural coatings, while overall sales of high gloss coatings has increased 46 percent over the same period. The overall sales-weighted average VOC content of high gloss coatings decreased 17 percent between 1990 and 1996 (ARB, 1999).

Proposed VOC Limit and Basis for Recommendation:

We recommend a 250 g/l VOC limit for the high gloss non-flat coating subcategory, effective January 1, 2003. In California, the 1989 SCM for architectural coatings recommended a 250 g/l VOC limit for non-flat coatings (ARB, 1989); this is the most common limit currently in effect for those California air pollution control districts that have architectural coatings rules. Thus, the proposed 250 g/l limit for the high gloss subcategory would retain the limit currently in effect for such coatings in those districts.

The proposed limit is lower than the national limit recently promulgated by the U.S. EPA for the non-flat coatings category. The U.S. EPA divides non-flat coatings into interior and exterior categories, but the same VOC limit, 380 g/l, applies to both (U.S. EPA, 1998). In 1999, the South Coast AQMD adopted a 150 g/l limit for non-flat coatings that will become effective July 1, 2002, and also adopted a 50 g/l limit that will become effective July 1, 2006. The South Coast AQMD also adopted a 250 g/l limit for a related category, quick-dry enamels, that will become effective July 1, 2002, and a 50 g/l limit for that category that will become effective July 1, 2006. Our proposed 250 g/l limit for high gloss coatings is consistent with the interim limit adopted by the South Coast AQMD for quick-dry enamel coatings.

Our recommendation for a 250 g/l VOC limit for high gloss coatings is due primarily to enforcement concerns, especially for California districts with fewer enforcement resources than the South Coast AQMD. Many high gloss non-flat coatings satisfy the gloss and dry time criteria of quick-dry enamels, a separate category in the SCM with a proposed VOC limit of 250 g/l. We recognize that there is overlap between the high gloss non-flat and the quick-dry enamel categories, and that companies could relabel products rather than reformulate them if the VOC limit is different for those two categories. Moreover, some high gloss products might be illegally labeled as quick-dry enamels even if they do not meet the dry time criteria, which would be problematic for enforcement personnel in some districts to detect. For greater enforceability, the proposed SCM includes a subcategory for high gloss non-flat coatings that has the same VOC limit as the quick-dry enamel category. Since most districts' architectural coatings rules currently include a quick-dry enamel category, the proposed SCM retains that category with its new VOC limit. This was done so that district rules, once amended in accordance with the proposed SCM, will clearly show that the VOC limit for quick-dry enamels is reduced from 400 g/l to 250 g/l. Further, we recommend that districts eventually eliminate the quick-dry enamel category from their architectural coatings rules, which would in effect require such products to meet the VOC limit of the high gloss non-flat subcategory.

As shown in Table VI-6, the 1998 ARB survey found that about 80 percent of the marketshare of high gloss coatings comply with the proposed 250 g/l VOC limit. About 330 of the 800 products reported comply with the proposed limit. About a third (29 percent) of the sales of non-complying products are for liter or smaller size units, which are exempt from district VOC limits (but counted in the marketshare determination). Of the 34 companies that reported for this subcategory, 27 offered high gloss coatings that comply with the proposed 250 g/l limit (ARB, 1999). As mentioned above, the proposed 250 g/l limit for the high gloss subcategory retains the limit currently in effect for such coatings in those districts that have architectural coatings rules. Therefore, no emission reductions are predicted from implementing the proposed VOC limit for this subcategory.

Table VI-6
High Gloss Non-Flat Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
250	333	79.5	0

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

The 1998 ARB survey indicates that 97 percent of the volume of interior high gloss coatings sold comply with the proposed limit, 46 percent of the exterior high gloss coatings comply, and 79 percent of the high gloss coatings sold for both interior and exterior use already comply. Those marketshares represent 100 products, 82 products, and 136 products, respectively (ARB, 1999).

Laboratory performance tests

Independent laboratory performance tests of a number of coatings were recently conducted by National Technical Systems (NTS) under contract with the South Coast AQMD. Also, in 1995, Harlan Associates, Inc., under contract with ARB, conducted performance tests on 10 interior and 10 exterior non-flat coatings. A comparison of the results of the NTS and the Harlan Associates tests of high gloss coatings with VOC levels at or below 250 g/l as versus those of quick-dry enamel coatings with VOC levels near 400 g/l is included in the quick-dry enamel category discussion.

Product information from manufacturers

Since we are not recommending a change in the current VOC limit for high gloss coatings, we have not included a discussion of product information published by coatings manufacturers for such products here. However, for completeness, we identified four high gloss products with VOC levels of less than 150 g/l, and included their performance characteristics in the table that follows the discussion of the low and medium gloss non-flat coatings category. Those products were from Con-Lux, Griggs Paint, Pittsburgh Paints, and Sherwin Williams. Also, please see the quick-dry enamel category discussion for a review of the performance characteristics published by product manufacturers of high gloss, quick-drying coatings that meet the 250 g/l limit.

Issues:

1. Issue: The Draft Environmental Impact Report indicates that high gloss paints that comply with the proposed 150 g/l VOC limit for non-flat coatings comprise only 46 products with 2.6 percent of the marketshare. The low marketshare suggests that those products don't work and people aren't buying them as a consequence. Also, ARB appears to use the logic that a high marketshare of complying products indicates that the proposed VOC limit is feasible for a given category. If that is the case, then the converse should be true - a low complying marketshare should indicate that the proposed VOC limit does not adequately allow formulation of paints that fill the needs of the category. High gloss paints have a complying marketshare of only 2.6 percent, indicating the proposed VOC limit is not feasible.

Response: The marketshare of complying products is just one element we considered in our evaluation of the feasibility of the proposed VOC limit. We also evaluated product information from manufacturers, laboratory performance tests, and information on available resin technology. However, as discussed above, after further evaluation we are now recommending that the non-flat coatings category include a separate subcategory for high gloss coatings with a VOC limit of 250 g/l, primarily due to enforcement concerns. The complying marketshare for high gloss products at the proposed 250 g/l limit is approximately 80 percent.

2. Issue: The proposed 150 g/l VOC limit for non-flat coatings will not allow for the formulation of quality high-gloss exterior coatings. There are no suitable resins available that allow for the formulation of premium quality high gloss exterior coatings. ARB staff should be truthful to the Board and explain that a 150 g/l VOC limit for high gloss paints will result in some sacrifices in performance. The market dictates this to a degree, but the proposed 150 g/l VOC limit amounts to the government dictating a decrement in performance. It is not right to pretend that performance won't be affected by the limit.

Response: We identified several high gloss exterior (including interior/exterior) coatings on the market with VOC levels less than 150 g/l that are classified as premium quality by their manufacturers. However, as discussed above, we have modified the proposed SCM to include separate subcategory for high gloss coatings with a VOC limit of 250 g/l, primarily due to enforcement concerns.

REFERENCES

Air Resources Board. Technical Support Document. “ARB-CAPCOA SCM for Architectural Coatings.” July, 1989. (ARB, 1989)

Air Resources Board. Final Report. “1998 Architectural Coatings Survey Results.” September, 1999. (ARB, 1999)

United States Environmental Protection Agency. “Final Rule: National Volatile Organic Compound Emission Standards for Architectural Coatings. “ 40 CFR part 59, subpart D. 63 FR 48848. September 11, 1998. (U.S. EPA, 1998)

4. Antenna Coatings

Product Category Description:

Antenna coatings are primers or topcoats designed for application to equipment and associated structural appurtenances that are used to receive or transmit electromagnetic signals. For example, these coatings are used on the satellite dishes and supporting structures used by the National Radio Astronomical Observatory (NRAO) and the National Aeronautics and Space Administration (NASA). The coatings are designed to minimize signal losses while protecting the antenna's metal surfaces from corrosion. These products should produce thin films, to avoid losses in signal strength, and should also scatter infrared waves, to avoid generating excess heat at the antenna's receiver (Triangle Coatings, 10/18/99).

We are proposing to add a new category for antenna coatings in the SCM. These coatings are not regulated in district architectural coatings rules as a separate category (but instead are subject to the industrial maintenance category). However, as explained below, we believe that a new category and VOC limit for these products is justified. In addition, the U.S. EPA's national architectural coatings rule contains a separate category and VOC limit for these products.

No antenna coatings were reported in the ARB's 1998 Architectural Coatings Survey. However, one manufacturer subsequently provided sales volumes in California, and VOC content information, indicating that these products contribute VOC emissions less than 0.01 tons per day statewide, excluding the South Coast AQMD.

Product Use and Marketing:

Antenna coatings are highly specialized paints used exclusively to paint satellite dishes and related equipment, and are not available to the general public. As mentioned above, the dry film thickness should be as thin as possible while still providing corrosion protection. As such, it may be necessary to completely remove all old coatings during repainting operations. Some antenna operators have developed detailed procedures that painting contractors must follow regarding surface preparation and painting application techniques (JPL, 2/15/96).

Product Formulation:

We are only aware of one manufacturer of antenna coatings. This manufacturer currently produces: (1) a solvent-based zinc chromate primer and a solvent-based flat white topcoat (Triangle No. 6), for reflective surfaces; and (2) a solvent-based glossy white topcoat (Triangle No. 710) for nonreflective surfaces, such as the antenna's supporting structures. This manufacturer has also developed a solvent-based acrylic-urethane replacement for the primer/topcoat system for reflective surfaces that does not require a primer. This system reportedly has superior performance with respect to the minimization of signal losses compared to the existing system (Otoshi, 11/15/99). Due to confidentiality concerns, we cannot reveal further details about these formulations.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 530 g/l VOC limit for antenna coatings, effective January 1, 2003. This VOC limit is consistent with the U.S. EPA's national architectural coatings rule. This limit is clearly technologically and commercially feasible because the proposed limit would essentially cap the VOC content of existing products, and would not require reformulation of existing products or result in emission reductions. We believe this proposed VOC level is appropriate because we are not aware of any lower VOC products, or existing technology that would allow for compliance with a lower VOC limit. In addition, lower VOC prototype water-based formulations that have been tested by the Jet Propulsion Laboratory have resulted in greater signal losses compared to existing solvent-based formulations (Otoshi, 8/15/99; Otoshi, 11/15/99; JPL, 12/7/99). The existing products have been extensively tested by the Jet Propulsion Laboratory, and are used by NASA and the NRAO in other antenna installations outside of California. Finally, as mentioned above, the emissions from these products are less than 0.01 tons per day statewide, excluding the South Coast AQMD.

REFERENCES

Air Resources Board. Final Report, "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Jet Propulsion Laboratory. "Painting or Thermal-Coating DSN Antennas and Supporting Structures." DSN-STD-1006, Rev. G. NASA Identification Number 23835. February 15, 1996. (JPL, 2/15/96).

Otoshi, T.Y., Cirillo, Jr., R., and Sosnowski, J. "Measurements of Complex Dielectric Constants of Paints and Primers for DSN Antennas: Part I." August 15, 1999. (Otoshi, 8/15/99)

Otoshi, T.Y., Cirillo, Jr., R., and Sosnowski, J. "Measurements of Complex Dielectric Constants of Paints and Primers for DSN Antennas: Part II." November 15, 1999. (Otoshi, 11/15/99)

Jet Propulsion Laboratory. Telephone conversation with ARB staff. December 7, 1999. (JPL, 12/7/99)

Triangle Coatings. Telephone conversation with ARB staff. October 18, 1999. (Triangle, 10/18/99).

5. Antifouling Coatings

Product Category Description:

Antifouling coatings are products designed for application to submerged stationary structures and their appurtenances to prevent or reduce the attachment of marine or freshwater biological organisms. We are proposing to add a new category for these coating products in the SCM. As defined in the U.S. EPA's national architectural coatings rule, these coatings may or may not be registered with the U.S. EPA as a pesticide. However, we are proposing that they be registered as a pesticide to qualify as an antifouling coating in this proposed SCM, consistent with district marine coatings regulations in California. Antifouling coatings are typically used on underwater structures such as docks, sea walls, oil drilling platforms, piers, and boat slips.

As shown in Table VI-6 below, the antifouling coatings that were reported in the ARB's Architectural Coatings Survey are solvent-based coatings with a sales-weighted average VOC content of 351 g/l. These coatings resulted in less than 0.01 tons per day of VOC emissions statewide in 1996, excluding the South Coast AQMD. Information on sales volumes cannot be provided for this category because not enough products were reported to protect data confidentiality.

Table VI-6
Antifouling Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	PD	PD	351	~0.00
Water-Based	0	0	N/A	N/A
Total	PD	PD	351	~0.00

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected data.

Product Use and Marketing:

Antifouling coatings, as defined in this proposed SCM, are highly specialized coatings that are also registered pesticides. According to one manufacturer, these products are not generally produced exclusively for submerged architectural structures (Hempel, 12/22/99). Instead, these products are designed primarily for marine vessels, but may also be used on architectural structures. These products are often used by shipbuilders, original equipment manufacturers, and large construction firms (in architectural coatings applications).

Product Formulation:

Due to the limited number of respondents to the ARB's Architectural Coatings Survey, we cannot reveal detailed information about the formulations of antifouling coatings. Based on the ARB survey data, these are solvent-based formulations. Antifoulant coatings in general release cuprous oxide or tributyl tin as the active ingredient that prevents the attachment of biological organisms.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 400 g/l VOC limit for antifouling coatings, effective January 1, 2003. This VOC limit is slightly lower than the 450 g/l VOC limit in the U.S. EPA's national architectural coatings rule. However, this limit is clearly technologically and commercially feasible because it effectively places a cap on the VOC content of existing products sold in California, as reported in the ARB's Architectural Coatings Survey. The proposed limit would not require reformulation of existing products or achieve emission reductions. We believe the proposed 400 g/l VOC limit is appropriate because it is consistent with the VOC limits for antifouling coatings in California's district marine coatings rules, with the exception of the San Diego Air Pollution Control district's 330 gram/liter VOC limit for pleasure craft (South Coast AQMD; SDAPCD; and BAAQMD). The antifouling coatings used for architectural coatings applications are generally the same as those subject to marine coatings rules. We also note that there were no products reported in the ARB's Architectural Coatings Survey that would meet the 250 g/l VOC limit for industrial maintenance coatings, which is generally the category these products would otherwise fall under. Finally, as mentioned above, the emissions from these products are less than 0.01 tons per day statewide, excluding the South Coast AQMD.

Table VI-7
Antifouling Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%)	Emission Reductions (excluding South Coast AQMD) (tons/day)
400	PD	100	0

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
PD = Protected data.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Bay Area Air Quality Management District. Rule 8-43. Surface Coating of Marine Vessels. Revised December 20, 1995. (BAAQMD)

Hempel Coatings. Telephone conversation with ARB staff. December 22, 1999.

(Hempel, 12/22/99)

San Diego County Air Pollution Control District. Rule 67.18. Marine Coating Operations. Revised May 15, 1996. (SDAPCD)

South Coast AQMD. Rule 1106, Marine Coating Operations. Amended January 13, 1995.

6. Bituminous Roof Coatings

Product Category Description:

Bituminous roof coatings are products labeled as and formulated exclusively for roofing, that incorporate bitumens. Bitumens are black or brown materials including, but not limited to, asphalt, tar, pitch, or asphaltite that are soluble in carbon disulfide, consist mainly of hydrocarbons, and are obtained from natural deposits or as residues from the distillation of crude petroleum or coal.

Table VI-8 below summarizes our estimate of sales and VOC emissions from the bituminous coatings category.

Table VI-8
Bituminous Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	117	1,295,827	225	1.38
Water-Based	34	3,623,800	3	0.04
Total / Overall	151	4,919,627	37	1.42

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

When we conducted the 1998 ARB survey, we included U.S. EPA's category of bituminous coatings. The data shown above therefore represent pavement sealers, bituminous primers, bituminous roof coatings and some industrial maintenance coatings. After further analysis of survey responses and discussions with several roof-coating manufacturers, we learned that many of the coatings with VOC contents less than 50 g/l are pavement sealers. For the purposes of this proposed SCM, we are limiting this category to bituminous coatings that are applied only to roofs. Those products, which are bituminous roof primers, are regulated under a separate bituminous roof primer category. Bituminous roof coating products that are self-priming are regulated as bituminous roof coatings. In addition, some bituminous roof coatings were reported as roof coatings.

Based on our survey data, discussions with manufacturers, and data supplied by the RCMA, it is staff's estimate that bituminous roof coatings account for approximately 20 percent of the sales volume and 72 percent of the emissions from the bituminous coatings category. In addition, the bituminous roof coating sales and emissions represent 81 and 26 percent, respectively, in the roof coating category. Combining this information with the data supplied by the Roof Coating Manufacturers Association, we estimate that the bituminous roof coating sales are approximately 4.5 million gallons per year statewide and emissions are about 1.1 tons per day excluding the South Coast AQMD. (ARB 1999)

Product Use and Marketing:

Bituminous roof coatings are applied at ambient temperatures (cold-applied) and, when the carrier evaporates, produce a cured water-resistant film. These products are marketed as economical products that are easy to use, and non-flammable. Bituminous roof coatings can be found in major home centers, paint stores and most local hardware stores. (RCMA, undated) They are applied over the main waterproofing membrane to protect against ultraviolet (UV) exposure. These coatings act as a sacrificial maintenance layer that protects and prolongs the life of the main waterproofing layer from UV and climate exposure.

Product Formulation:

Traditional bituminous roof coatings are gelled coatings made from cutback bitumens, petroleum solvents, clay fillers, surfactants, fibers, other fillers and optional reflective pigments. Cutback bitumens are made through a process of refining the distillate bitumens through vacuum distillation or oxidation to produce various physical properties (e.g. dry time, viscosity, etc). They are then dissolved in a petroleum solvent. (RCMA, undated)

Bitumens may also be emulsified in water. Emulsification allows the bitumens to be uniformly suspended in the water. As with the petroleum-based products, the film is formed when the carrier (water) evaporates from the coating and forms a hard dry coating. In addition, there are roof coatings that use a combination of an acrylic or elastomeric (non-bituminous) roof coating and asphalt or coal tar (bituminous) roof coatings. (RCMA, undated)

Proposed VOC Limit and Basis for Recommendation:

The proposed VOC limit of 300 g/l is technologically and commercially feasible by the January 1, 2003, effective date based on the current VOC limit in most districts (300 g/l), and data provided by the Roof Coatings Manufacturers Association (RCMA) which shows extremely high complying marketshare. Those manufacturers that need to reformulate can reduce the amount of petroleum and mix types of asphalt to comply with the proposed limit.

The high complying marketshare with the proposed VOC limit reflects the fact that the survey data are predominated by very low VOC water-based products (asphalt emulsions). However, after a detailed review of the survey data we also noted several solvent-borne bituminous roof coatings with substantial sales that meet the proposed 300g/l limit. Subsequent to the ARB survey, the RCMA supplied us with supplemental data gathered from a survey they conducted. These data showed that all of the water-based products can comply with our proposed limit and that 99 percent of the solvent-based products either meet or are within 50 g/l of the proposed limit. This 300 g/l VOC limit is also consistent with most districts including the current South Coast AQMD limit for bituminous roof coatings. The South Coast AQMD has a future effective limit of 250 g/l for bituminous roof coatings, which is effective in 2002. Due to climatic conditions present outside of the South Coast Air Basin we believe that a slightly higher VOC limit is appropriate for the remainder of the state.

The proposed VOC limit would not apply to all types of bituminous products. For example, bituminous pavement sealers are subject to the proposed VOC limits for flats/nonflats, and those bituminous coatings that are used in industrial maintenance applications and meet the industrial maintenance definition are subject to the proposed limit for the industrial maintenance coatings category. Bituminous roofing primers are subject to the bituminous roofing primer category limit of 350 g/l. Bituminous aluminum roof coatings would be considered metallic pigmented coatings, assuming such coatings meet the metallic pigmented coating definition.

As proposed, the bituminous roof coating category would include a provision for annual reporting, which would require manufacturers to submit their annual sales sold within California. Table VI-9 represents our estimates of the emission reductions from the proposed VOC limit.

Table VI-9
Bituminous Roof Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%)	Emission Reductions (excluding South Coast AQMD) (tons/day)
300	66	98.0	0.00

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

<u>Issues</u>:

1. **Issue:** The 250 g/l limit for bituminous coatings is technically infeasible.

Response: We believe the previously proposed 250 g/l limit is technically feasible based upon a detailed analysis of our survey data, and the data submitted by industry, in districts with climates similar to the South Coast AQMD. Ninety-eight percent of the bituminous coating market currently complies with the previously proposed 250 g/l limit. However, in order for the SCM to be applicable statewide, and to accommodate climatic conditions which occur more frequently outside the South Coast Air Basin, we believe that it is more appropriate for a 300 g/l limit for areas outside of the South Coast Air Basin. Bituminous roof primers are subject to the bituminous roof primer category.

2. **Issue:** The data collected in the 1998 Architectural Coatings Survey are incomplete and represent a fraction of the products manufactured and shipped into California.

Response: As discussed above, we have worked with the roof coatings industry to supplement the survey data for this category.

3. **Issue:** The performance characteristics of solvent-based roof and flashing cements and adhesives are inherently different from water-based bituminous coatings (emulsions). These two distinct types of products are not necessarily substitutes for one another.

Response: Our survey data show that there are solvent-based bituminous roof and solvent-based bituminous flashing cement products that meet the previously proposed 250 g/l limit. Ninety-eight percent of the market meets the proposed 300 g/l limit. Most roof adhesives and those flashing cements meeting the adhesive definitions would not be subject to the proposed VOC limit, since the districts regulate roof adhesives in their adhesive rules. Please check district rules for definitions of these products to determine if the adhesive or architectural coating rule applies.

4. **Issue:** If patching materials are included in the proposal, we recommend a 400 g/l VOC limit for wet and dry patching material, and a 50 g/l limit for all other patching material. Emulsion-based patching materials cannot be applied in wet conditions to immediately stop a leak, where the solvent-based and dry material can.

Response: Most patching materials are regulated in the adhesive and sealant rules by the local air districts. See local district rules for current limits.

5. **Issue:** Industry needs the solvent-based mastics at the 250-300 g/l limit in the South Coast AQMD's Rule 1113.

Response: We are now recommending a 300 g/l VOC limit in the SCM.

6. **Issue:** There is a problem with the definitions of roof and bituminous coatings. They were not adequately distinguished as they were in the National Rule. We would like to see no lower limits for these categories than those limits in the South Coast AQMD.

Response: The ARB staff met with roof and bituminous coating manufacturers to clarify these definitions. We also worked with the RCMA to gather additional data. As discussed above, we believe the South Coast AQMD's 250 g/l limit is feasible in the South Coast Air Basin and those areas with similar climates. However, for a statewide limit, we are recommending a higher 300 g/l limit.

7. **Issue:** We provided data on the performance of two coatings: a 250 g/l bituminous coating, and a 300 g/l bituminous coating. There are differences in the viscosity of these coatings, especially at lower temperatures.

Response: Please see response to Issue 1.

8. **Issue:** The proposed 250 g/l limit is precisely half of the limit permitted in the national rule (500 g/l for bituminous coatings). The proposed SCM should include a category for bituminous roof primers with a VOC content limit of 500 g/l.

Response: Please see response to Issue 1 and the Bituminous Roof Primer discussion.

9. **Issue:** The 250 g/l VOC level for bituminous coatings, as currently proposed, is too low for these products. We request that bituminous coatings be regulated at 300 g/l at a minimum. We request a category for bituminous primers. If regulated under the primers, sealers, and undercoaters category, a 200 g/l VOC limit would ban these products.

Response: Please see response to Issue 1 and the Bituminous Roof Primer discussion.

10. **Issue:** We are requesting the VOC level for bituminous coatings be no less than 300 g/l in California. We request a breakout category for bituminous primers of at least 400-450 g/l.

Response: Please see response to Issue 1 and the Bituminous Roof Primer discussion.

REFERENCES

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United States Environmental Protection Agency (U.S. EPA). "National Volatile Organic Compound Emission Standards for Architectural Coatings - Background for Promulgated Standards." EPA-453/R-98-006b. August 1998. (U.S. EPA, 1998)

7. **Bituminous Roof Primer Coatings**

Product Category Description:

Bituminous roof primer coatings are primers labeled as and formulated exclusively for roofing, that incorporate bitumens. Bitumens are black or brown materials including, but not limited to, asphalt, tar, pitch, or asphaltite that are soluble in carbon disulfide, consist mainly of hydrocarbons, and are obtained from natural deposits or as residues from the distillation of crude petroleum or coal. This new category does not include self-priming bituminous roof coatings, which are considered bituminous roof coatings. Bituminous roof primers are currently regulated in the primer, sealer and undercoater category. However, bituminous roof primers were reported in our 1998 survey under both the bituminous coating category and the primer, sealer, and undercoater category.

It is staff's estimate that bituminous roof primers account for approximately 1 percent of the sales volume and 5 percent of the emissions from the bituminous coatings category, while the sales and emissions represent less than 1 percent and 2 percent, respectively, in the primer, sealer and undercoater category. Combining this information with the data supplied by the Roof Coating Manufacturers Association (RCMA), we estimate that the Bituminous Roof Primers sales are approximately 200,000 gallons per year statewide, complying marketshare is approximately 57 percent, and emissions are approximately 0.2 tons per day excluding the South Coast AQMD (ARB 1999)

Product Use and Marketing:

Bituminous roof primers are sold in California in major home centers, paint stores, and hardware stores. The users range from the professional to the homeowner or do-it-yourselfer. Bituminous roof primers are used to prepare a "cleaned" roof surface for the application of an asphaltic coating. The primer wets out the residual dust and/or metal surfaces in preparation for the bituminous roof coating. Water-based bituminous roof primers can be used under water-based or solvent-based bituminous roof coatings and vice versa. Bituminous Roof Primers are typically applied in the morning and need to cure before applying a bituminous roof coating. One manufacturer claims the cure time is 8 to 24 hours, while another claims 1 to 8 hours. (Hunter, 2000; Beemer, 2000)

Product Formulation:

The bituminous roof primer category consists of water-based and solvent-based formulations and is currently within the primer, sealer and undercoater category. Our previous draft SCM proposed that they be included in the bituminous roof category. Although the 1998 ARB Architectural Coatings Survey did not specifically survey this newly created category its sales were included under the surveyed categories "bituminous coatings," or "primer, sealer, and undercoater." The VOC contents of products in this category fall within the range of 0 g/l to 500 g/l. The formulations are primarily composed of asphalt, mineral spirits, and fillers for solvent-based coatings, or asphalt, water, clay, and fillers for water-based coatings.

Proposed VOC Limit and Basis for Recommendation:

The proposed 350 g/l VOC limit for bituminous roof primers is technologically and commercially feasible by the January 1, 2003, effective date. District rules have regulated these coatings at 350 g/l for about ten years. As a result, there are numerous complying products on the market. ARB staff estimates that establishing a bituminous roof primer category will result in a slight decrease in anticipated emission reductions from the primer, sealer and undercoater category (moving from 200 g/l to 350 g/l). In creating this new category, staff considered the limited availability of 300 g/l bituminous roof primers in districts with significantly different climate than that of South Coast Air Basin.

Based on ARB staff research and information provided by industry, staff is unaware of bituminous roof primers at 250 g/l or 300 g/l that provide the necessary application and coating characteristics in cold climates that are provided by 350 g/l bituminous roof primers. However, current 250 g/l bituminous roof primers are considered acceptable for applications in locations with climates similar to the South Coast Air Basin. Formulating a 250 g/l bituminous primer requires the use of less solvent that results in unacceptable performance with regard to application and coating characteristics when used in some areas outside of the South Coast Air Basin.

ARB's proposal to create a bituminous roof primer category is based on ARB staff analysis, technical information provided by industry, and discussions with South Coast AQMD staff. As proposed, the bituminous roof primer category would include a provision for annual reporting, which would require manufacturers to submit their annual sales sold within California.

Issues:

1. Issue: We cannot make a bituminous primer that meets the current 350 g/l VOC limit. There are three main problems with the 350 g/l products: the viscosity is too heavy, they don't dry, and you can't put an emulsion over them. Previously, these coatings were around 500 g/l.

Response: Bituminous roof primers in most districts are subject to the primers, sealers, and undercoaters category limit. For approximately ten years, the districts have regulated this coating category at the 350 g/l VOC limit. There are several complying products, which have been on the market for many years. We believe that with modifications to formulations, non-complying bituminous primers can meet the 350 g/l VOC limit. Once the primer is dry, water-based and/or solvent-based coatings can be placed over the top of the primer.

2. Issue: There is a problem with the definitions of roof and bituminous coatings. They were not adequately distinguished as they were in the National Rule.

Response: The ARB staff met with roof and bituminous coating manufacturers to clarify these definitions. We also worked with the RCMA to gather additional data.

3. **Issue:** The proposed SCM should include a category for bituminous roof primers with a VOC content limit of 500 g/l.

Response: Please see response to Issue 1.

4. **Issue:** We request a category for bituminous primers. If regulated under the primers, sealers, and undercoaters category, a 200 g/l VOC limit would ban these products.

Response: Please see response to Issue 1.

5. **Issue:** We request a breakout category for bituminous primers of at least 400-450 g/l.

Response: Please see response to Issue 1.

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8. Clear Brushing Lacquer Coatings

Product Category Description:

Clear brushing lacquers are clear wood finishes, excluding clear lacquer sanding sealers, formulated with nitrocellulose or synthetic resins that dry by solvent evaporation without chemical reaction and provide a solid protective film which is intended for application by brush only. This is a new category that is currently included in the general lacquer category in district rules.

It is staff's estimate that clear brushing lacquers account for approximately five percent of the sales volume and three percent of the emissions from the general lacquer category.
(ARB 1999; Deft, 1999)

Product Use and Marketing:

Clear brushing lacquers are sold in California to major home centers, paint stores, lumber yards, and hardware stores. The users range from the professional, the homeowner or do-it-yourselfer, to arts and crafts enthusiasts. Clear brushing lacquers are used to finish interior wood surfaces such as furniture, cabinets, paneling, and crafts. In the last decade, wood products are increasingly supplied by the manufacturer pre-finished eliminating the need to apply a finish at home or in the field. In California, a majority of new home or remodeling cabinetry is delivered pre-finished and field finished cabinetry occurs on a limited basis (e.g., custom fabrication).

Product Formulation:

The clear brushing lacquer category consists of solvent-based formulations and falls within the general lacquer category. Although the 1998 ARB Architectural Coatings Survey did not specifically survey this newly created category its sales were included under the surveyed subcategory "clear lacquers." The VOC content of this category falls within the range of 650 g/l to 680 g/l. The formulations are clear coatings composed of synthetic thermoplastic film-forming materials in organic solvents (e.g., ketones and esters) that dry by solvent evaporation. Most lacquers are based on nitrocellulose the film forming material, dissolved in lacquer thinner, the solvent. Nitrocellulose is a cotton-like material derived from mixing the cellulose from trees with nitric acid. These solvent-based formulations have the unique quality of being able to be re-wetted or dissolved when more lacquer or lacquer thinner is applied over existing, dry lacquer. The ability to rewet or re-dissolve lacquer allows for easy repair and recoating without the need to sand between coats or completely remove the existing finish, with chemical solvent borne strippers.

Proposed VOC Limit and Basis for Recommendation:

The proposed 680 g/l VOC limit for clear brushing lacquers is technologically and commercially feasible by the January 1, 2003, effective date because this limit reflects the current VOC content for products in this category. ARB staff estimates that establishing a clear brushing lacquer category will result in a slight decrease in anticipated emission reductions from the general lacquer category, (moving from 550 g/l to 680 g/l). In creating this new category, staff considered the unavailability of 550 g/l brushing lacquers and the transfer efficiency of sprayed lacquer versus a lacquer applied by brush only.

Based on ARB staff research and information provided by industry, staff is unaware of clear brushing lacquer formulations at 550 g/l capable of providing the necessary application and finish characteristics that are available with current 680 g/l clear brushing lacquers. The formulation changes for a 550 g/l spraying lacquer are not acceptable for brushing lacquers. Current 550 g/l lacquers are considered acceptable for spraying applications only. Achieving a 550 g/l brushing lacquer requires the use of strong solvents (e.g., acetone) that result in unacceptable performance with regard to application and finish. Lacquers are typically applied in multiple coats to achieve the desired finish. These 550 g/l formulations bite into previous coats, which results in an unacceptable brush drag and the brush becoming stuck in the previous coat due to solvents softening the prior coat when the second or third coat is applied. With spraying lacquers this is not an issue. Requiring a 550 g/l limit for clear brushing lacquers would essentially shift the current brush application of clear brushing lacquers to spray applied lacquers resulting in lower transfer efficiency. (Deft, 1999)

The transfer efficiency of lacquers applied by brush is essentially 100 percent compared with the typical 65 percent transfer efficiency of a sprayed lacquer. Therefore, applying one gallon of brushing lacquer at 680 g/l (100% transfer efficiency) is equivalent to applying 1.5 gallons of spraying lacquer at 550 g/l covering the same surface area. Thus, applying one gallon of brushing lacquer at 680 g/l results in or 5.7 pounds of VOC and applying 1.5 gallons of sprayed lacquer at 550 g/l that results in 7 pounds of VOC. Consequently, the brush application of a 680 g/l lacquer compared to a 550 g/l sprayed lacquer results in about a 20 percent decrease in emissions. Finally, spray lacquers require greater amounts of cleaning solvent than brushing lacquers, which would result in additional emissions compared to brushing lacquers. (Deft, 1999)

Staff also considered a reformulation approach for a 550 g/l sprayed lacquer. The approach we considered involved displacing traditional VOCs with exempt compounds (e.g., acetone) to determine the necessary volume needed for a 550 g/l sprayed lacquer to achieve the same emissions as a 680 g/l brushing lacquer. ARB staff estimates that 20 percent (by volume) of the traditional VOCs in a 550 g/l spraying lacquer would have to be replaced with exempt compounds to achieve equivalent emissions of a 680 g/l brushing lacquer. Based on ARB staff research and information provided by industry, reformulation of brushing lacquers using acetone~~, T-buytl~~ or other exempt compounds has not yielded an acceptable product with the necessary application and finish properties.

ARB's proposal to create a clear brushing lacquer category is based on ARB staff analysis, technical information provided by industry and discussions with South Coast AQMD staff. As proposed, the clear brushing lacquer category would include a strict definition and labeling requirements prohibiting thinning. In addition, we are proposing a provision for annual reporting that would require the submission of annual volumes sold in California by manufacturers in order to monitor the category's usage patterns.

<u>Issues</u>:

1. Issue: This category was deemed unnecessary by the South Coast AQMD and was not included in Rule 1113. This proposed category represents another opportunity for industry to sell high VOC coatings, such as lacquers, by relabelling. Despite industry assurances that these coatings will only be brushed and not sprayed, enforcement at the point of sale will be impossible.

Response: The South Coast AQMD chose not to add a clear brushing lacquer category because it felt that the variance approach was more appropriate in order to encourage continued research on the part of the company requesting the variance. On April 20, 1999, the South Coast AQMD hearing board unanimously granted the company a variance for one year and expressed the opinion that a second year would be permitted if the company were unable to formulate a 550 g/l clear brushing lacquer. At the hearing, South Coast AQMD staff testified that there is no other compliant product in the market. The company has been researching 550 g/l brushing lacquer formulations for the past three years and under the variance it committed to continue diligent research towards compliance with a 550 g/l VOC limit.

Our proposal to create a clear brushing lacquer category is based on ARB staff analysis, technical information provided by industry and discussions with South Coast AQMD staff. As proposed, the clear brushing lacquer category would include a strict definition and labeling requirements prohibiting thinning. In addition, we are proposing a provision for annual reporting that would require the submission of annual volumes sold in California by manufacturers in order to monitor the category's usage patterns.

Enforcing the requirement that clear brushing lacquers will only be brushed and not sprayed is similar to current thinning prohibitions contained in existing coating rules. Brushing lacquers are too viscous to be sprayed, they require thinning to enable spray application. Thinning prohibitions can only be enforced via field inspections of coating operations and testing coating samples. Enforcing the "brush only" requirement will also require field enforcement. In addition, the labeling requirements will require the manufacturer to clearly identify on the primary label and application instructions that the product cannot be thinned or sprayed and must be applied by brush only.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Deft, Inc. 17451 Von Karman Avenue, Irvine, CA 92614. Thomas P. Barnum. Vice President. Trade Sales. Lloyd Haanstra. Trade Lab Director. (Deft, 1999)

9. **Faux Finishing Coatings**

Product Category Description:

Faux finishes are coatings designed to create special effects such as dirt, old age, smoke damage, marble, or wood grain (Ralph Lauren, 9/98; Flood Company, 1996a). These coatings are generally clear glazes that are tinted or mixed with latex or solvent-based coatings to produce colored glazes (Ralph Lauren, 9/98; Behr, 2/99). Some coating additives or "conditioners" are also used in conjunction with solvent-based or latex coatings to make faux finishes (Flood Company, 1996b; Flood Company, 1997). Japan finishes, which are flat, quick-drying paste colors (T.J. Ronan, 1/4/00), may also be used as faux finishes after thinning (Universal Studios, 1/4/00). Faux finishes do not include general use flat and non-flat coatings, which may also be used in some faux finishing techniques. Sales and emissions information for faux finishes is not available since the ARB's Architectural Coatings Survey did not include a separate category for these products. However, we expect these coatings to represent a minor percentage of the overall sales from architectural coatings.

Product Use and Marketing:

Faux finishing products are sold in paint stores and artist supply stores. These products are used by the general public, graphic artists, motion picture and television studios, and businesses that specialize in decorating with faux finishes.

Faux finishes are generally applied over a household interior semi-gloss or satin/eggshell coatings (Sherwin Williams, 3/98; Golden Artist Colors, 1/4/00). The color of the background coating will combine with the colored glaze, which is the faux finish. A variety of techniques may be used in creating the desired artistic effects. These techniques include additive processes (sponging, ragging, washing) in which a natural sponge, newspaper, paper bags, plastic wrap, etc. are used to add the colored glaze over the base coat. Subtractive processes include sponging-off, ragging-off, and stippling. To perform these processes, an even coat of the glaze is applied over the base coat, and the glaze is then removed with a damp natural sponge, newspaper, plastic wrap, or a stipple brush. Marble, leather, or wood grain finish, may be achieved using various layers and colors of glazes. Tools typically needed for faux finishing techniques include brushes, feathers, paper bags, graining tools, and thin plastic wrap. (Ralph Lauren, 9/98; Sherwin Williams, 3/98)

Faux finishes are generally clear glazes that are designed to be tinted, or mixed with latex coatings (or solvent-based coatings in the case of solvent-based faux finishes) before application. The mixture's ratios will vary with the color and degree of opaqueness desired. In some cases, the products may be used "as-is" when a clear coating is desired. Japan finishes are different in that they are high-solids pastes that may be thinned down prior to use (Universal Studios, 1/4/00).

Product Formulation:

As mentioned above, faux finishes are generally clear glazes prior to tinting or blending with other coatings, and thus contain resins, solvents, and water (in latex products), but no pigments. These products may have a higher concentration of slower evaporating solvents than typical household coatings in order to extend the “open” (wet) time. The longer “open” time allows the coating to be manipulated to create the desired artistic effects. After tinting or mixing with other coatings, the formulations will vary widely. Generally, when water-based faux finishes are mixed with household latex coatings, their VOC content would be expected to drop. Solvent-based faux finishes may be mixed with solvent-based coatings and mineral spirits (Sherwin-Williams, 1/99), which may increase or decrease the overall VOC content depending on the proportions used. Japan finishes are reportedly thick solvent-based alkyd coatings with a high concentration of pigments. These are reportedly thinned with solvent prior to use as faux finishes (Universal Studios, 1/4/00), which would increase their VOC content.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 350 g/l VOC limit for faux finishes, effective January 1, 2003. This VOC limit is technologically and commercially feasible as demonstrated by the complying water-based products currently on the market (Sherwin Williams, 3/98; Behr, 1/19/00). The U.S. EPA’s national architectural coatings rule provides a 700 g/l VOC limit. However, we believe the proposed 350 g/l VOC limit is appropriate because we are aware of faux finishes currently on the market that are below this VOC level. The proposed VOC limit is also consistent with the South Coast AQMD’s Architectural Coatings rule.

Manufacturers of noncomplying faux finishes have various reformulation options. Solvent-based products could switch to a water-based formulation or investigate the use of exempt VOC solvents. Water-based products will need to reduce the amount of solvents, or increase the amount of resin in the formulation. These changes may require manufacturers to investigate different solvents and resin systems, similar to the changes necessary for other general use flat and non-flat coatings. However, the 350 g/l VOC limit is substantially higher than the 100 and 150 g/l VOC limits proposed for general use flat and non-flat coatings, providing for a longer “open time” for these products.

Issues:

1. Issue: The ARB should create a 700 g/l VOC limit consistent with the U.S. EPA’s national architectural coatings rule. To date, there has not been an identifiable way to reformulate these products to achieve a lower VOC content while maintaining the characteristics required for acceptable use, such as an extended open time.

Response: As stated above, we are aware of existing faux finishes that have a VOC content below the proposed 350 g/l VOC limit. One of these products has an open time of about 15 minutes (Sherwin Williams, 3/98), which is comparable to some higher VOC faux finishes

(Sherwin Williams, 1/99; Golden Artist Colors, 1/4/00). We also note that a shorter open time can be accommodated by working in smaller sections.

2. Issue: It is unfair to calculate the VOC content of our water-based faux finishes on a less water basis. On a formula basis, the calculated VOC of our product can range up to 340 g/l. However, because the products are water-based, the VOC less water calculation results in a range of up to 700 g/l. Removing water to calculate the VOC content is unnecessary because achieving these effects depends upon creating transparent layers. The addition of water to these coatings is required for optimum performance and does not result in the application of greater volumes of material to offset the resulting lack of opacity. Not only is there no benefit to imposing this restriction on water-based products, the requirement for removing water from the calculation will likely result in less use of water-based finishes and greater total VOC emissions.

Response: We are aware of water-based faux finishes that comply with the proposed 350 g/l VOC limit, *less water,* and are designed to create transparent layers. We expect that these products will result in less emissions than higher VOC water-based faux finishes.

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Flood Company. "Your Guide to Fabulous Faux Finishing." 1996. (Flood Company, 1996a)

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Sherwin Williams. Product data sheet for Oil Based Faux Finish Glazing Liquid A46T34. January, 1999. (Sherwin Williams, 1/99)

T.J. Ronan Paint Corporation. Website information on Ronan's Superfine Japan Colors. www.ronanpaints.com/html/japan.htm. Viewed January 4, 2000. (T.J. Ronan, 1/4/00)

Universal Studios. Telephone conversation with ARB staff. January 4, 2000.
(Universal Studios, 1/4/00)

10. Fire-Resistive Coatings

Product Category Description:

Fire-resistive coatings, also known as fireproofing materials or fire-resistant coatings, are used to bring building and construction materials into compliance with federal, State, and local building code requirements. These coatings must be tested and rated by an approved testing agency for their ability to protect the structural integrity of steel and other structural materials by increasing the fire endurance. The testing is done using time-temperature criteria of ASTM Designation E 119-98, "Standard Test Methods for Fire Tests of Building Construction Materials." This method is virtually identical to Universal Building Code (UBC) Method 7-1, as specified in the California Building Code. This category is proposed to be included in the SCM for the first time.

The National Architectural Coatings Rule combines fire-retardant and fire-resistant coatings into one category. We are proposing two separate categories because the coatings work in different ways, and the effectiveness of the coatings in protecting substrates against fire are measured by different methods. Fire-retardant coatings limit the spread of flame on the surface of interior building materials, while fire-resistive coatings protect the integrity of structural elements by limiting the penetration of flame.

The South Coast AQMD created a category for fireproofing coatings in its 1996 amendments to Rule 1113. This category was requested by industry to be separate from the fire-retardant coating category. The reasons the South Coast AQMD added this category were that the mode of action and the test methods differ for fire-retardant and fireproofing coatings. The definition for fireproofing coatings in the South Coast AQMD rule, however, did not include interior structural materials (South Coast AQMD, 1996). The ARB staff has independently concluded that two separate categories for fire-retardant and fire-resistive coatings are needed.

The 1998 ARB Architectural Coatings Survey did not include a category for fire-resistive coatings. Therefore, we have no estimate of sales or emissions. However, our investigation has shown that the fire-resistive coating category is very small and specialized. Based on the estimated 4,000 gallons of solvent-based product sold yearly in the South Coast Air Basin (South Coast AQMD, 1996), we estimate that statewide sales are less than 10,000 gallons per year.

Product Use and Marketing:

Fire-resistive coatings are specialty products applied by contractors. They are available from distributors or direct from the manufacturer. They are used in public buildings such as schools, hospitals, nursing homes, factories, high-rise office buildings, and sports complexes. Fire-resistive materials are tested with ASTM E 119, "Standard Test Methods for Fire Tests of Building Construction and Materials." The entire structure, such as a firewall, coated with the fire-resistive material is placed in a furnace and the time required to reach critical parameters is measured. For example, in firewalls, the time to reach "burn through" of the coating is measured. In structural steel coated with fire-resistive materials, the failure criterion is the internal temperature of the steel, based on the fact that the structural integrity of steel fails at 1200^{o} F. The fire rating is the time in hours required to reach the critical parameter of the material being measured (Bratcher and Alvarez, 1996).

The California Building Code specifies fire-resistive ratings for various types of construction with different occupancy levels, based on varying degrees of public safety. For example, Type I construction (structural elements of steel, iron, concrete, or masonry) must have 2-hour fire-resistive ratings for floors and roofs, while exterior bearing walls must have a 4-hour fire-resistive rating. Type V structures (homes) have 1-hour fire-resistive ratings for these same elements (California Building Code, 1998).

Professional architects and engineers use the Underwriters Laboratories (UL) Inc. Fire Resistance Directory to help them design buildings with the appropriate structural fire-resistive designs and materials. The structural element coated with the fire-resistive material is listed in the directory as "UL design numbers" for fire resistance, which gives the number of hours or the depth of penetration of the fire resistance. The thickness of the fire-resistive coating that must be applied to a given structural element, which will give a certain hourly rating, are derived from these UL fire resistance designs. There are design values for, as examples, floor assemblies, roof assemblies, and walls. Within these categories, the thickness of the fire-resistive material depends on, for example, steel size and shape, type of concrete, and thickness of concrete (Grace, undated). There are books of these design numbers available for the large variety of structural elements used in construction (Woods, 1999).

For example, the California State Fire Marshal lists fire-resistive designs such as structural members and walls/partitions. Some examples of fire-resistive materials include expansion joints and head-of-wall/wall-to-wall joint systems. Each of these materials is tested using ASTM Designation E 119 (UBC 7-1). Other materials such as acoustical materials and interior coating materials are tested for flame spread index with ASTM E 84
(State Fire Marshal, 1999).

Thus, the building codes determine the degree of fire resistance needed, and the test method that is used to evaluate the fire resistance of the coating. Registered architects or professional engineers must determine which hourly rating, UL design, and thickness of fire-resistive coating is needed for a building project, and these decisions must be reviewed and approved by the building code official (Grace, undated). However, manufacturers can choose to test their fire-resistive coatings at any of several testing laboratories approved by the California Fire Marshal and other building code officials. These coatings and the results of the testing data must be registered with the State Fire Marshal (Woods, 1999).

Product Formulation:

Fire-resistive coatings are generally of three types: gypsum-based cementitious coatings, fibrous (i.e., treated paper) coatings, and intumescent mastic coatings. The first two are solid materials, sprayed as a slurry, which insulates the structural element with exposed air pockets.

Intumescent coatings form thick, puffy foam when exposed to high heat, which insulates the substrate against further intrusion of the flame.

Fire-resistive coatings are applied onto or impregnated into a substrate primarily for protective purposes, and they do not necessarily form a film. One commenter on the National Rule requested clarification about the applicability of gypsum or cement-based, spray applied fire-retardant products that are applied to steel building surfaces during construction or renovation. The U.S. EPA confirmed that these cementitious fire protection products, that are often spray-applied as a thick slurry up to 3-1/2 inches thick and do not form a film as do other opaque fire-retardant materials, should be included in the fire retardant/resistive category (U.S. EPA, 1998b).

The thin film intumescent coatings have become more popular for structural steel with architects in recent years because of their appearance and design options that are not possible with the thicker films. Whereas with traditional material, where one to two inches of fire-resistive material might be required, only 1/16th of an inch of the intumescent coating is needed to provide the same fire rating. The trade-off is that intumescent coatings cost more than traditional coatings (Bratcher and Alvarez, 1996).

Fire-resistive mastic coatings are usually solvent-based for exterior use and water-based for interior use. Fire-resistive coatings must be capable of withstanding abrasion, impact, freezing, and thawing, and must not form dust, flakes, cracks, or delaminate. They must withstand weathering, ultraviolet exposure, and vibration (Albi, undated). Water-based formulations are more challenging to formulate with the same hardness and exterior application properties under wet conditions (South Coast AQMD, 1996).

Some manufacturers recommend the use of a primer over steel, while others recommend that primer not be used, prior to the application of a fire-resistive coating. Some gypsum-based coatings can be used on the interior of structures, while others made with Portland cement can be used for exterior applications. Some coatings can be painted, but the painted surfaces must meet the surface flammability criteria of ASTM Method E 84. Sealers are usually not needed over these fire protection products (Grace, undated).

<u>Proposed VOC Limit and Basis for Recommendation</u>:

The proposed VOC limit of 350 g/l is technologically and commercially feasible by the January 1, 2003, effective date based on: the technology assessment and limit in effect in the South Coast AQMD; and the fact that no variances from the 350 g/l limit have been requested from the 350 g/l limit in South Coast AQMD Rule 1113. The proposed limit reflects current technology. We do not expect that reformulation will be required at this time.

The National Rule VOC limit for clear fire-retardant/resistive coatings is 850 g/l. The category appears in other states' rules. The U.S. EPA does not provide a rationale for this VOC limit in the preamble to the National Rule or the Background Information Document (U.S. EPA, 1998a; U.S. EPA, 1998b).

During our technology assessment, some manufacturers requested a VOC limit for fire-resistive coatings of 420-430 g/l. Manufacturers claim that this limit is needed for exterior mastic coatings because they must withstand more rigorous weathering than interior coatings. In contrast, the interior mastic coatings are very low in VOC, but do not withstand the weathering criteria. However, these manufacturers have not provided test data, product literature, or VOC content data to support the need for a higher limit.

We recommend that the VOC limit for fire-resistive coatings be 350 g/l, the same as in the South Coast and Antelope Valley Districts. This limit has been successfully in effect since 1999 in the South Coast AQMD. We concur with the technology assessment of the South Coast AQMD in which the manufacturers who requested the category claimed that they could achieve the 350 g/l limit by January 1, 1999. To date, the South Coast AQMD has received no applications for variances from manufacturers of fireproofing coatings; therefore coatings sold in the South Coast AQMD with a VOC content higher than 350 g/l would be in violation of Rule 1113 (Berry, 2000).

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11. Floor Coatings

Product Category Description:

Floor coatings are opaque coatings labeled and formulated for application to flooring including, but not limited to, decks, porches, steps, and other horizontal surfaces that may be subject to foot traffic. Due to their exposure to impacts and abrasion, floor coatings usually possess good adhesion qualities. These coatings are used in a variety of commercial and industrial applications, as well as residential applications. (Note: Clear coatings recommended for floors are not included in the floor coating category. Varnishes and lacquers that are recommended for use on wood floors are considered clear wood finishes and are subject only to the VOC content limit for their respective categories.) (South Coast AQMD, 1999)

The 1998 ARB survey shows that 1996 sales in California were 657,393 gallons for water-based formulations, or about 57 percent of the total floor coatings sales. The sales weighted average VOC content for water-based floor coatings is 164 g/l. The sales weighted average VOC content of the 493,568 gallons of solvent-based formulations was 197 g/l, which is less than the proposed 250 g/l VOC limit (ARB, 1999).

Table VI-10 below summarizes our estimate of sales and VOC emissions from the floor coatings category.

Table VI-10
Floor Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	246	493,568	197	0.46
Water-Based	332	657,393	164	0.33
Total	578	1,150,961	157	0.79

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Product Use and Marketing:

Typical uses of floor coatings include a variety of commercial, industrial, and residential applications. These coatings are designed and recommended for application to either wood or concrete flooring including, but not limited to, residential and commercial garage floors, commercial parking garages, warehouse floors and residential and commercial wood floors, decks, porches, and steps. Many floor coatings are resistant to many solvents, chemicals, and gasoline and oil spills. Floor coatings may also be formulated to have tire mark releasing properties when using an appropriate cleaner. Floor coatings are sold in hardware stores, at home improvement centers, and paint stores.

Appropriate surface preparation is essential to obtain adequate adhesion of floor coatings. Typical recommended preparation is to remove all dirt, grease, oil, efflorescence, waxes and other foreign matter from the surface to be coated. On glossy surfaces, the surface should be deglossed to allow for better adhesion of the coating. When coating raw/bare smooth cured concrete, it is commonly recommended that the surface first be cleaned and lightly etched with an acid based solution. It may then be necessary to completely neutralize the substrate (above and below the surface) and let it dry. Etching a smooth concrete surface will increase the surface profile, resulting in better adhesion. Substrate alkalinity is also often a critical factor that may affect adhesion and overall performance of certain floor coating formulations. Therefore, it is often recommended that concrete be allowed to cure for at least 28 days prior to coating.

Product Formulation:

Typically, the coating system includes a primer and topcoat or a two-component single coat coating. Although formulated using a number of resin systems, the highest performing floor coatings are based on epoxy or polyurethane systems. Over the past five years, the most significant progress in floor coatings has been the development of zero-VOC, two-component, aliphatic polyurethane coatings, and two-component epoxy coatings. Regardless of the resin system employed, the use of a primer/sealer is often recommended to enhance adhesion. The newer polyurethane technology is based on both 1-part and 2-part coatings, with numerous products being offered as completely solvent-free systems. (South Coast AQMD, 1999)

There have been recent developments in water-based polyurethane coatings for high performance floor applications. Several paint manufacturers have commercialized two-component water-based polyurethane systems for heavy-duty concrete floor protection. These systems are virtually odor free, have 0 g/l VOC content, and provide excellent wear resistance. These formulations are based on water-dispersible aliphatic polyisocyanates and water-dispersible polyester polyols. (MPC, 1996)

Two component formulations may be subject to degradation from ultra violet (UV) exposure. For example, epoxies may chalk from UV exposure. The chalking does not effect the durability of the finish, only the appearance. There are, however, UV stabilized formulations available at an additional cost. Use of an additional topcoat is also an alternative to improve UV performance.

Proposed VOC Limit and Basis for Recommendation:

The proposed SCM recommends a VOC limit of 250 g/l for floor coatings. The proposed VOC limit is technologically and commercially feasible by the January 1, 2003, effective date based on our review of the literature and trade journals, complying marketshare, and information provided by manufacturers and resin suppliers.

The proposed limit of 250 g/l differs from the previously proposed limit of 100 g/l. This is due primarily to enforcement concerns, especially for California districts with fewer enforcement resources than the South Coast AQMD. (The South Coast AQMD's Rule 1113 has a floor coating limit of 100 g/l, effective July 1, 2002.) Many coatings in other categories go on horizontal surfaces subject to foot traffic, such as industrial maintenance coatings, stains, and waterproofing wood sealers. These coatings categories have proposed limits of 250 g/l. We recognize that there are similarities between floor coatings and these other categories. Manufacturers could re-label products rather than reformulate them if the VOC limit is different among these categories and floor coatings. Accordingly, for improved enforceability outside of the South Coast AQMD, the proposed SCM has a floor coating limit of 250 g/l. This also has the effect of allowing for more complying single component floor coatings for residential use.

Survey Results

Table VI-11 below summarizes our estimates of the number of products that were marketed in 1996 that complied with the proposed VOC limit and their associated marketshare for that year. No the emission reductions would be realized if the limit were implemented in the non-South Coast AQMD portions of the State, because floor coatings currently are subject to the default VOC limit of 250 g/l, since there is no floor coatings category in most district architectural coatings rules.

Table VI-11
Floor Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
250	373	84.8	0

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Literature Search

As a part of our analysis, ARB staff gathered information on numerous floor coating systems that comply with the proposed limit.

For example, Air Products and Chemicals, a raw material supplier of architectural and high performance resins, is currently marketing the ADURA™ Polyols line, which is recommended for a variety of floor uses, including gymnasiums and industrial facilities. The two-component, aliphatic polyurethane formulations also provide excellent coverage. The lower-cost ADURA™ 50 is specifically recommended for concrete coating formulations. (South Coast AQMD, 1999)

The Sherwin-Williams Company markets a 100 percent solids, self-leveling epoxy coating called "ArmorSeal 650 SL/RC," which is a two-component, zero-VOC floor coating.

They also have a zero-VOC primer recommended for use with the topcoat, as well as additional formulations of zero-VOC floor coatings. (South Coast AQMD, 1999)

Coatings Resources Corporation (CRC), a Southern California coating manufacturer also manufactures several zero-VOC floor coatings. These include their CR-10, CR-11, CR-12, and CR-13 coatings, all 100 percent solids, epoxy or epoxy novolac formulations. In addition, CRC has single-component acrylic floor coatings with VOC contents of less than 50 g/l that are recommended for residential and commercial applications. (South Coast AQMD, 1999)

Madison Chemical Industries, Inc. has several high performance, zero-VOC, two-component coatings recommended for a variety of industrial and general maintenance uses, including flooring. Their Tufsheen II is a two-component aliphatic polyurethane coating that complies with the proposed limit for floor coatings. (MCI, 1999)

Hart Polymers, Inc., a supplier of raw materials and high performance coatings, also has a variety of water-based, zero-VOC, floor coatings. HP-100 is a two-component aliphatic urethane, offering excellent coverage and a pot life. Hart Polymers also markets zero-VOC, single-component floor coatings in both aliphatic polyurethane and acrylic/aliphatic polyurethane dispersions, labeled HP-140 and HP-130, respectively. These single component floor coatings can also be used in residential environments. (South Coast AQMD, 1999)

Poly-Carb, Inc., a company based in Cleveland, Ohio, has a variety of high build, 100 percent solids, two-component floor coatings, with specialty formulations available for a variety of chemical exposures. Specifically, the MARK-64.1 is a heavy duty floor coating recommended for wastewater and water treatment plant floors, industrial and manufacturing floors, laboratories, kitchens, food processing areas, high traffic areas, splash zones, and areas subject to corrosive acid and alkali spills. (South Coast AQMD, 1999)

Seal-Krete, Inc., a company based in Auburndale, Florida, markets several floor coatings that comply with the proposed VOC limit. Their zero-VOC product, Proformance Skid-Proof (PSP) is a water-based, acrylic-based, quartz, non-cementitious anti-skid coating. PSP is neutral in color and can be tinted by adding a desired color of exterior gloss acrylic, acrylic floor enamel or industrial acrylic enamel coating. When fully cured, it is hard and tough; yet flexible, with a high tensile strength, is waterproof, weather-resistant, impact resistant, salts resistant and chlorine resistant. PSP may be applied by trowel or spray hopper (a brush and roll down formulation is also available with 40 g/l VOC). During and after application before it has time to dry, PSP may be cleaned up with soap and water. PSP is used as a decorative, protective coating for long-term preservation of various surfaces including: concrete, wood, plywood, primed metal and styrofoam. PSP can be used on interior and exterior vertical and horizontal surfaces including traffic areas such as: walkways, patios, stairs, pool decks, balconies, ramps, and driveways. (Seal-Krete, 1999)

Vianova Resins, Inc., has developed floor coatings formulations (0 - 250 g/l VOC) based on their BECKOPOX epoxy resins and curing agents. These water-based coatings offer excellent adhesion, fast drying, high coverage rate, smooth flow and leveling and excellent lapping. (BECKOPOX, 1999)

Vianova Resins, Inc., has also developed their air-drying RESYDROL® AY466 high gloss enamel, an acrylic-modified, core-shell, alkyd emulsion formulation (72 g/l VOC). This high performance coating offers excellent application properties, superior scratch resistance, quick drying, and excellent weatherability, chemical resistance, and adhesion to wood. (Vianova Resins, 1999)

Other companies offering floor coatings that comply with the proposed 250 g/l limit include Polycoat Products, Ameron, United Coatings, Pacific Polymers, Tnemec, and Pittsburgh Paints. (South Coast AQMD, 1999)

Issues:

1. Issue: Two component coatings cost too much and are too difficult for the average homeowner to use.

Response: Many of today's two component coatings offer an extended pot life (up to 8 hrs) which greatly enhances their application. To assist homeowners, local hardware stores offer "How-To" clinics on many subjects. Sales representatives from one of the largest west coast retail hardware chains have indicated a positive response from homeowners regarding their use of two component floor coatings. In addition, although two component floor coatings will provide the highest performance, there are compliant single component coatings available with acceptable performance levels that are easier to use.

2. Issue: Two component coatings are too dangerous for the average homeowner to use.

Response: The moisture cured, two component, and prepolymer plus catalyst polyurethane coatings that contain free isocyanates can be hazardous and are only recommended for professional application.

There are other types of polyurethane coatings (oil modified, for example) that are available for the homeowner that have no free isocyanates. Two component epoxies do not have this type of hazard associated with their use. In addition, although two component floor coatings will provide the highest performance, there are compliant single component coatings available with acceptable performance levels.

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12. **Flow Coatings**

Product Category Description:

Flow coatings are products designed for use by electric power companies or their subcontractors to maintain the protective coating systems on utility transformer units. These coatings are extensively thinned with solvent to allow them to run down into electric utilities' transformer radiator fins to create a thin, even film that will not interfere with heat exchange. This method of application is necessary because it is difficult to apply paint in between the radiator fins by other painting methods (PG&E, 1/3/00a). According to one manufacturer, these coatings cannot be thinned down with water because they would dry too quickly in warm temperatures and would not flow out into a thin, even film (Triangle Coatings, 12/10/99).

We are proposing to add a new category for flow coatings in the SCM. These coatings are not regulated in district architectural coatings rules as a separate category (but instead are subject to the industrial maintenance category). However, as explained below, we believe that a new category and VOC limit for these products is justified. In addition, the U.S. EPA's national architectural coatings rule contains a separate category and VOC limit for these products.

No flow coatings were reported in the ARB's Architectural Coatings Survey. However, one manufacturer subsequently provided sales volumes in California, and VOC content information, indicating that these products contribute VOC emissions less than 0.01 tons per day (TPD) statewide, excluding the South Coast AQMD.

Product Use and Marketing:

Flow coatings are highly specialized coatings used by electric power companies or their subcontractors, and are not available to the general public through typical retail outlets. As mentioned above, these coatings are designed to produce a thin film on transformer radiator fins that will not impede heat exchange. These coatings are applied with a hose over the top of transformer radiators, and allowed to run down the fins (Triangle Coatings, 12/10/99; PG&E, 1/3/00b). The excess coating drips into a collection basin at the bottom of the radiator, and a pump then pulls the excess coating from the basin where it is again applied over the top of the radiator fins until all of the radiator surfaces are coated. The excess coating in the basin can be recovered.

Product Formulation:

We are only aware of one flow coatings manufacturer that sells these products in California. This manufacturer currently produces a water-based flow coating developed specifically for PG&E, that is thinned extensively with butyl cellosolve to allow for the desired flow-out in warm weather conditions. Due to confidentiality concerns, we cannot reveal further details about this formulation.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 420 g/l VOC limit for flow coatings, effective January 1, 2003. This is slightly lower than the 450 g/l VOC limit in the U.S. EPA's national architectural coatings rule. However, the proposed VOC limit is technologically and commercially feasible because it essentially places a cap on the VOC content of existing products sold in California. We believe this proposed VOC level is appropriate because we are not aware of any lower VOC products or existing technology that would allow for compliance with a lower VOC limit. Increasing the solids level, or the amount of water, would not allow for the flow out needed in this application. These products would generally be subject to the 50 g/l VOC limit proposed for industrial maintenance coatings if they are not provided with a separate category. Finally, as mentioned above, the emissions from these products are less than 0.01 TPD statewide, excluding the South Coast AQMD.

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Triangle Coatings. Telephone conversation with ARB staff. December 10, 1999. (Triangle Coatings, 12/10/99)

13. **High-Temperature Coatings**

Product Category Description:

High-temperature coatings are high performance products formulated, recommended, and designed for use on the surface of materials exposed continuously or intermittently to temperatures above 204°C (400°F). [This category differs from industrial maintenance coatings which are designed for repeated exposure to temperatures above 121°C (250°F)].

Table VI-12 below summarizes our estimate of sales and VOC emissions from the high-temperature coatings category.

Table VI-12
High-Temperature Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	91	22,839	367	0.05
Water-Based	113	175	222	~0.00
Total	204	23,014	366	0.05

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

A high-temperature coating that also meets the definition of "metallic pigmented coating," containing at least 48 grams of elemental metallic pigment per liter (0.4 lb/gal) of coating as applied (see Section B-10), is subject only to the proposed 500 g/l VOC limit for "metallic pigmented coatings." A new category for "temperature-indicator safety coatings" (see Section A-28~~6~~) is being proposed as a separate category from the "high-temperature coatings" category. Section 3.2 of the proposed SCM has been revised to clarify that these categories are not subject to the most restrictive limit.

Product Use and Marketing:

Typical uses of high-temperature coatings include the protection of metal surfaces of furnaces, stacks, power plants, heat exchangers, boilers, exteriors of reactors, oil refineries, chemical plants, piping, exhaust mufflers, as well as other surfaces exposed to high temperatures.

Surface preparation and coating application methods should be similar to those for the more typical "industrial maintenance coatings" (see Section A-14~~2~~). Manufacturer recommendations may include surface preparation by abrasive blasting or other methods, and application of the coating within a specified time period to avoid new rust. Application may be by spray equipment, especially for larger jobs. Some coatings may also be applied by brush or roller.

High-temperature coatings are sold by independent coating retailers and brand-name sales outlets that also sell the more typical "industrial maintenance coatings" (see Section A-14 ~~12~~), however, there are fewer high-temperature coating products available and hence market availability is likely to be more limited.

Product Formulation:

Current high-temperature coatings are predominately solvent-based, constituting 99 percent of the sales volume reported in the 1998 ARB survey. High-temperature coatings may be formulated with resins containing silicon compounds, while containing less organic compounds that tend to deteriorate at higher temperatures. Traditional moderate temperature heat-resistant coatings include solvent-based silicone alkyd and silicone acrylic formulations, sometimes with zinc or aluminum pigments. Higher temperature heat-resistant coatings include solvent-based pure silicone formulations. Some heat resistant coatings require heat curing upon restarting (and thus reheating) the painted equipment. Newer heat-resistant coatings include a low-VOC (less than 250 g/l) siloxane formulation that is heat resistant up to 1112° F (600° C).

Proposed VOC Limit and Basis for Recommendation:

The proposed VOC limit is 420 g/l, effective January 1, 2003. The proposed limit is technologically and commercially feasible, by the effective date, based on our review of complying marketshare, currently available coatings, the Harlan Associates Study, and the 420 g/l VOC limit currently in effect in eight district rules.

As indicated in Table VI-13 below, 52 percent of the market already complies with the proposed limit. According to the ARB 1998 survey, a notable portion of the market consists of coatings with VOC content in the range from 450 to 500 g/l, which is slightly higher than the proposed VOC limit of 420 g/l. Coatings in this range may have the option to comply by adjusting their resins/formulations, tightening quality control, increasing solids content, or substitution of solvents with exempt compounds, such as Oxsol 100™ ~~or the potential future exempt solvent tertiary-butyl acetate (TBAc™~~).

Table VI-13
High-Temperature Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
420	54	52	0.00

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

The proposed limit is already in effect in eight districts, with a ninth district (the South Coast AQMD) to have the limit in effect on July 1, 2006. In the eight districts the VOC limit will remain the same, resulting in essentially no reduction in the non-South Coast AQMD portion of the State with the proposed SCM limit. To allow time for the unique temperature-indicator safety coatings to comply with the 420 g/l limit, the South Coast AQMD has provided an interim limit of 550 g/l for the period from July 1, 2002, to July 1, 2006.

The following summarizes VOC limits in the U.S. EPA regulation for high-temperature and related coatings.

VOC Limits Adopted by U.S. EPA

Coating Category	VOC Limit (g/l)*
High-Temperature	650
Heat-Reactive**	420

* Grams VOC per liter of coating, less water and exempt compounds.

** "Heat-reactive" coatings are phenolic-based coatings that require heat for curing (see Section B-9).

Harlan Associates Study

The Harlan Associates Study (Study) included testing of three high-temperature coatings with VOC contents below the 420 g/l limit, and two high-temperature coatings with VOC contents above the 420 g/l limit. The Study indicated that the performance of the high-VOC coatings and the low-VOC coatings was essentially equivalent for a number of critical areas. The tests included evaluations of coating heat resistance, stability, hardness, adhesion, dry-to-touch time, abrasion resistance, and impact resistance.

Issues:

1. Issue: The limit should initially be 550 g/l (as in South Coast AQMD rule), with the limit dropping to 420 g/l in the year 2006. For safety reasons, an oil refinery must use certain high-temperature indicator coatings, as required by current equipment designs. An initial limit of 550 g/l would allow current coatings to be used, while other products for high-temperature service are evaluated.

Response: A new category for "temperature-indicator safety coatings" is being proposed for this unique type of coating (see Section A-28~~6~~). The limit for the new category is proposed to be 550 g/l, effective January 1, 2003. A limit of 420 g/l is proposed to be retained for other high-temperature coatings.

REFERENCE

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

14. Industrial Maintenance Coatings

Product Category Description:

Industrial maintenance coatings are high performance products designed for use to protect the surface of structures and other stationary equipment ~~(except floors)~~ exposed to one or more of the following extreme environmental conditions:

a. Immersion in water, wastewater, or chemical solutions (aqueous and non-aqueous solutions), or chronic exposure of interior surfaces to moisture condensation;
b. Acute or chronic exposure to corrosive, caustic or acidic agents, or to chemicals, chemical fumes, or chemical mixtures or solutions;
c. Repeated exposure to temperatures above 121^{o}C (250^{o}F). [However, if a coating is formulated, recommended, and used for applications to surfaces and materials exposed continuously or intermittently to temperatures above 204°C (400°F), the coating would fall into the category of "high-temperature coating" (see Section A-13)].
d. Repeated (frequent) heavy abrasion, including mechanical wear and repeated (frequent) scrubbing with industrial solvents, cleansers, or scouring agents; or
e. Exterior exposure of metal structures and structural components.

These coatings include primers, sealers, undercoaters, intermediate coats, and topcoats. ~~Industrial floor coatings are not in the "industrial maintenance coatings" category, but are included in the "floor coatings" category with a VOC limit of 100 g/l.~~

A coating meeting the definition of "industrial maintenance coatings" may also meet the definition of "high-temperature coatings," "metallic pigmented coatings" (e.g. anti-rust primers formulated with zinc dust), "pre-treatment wash primers," or "temperature-indicator safety coatings." Section 3.2 of the proposed SCM ~~has been revised to~~ clarif~~y~~ies that these categories are not subject to the proposed limit for industrial maintenance coatings.

Some categories of coatings meet both the definition of "industrial maintenance coating" in the SCM and another coating category as defined in the U.S. EPA's national rule. In the national rule these "national categories" coatings are treated as separate categories with less stringent VOC content limits. In the SCM, only three of the "national categories" are treated as separate categories - "antenna coatings," "anti-fouling coatings," and "flow coatings." Section 3.2 of the proposed SCM clarifies that these categories are not subject to the proposed limit for industrial maintenance coatings. These categories are discussed in Sections A-~~3,~~4, 5, and ~~10~~ 12.

The SCM does not consider the remaining "national categories" separately, so the VOC limit for "industrial maintenance coatings" would generally apply to these categories (as discussed in Section C of this Chapter).

In the South Coast AQMD rule, two other coating categories were separated from the industrial maintenance coating category (Rule 1113 - "Architectural Coatings," amended May 14, 1999). These categories are "chemical storage tank coating" and "essential public service coating." As defined in the South Coast AQMD rule, a "chemical storage tank coating" (at 420 g/l, interim limit) is a coating used as an interior tank lining for the storage of oxygenated solvents, oxygenated solvent mixtures, or acid based products. As defined in the South Coast AQMD rule, "essential public service coating" (at 340 g/l, interim limit) is defined as a protective (functional) coating applied to components of power, municipal wastewater, water, bridges and other roadways; transmission or distribution systems during repair and maintenance procedures." Instead of using the South Coast AQMD approach, the SCM would generally keep chemical storage tank and essential public service within the "industrial maintenance coating" category. However, to allow time for essential public service agencies to complete their separate technology assessment and their administrative processes before low VOC coatings can be used, the proposed compliance date is extended until January 1, 2004. This extension would avoid the need to provide essential public services a higher VOC limit until they receive approval to use complying coatings. Coatings for lining tanks and for aggressive exterior exposure are available with VOC contents below 250 g/l, including several with zero VOC (see references - "Example Low-VOC Coatings for Tank Linings" and "Example Low-VOC Coatings for Aggressive Exterior Exposure").

Table VI-14 below summarizes our estimate of sales and VOC emissions from the industrial maintenance coating category.

Table VI-14
Industrial Maintenance Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	1,880	3,902,392	321	7.64
Water-Based	771	379,074	170	0.20
Total	2,759	4,281,466	300	7.84

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
****** Grams VOC per liter of coating, less water and exempt compounds.

Product Use and Marketing:

Industrial maintenance coating is a generic term for a variety of high performance coatings used in areas with harsh environmental conditions. Typical users include onshore and offshore oil and gas production, refineries, petrochemical production and processing, marine (except boats, ships, and other watercraft), pulp and paper mills, bridges, manufacturing facilities, water supply facilities, and waste water treatment facilities. Coatings may be used for specific purposes. More specific examples include: rust prevention for steel bridges exposed to coastal air and weathering; chemical protection of the interior of petroleum storage tanks and piping; corrosion prevention of the interior of tanks (such for potable water or sewage) at essential public services; protection of equipment at pharmaceutical manufacturing and food processing plants; and protection of industrial concrete surfaces ~~(except floors)~~. Some industrial maintenance coatings are intended for limited types of use while others are versatile and multifunctional. The coating may be recommended for heavy, moderate, or light industrial environments.

Industrial maintenance coatings do not include coatings used for shop application, such as for the manufacture of parts or products in a factory, nor coatings applied to vehicles, such as railcars, ships, boats, and airplanes (see definition of "architectural coating" in Section 2.5 of proposed SCM). For coating operations such as these, districts may have separate rules regulating the use and VOC content. Also, districts may, through their permitting process, impose facility-specific permit conditions for coating and related operations.

Industrial coatings are restricted to ~~industrial~~ professional users, as prescribed by the coatings manufacturer. Marketing methods vary, in the way coatings get from the manufacturers to the end-users at industrial facilities. Independent coating retailers may provide specialized sales and services for industrial customers. The services may include field evaluations and consultation to determine appropriate coatings, available from a variety of manufacturers, and to facilitate proper coating selection and application. These independent retailers may sell certain coatings (non-industrial) to the public as well. Other independent retailers may sell primarily to the public consumer, and may provide industrial coatings on a limited basis or not at all. Some brand-name outlets market only its own proprietary line of coatings or predominantly its own line with supplemental coating products from other manufacturers. The brand-name companies may have large regional sales centers that provide consultation services and may sell their entire line of coatings for a multitude of purposes, including industrial maintenance. A manufacturer of industrial maintenance coatings, such as smaller companies with limited market distribution, may directly market and consult with industrial end-users. The industrial end-user may either have its own painting/maintenance staff or hire painting/maintenance contractors. [Note: Coatings in the "rust-preventative coatings" category are intended for ~~residential~~ non-industrial use. Rust-preventative coatings may not be used for "extreme environmental condition" purposes in industrial facilities, unless the rust preventative coating complies with the 250 g/l VOC limit for industrial maintenance coatings. (see Section A-23)]

Because of the variety of uses and types of coatings, the recommended surface preparation and application methods vary. For surface preparation in some situations, such as rust prevention of steel structures, abrasive blasting may be required to meet industry-standard surface condition specifications. Some abrasive blasting operations need containment equipment to reduce the spread of abrasives and debris beyond the immediate area. Concrete surfaces to be submerged may need abrasive blasting or etching with muriatic acid. In highly demanding environments, thorough surface preparation is crucial to the successful performance of the coating. In other situations, high-pressure water blasting, handtool cleaning, or wire brushing may be appropriate. Less demanding situations may require clean and dry surfaces with appropriate primers or base coats.

Application methods vary, from conventional air spray, airless spray, roller, spreader, squeegee, brush, or various combinations, depending on the coating and equipment to be coated. For larger jobs, spray application may be desirable because of faster application and less overall labor costs. Sometimes industrial-grade spray equipment and professional protective gear/clothing, including respirators, may be needed. Adequate ventilation must be provided, such as when working in the confined spaces of tank interiors. Two-part coatings (e.g. two-component polyurethane coatings and two-component epoxy coatings) require mixing, sometimes with power equipment, of the components shortly before application, providing a "pot life" usually within hours for surface application of the coating mix. Some coatings may be applied to entire pieces of equipment, while other coatings may be used during "touch up" of small areas. An industrial facility may need to take certain equipment, part of the facility, or the entire facility, out of operation (such as during scheduled maintenance periods) to apply the coating. Equipment intended for "immersion service" may need to be emptied and made safe for the workers. Because of the extreme conditions in some industrial environments, multi-coat systems (primer coat with midcoats/topcoats) may provide the best coating performance.

Product Formulation:

The industrial maintenance coating system may include a primer and topcoat or primer, midcoat, and topcoat, or "high-build" (thick, dry) coating. Coating formulations may be water-based or solvent-based. Among the high performance coatings are the alkyd, polyurethane, epoxy, acrylic, silicone, inorganic zinc, and vinyl formulations. Newer technology is based on both one-component and two-component coatings that achieve lower VOC content while maintaining or enhancing the protection characteristics of the coatings (South Coast AQMD, May 14, 1999).

Traditional industrial maintenance coatings include the solvent-based alkyd formulations, with VOC contents ranging from about 300 g/l to 420 g/l. Newer high-solids alkyd formulations are available with somewhat lower VOC content (up to about 340 g/l) than traditional alkyd formulations. Past efforts to market water thinnable alkyd formulations with lower VOC contents showed low market acceptance (Gordon and McNeill, 1992). However, the development of water reducible alkyd formulations is still a possible option for achieving lower VOC content levels in the future.

Among newer technologies, one of the most important is the development of aliphatic polyurethane formulations. These include water-based, zero-VOC, two-component formulations that are intended to meet or exceed the industrial high-performance level of traditional solvent-based coatings. Other polyurethane formulations are available with low VOC contents (up to 100 g/l), much lower than traditional coatings. Besides water-based polyurethane, solvent-based polyurethane formulations are also available, but with higher VOC contents (up to about 350 g/l). Two-component polyurethane coatings must be prepared by mixing-in a curing agent prior to application. Besides two-component formulations, moisture-cured polyurethane formulations are available that rely on absorption of moisture from ambient air for curing. Polyurethane coatings provide exterior durability, chemical resistance, and high gloss.

Another important technology is the development of epoxy formulations. These coatings include water-based formulations with zero or low-VOC content (up to 100 g/l), and solvent-based formulations with higher VOC content (up to about 350 g/l). These are generally two-component coatings prepared by mixing-in a hardener prior to application. Epoxy coatings are used for their chemical resistance, such as to alkalies, soaps, detergents, oils, and solvents, as well as their resistance to hot and cold water, and for their adhesion to surfaces and materials. Because of these characteristics, epoxy coatings are often used as primers, linings for tanks and piping, and concrete surfacing. "High-build" epoxy coatings are available for lining tanks to protect them during immersion service. In some situations, epoxy coatings are not preferred for use as exterior topcoats, because they may chalk after exterior exposure (Gordon and McNeill, 1992).

Acrylic coating technology, in water-based and solvent-based formulations, is used for industrial maintenance because of the exterior durability and chemical inertness of the coatings. Many water-based acrylic formulations are available with low VOC contents. An acrylic coating may be recommended as a primer, topcoat, or as a single coat (sometimes referred to as "direct to metal" for steel). Some acrylic coatings, such as for single coat use, are recommended for light to moderate industrial environments. Certain acrylic coatings are suitable for use in food processing facilities regulated by the U. S. Department of Agriculture. Vinyl technology provides coatings with water, abrasion, and chemical resistance characteristics (Gordon and McNeill, 1992).

Zero and low VOC coatings may be formulated with novolac (phenol formaldehyde resin) technology or with siloxane technology. Siloxane is a class of silicon containing compounds. Siloxane technology may be used for providing greater heat-resistance characteristics to the coating.

There are modern coating systems available with zero-VOC content that combine a water-based epoxy primer and a water-based polyurethane topcoat. In this coating system, the best characteristics of epoxy and polyurethane coatings are used in a combination that is superior to either type of coating alone. Similar epoxy primer/polyurethane topcoat systems are available with low VOC contents. There are coating systems that combine an epoxy primer with an acrylic topcoat.

Coal tar epoxy coatings are used to protect steel and concrete in underground and immersion service and for protection against attack by acids, alkalies, petroleum, petrochemicals, sewage, and other chemicals. Some of these coatings are high solids formulations with low VOC content (up to about 250 g/l).

Zinc primers, containing zinc dust, are used for corrosion protection of iron and steel surfaces and structures in industrial situations. [A coating meeting the "metallic pigmented coating" definition would be subject to the proposed 500 g/l VOC limit for that category (see Section C-11)]. However, if a primer contains less than this level of metallic pigment, the coating would typically fall into the "industrial maintenance" category.] The function of zinc primers is to provide cathodic protection for underlying iron or steel, in situations where repainting is much more cost-effective than replacement of the iron or steel. Resins may be organic or inorganic (Gordon and McNeill, 1992). Inorganic zinc primers are available with zero and low VOC contents.

Proposed VOC Limit and Basis for Recommendation:

The proposed VOC limit is 250 g/l, except for certain climatic areas where the proposed VOC limit is 340 g/l, when justified. Both limits are to be, effective January 1, 2004. The proposed limits is are technologically and commercially feasible, by the effective date, based on our review of complying marketshare, currently available coatings, the Harlan Associates Study, the National Technical Systems (NTS) study, trade journals, and information from coatings and resin manufacturers, and field experience by the California Department of Transportation (Caltrans).

The VOC limit of 340 g/l would be allowed through a petition process and would be used only in the districts in the North Central Coast, San Francsico Bay Area, and North Coast Air Basins (see Section 3.8 of the proposed SCM). This separate VOC limit is provided because of past difficulties and limited opportunities to apply coatings complying with a 250 g/l VOC limit, for steel bridges in low-temperature, high-humidity, persistent fog areas along the California coast. The petition process would require a coating manufacturer, seller, or user to petition the Air Pollution Control Officer for the use of industrial maintenance coatings with VOC content up to 340 g/l, and to certify that coatings with VOC content below 250 g/l are not available for job requirements. A maximum allocation of VOC emissions due to excesses above 250 g/l would be available in each district by calendar year. The allocation would be provided by reserving a portion of the emission reduction, at 250 g/l VOC, that is not to be claimed for State Implementation Plan purposes.

The 1998 ARB survey shows that 28 percent of the market and 941 of the coating products already meet the proposed limit (Table VI-15). We estimate that emission reductions in the non-South Coast AQMD portion of the State will be 3 TPD from a 250 g/l limit.

Table VI-15
Industrial Maintenance Coatings*

Proposed VOC Limit (g/l)**	No. of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
250	941	28	2.98 2.95

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

There are numerous coating formulations on the market, with zero or low-VOC contents that would comply with the proposed 250 g/l limit. Some are within the zero to 100 g/l range (South Coast AQMD, May 14, 1999; ARB list of coatings in Tables E-11 and E-12). Many of these are water-based polyurethane, epoxy, or acrylic formulations. There are solvent-based polyurethane, epoxy, and acrylic formulations with higher VOC contents in the 250-350 g/l range. We believe these coating formulations may be modified to comply with the proposed limit. For example, the resin may be modified to allow the solids content to be increased to displace some of the solvent. Current formulations with VOC contents above 350 g/l may need more extensive reformulation, such as solvent substitution with exempt compounds (e.g. Oxsol 100™ ~~or the potential future exempt solvent tertiary-butlyl acetate (TBAc™)~~). For solvent-based two-component polyurethane formulations, it may be possible to lower the VOC content with new polyurethane prepolymers that need less solvent, and reformulating with reactive diluents (Dassner and Johnson, 1996). Reactive diluents initially act as solvents and then form part of the coating, instead of evaporating away, thus reducing VOC emissions.

The solvent-based alkyd formulations may contain VOCs in the range of 300 to 420 g/l. One possible compliance option for these coatings would be substitution of traditional organic solvents with low-reactivity exempt solvents. Oxsol 100™ is one exempt solvent currently available. ~~A potential future exempt solvent is tertiary-butlyl acetate (TBAc™), believed to be a potential replacement for a variety of traditional organic solvents, such as toluene, xylene, methyl ethyl ketone (MEK), and methyl isobutyl ketone (MIBK) (Pourreau et. al., 1999).~~ Two other options being considered are high-solids alkyd formulations and water reducible alkyds. Other options, going beyond pure alkyd formulations, involve the development of alkyd hybrids to achieve lower VOC levels while possibly enhancing other performance characteristics. Possible hybrids include rosin and phenolic-modified alkyds, acrylic alkyd copolymers, silicone alkyds, and epoxy ester modifications (Ryer, 1998).

The most common current district VOC limit is 420 g/l, although several districts have a VOC limit of 340 g/l. In the South Coast AQMD, the interim VOC limit is 250 g/l, effective July 1, 2002, and the final VOC limit is 100 g/l, effective July 1, 2006 (except for essential public service coatings and chemical storage tank coatings with different interim limits, as previously discussed).

The following summarizes VOC limits in the U.S. EPA regulation for industrial maintenance and related coatings.

VOC Limits Adopted by U.S. EPA

Coating Category	VOC Limit (g/l)*
Industrial Maintenance	450
Antenna	530
Anti-Fouling	450
Anti-Graffiti	600
Chalkboard Resurfacers	450
Extreme High Durability	800
Flow	650
Heat Reactive	420
Impact Immersion	780

Nonferrous Ornamental Metal Lacquers and Surface Protectants	870
Nuclear	450
Repair and Maintenance Thermoplastic	650
Thermoplastic Rubber and Mastics	550

* Grams VOC per liter of coating, less water and exempt compounds.

Harlan Associates Study

The Harlan Associates Study tested the performance of 13 industrial maintenance primers (5 below 250 g/l, and 8 above), and 12 industrial maintenance topcoats (5 below 250 g/l, and 7 above). For the primers, the performance characteristics tested include stability, hardness, application, adhesion, drying time, impact resistance, flexibility, and salt spray. For the topcoats, the performance characteristics tested included the same tests and added tests for accelerated weathering and gloss.

In general, the performance of low-VOC coatings was similar to high-VOC coatings, however, some differences were noted. For the primers, the low-VOC primers showed better results from the tests for adhesion, flexibility, and impact resistance, while the high-VOC primers showed better results from the tests for salt spray, and water immersion. For the topcoats, the low-VOC topcoats showed better results from the tests for flexibility, while the high-VOC topcoats showed better results from the tests for appearance, salt spray, and gloss.

NTS Study

The National Technical Systems study tested the performance of industrial maintenance coatings individually as primer coats and topcoats, and together as coating systems (primer coats with appropriate topcoats). More than half of the 47 coatings tested were two-component coatings.

The study showed the performance of low-VOC coating systems was essentially similar to high-VOC coating systems except during one test. The low-VOC coating systems showed better mar resistance than the high-VOC coating systems. The study also showed that the performance of low-VOC primer coats and topcoats (tested separately) was essentially similar to that of high-VOC coatings.

<u>Issues</u>:

1. Issue: A limit of 250 g/l is not stringent enough, and an effective date of July 1, 2002, (previously proposed) is too late. Ultra-low VOC coatings and the raw materials to make them are already available. Currently available ultra-low VOC coatings outperform existing solvent-based coatings. The South Coast AQMD has identified 55 commercially available high-performance industrial maintenance coatings at 100 g/l or lower for essentially any use and application. The ARB should lower the VOC limit to 100 g/l, to be effective January 1, 2001.

Response: The industrial maintenance coatings category covers a very broad range of coating uses and coating formulations. The proposed VOC limit of 250 g/l and the proposed effective date (revised to January 1, 2004) would provide more opportunity for a broader variety of coating formulations to be available in the future to meet those varied needs. For example, the current alkyd formulations are solvent-based with VOC contents of about 400 g/l. We are aware of efforts to develop low-VOC alkyd formulations, including water-reducible alkyds. We believe that the proposal would allow resin and coating manufacturers to continue to develop different types of low-VOC coatings. This would ultimately provide more flexibility to industrial end-users to address specific coating needs.

2. **Issue:** The "industrial maintenance" category is too broad and does not consider special uses. Subcategories should be created and provided with less stringent limits when justified. Various commenters suggested the following subcategories.

- "Essential public services" (as in South Coast AQMD rule)
- Combining similar private facilities with "essential public services"
- "Chemical storage tank" (as in South Coast AQMD rule)
- Tank lining and piping
- Immersion service - water, wastewater, petrochemicals, other chemicals (general)
- Bridges and similar structures, storage tanks
- Zinc-rich coatings

Include "new construction" in the definition of "industrial maintenance coatings"
Include "commercial" and "institutional" use in definition of "industrial maintenance coatings"

More stringent limits and low-VOC technologies should be directed toward uses in which the technologies are most feasible. Less stringent limits should be provided for uses in which low-VOC technologies are less feasible.

Response: In general, dividing the "industrial maintenance" category into subcategories would make the SCM provisions more difficult for districts to enforce and create more confusion to the regulated community. As discussed above, there are several reformulation options available to meet the proposed limit. To provide time for essential public service agencies to complete <u>their separate technology assessment and their</u> administrative processes before low VOC coatings can be used, the ARB staff is proposing to delay the effective date of the 250 g/l limit until January 1, 2004. This extension would avoid the need to provide essential public services a higher VOC limit until they receive approval to use complying coatings.

<u>As discussed above, we are proposing to allow up to 340 g/l coatings for all qualified users in districts with high humidity, persistent fog and cold temperatures.</u>

3. **Issue:** Government agencies may specify or may need to approve coatings for certain types of use. There is a problem when no low VOC coating is specified/approved, because several years of field testing and evaluation by another organization may be needed before a low VOC coating can be used in some situations.

Response: The ARB staff is proposing to delay the effective date of the 250 g/l limit until January 1, 2004. This would provide time for essential public service agencies to complete their separate technology assessment and their administrative processes, required before low VOC coatings can be used. This extension would avoid the need to provide essential public services a higher VOC limit until they receive approval to use complying coatings. As discussed above, there are several complying solvent-based and water-based coatings reformulation options available. Existing coatings meeting the proposed 250 g/l limit are available now.

4. **Issue:** For immersion service, there are no accelerated test methods available. Many years of field testing are needed to demonstrate the suitability of a new coating for immersion service.

While in service, the coating may be submerged for years and may not be easily inspected visually. High-volume, turbulent liquid flow rates inside piping may substantially accelerate any coating failure and the subsequent equipment failure, if a defect starts in the coating. The coating must be highly reliable. The liability of coating failure is very high.

Essential public services, such as agencies that supply fresh water or treat wastewater, recommend a limit in the 340 to 350 g/l range to allow time for laboratory, field testing, and approval of low-VOC coatings. To address these concerns, South Coast AQMD has provided an interim district limit of 340 g/l for "essential public service coatings."

Response: See responses to issues 2 and 3.

5. **Issue:** Most bridges and similar structures have isolated areas that need higher-VOC coatings. Also, bridges exposed to the severe conditions along the California coast need higher-VOC coatings. These coatings have no suitable replacement. To address these concerns, the South Coast AQMD has provided an interim district limit of 340 g/l for "essential public service coatings."

Response: See responses to issues 2 and 3.

6. **Issue:** Development time for chemical tank coatings is very long. It is not possible to predict the types of aggressive chemicals that will need storage. For example, the composition of gasoline changes with respect to additives. To address these concerns, the South Coast AQMD has provided an interim district limit of 420 g/l for "chemical storage tank coatings" used for the interior of tanks storing oxygenated solvents, oxygenated solvent mixtures, or acid-based products.

Response: See responses to issues 2 and 3.

7. **Issue:** Some structures that were originally coated with solvent-based coatings need patch repair and maintenance with compatible coatings. A coating manufacturer or government agency may require specific high-VOC coatings for this purpose.

Response: See responses to issues 2 and 3. The time extension would apply to all uses, including patch and repair.

8. **Issue:** Consideration should be given to atmospheric conditions more extreme than in the South Coast AQMD during application of coatings. Other areas of California have higher temperatures, lower temperatures, and higher humidity. To accommodate these conditions, higher VOC coatings are needed. A limit of 340 g/l may be appropriate.

Response: See responses to issues 2 and 3.

9. **Issue:** A limit of 250 g/l is not proven for tank lining exposure or for aggressive exterior exposure involving ultra-violet light together with moisture, salt, chemical fumes, temperature extremes.

Response: See responses to issues 2 and 3. Coatings for lining tanks and for aggressive exterior exposure are available with VOC contents below 250 g/l, including several with zero VOC.

10. **Issue:** A limit of 250 g/l would prohibit the use of more than 95 percent of the coatings now used for oil refinery tanks. Similar problems exist with coatings for refinery vessels, exchangers, furnaces, and piping.

Response: See responses to issues 2 and 3.

11. **Issue:** A limit of 250 g/l is feasible with one important exception - coatings for tanks and piping.

Response: See responses to issues 2 and 3.

12. **Issue:** The VOC limit should initially be 420 g/l, lowered to 340g/l after several years, and then lowered further to 250 g/l after several more years.

Response: See responses to issues 2 and 3.

13. **Issue:** To meet a limit of 250 g/l by 2002 (previously proposed effective date), regulatory flexibility should be provided for low volume, noncompliant, special-use coatings. Examples of regulatory provisions for flexibility include averaging, variance procedure, and/or small volume exemption.

Response: As discussed above, the ARB is proposing to include three of the small "national" categories in the SCM. These new categories include special-use small volume coatings for which it is not technologically and commercially feasible to meet the proposed 250 g/l limit. To provide flexibility for climatic conditions, the ARB is proposing a provision to allow a 340 g/l VOC limit for industrial maintenance coatings applied in persistent fog, low temperature regions in accordance with a petition process, as discussed above. To provide compliance flexibility, the ARB staff is considering development of an optional averaging provision for coatings manufacturers.

14. **Issue:** The ARB should withhold adoption of any SCM limit until results from the NTS study are reviewed by ARB and industry. The performance of reformulated industrial maintenance coatings is a major concern to painting contractors.

Response: As discussed above, the NTS study shows the performance of zero and low-VOC industrial maintenance coatings is similar to the performance of traditional high-VOC coatings. Results showed the mar resistance of low-VOC coating systems was better than high-VOC coating systems. The ARB staff is proposing to delay the effective date of the 250 g/l limit until January 1, 2004.

15. **Issue:** It is not possible to make industrial maintenance coatings of the quality, flexibility of application, and chemical safety expected by customers at the proposed VOC limit.

Response: See responses to issues 2 and 3. In addition, zero and low-VOC formulations result in lower VOC emissions and thus provide the safety benefits of lower solvent levels in the air.

16. **Issue:** There should be language uniformity with the national rule to minimize the marketing of two types of industrial maintenance coatings, one to California customers and another to the rest of the nation. Also, different definitions and different limits would prevent California customers from obtaining the best products.

Response: The national rule is intended to be minimum national requirements. Because California has the most severe ozone air quality problem in the nation, California needs to adopt lower VOC limits that are technologically and commercially feasible. The proposed SCM definition for industrial maintenance is similar to the national definition.

17. **Issue:** Water-based industrial maintenance primers will not adhere to concrete treated with form release compounds. Galvanized metal and aluminum and concrete treated with silicone, silane, or siloxanes do not allow water-based primers to stick. Solvent-based primers at 350 g/l are needed.

Response: See responses to issues 2 and 3. Proper surface preparation of the substrate is crucial to the performance of any coating, and especially so in the case of high-performance industrial maintenance coatings.

18. Issue: The definition of "industrial maintenance coating" should include coatings for electric transformers on a pole and underground vaults.

Response: The definition of "industrial maintenance coating" is sufficiently broad to include coatings for electric transformers on a pole and underground vaults. More specifically, section 2.25.1 refers to "…chronic exposure of interior surfaces to moisture condensation…", section 2.25.2 refers to "…chronic exposure to corrosive, caustic, or acidic agents…"; and section 2.25.5 refers to "… exterior exposure of metal structures and structural components…"

19. Issue: There is confusion concerning the use of "industrial maintenance coatings" and the use of "rust preventative coatings" because of category overlap, inconsistencies of the definitions, labeling requirements, and other inconsistent provisions.

Response: The ARB staff has revised the proposal to address these comments. The staff has deleted the provision that would have allowed "rust preventative coatings" that also meet the definition for "industrial maintenance coatings" to be subject only to the less stringent 400 g/l limit for "rust preventative coatings." Also, "rust preventative coatings" are for ~~residential~~ non-industrial use only and only on metal substrates. We are adding a definition for non-industrial use to clarify the distinction between industrial maintenance and rust preventative coatings.

20. Issue: There is a potential for manufacturers of industrial maintenance coatings to relabel higher VOC coatings into the "rust preventative coatings" category, to take advantage of a less stringent limit of 400 g/l. This could result in less emission reductions achieved in the "industrial maintenance coatings" category. The "rust preventative coatings" category is intended for residential users.

Response: The staff has deleted the provision that would have allowed "rust preventative coatings" that also meet the definition for "industrial maintenance coatings" to be subject only to the less stringent 400 g/l limit for "rust preventative coatings." This revision should more effectively separate the use of coatings in these two categories. ARB staff will monitor the sales of "rust preventative coatings" by evaluating data obtained from coatings manufacturers, to be submitted in accordance with Section 5.2 of the proposed SCM.

21. Issue: Anti-graffiti coatings are within the "industrial maintenance coatings" category. Since only industrial users may use coatings in this category, this creates a problem for residential, commercial, and institutional users of anti-graffiti coatings, who are not clearly industrial users. Certain high-performance coating characteristics are needed in anti-graffiti coatings, and hence they are similar to some types of industrial maintenance coatings.

Response: ~~In addition to industrial use, the SCM allows the commercial and institutional use of anti-graffiti coatings that are classified as industrial maintenance coatings, for areas with extreme environmental conditions including surfaces subject to graffiti abuse/subsequent cleaning. For residential use (and for commercial, institutional, and industrial use as well), our review of anti-graffiti coatings (see Section B-1) shows there are numerous available coatings,~~

including the permanent-type and the sacrificial-type, that can meet the proposed VOC limit of 100 g/l for flat coatings and the proposed VOC limit of 150 g/l for non-flat coatings. Permanent-type anti-graffiti coatings designed to resist repeated scrubbing with harsh solvents may be formulated and marketed by coatings manufacturers to be classified as either an industrial maintenance coating or as a flat/non-flat coating for general use, including residential use.

Industrial maintenance coatings are not limited to industrial applications. Residential, commercial, and institutional users can use anti-graffiti coatings subject to the 250 g/l industrial maintenance VOC limit. This is because industrial maintenance coatings can be used in commercial and institutional applications, and because we have removed the prohibition on the use of industrial maintenance coatings in residential applications.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Bassner, S.L. and Johnson, T. "NEW TECHNOLOGIES for Ultralow-VOC Polyurethane Coatings." Paint & Coatings Industry. pp 48-56. April 1996. (Bassner and Johnson, 1996)

Example Low-VOC Coatings for Aggressive Exterior Exposure: Sherwin-Williams Centurion (also known as Poly-Dura-Thane) (66 g/l), Dupont Imron 230ZV (0 g/l), Ameron PSX 700 (120-204 g/l), Ameron Dimetcote 21-5 (0 g/l), Ameron Amercoat 220 (180 g/l), MAB Paints & Coatings Ply-Mastic Epoxy Coating (90 g/l), Envirocoat AST D45+ (212-229 g/l).

Example Low-VOC Coatings for Tank Linings: Advanced Polymer Sciences Siloxirane 2031 (108 g/l), Advanced Polymer Sciences Siloxirane 2032 (108 g/l), Coatings Resource Corp. CR-26 (0 g/l), and Coatings Resource Corp. CR-27 (0 g/l).

Gordon, J.A. and McNeill, R.A. (1992) A Condensed Comprehensive Course in Coating Technology - Syllabus. (Gordon and McNeill, 1992)

Pourreau, D.B., Kelly, G.B., Junker, L.J., Wojcik, R. T., Goldstein, S.L., and Morgan, M.J. "Formulating VOC-Compliant Coatings with Exempt Solvents - A Case Study on Tertiary-Butyl Acetate (TBAc™)." Paint & Coatings Industry. pp 84-100. November 1999. (Pourreau et. al., 1999)

Ryer, R. "Alkyd Chemistry and New Technology Trends in Coatings Resin Synthesis". Paint & Coatings Industry. pp. 76-83. January 1998.(Ryer, 1998)

South Coast AQMD. Staff Report. Amend Rule 1113 - Architectural Coatings. May 14, 1999 Board Meeting. (South Coast AQMD, May 14, 1999)

15. Lacquer Coatings

Product Category Description:

Lacquers are clear or opaque wood coating products, including clear lacquer sanding sealers, formulated with cellulosic or synthetic resins to dry by evaporation without chemical reaction and to provide a solid, protective film. Lacquer sanding sealers are included in the category description and definition because they function like lacquers. Nitrocellulose and cellulose acetate butyrate are the most common film forming ingredients found in traditional lacquers.

Table VI-16 below summarizes our estimate of sales and VOC emissions from the lacquer coating category.

Table VI-16
Lacquer Coatings*

	Number of Products	Category Sales (gallons/ year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	340	625,938	647	2.48
Water-Based	63	43,679	181	0.02
Total / Overall	403	669,617	617	2.50

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Product Use and Marketing:

Lacquers are sold in California to major home centers, paint stores, lumber yards and hardware stores. The users range from the professional contractor to the homeowner or do-it-yourselfer. The many uses for lacquer include wood finishing for, but are not limited to, wood paneling, floors, doors, windows, furniture, and cabinets. In the last decade, wood products are increasingly supplied by the manufacturer pre-finished, eliminating the need to apply a finish at home or in the field. In California, a majority of new home or remodeling cabinetry is delivered pre-finished and field finished cabinetry occurs on a limited basis (e.g., custom fabrication).

Product Formulation:

The lacquer category is dominated by solvent-based formulations. Based on the 1998 ARB Architectural Coatings Survey solvent-based formulations accounted for 94 percent of the total sales volume with water-based formulations comprising the remaining six percent. In the 1998 ARB Architectural Coatings Survey this category is further broken down into clear and opaque lacquer categories. Clear lacquer formulations accounted for 69 percent of the total sales volume with opaque formulations accounting for the remaining 31 percent.

The VOC contents of traditional solvent-based lacquers are in the 650 g/l to 680 g/l range. The 1998 ARB Architectural Coatings Survey reports a VOC content range of 600 g/l to 680 g/l for solvent-based products, with a sales weighted average of 647 g/l. The formulations are clear coatings composed of synthetic thermoplastic film-forming materials in organic solvents (e.g., lacquer thinner or mineral spirit) that dry by solvent evaporation. Most lacquers are based on nitrocellulose, the film forming material, dissolved in lacquer thinner, the solvent. Nitrocellulose is a cotton-like material derived from mixing the cellulose from trees with nitric acid. These solvent-based formulations have the unique quality of being able to be re-wetted or dissolved when more lacquer or lacquer thinner is applied over existing, dry lacquer. The ability to rewet or re-dissolve lacquer allows for easy repair and recoating without the need to completely remove the existing finish.

For the water-based formulations, the 1998 ARB Architectural Coatings Survey reports a VOC content range of 160 g/l to 220 g/l with a sales weighted average of 181 g/l. Water-based formulations are similar to solvent-based formulations in creating a thermoplastic film, but with the use of vinyl, acrylic, polyurethane or urethane/acrylic latex blend type resins that are not resoluble in their original solvent.

Proposed VOC Limit and Basis for Recommendation:

The proposed 550 g/l limit for lacquers is technologically and commercially feasible by January 1, 2003, based on information from coating manufacturers and complying marketshare. The use of acetone as an alternative VOC exempt solvent has resulted in achieving 550 g/l VOC contents without sacrificing significant properties preferred by the wood finishing industry. Major manufacturers have introduced nitrocellulose lacquers using acetone to lower the VOC content to 550 g/l. Other alternative solvents for lacquer may include ~~t-butyl-acetate (VOC exemption pending) and~~ Oxsol 100 (parachlorobenzotrifluoride - VOC exempt).

The South Coast AQMD Rule 1136 “Wood Products Coatings” was amended in June 1996 to include a 550 g/l VOC limit for these coatings. At that time, the coating formulators supported the South Coast AQMD 550 g/l limit for lacquers. Surface Protection, Inc., Guardsman, Akzo-Nobel, Sherwin Williams, and AMT have all introduced acetone-based formulations of nitrocellulose lacquers, which have been used successfully by manufacturers of wood furniture, kitchen and bath cabinets, and shutters. (South Coast AQMD, 1996)

Alternative formulations of lacquers have seen significant development in recent years. The water-based formulations reported in the 1998 ARB Architectural Coatings Survey also provide formulators an avenue of compliance. The proposed VOC limit provides manufacturers the flexibility to continue the use of traditional lacquers or take advantage of existing water-based formulations. The emission reductions below have been adjusted to exclude the Clear Brushing Lacquer category.

Table VI-17 summarizes our estimate of complying products, marketshare, and emission reductions outside the South Coast AQMD.

Table VI-17
Lacquer Coatings*

Proposed VOC Limit (g/l)	No. of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons per day)
550	138	13.8	~~1.04~~ 1.03

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

Issues:

1. Issue: The use of acetone could result in flammability problems.

Response: Many of the solvents used in solvent-based lacquers or other coatings are also flammable and must be handled with care. Acetone's flashpoint temperature, flammability classification and lower explosive limit are similar to other solvents (e.g., MEK, toluene, xylene) found in solvent-based coatings. Flammability classifications by the Fire Department are the same for acetone, MEK, toluene, and xylene. Using operating guidelines for working with flammable coatings under well-ventilated areas, as prescribed by fire department codes, will avoid the concentration of acetone vapors required to cause an explosion. (South Coast AQMD, 1996)

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Air Resources Board. Technical Support Document. "ARB-CAPCOA SCM for Architectural Coatings." July, 1989. (ARB, 1989)

South Coast AQMD. Draft Staff Report. "Proposed Amendments to Rule 1113 – Architectural Coatings." September 26, 1996. (South Coast AQMD, 1996)

United States Environmental Protection Agency. "Final Rule: National Volatile Organic Compound Emission Standards for Architectural Coatings." 40 CFR part 59, subpart D. 63 FR 48848. September 11, 1998. (U.S. EPA, 1998)

16. Low Solids Coatings

Product Category Description:

Low solids coatings are products formulated to contain one pound (0.12 kilogram) of solids or less per gallon of coating. The VOC content of the low solids coating is calculated as the actual VOC of the material, that is, without subtracting out the water and exempt compounds. This category was not included in the 1989 SCM, although it is in some more recently amended district rules. The only low solids coatings reported in the 1998 ARB survey are low solids stains and low solids wood preservatives.

The National Rule has separate categories for low solids stains and low solids wood preservatives, both with VOC limits of 120 g/l. The U.S. EPA's rationale was that a low solids category was needed because at a very low solids content, coating coverage is controlled by volume, not the solids content. In other low solids applications, such as lacquers for metal, the solids content, rather than the volume, determines the amount of coating used; that is, more gallons of a low solids coating would be needed for the same coverage as a higher solids coating. Thus, the U.S. EPA restricted the low solids category to stains and wood preservatives because it had no data or other information about any other low solids categories (U.S. EPA, 1998).

Tables VI-18a and VI-18b below summarize our estimate of sales and VOC emissions from the low solids coating category.

Table VI-18a
Low Solids Stains*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD (tons/day)
Solvent-Based	0	0	N/A	0.00
Water-Based	PD	PD	77	0.01
Total	PD	PD	77	0.01

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected Data.

Table VI-18b
Low Solids Wood Preservatives*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD (tons/day)
Solvent-Based	0	0	N/A	0.00
Water-Based	PD	PD	42	0.00
Total	PD	PD	42	0.00

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected Data.

It should be noted that the definition used in the ARB's 1998 Architectural Coatings Survey was that of the draft National Rule, which included a 50 percent water requirement.

Product Use and Marketing:

Low solids coatings are sold in hardware stores and home centers. The products are used for the same purposes as regular stains and wood preservatives, for example, protection of exterior wood surfaces.

Product Formulation:

Low solids stains and wood preservatives are formulated to contain less than one pound of solids per gallon of coating. This category includes high water, low solids coatings that could meet the 120 g/l VOC limit by formulating with water or exempt solvents.

The calculation of VOC on a material basis is an important criterion in this category. For example, in a typical low solids product, on a less water and exempt solvents basis, the labeled VOC would be 470 g/l, but only 80 g/l on a material basis. Because the low solids products are mostly water, we believe this calculation is a reasonable approach for determining the VOC content.

Proposed VOC Limit and Basis for Recommendation:

The proposed 120 g/l VOC limit is technologically and commercially feasible by the January 1, 2003, effective date based on: complying marketshare; the limit in current district rules and the National Rule; and discussions with manufacturers and other interested parties.

We recommend that the low solids stains and low solids wood preservatives be combined into one low solids category because both subcategories have the same VOC limit. This is a cap on current VOC contents.

The tables below also show that VOC emission reductions in the non-South Coast AQMD portion of California would be virtually zero from implementing the proposed limit of 120 g/l for low solids coatings.

Table VI-19a
Low Solids Stains*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
120	PD	100	0.00

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
PD = Protected Data.

Table VI-19b
Low Solids Wood Preservatives*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
120	PD	100	0.00

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
PD = Protected Data.

<u>Issues</u>:

1. **Issue:** In the definition for low solids coating, at least half of the volatile component is water. It is unclear whether this requirement is by weight or by volume.

Response: In an earlier version of the proposed SCM, we had included the language from the National Rule requiring that at least half of the volatile component be water. We have dropped that requirement to allow for the use of either exempt solvents or water in the formulation of low solids products.

2. **Issue:** Industry needs limits for low-solids stains and preservatives, as well as low-solids waterproofing sealers and general sealers.

Response: The suggested low solids products are included in the category. We have named the category "low solids coatings" to allow formulation of other types of low solids products such as these coatings.

3. **Issue:** The low-solids definition in the National Rule doesn't specify whether the half of the volatile component is water by weight or volume; we assume it's by volume. The definition should say "water or exempt compounds." This definition is considerably at variance with the definition in Rule 1113 and the National Rule.

Response: The commenter refers to a previous version of the SCM in which we used the National Rule definition that included the 50 percent water requirement and did not allow the use of exempt compounds. This definition was different from the South Coast AQMD definition in Rule 1113. The proposed definition is now identical to the definition in several district rules and does not exclude the use of exempt solvents.

4. Issue: The definition for low solids coatings should include earlier proposed language limiting low-solids coatings to those with water comprising half of the volatile component, unless this is considered redundant.

Response: The proposed definition matches the definition in several existing district rules. Under the proposed definition, low solids coatings must include a large percentage of water or exempt solvents to qualify for inclusion in the category.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

United States Environmental Protection Agency (U.S. EPA). "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards." EPA-453/R-98-006b. August 1998. (U.S. EPA, 1998)

17. Multi-Color Coatings

Product Category Description:

Multi-color coatings are coatings packaged in a single container that, when applied in one layer, exhibit more than one color. They are designed for use as a substitute for wallpaper in offices, hotels, hospitals, and other public buildings. The individual colored pigment flecks are suspended in a base of a contrasting color, and when sprayed on a surface, produce a speckled, textured surface. These coatings are durable enough to withstand repeated washings (South Coast AQMD, 1996; LeSota, 1995; Coronado Paint, undated).

Table VI-20 below summarizes our estimate of sales and VOC emissions from the multi-color coatings category.

Table VI-20
Multi-Color Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based***	PD	PD	520	~0.00
Water-Based	PD	PD	268	0.04
Total	22	40,224	263	0.04

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
****** Grams VOC per liter of coating, less water and exempt compounds.
******* Includes 100 percent solid coatings.
PD = Protected Data.

Product Use and Marketing:

Multi-color coatings are not a do-it-yourself item, and are sold by distributors or direct from the manufacturer to the end user. These products are a specialty item applied by professional contractors who specialize in applying multi-color coatings.

Multi-color coatings are spray applied, but the manufacturer's recommendation must be followed on the type of spray system that should be used. Stirring should also follow the manufacturer's directions to avoid disrupting the suspended contrasting color particles. Also, color uniformity batch-to-batch may be more challenging with these coatings than with other coatings. It is possible for the applicator to achieve an individual stylized effect by using different background shadings, blending different colors, or using different application techniques. Multi-color coatings can be used on drywall, wood, masonry, steel, galvanized metal, aluminum, and wallpaper, provided the proper surface preparation and primers are used. Touch-up also must be done following the manufacturer's recommendations. A clear coat can be applied on top of the multi-color coating to give a glossy surface or a slight shine, and to improve scrubbability and abrasion resistance (Coronado Paint, undated).

Product Formulation:

There are a number of high-VOC solvent-based coatings, as well as several complying water-based formulations reported in the 1998 ARB Architectural Coatings Survey.

The South Coast AQMD performed a technology assessment of these coatings during development of its 1996 amendments to Rule 1113. Water-based formulations using a modified acrylic resin system have the same properties as the older solvent-based alkyd or lacquer resin technology. Manufacturers reported some difficulty with reformulating metallic multi-color coatings, but were able to reformulate prior to January 1998, the effective date of the South Coast AQMD's 250 g/l VOC limit (South Coast AQMD, 1996).

The ARB concurs with the South Coast AQMD's conclusions based on its own investigation. ARB staff contacted three manufacturers of multi-color coatings. Two of the manufacturers are currently selling water-based products that are acceptable substitutes for their solvent-based formulations. The VOC contents are at or below 250 g/l. The third manufacturer is in the final stages of development of a water-based, complying product that will be available for the January 1, 2003, compliance date of the SCM.

Proposed VOC Limit and Basis for Recommendation:

The proposed 250 g/l VOC limit is technologically and commercially feasible by the January 1, 2003, effective date based on: complying marketshare; discussions with manufacturers who have or will soon have complying products; the limit in effect in the South Coast and Antelope Valley districts; and the technology assessment performed by the South Coast AQMD in 1996.

Lower-VOC water-based technology is available and has been commercially accepted as a viable alternative to the higher-VOC, solvent-based multi-color coatings. Reformulation efforts to achieve compliance with the proposed limit will continue to focus on replacing solvent-based formulations with water-based products. One manufacturer noted that many contractors prefer water-based multi-color coatings because they are less hazardous to apply, and they can be used in healthcare facilities where solvent odor must be minimized.

The table below also shows that VOC emission reductions in the non-South Coast AQMD portion of California would be approximately zero tons per day, on an annual average basis, from implementing the proposed limit of 250 g/l.

Table VI-21
Multi-Color Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
250	13	65.80	0.01

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

<u>Issues</u>:

1. Issue: "Applied in a single coat" is not clear in the category definition. That might mean that someone couldn't put a second coat on. Should change to "that exhibits more than one color when applied in a single coat."

Response: We have changed the wording of the definition to clarify that the coating exhibits more than one color when applied in a single coat.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Coronado Paint Company. Product literature. Undated. http://www.coronadopaint.com/multicolor/tollfect.htm. (Coronado Paint, undated)

LeSota, Stanley (ed.). *Coatings Encyclopedic Dictionary*. Federation of Societies for Coatings Technology. 1995. (LeSota, 1995)

South Coast AQMD. "Draft Staff Report for Proposed Amendments to Rule 1113 – Architectural Coatings." September 26, 1996. (South Coast AQMD, 1996)

18. Primer, Sealer, and Undercoater Coatings

Product Category Description:

The primer, sealer, and undercoater category is a generic term used to describe coatings, typically the initial coat, used to provide a smooth surface for subsequent coats. Primers, sealers and undercoaters are also used to provide a shield between the substrate and the subsequent coat or to provide adhesion for the topcoat. (South Coast AQMD 1999).

This category excludes specialty primers, which are those products formulated to block stains, or for application to substrates damaged by fire, smoke, or water, or to condition excessively chalky surfaces. This category also excludes primer, sealer and undercoater products that are dry to the touch in 30 minutes and can be recoated in two hours. These products fall under the category of quick-dry primer, sealer, and undercoater coatings.

The National Rule has one category for primers and undercoaters, and another category for sealers. (U.S. EPA, 1998) Because of the trend toward multi-functional products that are primers, sealers, and undercoaters, we have grouped these products, with the exceptions noted above, into one category. This is also how most district rules treat these coatings.

Table VI-22 below summarizes our estimate of sales and VOC emissions from the primer, sealer, and undercoater coatings category. These numbers are a compilation of two product categories surveyed in the 1998 ARB Architectural Coatings Survey- Primers, Sealers, and Undercoaters; and Sealers (ARB, 1999).

In 1996, nearly 900 products were sold in California by 81 companies, accounting for over 6 million gallons of product per year. Approximately 55 percent of the sales are water-based products, and 45 percent of the sales are solvent-based products. The sales weighted average (SWA) VOC content for all products in this category is 169 g/l; water-based products have a SWA VOC content of 105 g/l, and solvent-based products have a SWA VOC content of 360 g/l. The VOC emissions for water-based products, excluding those emissions occurring in the South Coast AQMD, are 1.2 tons per day (TPD), and the VOC emissions for solvent-based products is 3.4 TPD, yielding non-South Coast AQMD VOC emissions of 4.6 TPD for the category.

Please note that the specialty primer category was not surveyed as a separate category, and some of the products reported in the primer, sealer, undercoater category are actually specialty primers.

Table VI-22
Primer, Sealer, and Undercoater Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	398	1,573,273	360	3.39
Water-Based	493	4,689,604	105	1.19
Total	891	6,262,877	169	4.59

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Product Use and Marketing:

Primers, sealers, or undercoaters are particularly useful when coating new wood or other surfaces that have not been previously coated, when recoating a surface that is uneven or badly deteriorated, and when coating a surface that has been stripped or is worn down to the original surface. (PQI,a) The use of these products will reduce the incidence of cracking and flaking, which may occur when coating is applied directly to the substrate. (PQI, b)

Traditionally, there have been specific coatings for a variety of uses, including priming, sealing, stain blocking, and hiding. Furthermore, specific coatings were formulated for different substrates, including wallboard, plaster, concrete, masonry block, pipe insulation, and coated glossy and non-glossy surfaces. However, the recent trend has been to develop multi-functional primers that can be used for a variety of substrates. (South Coast AQMD 1999)

Primers, sealers and undercoaters are applied to a wide variety of substrates, including, but not limited to, brick, ceramic tile, cinder block, concrete, cured plaster, Masonite®, metal, fiberglass, Formica®, glass, vinyl siding, stucco, wallcoverings, as well as previously coated surfaces.

Primers, sealers and undercoaters can be purchased by all consumers at outlets such as hardware stores, home supply stores, and retail paint stores, and by professionals at wholesale only outlets.

Surface preparation is the most important step in any coating application because it directly affects the durability and appearance of the completed job. Coatings manufacturers develop surface preparation recommendations for their products and provide these recommendations to the consumer by printing them in their literature and product labels. Most companies consider these methods to be minimum requirements for a satisfactory job, and by following these recommendations the consumer is assured a satisfactory job under most conditions. (McNeill)

General surface preparation calls for all surfaces to be clean and dry. All dirt, dust, rust, stains, scale, mildew, wax, grease, oil, bond-breakers, efflorescence, and other contaminants that can adversely affect the coating adhesion and performance should be removed, as should all loose, peeling, or checked paint. Glossy surfaces should be deglossed. (Dunn-Edwards)

Product data sheet review indicates that the minimum recommended application temperature (air, surface, and product) for primers, sealers, and undercoaters ranges from 40^{o} F to 50^{o} F, depending upon the formulation. Problems such as “ghosting”, “mud cracking”, and other film irregularities can occur if the proper product is not chosen for the range of application. (Bennette, a) A review of product data sheets for primer, sealer, and undercoater products indicated that most latex products recommend a minimum application temperature of 50^{o}F, and most alkyd products recommend a minimum application temperature of 40^{o}F.

Manufacturer’s recommendations for maximum application temperature must also be adhered to, as painting in hot weather can also result in less than satisfactory results. While most manufacturers do not indicate a recommended maximum application temperature, some specify maximum application temperatures as high as 120^{o}F, while others specify maximum application temperatures as low as 85^{o}F. Temperatures exceeding 90^{o}F will often cause a coating to dry too fast, and “dry rolling” will be accentuated at higher temperatures, and painting in direct sunlight at temperatures above 90^{o}F may cause surface wrinkling. (Bennette, b) Primers, sealers, and undercoaters may be applied by brush, coating pad, roller, airless sprayer, high-volume low-pressure sprayer, or electrostatic sprayer.

Depending on the porosity of the substrate, coverage per gallon typically ranges from 250 to 450 square feet. In addition to the porosity of the substrate, coverage is also influenced by the amount of solids and hiding pigment in the coating. (Dunn-Edwards) These products are to be stirred thoroughly prior to use, and stirred occasionally during use. The product should be applied liberally and spread evenly and quickly, working from wet area to dry area to avoid lapping, and allowed to dry for the recommended time prior to recoating.

In addition to a minimum recoat or topcoat time, some manufacturers recommend a maximum recoat time for primers, sealers, and undercoaters. After they are applied, these products can begin to weather and harden. If not topcoated within a reasonable time, they can become too hard or weathered to allow the topcoats to penetrate and adhere, and peeling may result. This situation occurs mostly with oil based or other solvent-based primers; affected products will have a statement on the product label and information sheet stating the recoat “time window.” Water-based acrylic primers will generally not become too hard to allow for proper adhesion of the topcoats, however, if they are not topcoated within a reasonable time, they can begin to weather, which can cause adhesion problems. (Dunn-Edwards)

Product Formulation:

This category includes a variety of available coating technologies in its formulations; alkyds, modified alkyds, oleoresins, epoxies, specialty resins, and emulsions are just a few of the formulations used. (South Coast AQMD 1999).

Coatings ingredients fall into four basic categories:

- Pigments to provide color and hide;
- Binder to hold the pigment particles together and provide adhesion;
- Liquid to act as a carrier for the pigments and binder; and
- Additives to enhance certain properties like brushing ease and mildew resistance (PQI,c).

As indicated previously, over half of the products reported in the 1998 ARB survey are water-based, that is, water is the liquid that acts as the carrier for the pigments and binder. The binder consists of a dispersion of fine particles of synthetic resin, and so the products are also referred to as latex coatings. Latex binders may be acrylic, vinyl chloride, vinyl acetate, styrene, or a combination of these materials in a single resin. (PQI,c) The largest contributors of VOCs in latex coatings are glycols, whose main purpose is to provide freeze/thaw resistance, and coalescence.

In alkyd and oil-based coatings, most of the liquid is a solvent, usually a petroleum distillate. The solvent-based coatings in this category are commonly formulated using alkyd resins as binders.

Proposed VOC Limit and Basis for Recommendation:

The proposed VOC limit for the primer, sealer, undercoater category is 200 g/l. The proposed VOC limit is technologically and commercially feasible by the January 1, 2003, effective date based on our review of product data sheets, analysis of complying marketshare, information provided by manufacturers, and laboratory performance tests as described below. Our recommended limit is consistent with the interim limit adopted by the South Coast AQMD in Rule 1113.

Industrial maintenance coatings recommended for use as primers, sealers, or undercoaters are subject to the proposed VOC content limit for industrial maintenance coatings (250 g/l). The National Rule VOC limit for primers and undercoaters is 350 g/l, and the VOC limit for sealers is 400 g/l.

The 1998 ARB survey, the national survey, and the South Coast AQMD staff survey of product data sheets all indicate that compliant primers, sealers, and undercoaters are commercially available and command a large marketshare.

Data reported in the 1998 ARB survey indicate that 73 percent of the products sold in California already comply with the proposed VOC limit of 200 g/l. We estimate emission reductions of ~~0.77~~ 0.64 TPD VOC from the proposed limit for the areas outside of the South Coast AQMD.

Table VI-23
Primer, Sealer, and Undercoater Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
200	445	73	~~0.77~~ 0.64

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

To meet the proposed VOC limit, manufacturers can employ water-based technology, and achieve further reductions in water-based technology through the use of lower VOC coalescing solvents and freeze/thaw resistance additives.

The Sherwin-Williams Company, in their 1998-1999 Painting & Coating Systems catalog for Specifiers and Applicators, includes numerous primers, sealers, and undercoaters that comply with the proposed limit. A few of these are discussed below.

Sherwin-Williams' Loxon Exterior Acrylic Masonry Primer (A24 Series) is recommended for masonry, cement, and stucco, and has a VOC of only 60 g/l. The product data sheet indicates that this primer passes moisture resistance, wind-driven rain, moisture vapor permeability, flexibility, tensile strength, alkali resistance, and mildew resistance tests. (South Coast AQMD, 1999)

Sherwin-Williams' PrepRite 200 and 400 Interior Latex Primer are considered their professional best line, and good quality, professional line, respectively. Both of these products have VOC contents that are below the proposed limit. The product data sheets indicate that these products prime and seal, have excellent holdout, and accept latex, alkyd, and waterborne epoxy topcoats. Their PrepRite Classic Interior Latex Primer, also with a VOC content below the proposed limit, is indicated as "our finest quality primer and sealer, designed for use on interior wood, drywall and masonry/concrete surfaces, providing excellent enamel hold out for any recommended topcoat and excellent sanding characteristics." It is recommended as a high quality wall primer or enamel undercoater. Their PrepRite ProBlock Latex Primer/Sealer has the same low VOC content, is recommended for both interior and exterior uses, has excellent adhesion to hard, slick, or glossy surfaces, and can be topcoated with a latex or alkyd topcoat. Their catalog includes several, additional primers for both interior and exterior uses. The VOC content information provided above is for white coatings only. (South Coast AQMD, 1999)

Insl-X, Zinsser, and Zehrung have developed and marketed zero- and low-VOC primers, sealers, and undercoaters recommended for a variety of uses. (South Coast AQMD, 1999)

Harlan Study

In 1995, Harlan Associates tested 20 different primers/sealers. In this test, only two of the twenty coatings tested qualify as "quick-dry primers" as defined by several district rules. According to these tests, most of the low VOC primers had performance characteristics similar to the high-VOC primers. The following tests showed relatively equivalent results including:

- Stability
- Application
- Adhesion
- Appearance
- Dry-to-Touch Time
- Flexibility
- Grain Raising
- Sag Resistance
- Alkali Resistance

Two differences were noted between the low-VOC and high-VOC primer/sealers; freeze-thaw resistance and dry-to-recoat times. The freeze-thaw resistance test is used to determine the resistance of a coating to storage in very cold temperatures and only affects water-based coatings. Nine out of twelve low-VOC coatings passed this test. Also, ten of the twelve low-VOC coatings tested had acceptable dry-to-recoat times of 6 hours or less. (ARB, 1995; Cowen, 1999)

NTS Study

ARB staff's analysis of the National Technical Systems (NTS) data from the South Coast AQMD's "Phase II Assessment Study of Architectural Coatings" indicates that overall, low-VOC primer, sealer, and undercoater coatings exhibited similar performance to high-VOC primer, sealer, undercoater coatings. This study evaluated the performance characteristics of primers, sealers, and undercoaters for a variety of characteristics, including brushing properties, dry times, leveling, sag resistance, hiding, and film thickness. (NTS, 1999)

<u>Issues</u>:

1. Issue: As currently written, the primers category would include those made from bituminous resins. Bituminous primers should be separately defined or should be included in the bituminous coatings category at the federal level.

Response: Bituminous roof coatings are defined as a coating labeled and formulated for roofing that incorporates bitumens. Bituminous primers would be included in that coatings category. Please refer to the section on bituminous roof coatings for further information.

2. Issue: The primer, sealer, and undercoater category should be divided/categorized into the following: interior primers and undercoaters; exterior primers and undercoaters; interior sealers; and exterior sealers.

Response: As indicated by product labels and product data sheets, many of the products in the primer, sealer, undercoater category are intended for use on interior and exterior surfaces. The 1998 ARB survey indicates that 41 percent of the products reported in this category are for interior use, 31 percent are for exterior use, and 28 percent can be used on either interior or exterior surfaces. For the sealer category, which was surveyed separately, the survey indicates that 61 percent of the products are for interior use, 26 percent are for exterior use, and 14 percent can be used on either interior or exterior surfaces. Further, the trend toward multi-use products has resulted in products for which there is no clear-cut distinction between products that seal and products that prime or undercoat. Subcategorization of the primer, sealer, undercoater category into exterior and interior and sealer vs. primer or undercoater would create artificial categories for which very few products exist.

3. **Issue:** A specialty primer category with a VOC content of 350 g/l should be established. We sell three specialty primers that are used to prime poured-in-place concrete and tilt-up concrete. The product is designed to go through form oils and release agent materials that are used in the forming of the concrete and remain on the surface of the concrete. Lower VOC products (including latex systems) cannot penetrate these materials and provide the required adhesion.

Response: Concrete should be allowed to cure for 30 to 60 days before coating, and the moisture content should be no higher than 15 percent to ensure success. Moisture is a common cause of coatings failing to properly adhere on concrete. If moisture can penetrate cured concrete it will leach out alkaline salts that can react with the resin in many coatings causing early adhesion failure. A test for moisture migration should be conducted if a moisture condition is suspected.

Release compound is formulated to weather off within a relatively short time, and should decompose by the time the concrete has cured to the correct moisture content. It is only necessary to brush off the decomposed release compound before coating. Release compound not decomposed by weathering must be removed before coating for proper adhesion. Water or abrasive blasting will effectively remove release compound.

A review of product data sheets indicates there are products for the specific applications indicated by the commenter that comply with the proposed standard. For all but one product, use instructions direct the applicator to allow the concrete to fully cure, as specified above.

4. **Issue:** We have two specialty solvent-based primers designed to go over less than ideal wood surfaces and chalky coating. The higher VOC (350 g/l) solvent primers penetrate the chalky surfaces and provide excellent adhesion for subsequent topcoats. Other surface types requiring specialty primers with VOC levels of 350 g/l are galvanized metal, aluminum, copper, stainless steel, ferrous metal, and baked enamels.

Response: We are proposing a specialty primer category with a VOC limit of 350g/l to address these issues.

5. Issue: We feel the categories of quick dry primers, sealers and undercoaters should be reinstated.

Response: The Quick-dry primer, sealer, and undercoater category exists in this proposed SCM. However, it should be noted that the proposed VOC limit for the quick-dry primer, sealer, undercoater category is the same as the proposed VOC limit for the primer, sealer, undercoater category. Please refer to the section on quick-dry primers, sealers, and undercoaters for further information.

6. Issue: In the South Coast AQMD rule, they provided a higher VOC limit for specialty primers applied to chalky substrates. We propose a stain blocking primer, or including stain blocking in the specialty primer definition. Woods have tannins that bleed through water-based products.

Response: We have created a specialty primer category with a VOC limit of 350 g/l for primers applied to block tannins and other stains, and to condition excessively chalky surfaces. Please refer to the section on specialty primers for further information.

7. Issue: The definition for sealers precludes sealers which are used to seal a substrate to protect it from penetration of foreign matter but which are not topcoated. This needs to be corrected.

Response: We do not agree. Primers, sealers, and undercoaters in district rules have always been defined as a primary coat which is topcoated. Primers, sealers, and undercoaters are grouped together for this reason. We are proposing 250 g/l VOC limits for sealers designed as topcoats, such as waterproofing sealers for wood or concrete. Please refer to the waterproofer sealers category descriptions.

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19. Quick-Dry Enamel Coatings

Product Category Description:

Quick-dry enamel coatings are high gloss coatings designed to dry quickly. They are used on interior and exterior surfaces of residential and commercial buildings. Quick-dry enamels are a subset of high gloss non-flat coatings, but have historically been treated as a separate category in district architectural coatings rules. In order for a non-flat coating to be classified as a quick-dry enamel, it must be dry to touch within two hours after application, be tack-free within four hours, and dry hard within eight hours. It must also have a gloss of 70 or above on a 60^{o} meter.

Table VI-24 below summarizes our estimate of sales and VOC emissions from the quick-dry enamel coatings category based on the 1998 ARB Architectural Coatings Survey results. This category is the seventh largest coatings category with regard to VOC emissions and the fifteenth largest category with regard to sales volume. The VOC emissions from quick-dry enamels represent about 4 percent of the total emissions from architectural coatings (ARB, 1999). VOC emissions in California, excluding the South Coast AQMD, are approximately 2.2 tons per day. As shown below, all of the emissions from this category are from solvent-based products.

Table VI-24
Quick-Dry Enamel Coatings*

	Number of Products	Category Sales (gallons/year)	Sales-Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	154	904,739	403	2.24
Water-Based	0	0	N/A	N/A
Total	154	904,739	403	2.24

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Product Use and Marketing:

As with other non-flat coatings, quick-dry enamels can be brushed, rolled, or sprayed on the surface to be coated. "Do-it-yourselfers" and paint contractors can purchase coatings that meet the quick-dry enamel criteria at outlets including hardware stores, home supply stores, and retail paint stores. Quick-dry enamels are typically used where the coated surface needs to dry quickly to minimize dust contamination (e.g., new home construction) or the area needs to be returned to service quickly (e.g., restaurants) (South Coast AQMD, 1999). As with other non-flat coatings, quick-dry enamels may be used on surfaces where frequent cleaning is necessary and in rooms where moisture is present. Kitchens, bathrooms, hallways, children's rooms, doors, window frames, shutters, and wood trim may be coated with such coatings. Commercial buildings and institutions may use quick-dry enamel coatings on surfaces such as walls, corridors, and stairwells. With proper surface preparation and priming (if necessary), quick-dry enamels can be used on a large variety of interior and exterior substrates including drywall, plaster, masonry, wood, and metal.

The 1998 ARB survey showed that about 22 percent of the quick-dry enamels sold in 1996 were formulated for interior applications, 4 percent for exterior applications, and 74 percent were formulated for both interior and exterior applications (ARB, 1999).

Product Formulation:

As previously mentioned, all of the coatings reported under the quick-dry enamel category in the 1998 ARB survey were solvent-based. Quick-dry enamels are typically formulated using alkyd resins as binders. The amount of quick-dry enamels sold has increased approximately 87 percent since the 1993 ARB survey of architectural coatings (which reflected 1990 sales). Past ARB surveys show a large fluctuation in the volume of quick-dry enamel coatings sold (ARB, 1991; ARB, 1986). The overall sales-weighted average VOC level for quick-dry enamels has remained the same since 1990, and all of the products reported in this category have remained solvent-based (ARB, 1999).

Product information sheets published by coatings manufacturers indicate that there are a number of lower-VOC, water-based latex coatings available that meet the gloss and dry time criteria of quick-dry enamels, although those products may not be labeled as quick-dry enamels. Those products are discussed in more detail below.

Proposed VOC Limit and Basis for Recommendation:

We recommend a 250 g/l VOC limit for quick-dry enamel coatings, effective January 1, 2003. The proposed VOC limit is technologically and commercially feasible by January 1, 2003, based on our review of ARB survey data on marketshares, product information from manufacturers, and laboratory performance tests. The proposed VOC limit is lower than the 450 g/l national limit recently promulgated by the U.S. EPA (U.S. EPA, 1998). The most common limit for quick-dry enamels currently in effect for those California air pollution control districts that have architectural coatings rules is 400 g/l. Since September 1990, the Santa Barbara County Air Pollution Control District has included a 250 g/l limit for quick-dry enamels in its architectural coatings rule. In 1999, the South Coast AQMD adopted a 250 g/l limit for quick-dry enamels that will become effective July 1, 2002, and also adopted a 50 g/l limit that will become effective July 1, 2006. Our recommended limit is consistent with the interim limit adopted by the South Coast AQMD.

As discussed in the non-flat coatings category description, we are recommending the same 250 g/l VOC limit for the quick-dry enamel category as for the high gloss subcategory of non-flat coatings. Our recommendation is primarily based on enforcement concerns, especially for California districts with fewer enforcement resources than the South Coast AQMD. Many high gloss non-flat coatings satisfy the gloss and dry time criteria of quick-dry enamels, and there is overlap between the high gloss non-flat and quick-dry enamel categories. Companies could relabel products rather than reformulate them if the VOC limit is different for those two categories. Moreover, some high gloss products might be illegally labeled as quick-dry enamels even if they do not meet the dry time criteria, which would be problematic for enforcement personnel in some districts to detect. Thus, for greater enforceability, the proposed SCM includes a subcategory for high gloss non-flat coatings that has the same VOC limit as the quick-dry enamel category.

Since most districts' architectural coatings rules currently include a quick-dry enamel category, the proposed SCM retains that category with its new VOC limit. This was done so that district rules, once amended in accordance with the proposed SCM, will clearly show that the VOC limit for quick-dry enamels is reduced from 400 g/l to 250 g/l. Further, we recommend that districts eventually eliminate the quick-dry enamel category from their architectural coatings rules, which would in effect require such products to meet the VOC limit of the high gloss non-flat subcategory.

Table VI-25 does not present specific data regarding the marketshare of products that comply with the proposed limit due to confidentiality concerns (ARB, 1999). It is important to point out that manufacturers in the past have typically marketed only solvent-based alkyd coatings as quick-dry enamels. However, as discussed below, a number of water-based latex coatings that comply with the proposed limit meet the gloss and dry-time requirements of this category. We expect that, in order to meet the proposed limit, most solvent-based alkyd products would be reformulated as water-based latex products. More information on the formulation of water-based latex products can be found in the low and medium gloss non-flat category description. Coating manufacturers may also choose to reformulate solvent-based alkyd products using existing low-VOC alkyd technology (e.g.,Vianova Resins, 1999).

The table below shows that VOC emission reductions in the non-South Coast AQMD portion of California would be approximately one ton per day, on an annual average basis, from implementing the proposed limit of 250 g/l.

Table VI-25
Quick-Dry Enamel Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
250	PD	PD	0.99

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
PD = Protected Data.

NTS Study

Independent laboratory performance tests of a number of coatings were recently conducted by National Technical Systems (NTS) under contract with the South Coast AQMD. Included in those tests were eight coatings with VOC levels at or below 250 g/l (range: 0 to 250 g/l) that meet the gloss and dry time criteria of quick-dry enamels. NTS also tested 5 coatings that were labeled as quick-dry enamels that had VOC levels of 400 g/l. Although three of the five 400 g/l coatings did not appear to meet the gloss criterion, they will be included in this comparison. For this discussion, those coatings that comply with the proposed 250 g/l limit ("low-VOC coatings") are compared with the 400 g/l coatings ("high-VOC coatings"). Similar performance for low-VOC and high-VOC coatings was seen in tests of brushing properties and film thickness. The high-VOC coatings had somewhat better leveling performance, but the low-VOC coatings performed better with regard to sag resistance. Block resistance tests for the interior coatings showed that some of the best-performing coatings were in the low-VOC category. Block resistance for exterior coatings was somewhat better for high-VOC coatings. Low and high-VOC interior coatings had similar results in tests for dirt removal ability. High-VOC interior coatings generally showed better scrub abrasion resistance, although one low-VOC coating had the best performance in this test (NTS, 1999).

Harlan Study

In 1995, Harlan Associates, Inc., under contract with ARB, conducted performance tests on 10 interior and 10 exterior non-flat coatings. Those coatings were selected in 1994 from commercially available coatings. The VOC levels of the twenty coatings ranged from 15 g/l to 459 g/l. Inspection of the gloss levels and dry times of the coatings as measured in the tests indicates that three complying interior coatings and three complying exterior coatings met the gloss and dry-time criteria for quick-dry enamels. Some of the coatings that were labeled as quick-dry enamels did not meet the criteria.

For the three interior coatings that met the quick-dry enamel criteria, all were water-based and had VOC levels that ranged from 178 g/l to 209 g/l. The three exterior coatings that met the quick-dry enamel criteria were also all water-based, and had VOC levels that ranged from 183 g/l to 257 g/l; the high end of that range is just over the proposed limit of 250 g/l ("low-VOC coatings"). There was one interior coating and four exterior coatings tested that had VOC levels above 250 g/l ("high-VOC coatings") from which to compare performance characteristics.

The results suggest that the low-VOC coatings had performance characteristics similar to the high-VOC coatings with regard to stability, hardness, application, adhesion, appearance, abrasion resistance, flexibility, accelerated weathering, impact resistance, and fungus resistance. In addition, the low-VOC coatings appeared to perform better than the high-VOC coatings with regard to accelerated yellowing and sag resistance. On the other hand, the high-VOC coatings appeared to perform better overall with regard to blocking resistance, although there was a high degree of variability in the results of this test, with some high-VOC products showing poor performance in this area and some low-VOC coatings showing good performance. (ARB, 1995; Cowen, 1999).

Product information from manufacturers

A number of products that are currently available satisfy the quick-dry enamel criteria and meet the proposed VOC limit. Product information sheets published by coatings manufacturers indicate that a number of coatings meet the gloss and dry time criteria of quick-dry enamels and have VOC levels at or below 250 g/l. The products we identified are all water-based, but the 250 g/l limit may not exclude all solvent-based coatings. At the end of this discussion are tables of information about specific products that meet the proposed VOC limit and, for comparison, products that exceed the proposed limit. We identified specific high-gloss quick-drying products with a VOC content of 250 g/l or less offered by Dunn Edwards,
Evr-gard, ICI Dulux, Kelly Moore, and Sherwin-Williams. A list of performance characteristics compiled from product information sheets for such coatings is presented below and includes characteristics of products formulated for interior, exterior, and interior/exterior uses. Please note that not all high gloss, quick-drying coatings with VOC levels at or below 250 g/l possess all of the characteristics listed below:

High gloss, quick-drying coatings
highest premium finish, premium quality
very good non-blocking characteristics
excellent gloss retention
excellent color retention
alkyd-like hardness and durability
durable, exceptional toughness and durability, durable protection
dries quickly and cures to a washable finish
abrasion resistant
stands up to harsh use on interior surfaces
tough wear-resistant and weather-resistant finish
non-yellowing
high hiding
easy application
mildew resistant
excellent adhesion to aged alkyd enamels, excellent adhesion even to difficult surfaces
designed to provide service performance equal to high quality alkyd enamels
resists blistering, peeling , and flaking
excellent flow and leveling

Issues:

1. Issue: Water-based enamels don't dry fast enough, are not high enough in gloss, and don't have enough block resistance to be used in areas where quick-dry enamels are typically used.

Response: We were able to identify, through product information sheets published by coatings manufacturers, a number of coatings that meet the gloss and dry time criteria of quick-dry enamels and have VOC levels at or below 250 g/l. One of those coatings was described as having very-good non-blocking characteristics, demonstrating that current technology provides the ability to include such characteristics in a coating formulation.

In addition, independent laboratory studies conducted by NTS and Harlan and Associates identified commercially-available coatings with VOC levels at or below 250 g/l that meet the gloss and dry time criteria of quick-dry enamels. Results of laboratory tests of block resistance for those lower-VOC coatings (giving the most weight to the recent NTS tests which better reflect current technology) indicate that some of the lower-VOC coatings tested performed as well or better than high-VOC coatings. Those results show that some manufacturers have been able to formulate and market high-gloss, quick-drying coatings with good block resistance that meet the proposed 250 g/l limit.

2. **Issue:** The 1989 version of the SCM (ARB, 1989) recommended that the quick-dry enamel category be eliminated. This category was considered a popular loophole for manufacturers attempting to sidestep more aggressive controls. CARB should re-evaluate the benefit of reinstating this category and its VOC limit in the SCM.

Response: The proposed VOC limit for this category will drop from the 400 g/l limit currently found in most district rules to 250 g/l. This will eliminate the use of the quick-dry enamel category as a possible loophole. Also, as discussed above, due to enforcement concerns, we are recommending the same 250 g/l VOC limit for both the high gloss non-flat subcategory and the quick-dry enamel category. Since most districts' architectural coatings rules currently include a quick-dry enamel category, the proposed SCM retains that category so that district rules, once amended in accordance with the proposed SCM, will clearly show that the VOC limit for quick-dry enamels is reduced from 400 g/l to 250 g/l. We recommend that districts eventually eliminate the quick-dry enamel category from their architectural coatings rules, which would in effect require such products to meet the VOC limit of the high gloss non-flat subcategory.

3. **Issue:** Bathtub refinishing products have in the past been included in the quick-dry enamel category. They used to be called "tile-like glaze." The 250 g/l limit would be a problem for these coatings.

Response: Bathtub, shower, and sink refinishing products are commonly supplied in quart or smaller sized containers, which are exempt from the proposed SCM. Thus, those product types are not affected by the proposed limit. This conclusion is consistent with the 1989 SCM, in which staff recommended that the "tile like glaze" category be excluded from the SCM.

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20. Quick-Dry Primer, Sealer, and Undercoater Coatings

Product Category Description:

The quick-dry primer, sealer, and undercoater category is a generic term used to describe coatings, typically the initial coat, used to provide a smooth surface for subsequent coats or to provide a shield between the substrate and the subsequent coat or to provide adhesion for the topcoat. By definition, the dry to touch time needs to be less than 30 minutes, and the recoat time needs to be less than two hours, both tested by ASTM Method D 1640 (South Coast AQMD 1999).

The National Rule defines this category as follows: "Quick-dry primer, sealer, and undercoater means a primer, sealer, or undercoater that is dry to the touch in ½ hour and can be recoated in 2 hours when tested in accordance with ASTM Method D 1640-83 (Reapproved 1989), Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature." (U.S. EPA, 1998)

Table VI-26 below summarizes our estimate of sales and VOC emissions from the quick-dry primer, sealer, and undercoater coatings category based on products reported in the ARB's 1998 Architectural Coatings Survey. (ARB, 1999) Thirty-six companies reported a total of 150 products, which accounted for sales of nearly two million gallons per year in California. The sales-weighted average VOC content of all reported products is 303 g/l and the VOC emissions outside of the South Coast AQMD totaled 3.3 tons per day. Solvent-based products account for approximately 56 percent of the total sales volume, and 89 percent of the emissions. Water-based products account for the remaining 44 percent of the sales volume and 11 percent of the category emissions.

Please note that the specialty primer category was not surveyed separately, and some of the products reported in the quick-dry primer, sealer, undercoater category are actually specialty primers.

Table VI-26
Quick-Dry Primer, Sealer, and Undercoater Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	112	1,076,267	432	2.90
Water-Based	38	836,648	136	0.37
Total	150	1,912,915	303	3.27

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Product Use and Marketing:

Products in the quick-dry primer, sealer, undercoater category are typically used where the substrate to be coated needs to dry quickly to minimize dust contamination, such as new home construction, or be returned to service quickly, such as a restaurant. (South Coast AQMD 1999) Quick-dry primer, sealer, undercoaters can be purchased by all consumers at outlets such as hardware stores, home supply stores, and retail paint stores, and by professionals at wholesale-only outlets.

Please refer to the chapter on primers, sealers, and undercoaters for additional information on general surface preparation, product application recommendations, and product coverage.

Product Formulation:

This category utilizes a variety of available coating technologies in its formulations; alkyds, modified alkyds, oleoresins, epoxies, specialty resins, and emulsions are just a few of the formulations used. (South Coast AQMD 1999).

Coatings ingredients fall into four basic categories:

- Pigments to provide color and hide;
- Binder to hold the pigment particles together and provide adhesion;
- Liquid to act as a carrier for the pigments and binder; and
- Additives to enhance certain properties like brushing ease and mildew resistance.

(PQI)

In alkyd and oil-based coatings, most of the liquid is a solvent, usually a petroleum distillate. The solvent-based coatings in this category are commonly formulated using alkyd resins as binders. While nearly three times as many solvent-based products as water-based products were reported in the 1998 ARB survey, by volume the solvent-based products account for approximately 56 percent of the sales in this category.

Approximately 44 percent of the volume of quick-dry primer, sealer, undercoater products reported in the 1998 ARB survey are water-based, that is, water is the liquid that acts as the carrier for the pigments and binder. The binder consists of a dispersion of fine particles of synthetic resin, and so the products are also referred to as latex coatings. Latex binders may be acrylic, vinyl chloride, vinyl acetate, styrene, or a combination of these materials in a single resin. (PQI) The largest contributors of VOCs in latex coatings are glycols, whose main purpose is to provide freeze/thaw resistance, and coalescence agents.

Proposed VOC Limit and Basis for Recommendation:

The recommended VOC limit for quick-dry primer, sealer, and undercoaters is 200 g/l. The proposed VOC limit is technologically and commercially feasible by the January 1, 2003, effective date based on our review of product data sheets, analysis of complying marketshare, information provided by manufacturers, and laboratory performance tests as described below. Our recommended limit is consistent with the interim limit adopted by the South Coast AQMD. The National Rule Limit is 450 g/l (U.S. EPA, 1998), as is the most common district limit, most of which have been in effect for many years. Several districts have no limit for this category.

To meet the proposed VOC limit, manufacturers can employ water-based technology, and achieve further reductions in water-based technology through the use of lower VOC coalescing solvents and freeze/thaw resistance additives. The 1998 ARB survey data indicate that compliant, quick-dry primers, sealers, and undercoaters are commercially available. Almost 44 percent of the quick-dry primers, sealers, and undercoaters from the survey are water-based formulations, and have a sales weighted average VOC content of 136 g/l. On a total volume basis, in 1996, 35 percent of the volume of quick-dry primers, sealers, and undercoaters was below the proposed 200 g/l VOC content limit. These include products recommended for interior, exterior, and dual interior/exterior uses. We estimate a VOC reduction of about one ton per day from the proposed limit in the non South Coast AQMD portion of the State.

Table VI-27
Quick-Dry Primer, Sealer, and Undercoater Coatings*

Proposed VOC Limit (g/l)	No. of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
200	19	34.6	1.00**

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Since much of the State has no limit, or limits higher than the National Rule limit, for this category, the National Rule limit will result in a 0.27 tons per day reduction in the non-South Coast AQMD portion of the State.

Harlan Study

A study conducted by Harlan and Associates for the ARB in 1995 analyzed a large number of coatings listed as quick-dry primers, sealers, and undercoaters, and concluded that most of the coatings labeled as 'quick-dry' did not meet the definitional requirements and thus should not be classified as such. In addition, the study concluded that some of the water-based technology included in the testing actually met the requirements of a quick-dry coating, but were not necessarily listed as a quick-dry coating. (South Coast AQMD 1999)

Harlan Associates tested 20 different primers/sealers. These coatings were also selected to determine the need for the "quick-dry" primer, sealer and undercoater category. In the 1989 SCM, there was no "quick-dry" category, which effectively limited the VOC content for these coatings to 350 g/l (the same limit as primers, sealers, and undercoaters).

In this study, only two of the twenty coatings tested qualified as "quick-dry primers" as defined by several district rules. The remainder of the coatings dried too slowly to be classified as quick-dry (more than 30 minutes to touch or more than 2 hours to recoat).

In this testing, the performance of the high-VOC quick-dry primer/sealers versus the low-VOC quick-dry primers/sealers was essentially equivalent for a number of critical areas. Most of the low-VOC primers had performance characteristics similar to the high-VOC primers. The following tests showed relatively equivalent results including:

- Stability
- Application
- Adhesion
- Appearance
- Dry-to-Touch Time
- Flexibility
- Grain Raising
- Sag Resistance
- Alkali Resistance

Two other differences were noted between the low-VOC and high-VOC primers/sealers-freeze-thaw resistance and dry-to-recoat times. The freeze-thaw resistance test determines the resistance to storage in very cold temperatures and only affects water-based coatings. Nine out of the twelve low-VOC coatings passed this test. Also, ten of the twelve low-VOC coatings tested had acceptable dry-to-recoat times of 6 hours or less. (ARB, 1995; Cowen, 1999)

NTS Study

ARB staff's analysis of the National Technical Systems (NTS) data from the South Coast AQMD's "Phase II Assessment Study of Architectural Coatings" indicates that overall, low VOC quick-dry primers, sealers, and undercoaters exhibited similar performance to high VOC quick-dry primers, sealers, and undercoaters. This study evaluated the performance characteristics of quick-dry primers, sealers, and undercoaters for a variety of characteristics, including brushing properties, dry times, leveling, sag resistance, hiding, and film thickness. (NTS, 1999)

<u>**Issues:**</u>

1. Issue: The 1989 version of the SCM recommended that the quick-dry primer, sealer, and undercoater category be eliminated. This category was considered a popular loophole for manufacturers attempting to sidestep more aggressive controls. The ARB should re-evaluate the benefit of this category and its VOC limit in the SCM.

Response: To eliminate potential confusion, we are proposing to include the quick-dry primer, sealer, and undercoater category in the SCM. We are including this category to make it clear that the SCM is proposing a limit for quick-dry primers, sealers, and undercoaters. Please note that while a separate category is proposed for this category, the proposed limit is the same as that proposed for the primer, sealer, and undercoater category. Because these limits are the same, there would be no advantage to manufacturers to make quick-dry claims that do not apply to their primers, sealers, and undercoaters. <u>We recommend that districts eventually eliminate the quick-</u>

dry primer, sealer, undercoater category from their architectural coatings rules, which would in effect require such products to meet either the VOC limit of primers, sealers, and undercoaters or specialty primers, sealers, and undercoaters.

REFERENCES

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National Technical Systems. "Phase II Assessment Study of Architectural Coatings," under contract with the South Coast AQMD, data available as of June 1999. (NTS, 1999)

Paint Quality Institute. Training Manual "An Introduction to Paints and Coatings." (PQI)

South Coast AQMD. Staff Report for Proposed Amendments to Rule 1113 – Architectural Coatings. May 14, 1999. (South Coast AQMD 1999)

United States Environmental Protection Agency. "Final Rule: National Volatile Organic Compound Emission Standards for Architectural Coatings." 40 CFR part 59, subpart D. 63 FR 48848. September 11, 1998. (U.S. EPA, 1998)

21. **Recycled Coatings**

Product Category Description:

Recycled coatings are products made with not less than 50 percent post-consumer and secondary coating by weight, and not less than 10 percent post-consumer coating by weight. Post-consumer coating is a finished coating that has completed its usefulness to a consumer, and that would otherwise be disposed of as solid waste. Post-consumer coating does not include manufacturing waste. Secondary coating is a fragment of finished coating or finished coating that converts resources into a commodity of real economic value, not including excess virgin resources from manufacturing. Secondary coatings are commonly referred to as "rework" in the industry. These definitions are adapted from California Public Contract Code (PCC) section 12200, which describes the content of recycled products (not just coatings) purchased by the State of California.

For the purposes of the SCM, post-consumer coating is a product that was purchased by a consumer but not used up, and then recycled in another product (California Acquisition Manual, 1999). Post-consumer coating can include waste coating collected from household hazardous waste collection programs, coating returned directly to the manufacturer by the consumer, or coating donated to the manufacturer by contractors or other coating manufacturers. Secondary coating includes material that did not reach the consumer before being recycled (California Acquisition Manual, 1999). Examples of secondary coatings are coatings that do not meet manufacturers' specifications, partially manufactured coatings that were subject to a manufacturing error, or off-color coatings.

The South Coast AQMD, in Rule 1113, defines recycled coatings as those collected through household hazardous waste or other resource recovery programs, that contain not less than 50 percent secondary post-consumer waste coating, and not less than 10 percent post-consumer waste coating (South Coast AQMD, 1999). This is essentially the same definition as we are proposing.

Thus, recycled coating, as the term is used in the proposed SCM, refers to a coating that has been reprocessed to maximize its application and performance qualities. Recycled coating also includes consolidated coatings that are reprocessed (e.g., those that are collected by counties, reprocessed by a recycled coating manufacturer, and sold back to the counties), but does not include consolidated coatings that are simply combined and reused without reprocessing. This reprocessing criterion is intended to ensure the highest quality for the recycled coatings.

Recycled coatings were not included in the 1998 ARB Architectural Coatings Survey. Based on manufacturers' estimates, statewide sales of recycled coatings are at least 100,000 gallons per year, not counting unprocessed consolidated coatings. Additional coatings are reused "as is" by donation to charitable organizations. Recycled coatings are regulated currently as flats or non-flats at the prevailing VOC limit in district rules of 250 g/l.

Product Use and Marketing:

The California Integrated Waste Management Act of 1989 created a statutory goal of diverting solid waste from landfills by 50 percent by the year 2000 (Public Resources Code sections 40050-40063). The California Integrated Waste Management Board (CIWMB) oversees this program, which requires all local governments in the State to meet this goal. Further, the Hazardous Waste Recycling Enhancement Act of 1998 requires State agencies to purchase recycled products, including coatings, whenever the recycled products are available at the same cost or a lower cost than the non-recycled products, as long as the fitness and quality are equal (PCC sections 12170, 12200, and 10233). The State agencies have minimum goals of using at least 50 percent recycled coatings in 2000 (Recycled Product Purchasing, undated).

Based on various surveys, the average household generates one to three gallons of excess coating per year, and on average, stores the coating for 4.6 years before disposing of it (Wills, 1995). There is a great deal of recyclable latex coating collected at community household hazardous waste collection sites. In the South Coast AQMD alone, 239,000 gallons were collected in 1996-1997, and about 275,000 gallons were collected in 1997-1998 (Baker, 1999). The statewide total of water-based latex coating collected in 1998 was about 6.5 million pounds, and is growing (Halverson, 1999). This translates to nearly 765,000 gallons statewide, based on a conversion factor of 8.5 pounds per gallon.

CIWMB reports that currently there are eight manufacturers of recycled latex coating in California, and three sources of consolidated coating. The post-consumer coating content of the recycled coatings ranges from 35 to 100 percent (CIWMB, 1999).

Recycled coatings are sold and used in many of the same ways as virgin coating. Some manufacturers sell recycled coatings through their retail stores, while others sell by special order. Some manufacturers receive coatings from counties, then reprocess the coating, and sell the product back to the counties. Recycled coating meeting the specifications for reprocessed and consolidated coating in General Services Administration (GSA) specification TT-P-2846, is also sold by the federal GSA (U.S. EPA, 1997).

Recycled coating is available in flat, semigloss, and gloss, and some manufacturers can custom-match colors. Local governments often consolidate coatings for use in graffiti abatement programs, but the coating is not processed by the manufacturer to meet performance specifications. However, Caltrans notes that municipalities expect the coating used in sound wall graffiti abatement to be color-matched (Tsztoo, 1999).

Product Formulation:

All recycled coatings currently for sale in California are water-based latex flats or non-flats.

A study for the CIWMB (Wills, 1995) showed that collected recyclable coatings are low in viscosity, density, and solids content. Most of the collected coatings contain filterable solids up to one percent, which indicates that filtration will be needed to produce a finished coating that can be sprayed.

The dry time, dry opacity, sag, lead, mercury, cadmium, and VOC content of recycled coatings are specified in the State of California bid specification (Bid Specification, 1998). The federal specification (Federal Specification, 1993) also contains requirements for freeze-thaw stability, application properties, odor, scrub resistance, total solids, fineness of dispersion, and gloss.

<u>Proposed VOC Limit and Basis for Recommendation</u>:

The proposed VOC limit of 250 g/l is technologically and commercially feasible by the January 1, 2003, effective date based on: discussions with current and prospective manufacturers, regulators at the State and federal levels, and end users; and an evaluation of State and federal statutes, regulations, specifications, and guideline documents.

Only one district rule has a category for recycled coatings. South Coast AQMD added this category in its May 14, 1999, amendments to Rule 1113, with a VOC limit of 250 g/l, effective May 14, 1999, and a 100 g/l limit in 2006.

We have included a reporting requirement in the SCM that is similar to that in South Coast AQMD Rule 1113. Recycled coating manufacturers must file a letter with the Executive Officer of the ARB certifying their status as a recycled coating manufacturer. They must also submit annual reports to the ARB, by April of each year, stating the total number of gallons of all recycled coatings distributed in California.

<u>Issues</u>:

1. Issue: ARB should look into the inability of coating manufacturers to handle recycled materials because they are non-licensed recyclers.

Response: California has no special licensing requirements to process recycled coatings. Health and Safety Code section 25217.4 states that a person may recycle recyclable latex coating at a facility that does not have a hazardous waste facility permit if the person complies with section 25217.2. This includes storing and handling the coating to minimize the chance of exposing the handler and the environment to potentially hazardous constituents, managing any non-recyclable material accepted as hazardous waste, and having emergency response plans and procedures in place.

<u>**2. Issue:** It is unclear why labeling requirements for recycled coatings in a previous SCM draft have been removed. The labeling requirement for recycled coatings should be retained for consistency with the labeling requirements of the National AIM Rule.</u>

<u>**Response:** The recycled coating compliance option in the National Rule is voluntary and allows manufacturers of such coatings to calculate an adjusted-VOC content, based on the</u>

amount of post-consumer material contained in the recycled coating. There are labeling and reporting requirements associated with this provision. The labeling requirement contained in a previous version of the SCM was similar to the labeling requirement in the National Rule, which required the labeling of the post-consumer coating content of the recycled coating. However, consistent with South Coast AQMD Rule 1113, the ARB staff has proposed simply applying a VOC limit to recycled coatings, and defined the minimum post-consumer and secondary coating content. Because there is no need to calculate the VOC content based on post-consumer coating content, the labeling requirement was judged to be burdensome and was removed. California manufacturers who choose to participate in the federal recycled coating program would have to comply with the federal labeling requirements.

3. Issue: The reporting requirements for recycled coatings contained in a previous SCM draft should be restored. This information must be reported to EPA under the National AIM rule, and would not represent an additional burden to manufacturers. The ARB should ensure than manufacturers are meeting the minimum percentages of secondary or post-consumer contents.

Response: The commenter is referred to the response to Comment #5-4 of the Final Program EIR for a discussion of the reason for the labeling and reporting requirements in the National Rule. Because we are proposing a VOC limit for recycled coatings, and not the provisions of the federal program, the ARB staff believes that reporting requirements to monitor the post-consumer and secondary coating content would be burdensome, particularly to many small manufacturers who already make recycled coatings. There is an economic incentive to maximize the amount of post-consumer and secondary coating used in recycled coatings, and to minimize the use of virgin coating. Consistent with South Coast AQMD Rule 1113, we are proposing only that manufacturers submit an initial notification of their status as a recycled paint manufacturer, and an annual report of the number of gallons of recycled paint produced. California manufacturers who participate in the federal recycled coating program would have to comply with federal reporting requirements.

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California Integrated Waste Management Board (CIWMB). "Recycled Latex Paint." Publication #431-97-034. July 1999. http://www.ciwmb.ca.gov/condemo/factsheets/paint.htm (CIWMB, 1999)

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Wills, Max T. "Sampling, Testing, and Evaluation of Recyclable and Recycled Latex Paint" Report prepared for the California Integrated Waste Management Board, by California Polytechnic State University, San Luis Obispo, CA. December 1, 1995. (Wills, 1995)

22. Roof Coatings

Product Category Description:

Roof coatings are non-bituminous coatings labeled as and formulated exclusively for application to exterior roofs for the primary purpose of preventing penetration of the substrate by water or reflecting heat and reflecting ultraviolet radiation. Those polymer modified roof coatings containing bitumens are included in the bituminous roof coatings category. Metallic pigmented roof coatings, which qualify as metallic pigmented coatings are included in the metallic pigmented coatings category. Roofing primers are included in the primers, sealers, and undercoaters category. (RCMA, undated)

Table VI-28 below summarizes our estimate of sales and VOC emissions from the roof coatings category.

Table VI-28
Roof Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Borne	70	116,174	259	0.19
Water-Borne	104	2,793,258	13	0.11
Total	174	2,899,615	23	0.30

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Subsequent to the ARB's 1998 Architectural Coatings Survey, the Roof Coatings Manufacturer Association (RCMA) supplied us with supplemental data gathered from a survey they conducted. These data cover additional companies that did not report in the 1998 ARB survey and totaled approximately 300,000 gallons. After review of these additional data, we found that they support the findings of our ARB survey.

Product Use and Marketing:

Roof coatings are designed to be used at ambient temperatures and require little if any heating to facilitate application. Roof coatings are used primarily by professional roofers. However, these products are designed for ease of use and may be used by the homeowner. Products can be found in a variety of locations including local hardware stores.
(RCMA, undated)

Product Formulation:

Typically, roof coatings are comprised of a resin (butadiene, urethane, polyvinyl acetate), a carrier solvent (water or petroleum solvent), reinforcing fillers (fibers, clays), and optional reflective pigments. Upon application, the carrier solvent evaporates from the coating leaving a cured water-resistant film. These coatings are formulated with a variety of synthetic polymer resins, similar to latex house coatings. There are several enhanced performance characteristics of these polymeric roof coatings: low temperature flexibility, chemical resistance and elasticity. (RCMA, undated)

Proposed VOC Limit and Basis for Recommendation:

The proposed VOC limit of 250 g/l is technologically and commercially feasible by the January 1, 2003, effective date based on the following factors: complying marketshare; data provided by the RCMA; and, meetings with members of the roofing industry.

The proposed VOC limit of 250 g/l is the same as the limit in the National Rule. While most district rules have a 300 g/l limit, the national rule sets a 250 g/l limit for this category. South Coast AQMD Rule 1113 also has a 250 g/l limit for this category. The complying products and marketshare for the ARB survey data are shown below in Table VI-29. The supplemental data provided by RCMA shows a similar complying marketshare of 95 percent.

Reformulation efforts will continue in the replacement of solvent-borne coatings with water-based. This trend is shown in the Supplemental Roof Coatings Data table above.

Table VI-29
Roof Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
250	125	97	0**

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

** The proposed limit is identical to the National Rule limit. Accordingly, no additional reductions will occur from the proposed SCM limit. However, the national limit will result in 0.01 tons per day reduction in the non-South Coast AQMD portion of the State.

Issues:

1. Issue: If patching materials are included in the proposal, we recommend a 400 g/l VOC limit for wet and dry patching material, and a 50 g/l limit for all other patching material. Emulsion based patching materials cannot be applied in wet conditions to immediately stop a leak, whereas the solvent-based and dry materials can.

Response: Most patching materials are regulated under the district adhesives rules. Please see discussion in bituminous roof coatings description for more information.

(ARB, 1998)

2. **Issue:** It is important to acknowledge that roof coatings are non-bituminous.

Response: The proposed definition has been changed accordingly.

3. **Issue:** There is a problem with the definitions of roof and bituminous coatings. They were not adequately distinguished as they were in the National Rule. We would like to see no lower limits for these categories than in South Coast AQMD.

Response: ARB staff met with many roof coating manufacturers and the RCMA to clarify the definitions for roof and bituminous coatings. Please see the product category descriptions for additional information.

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23. Rust Preventative Coatings

Product Category Description:

Rust preventative coatings are products designed for use to prevent the corrosion of metal surfaces in ~~residential~~ nonindustrial situations as defined in the proposed SCM. Nonindustrial use generally includes residential, light commercial, and institutional use. The coating users are generally do-it-yourselfers, house painters, and other professional contractors not trained for using two-component industrial maintenance coatings. The coatings in this category are limited to those used for metals, such as iron, steel, aluminum, and galvanized iron/steel. Coatings recommended for nonmetallic substrates, such as wood, masonry, plaster, drywall, or fiberglass, are excluded from this category. Residential use means use in areas where people reside or lodge including, but not limited to, single and multiple family dwellings, condominiums, mobile homes, apartment complexes, motels, and hotels.

Rust preventative coatings that comply with the industrial maintenance VOC limit of 250 g/l may be used at industrial facilities.

Table VI-30 below summarizes our estimate of sales and VOC emissions from the rust preventative coatings category.

Table VI-30
Rust Preventative Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	PD	PD	382	0.14
Water-Based	PD	PD	144	~0.00
Total	25	63,099	371	0.14

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected Data.

Product Use and Marketing:

Typical uses of rust preventative coatings include the corrosion protection of residential, light commercial, and institutional metal attachments and fixtures, such as handrails, fencing, doors, and gutters. This category is intended to include coatings with ease of application, which is required by ~~the~~ typical do-it-yourself homeowners, house painters, ~~or~~ and light commercial/institutional painting contractors (South Coast AQMD, May 14, 1999). Surface preparation may require dry and clean surfaces. Small amounts of rust that are not easily removed may be left in place for some coatings. A rust preventative coating is oftentimes a primer. Generally, common application methods, such as by brush, roller, or spray may be used.

Rust preventive coatings are available to the residential consumer and painting contractor through typical sales outlets, including paint stores, hardware stores, and mass-market general merchandise stores.

Product Formulation:

Rust preventative coatings include primers and topcoats. The traditional solvent-based alkyd formulations are generally noted for being user-friendly, easily brushed, and more tolerant of less than perfect surface preparation of metal. It may be difficult for the do-it-yourselfer, house painter, or light commercial/institutional contractor to thoroughly remove rust and other contaminants from the metal, especially if sandblasting equipment is not available. The alkyd formulations will better adhere to the metal under these conditions compared with other types of formulations. Primers may contain various rust inhibitive pigments, such as silicate compounds.

An example of other formulations is water-based acrylics. Water-based formulations may be user-friendly because of less objectionable odor and easier cleanup.

Formulations in the rust preventative coatings category generally do not include the more sophisticated two-component polyurethane and two-component epoxy formulations that require special training and professional equipment (such as industrial-grade protective gear, including respirators).

Proposed VOC Limit and Basis for Recommendation:

The proposed VOC limit is 400 g/l, effective January 1, 2003. The proposed limit is technologically and commercially feasible, by the effective date, based on our review of complying marketshare and information on current coatings (e.g. product data sheets).

As indicated in Table VI-31 below, 64 percent of the market already complies with the proposed limit. Because districts have included rust preventative coatings in the "industrial maintenance coatings" category, some of the traditional alkyd coatings are now formulated to below 420 g/l, the current VOC limit for "industrial maintenance coatings" in many districts. Some of these rust preventative coatings also comply with the proposed VOC limit of 400 g/l. Non-complying coatings generally are in the range from 400 to 500 g/l. Manufacturers of non-complying coatings have the option of adjusting formulations, tightening quality control, increasing solids content, or substituting solvents with exempt compounds [e.g. Oxsol 100™ ~~or the potential future exempt solvent tertiary-butlyl acetate (TBAc™)~~], to comply with the proposed limit.

Table VI-31
Rust Preventative Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
400	16	63.5	0***

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.
*** The proposed limit is identical to the National Rule limit. Accordingly, no additional reductions will occur from the proposed SCM limit. However, the national limit will result in 0.01 tons per day reduction in the non-South Coast AQMD portion of the State.

The South Coast AQMD is currently the only district that has a VOC limit specific to this category. The South Coast AQMD limits are 400 g/l (effective May 14, 1999) and 100 g/l (effective July 1, 2006). In other districts, rust preventative coatings have been included in the "industrial maintenance coatings" category.

The proposed limit is the same as the U.S. EPA limit in the national rule and the South Coast AQMD limit effective on ~~July 1, 2002~~ May 14, 1999.

Issues:

1. Issue: The proposed "rust preventative coating" category is needed because residential users and painting contractors need single-component rust preventative coatings that are user-friendly. These coatings are typically alkyd-based formulations at around 400 g/l. "Industrial maintenance coatings" are generally not suitable for residential users. A lower VOC content limit would create a shift in technology, such as to two-component polyurethane or two-component epoxy coatings that are too difficult for the typical homeowner to use.

Response: The ARB staff agrees and is proposing the "rust preventative coating" category with a VOC limit of 400 g/l.

2. Issue: The limit should be left at the level of the national rule limit at 400 g/l.

Response: See Response to Issue 1.

3. Issue: There is confusion concerning the use of "industrial maintenance coatings" and "rust preventative coatings" because of category overlap and inconsistencies of the definitions and labeling requirements. Also, there is confusion concerning commercial and institutional use in terms of which category applies, if any.

Response: The staff has deleted the provision that would have allowed "rust preventative coatings" that also meet the definition for "industrial maintenance coatings" to be subject only to the higher 400 g/l limit for "rust preventative coatings." We are also clarifying that rust preventative coatings are only for "nonindustrial use" and we have added a detailed definition of "nonindustrial use" that will distinguish between industrial maintenance and rust preventative coatings. ~~This~~ These revisions should more effectively separate the use of coatings in these two categories. Labeling and reporting requirements for coating manufacturers will also distinguish coatings between the categories. The rust preventative category is for nonindustrial use as defined in the proposed SCM, which generally means residential, light commercial, and institutional use. Industrial maintenance coatings may be used in commercial and institutional situations that are exposed to the extreme environmental conditions identified in Section 2.2~~5~~6 of the proposed SCM. Only rust preventative coatings that comply with the industrial maintenance VOC limit of 250 g/l may be used at industrial facilities.

4. Issue: There is overlap and confusion between the "rust preventative coating" category and the "primer, sealer, undercoater" and the "quick-dry primer, sealer, undercoater" categories.

Response: The primers in the "rust preventative coatings" category must be labeled for rust prevention of metals and are limited to ~~residential~~ nonindustrial users as defined in the proposed SCM (including residential users for single and multiple family dwellings, condominiums, mobile homes, apartment complexes, motels, and hotels, light commercial users, and institutional users). ~~Section 3.2 of the SCM has been revised to clarify that rust preventative coatings (including primers) are not subject to the most restrictive limit (e.g. the VOC limits for primers, sealers, and undercoaters, and for quick-dry primers, sealers, and undercoaters).~~

5. Issue: The "rust preventative coating" category has the potential for abuse. Some coating manufacturers may relabel "industrial maintenance coatings" to be "rust preventative coatings" to take advantage of a less stringent limit and avoid reformulation.

Response: The staff has deleted the provision that would have allowed "rust preventative coatings" that also meet the definition for "industrial maintenance coatings" to be subject only to the less stringent 400 g/l limit for "rust preventative coatings." This revision should more effectively separate the use of coatings in these two categories. ARB staff will monitor the sales of "rust preventative coatings" by evaluating sales data obtained from coatings manufacturers, as required by Section 5.2 of the SCM.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

South Coast AQMD. Staff Report. Amend Rule 1113 - Architectural Coatings. May 14, 1999 Board Meeting. (South Coast AQMD, May 14, 1999)

24. Specialty Primer Coatings

Product Category Description:

Specialty primer coatings are products designed for application to a substrate to block stains; to seal fire, smoke, or water damage; or to condition excessively chalky surfaces. An excessively chalky surface is one that is defined as having a chalk rating of four or less as determined by ASTM D-4214 – Photographic Reference Standard No.1 or the Federation of Societies for Coatings Technology "Pictorial Standards for Coatings Defects."

Under the proposed SCM, the labels of all specialty primers must prominently display language specifying that they are for use only to block stains, or on substrates damaged by fire, smoke, or water, or on excessively chalky substrates.

The specialty primer category was not surveyed in the Air Resources Board's 1998 Architectural Coatings Survey, but is comprised of products reported under the primer, sealer, and undercoater category, the sealer category, and the quick-dry primer, sealer, and undercoater category. The estimate of sales is based on information provided by industry and review of product data sheets making claims of efficacy when used on substrates damaged by fire, smoke, water, stains, or on substrates with excessively chalky surfaces.

The total number of specialty primer coatings is estimated to be approximately 5 percent of the aforementioned categories reported under the 1998 ARB survey, which would equate to approximately 409,000 gallons per year. The VOC content listed on the product data sheets reviewed ranged from "too low to measure" (Zehrung Z-Prime II) to 450 g/l. (Bennette Super Kill White Primer, Kilz Ultra Low Odor, Dunn-Edwards Block-It Quick-Dry Primer Sealer, Zehrung Z-Prime).

Product Use and Marketing:

Specialty primers can be purchased by all consumers at outlets such as hardware stores, home supply stores, and retail paint stores, and by professionals at wholesale-only outlets.

Specialty primers are intended for use only on substrates with specific damage, as indicated by the definition, that can not be effectively sealed by general use primers, sealers and undercoaters or quick-dry primer, sealers and undercoaters. Stains resulting from extractive bleeding are difficult to block and are discussed in detail below. Other types of stains not discussed in this section may also necessitate the use of specialty primers. Conditions which may necessitate the use of specialty primers, are described below:

Excessively Chalky Surfaces

Chalking is the formation of a fine powder on the surface of a coating. It can result when the coating binder is destroyed by sun and moisture, the coating contains insufficient binder to wet the pigment, or too much thinner has been added to the coating. As the binder disintegrates, the pigment becomes exposed on the surface as a fine powder. (McNeill) Generally, alkyd coatings chalk more quickly and to a greater degree than acrylic latex coatings.

There are various degrees of chalking. Rubbing the surface with a finger or dark cloth will indicate the severity of the chalking condition. Very light chalking, particularly on white coatings, is often desirable because the surface powder washes off with rainfall to maintain a clean surface. Medium and heavy chalking will cause a tinted coating to lose its color and become lighter. Severe chalking makes recoating a problem because the extreme porosity of the surface powder will affect adhesion and does not provide the coating a firm surface for bonding. (McNeill)

Extractive Bleeding Stains

Dry wood is composed of cellulose, lignin, hemicelluloses and minor amounts of extraneous materials, which may be either organic or inorganic. The organic components of the extraneous materials are referred to as extractives because they can be removed by extraction with solvents without altering the cellulose/lignin structure of the wood. Extractives include tannins and other poly-phenolics, coloring matter, essential oils, fats, resins, waxes, gums, and starch.

Extractives are often classified according to the type of solvent that will extract them from the wood. Solvents include water, alcohol, and ether. Once in solution, extractives typically exhibit a reddish brown color. Upon evaporation of the solvent, the colored extractives are deposited on the evaporating surface, causing discoloration. When the surface is a painted or stained wood surface, the discoloration can be a problem.

Water-soluble extractives are the extractives most commonly responsible for discoloration of coatings. Discoloration of coatings or stains may occur when extractives that are dissolved into solution by water reach the coated surface and remain as a gray to reddish-brown stain after the solvent evaporates. This is termed extractive bleeding. Water soluble extractives are found in the heartwood of most species, but high concentrations are often found in the heartwood of decay resistant species such as western red cedar and redwood.

When extractive discoloration occurs, water is typically the primary causal agent. In some species, extractives migrate to the wood surface during the drying process. If concentrations at the surface are high enough, the extractives may interfere with proper penetration, absorption and/or drying properties of the applied finish. Most extractive-related coating discoloration problems, however, are a result of moisture incurred after installation and coating.

Diffused discoloration of a coating typically results from the penetration of the coating film by liquid water or water vapor. These exterior sources of water include rain, dew, irrigation and high humidity. Diffused discoloration will usually occur in the first cycles of wetting after painting and can be attributed to a porous or thin coating which is either insufficient or inadequate to prevent water penetration.

The water present as the carrier in water-based finishes can also contribute to diffused extractive discoloration. Usually, discoloration is evident at the time of application, before the finish dries. It is for this reason that either solvent-based oil or alkyd or stain-blocking latex primers are usually specified for wood species that are prone to extractive bleeding.

In all cases for all species of wood, the primer is the most important coat in preventing discoloration when coatings are used. Top quality stain-blocking primers prevent the extractives from being transported to the topcoat. (Donegan, et al)

Water, Smoke and Fire Damage

These stains must be properly sealed before coating or they will continue to bleed through newly applied coats of latex coatings. Water stains allow various substances, such as roofing tar and iron oxide, to bleed through and cause discoloration. (Dunn-Edwards)

Surface Preparation

Chalky surfaces require different degrees of preparation depending on the amount of chalk on the surface. Severe chalking requires pressure washing or sandblasting to remove chalked coating and provide a firm, sound surface. (Dunn-Edwards) If a pressure washer or sand blaster is not available, the surface can be washed with mild detergent and a stiff brush, and the residue removed with a stream of water from a garden hose. Proper cleaning of surfaces before applying primer is critical on smoke damaged substrates. After thorough cleaning the surface may be primed. The topcoat should be tested over a small section to assure the stain has been sealed. If the stain burns through, a second coat is typically applied and tested again before proceeding with the topcoat. (KILZ Sealer, Primer, Stain Blocker)

Please refer to the section on *Surface Preparation* in the chapter on primers, sealers, and undercoaters for additional information on general surface preparation, product application, and minimum and maximum recoat times.

<u>Product Formulation</u>:

This category utilizes a variety of available coating technologies in its formulations, including alkyds, modified alkyds, oleoresins, epoxies, specialty resins, and emulsions.

Coatings ingredients fall into four basic categories:

- Pigments to provide color and hide;
- Binder to hold the pigment particles together and provide adhesion;
- Liquid to act as a carrier for the pigments and binder; and
- Additives to enhance certain properties like brushing ease and mildew resistance.

(PQI)

In alkyd and oil-based coatings, most of the liquid is a solvent, usually a petroleum distillate. The solvent-based coatings in this category are commonly formulated using alkyd resins as binders. Because the specialty primer category was not surveyed, our analysis of the product category was dependent mainly upon review of product data information sheets. This review indicates that the majority of the specialty primer products are alkyd-based products.

Most of the products in the specialty primer category are white. While some product data sheets reviewed indicate that the product may be tinted, others give specific recommendations against tinting. Titanium dioxide is the most widely used white pigment because of its superior hiding power.

Proposed VOC Limit and Basis for Recommendation:

The recommended VOC limit for the specialty primers category is 350 g/l, effective January 1, 2003. The proposed VOC limit is technologically and commercially feasible by the January 1, 2003, effective date based on our review of product data sheets and information provided by manufacturers. Our recommended limit is consistent with the interim limit adopted by the South Coast AQMD. The proposed limit is consistent with the current national limit for primers, sealers, and undercoaters. Currently, products meeting this limit can perform the functions of specialty primers, as defined above.

As previously mentioned, this category was not surveyed under the ARB's 1998 Architectural Coatings Survey, so data on number of complying products and complying marketshare are not available. However, a review of product data information sheets indicates a large number of products, both water-based and solvent-based, meet the proposed limit of 350 g/l.

Product data sheet review indicates there are several acrylic resin water-based specialty primers with VOC contents of less than 350 g/l which make claims of efficacy on stained substrates, including substrates with tannin staining. Product data sheet review also indicates that there are alkyd resin solvent-based specialty primer products with VOC contents of less than 350 g/l, including products that are designed specifically to bind and hold residual chalky materials to the surface. (Dunn-Edwards Surfaco Masonry Surface Conditioner)

Issues:

1. **Issue:** The definition for specialty primers should include products intended for application to substrates where it is necessary to block stains, odors, or efflorescence.

Response: The proposed category definition was revised to include products that block stains. Review of product data sheets indicated no specialty primers that made reference to use as an odor blocker, so inclusion of these products in the category was not deemed necessary. Product data sheet review also indicated low-VOC products are available for use on substrates with efflorescence; therefore, the higher VOC content allowed for specialty primers is not necessary for substrates with efflorescence.

2. **Issue:** An additional category should be established for specialty primers.

Response: The specialty primer category has been established to address this concern.

3. Issue: Specialty primers are required for bonding old chalky surfaces. A category is needed for specialty primers with a VOC limit of 350 g/l.

Response: The specialty primer category, with a proposed VOC limit of 350 g/l, includes those products that are for use on excessively chalky substrates.

4. Issue: A separate category for specialty primers should be established with a VOC limit of 400 g/l. Water-based primers do not prevent water-soluble stains from bleeding through a water-based topcoat.

Response: A review of available product data sheets indicates there are water-based specialty primers below 350 g/l available that are recommended for use on water damaged substrates, and which make claims of preventing the recurrence of water soluble stains. Product data sheet review also indicates that solvent-based specialty primers are available with a VOC content of 350 g/l or less which make similar claims.

REFERENCES

Bennette Paint Manufacturing Company, Inc. Material Safety Data Sheet for "Super Kill White Primer." (Bennette Super Kill White Primer)

Donegan, Vernon, et al. Understanding Extractive Bleeding. http://www.calredwood.org/probuild/techtalk/extract/ttextrac.htm (Donegan, et al)

Dunn-Edwards Paints. Repaint and Maintenance Guide to Products and Services. 1996 (Dunn-Edwards)

Dunn-Edwards Paints. Product Information Sheet for "Block-It Quick-Dry Primer/Sealer." (Dunn-Edwards Quick-Dry Primer Sealer)

Masterchem. Internet Site. http://www.masterchem.com/ultra.html (Kilz Ultra Low Odor)
McNeill, Robert A. Course materials on surface preparation from A Condensed Comprehensive Course in Coatings Technology. October, 1992. (McNeill)

Paint Quality Institute. Training Manual "An Introduction to Paints and Coatings" (PQI)

Zehrung Corporation. Technical Data Sheet for "Z-Prime." (Zehrung Z-Prime)

Zehrung Corporation. Technical Data Sheet for "Z-Prime II." (Zehrung Z-Prime II)

25. Stains

Product Category Description:

Stains can be semi-transparent or opaque (solid) coating products designed and formulated to change the color of a surface but not conceal the grain pattern or surface texture. Semi-transparent stains will add color to the surface without concealing its natural grain pattern and surface texture. Opaque stains completely conceal the color variations of the grain pattern while allowing the texture of the ~~grain pattern~~ surface to be seen. Many stains also protect the wood from UV exposure, provide some level of moisture repellency, and minimize tannin bleed through. This category includes ~~lacquer~~ concrete stains. (South Coast AQMD, 1999)

Table VI-32 below summarizes our estimate of sales and VOC emissions from the stains category.

Table VI-32
Stains*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	890	1,135,055	440	3.13
Water-Based	433	1,825,921	163	0.76
Total	1323	2,960,976	269	3.89

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Product Use and Marketing:

These types of coatings are used in cabins and homes with soft wood exterior siding, as well as on wood fences, decks, ~~and~~ awnings, and concrete floors, walks and patios. They are used to protect the ~~wood~~ substrate from ultra violet (UV) exposure, moisture, and minimize tannin bleed through. The survey results indicate that 99 percent of opaque stains are recommended for exterior use only, and less than 1 percent are for interior use only. Whereas 50 percent of semitransparent stains are for exterior use, 32 percent are for interior use, and 18 percent are for interior and exterior use (ARB, 1999). Stains are sold in hardware stores, ~~department stores,~~ at home improvement centers, and paint stores.

Product Formulation:

Semi-transparent stains have traditionally been oil-based formulations that penetrate the ~~wood~~ substrate to protect against cracking, splitting, and warping of wood, and can be both interior and exterior use products. In contrast, opaque stains are primarily acrylic/latex-based formulations for exterior use, and impart color to the smooth or rough siding, wood shingles/shakes, wood trim, ~~and~~ plywood, and concrete floors, walks and patios. Both types of stains are now available in acrylic or oil-based formulations.

~~Lacquer stains are semi-transparent wood coating products formulated with cellulosic or synthetic resins to dry by evaporation without chemical reaction.~~

Proposed VOC Limit and Basis for Recommendation:

The proposed VOC limit for stains is 250 g/l. However, low solids stains that meet the criteria of a low solids coating would be subject to the proposed 120 g/l VOC limit for low solids coatings (including water and exempt compounds). The proposed VOC limit is technologically and commercially feasible by the January 1, 2003, effective date based on our review of the literature and trade journals, complying marketshare, existing regulatory limits, literature searches, and information provided by manufacturers or resin suppliers.

Table VI-33 below summarizes our estimates of the number of products that were marketed in 1996 that complied with the proposed VOC limit, their associated marketshare, and the emission reductions that would be realized if the limit were implemented in the non-South Coast AQMD portions of the State. As shown in Table VI-33, over half of the market currently complies with the proposed VOC limit.

Table VI-33
Stains*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
250	337	52.8	0.64

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

Literature Searches

Several new lower-VOC interior and exterior semi-transparent stains, as well as opaque exterior stains, are available that comply with the proposed limit.

Behr Process Corp. currently markets four stain products with VOC contents of less than 250 g/l. Deck Plus® Solid Color Deck, Fence & Siding Stain is a 100 percent acrylic latex emulsion with 159-184 g/l VOC. Behr No. 9 Oil/Latex Redwood Stain is an oil-latex emulsion with 156 g/l VOC. Plus 10 Solid Color Oil/Latex Stain is an oil-latex emulsion with 110-116 g/l VOC. Plus 10 Semi-Transparent Oil/Latex Stain is an oil-latex emulsion with 210-225 g/l VOC. (Behr, 1999)

Vianova Resins, Inc., has utilized an alkyd/acrylic hybrid polymer known as RESYDROL® for formulating low-VOC (less than 250 g/l) semi-transparent, opaque, and interior wiping stains. The manufacturer states that exterior exposure studies, indicate that over four years of exterior exposure can be expected, without any flaking, cracking, or peeling. This polymer will form a film at or near freezing temperatures without using any co-solvents. Several formulations below the proposed 250 g/l limit are available from Vianova Resins. (RESYDROL®, 1999; PCI, 1999)

Sherwin-Williams has several stains that have a VOC content less than 250 g/l. Okon, Performance Coatings, FSM Corporation, PPA Technologies, Rhinoguard, and Sierra Performance Coatings also have coatings containing less than 250 g/l VOC. Interior semi-transparent stains that comply with the proposed 250 g/l are available from Deft, Inc., Sierra Performance Coatings, PPA Technologies, and Führ Research Laboratories. (South Coast AQMD, 1999)

Blue River Coatings markets a water-based stain with 60 g/l VOC content developed to act as a stain and primary sealer. The resins in the product are designed to help the product dry quickly thus minimizing excessive grain raising, seal the wood to help repel water, and not allow the pigment to chalk off like other stains. A water-based or solvent-based sanding sealer or topcoat is recommended. This product is currently used by two major manufacturers of whirlpool hot tubs. (Blue River, 1999)

Consumer Reports magazine rated nine high-VOC solvent-based semi-transparent stains and lower-VOC water-based stains. They concluded that there were three water-based stains in the good to very good category, with four solvent-based formulations performing in the very good to excellent range. However, the water-based semi-transparent stains outperformed two solvent-based coatings. (CR, 1998)

Issues:

1. **Issue:** Low VOC stains have limited open time and poor lapping performance.

Response: The new alkyd/acrylic hybrid polymers, alkyd-modified acrylics, and modified acrylic/water dispersible drying oil formulations make claims of acceptable open time and lapping performance. Also, one must consider the area to be covered as well as environmental conditions when determining the appropriate application technique which should be used in order to maintain a wet edge and avoid lapping problems. In addition, the use of water-based pre-stain and wood conditioners will help minimize blotching.

2. **Issue:** Low VOC stains do not penetrate as well as high VOC stains.

Response: With the new alkyd/acrylic hybrid polymers, alkyd-modified acrylics, and modified acrylic/water dispersible drying oil formulations, open time is longer which also results in better penetration. Penetration has also been enhanced by advancements in pigment technology, which have substantially reduced the size of available pigments, which results in better penetration.

3. **Issue:** Water-based semi-transparent stains open the wood’s grain and dry too fast.

Response: With the new alkyd/acrylic hybrid polymers, alkyd-modified acrylics, and modified acrylic/water dispersible drying oil formulations, there are excellent open times and minimal, if any, grain raising. In addition, the use of water-based pre-stain and wood conditioners will reduce grain raise on all bare wood surfaces.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Behr Process Corp. Product Data Sheets. (Behr, 1999)

Blue River Coatings. Product Data, Wood Stain. (Blue River, 1999)

Consumer Reports. June 1998. (CR, 1998)

Paint and Coatings Industry Magazine. November 1999. pp. 42-44. "Varnishes and Stains." (PCI, 1999)

South Coast AQMD. Draft Staff Report. "Proposed Amendments to Rule 1113 – Architectural Coatings." May 14, 1999. (South Coast AQMD, 1999)

Vianova Resins. Technical Update. "RESYDROL®, Acrylic-Modified Alkyd Emulsions for Wood Stains and Varnishes that Perform Better than Solvent-Borne Systems." (RESYDROL®, 1999)

26. Swimming Pool Coatings

Product Category Description:

Swimming pool coatings are coatings applied to the interior of swimming pools and are formulated to resist swimming pool chemicals. Swimming pool coatings are water-based or solvent-based coatings such as epoxies or acrylics that are applied on uncoated pool surfaces or over other similar coatings.

Table VI-34 below summarizes our estimate of sales and VOC emissions from the swimming pool coatings category.

Table VI-34
Swimming Pool Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	PD	PD	438	0.01
Water-Based	PD	PD	147	~0.00
Total	18	3,492	406	0.01

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected Data.

Product Use and Marketing:

Swimming pool coatings are sold at pool supply stores, do-it-yourself home centers, hardware stores, and are sold directly from the manufacturer by mail order or contract. They are usually applied by the homeowner or swimming pool repair and maintenance companies. Swimming pool coatings are applied by roller or thinned and sprayed. They are high in solids, and need to be applied in a thick coating. Swimming pool primers are often used on bare surfaces, although many coatings are self-priming. Thinning of the first coat is often recommended, and more than one coat is often recommended.

Surface preparation is required for the application of any swimming pool coating, including draining the pool, washing the pool surfaces with a trisodium phosphate solution, acid etching with muriatic acid solution, washing again with trisodium phosphate solution, and thorough drying. The coating must be applied at the proper conditions including temperature, sunlight, and lack of rainfall. The pool cannot be refilled for five to seven days after coating.

Swimming pools are coated primarily for aesthetic reasons, to provide a glossy surface over rough concrete. These coatings are also used to seal the pool's rough surface, and to prevent growth of algae or bacteria in the porous surfaces of the concrete. Coatings can be used where color is desired, or to cover discoloration. With the required surface preparation, most people recoat the whole pool, rather than simply repairing small areas.

The service life of any swimming pool coating is highly dependent on the surface preparation, weather conditions during coating, how long the homeowner waits before refilling the pool, and the care the homeowner takes in maintaining proper water balance and performing other routine maintenance.

Product Formulation:

Chlorinated rubber-based pool coatings were used exclusively on swimming pools prior to the development of epoxy coatings. Much of the demand for rubber or synthetic rubber coatings can be attributed to the fact that rubber-based coatings are needed for compatibility with the old coating. Chlorinated or synthetic rubber coatings last one to five years with residential use, depending on the grade and the amount of rubber in the coating.

Epoxies are a fast-growing product as a replacement for chlorinated rubber-based coatings because of their durability. Depending on the manufacturer and the grade of product, epoxies may give four to ten years of service life, two or three times that of chlorinated rubber-based coatings. All epoxies are subject to surface chalking on exposure to ultraviolet light, but this is surface chalking that can easily be cleaned off. Severe rub-off chalking indicates another problem such as water imbalance or refilling the pool too soon. Most epoxies are two-part solvent-based products, although there are water-based epoxies. Manufacturers we interviewed generally are satisfied with the performance of their epoxy coatings.

Acrylic swimming pool coatings are water-based, can be applied on damp surfaces and cure within three days. They can be applied over chlorinated rubber or properly prepared epoxy coatings.

Proposed VOC Limit and Basis for Recommendation:

The proposed VOC limit of 340 g/l is technologically and commercially feasible by the January 1, 2003, effective date based on: complying marketshare; a review of product literature on coatings included in this category; and discussions with manufacturers and retailers of these coatings.

The complying products are either two-part epoxy or single-component acrylic. Epoxies can be either solvent-based or water-based.

All districts except San Diego County and Mojave Desert (both with a VOC limit of 650 g/l) currently have a 340 g/l VOC limit, although the category is exempt in the Bay Area, Butte County, Colusa County, Feather River, and Monterey Districts. The swimming pool coating category was created in the 1989 SCM with a VOC content limit of 340 g/l, effective in 1992 (TRG/ARB, 1989).

Several manufacturers make solvent-based epoxies with VOC content ranging from 340 g/l to 425 g/l. The water-based epoxies range from 230 g/l to 250 g/l. The VOC content of acrylic coatings range from 200 g/l to 230 g/l. The primers are either solvent-based or water-based and range from 70 g/l to 420 g/l.

The 1998 ARB Architectural Coatings Survey shows that 43 percent of the swimming pool coatings already comply with the proposed 340 g/l limit. Reformulation of existing non-complying coatings will likely focus on the water-based epoxies and acrylics, and further reducing the VOC content of the solvent-based primers and epoxy coatings. We would expect that as more solvents are exempted from VOC status by the U.S. EPA and districts, manufacturers will try to reformulate chlorinated rubber coatings with these solvents.

Although Table VI-35 shows that the VOC emission reductions in the non-South Coast AQMD portion of California would be very low from implementing the proposed limit of 340 g/l, we note that there could be minor emission reductions if districts without a VOC limit for swimming pool coatings adopt the proposed limit.

Table VI-35
Swimming Pool Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
340	PD	PD	0

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected Data.

<u>**Issues**</u>**:**

1. Issue: The specified VOC limit for swimming pool repair and maintenance coatings of 650 g/l in Table 1 is higher than the 600 g/l limit these coatings must meet under U.S. EPA's National AIM Rule. The SCM should recommend a VOC limit that is consistent or more stringent than the 600 g/l limit specified in the U.S. EPA's rule.

Response: The commenter is referring to an earlier version of the proposed SCM in which a VOC limit of 650 g/l was proposed for swimming pool repair and maintenance coatings. We are now proposing a more stringent 340 g/l VOC limit.

2. Issue: The proposed SCM contains proposed VOC limits for swimming pool repair coatings at 650 g/l. This is a relaxation of the 1989 SCM and Ventura County APCD Rule 74.2. We recently initiated enforcement action on the sale of coatings exceeding this standard.

Response: The commenter is referred to the response to issue number 1.

3. **Issue:** If you have to repair a chlorinated rubber coating, the repair coating has to be chlorinated rubber. At 340 g/l, it's not going to be chlorinated rubber; it's a different technology. Epoxy-based swimming pool coatings have to be replaced more often because they fail more frequently than chlorinated rubber-based coatings.

Response: Chlorinated rubber coatings must be repaired with either chlorinated rubber coatings or acrylic coatings. We disagree that epoxy-based swimming pool coatings don't last as long as chlorinated rubber coatings. According to manufacturers who make both epoxy and chlorinated rubber coatings, the epoxies last more than twice as long as rubber-based coatings.

4. **Issue:** Epoxy coatings are not necessarily better, and they fail for a lot of reasons. I don't think we should assume that if it says epoxy or urethane that those are superior in the configurations that are currently sold.

Response: Both epoxies and chlorinated rubber coatings will fail if the surface is not properly prepared. Overall, epoxies are expected to outlast rubber-based coatings.

5. **Issue:** Are there two categories under swimming pool, swimming pool and swimming pool repair? We need to make that clearer.

Response: To avoid confusion with existing district rules, we have created two categories of swimming pool coatings in the proposed SCM, swimming pool coatings and swimming pool repair and maintenance coatings, both at 340 g/l. However, we recommend that districts eventually eliminate the swimming pool repair and maintenance coating category from their architectural coatings rules, since such products, as defined, will no longer be compliant.

6. **Issue:** Two component swimming pool coatings show blistering and peeling.

Response: Two component epoxies have been used in swimming pools for years, and they are becoming more popular because they last longer than traditional chlorinated rubber coatings. In conversations with manufacturers, there was no mention of blistering and peeling.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Technical Review Group and Air Resources Board (TRG/ARB). "ARB-CAPCOA SCM for Architectural Coatings, Technical Support Document." July 1989. (TRG/ARB, 1989)

27. Swimming Pool Repair and Maintenance Coatings

Product Category Description:

Swimming pool repair and maintenance coatings are rubber-based coatings used for the repair and maintenance of existing rubber-based swimming pool coatings (i.e., chlorinated rubber or synthetic rubber).

Table VI-36 below summarizes our estimate of sales and VOC emissions from the swimming pool repair and maintenance coatings category.

Table VI-36
Swimming Pool Repair and Maintenance Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	6	12,774	569	0.05
Water-Based	0	0	N/A	0.00
Total	6	12,774	569	0.05

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Product Use and Marketing:

The swimming pool repair and maintenance coatings consist solely of chlorinated rubber or synthetic rubber coatings. Please see additional discussion under swimming pool coatings.

Product Formulation:

Swimming pool repair and maintenance coatings are formulated with either chlorinated rubber or synthetic rubber ingredients that are only soluble in solvents. Some examples of solvents used in these coatings are mineral spirits, ethylbenzene, and xylene. These coatings are high in solids and are applied in a thick layer. The percentage of the rubber ingredient used in the formulation influences the cost and service life of the coating.

Proposed VOC Limit and Basis for Recommendation:

The proposed VOC limit of 340 g/l is technologically and commercially feasible by the January 1, 2003, effective date based on the successful replacement products discussed under the general swimming pool coating category.

Compliant epoxy coatings are a viable reformulation option for coatings applied to new surfaces. Also, compliant water-based acrylics can be used to repair existing rubber-based coatings.

Table VI-37 shows that currently there is no complying marketshare. The reason is that this category is comprised of chlorinated rubber coatings that cannot currently be formulated to meet the proposed VOC limit. However, there are two complying technologies (as discussed above) in the general swimming pool coating category that are an acceptable alternative for chlorinated rubber coatings. Further, there is a three-year sell-through period in most district rules, allowing for retail sale of chlorinated rubber coatings to continue until 2006. We believe this is sufficient time for manufacturers to reformulate their existing coatings to comply with the proposed limit. Also, manufacturers may be able to reformulate rubber-based coatings using exempt solvents.

The table below also shows that VOC emission reductions in the non-South Coast AQMD portion of California would be 0.03 tons per day, on an annual average basis, from implementing the proposed limit of 340 g/l.

Table VI-37
Swimming Pool Coatings - Repair and Maintenance Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
340	0	0.00	0.03

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

<u>Issues</u>:

1. Issue: Please refer to the swimming pool coatings category.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

28. Temperature-Indicator Safety Coatings

Product Category Description:

Temperature-indicator safety coatings are high performance products formulated, recommended, and designed for use on the surface of equipment and piping for temperature monitoring and safety purposes. At predetermined temperature levels and exposure durations, the coating progressively changes color to indicate how dangerous the overheating problem is underneath the coating. These coatings are used on the surface of materials exposed continuously or intermittently to temperatures above 204°C (400°F), as in the related "high-temperature coatings" category. "Temperature-indicator safety coatings" is a new category, separated from the "high-temperature coatings" category, to allow for coatings needed for safety purposes.

Temperature-indicator safety coatings were not reported separately in the ARB's 1998 Architectural Coatings Survey, but were included in the "high-temperature coatings" category. Available information on sales volume from one manufacturer indicates that VOC emissions from temperature-indicator safety coatings contribute less than 0.01 tons per day statewide, excluding the South Coast AQMD.

Product Use and Marketing:

Temperature-indicator safety coatings are used to monitor and protect equipment and piping at oil refineries, power plants, chemical plants, industrial boiler units, heat treating plants, and similar facilities. For example, if there is breakdown of thermal insulation, the temperature-indicator safety coating covering the exterior of the equipment or piping would mark the location and indicate the severity of dangerous "hot spots" by the extent of the color change. This color change is irreversible, so after the equipment, piping, or insulation is repaired, the surface generally needs to be cleaned, prepared, and recoated.

Surface preparation and coating application methods are similar to those for the more typical "industrial maintenance coatings" (see Section VI-A-14). Manufacturer recommendations may include surface preparation by abrasive blasting, wire brushing, or sanding. A primer coat may also be recommended. Application may be by conventional spray, airless spray, brush, or roller.

Product marketing is similar to marketing for the more typical "industrial maintenance coatings" (see Section VI-A-14), however, temperature-indicator safety coating products are not commonly used, and hence market availability is expected to be limited.

Product Formulation:

Temperature-indicator safety coatings may be formulated with solvent-based, heat-resistant silicone-alkyd or silicone resins. Organic pigments in the coatings chemically change to different colors, progressively, at certain higher temperatures and temperature durations.

Coatings are formulated for different initial indicator temperatures, such as starting at 350°F or at 500°F.

<u>Proposed VOC Limit and Basis for Recommendation</u>:

The proposed VOC limit is 550 g/l, effective January 1, 2003. The proposed limit is technologically and commercially feasible, by the effective date, based on our review of currently available coatings and discussion with industry representatives. The proposed VOC limit serves as a VOC content "cap" for coatings in this category.

The limit is proposed because certain equipment at oil refineries need specific temperature-indicator safety coatings for safety purposes (Chevron, 1999). These coatings do not comply with the VOC limit of 420 g/l in the "high-temperature coatings" category (see Section VI-A-13). The current temperature-indicator safety coatings are generally in the VOC range of 450 g/l to 550 g/l. Based on available information, the volume of coatings used is low. For example, information from a few of the larger oil refineries in California indicates that a refinery typically uses approximately ten gallons of coating over a two to three year period.

Most district rules have a VOC limit of 420 g/l for high-temperature coatings, which currently covers temperature-indicator safety coatings in those districts. The South Coast AQMD has an interim limit of 550 g/l for high-temperature coatings, which covers temperature-indicator safety coatings in that district. The South Coast AQMD provided this interim limit, from July 1, 2002, to July 1, 2006, so that users of the temperature-indicator safety coatings would have sufficient time to comply with the district's final limit of 420 g/l, effective July 1, 2006.

The U.S. EPA limit for high-temperature coatings is 650 g/l, which covers temperature-indicator safety coatings.

REFERENCE

Chevron Products Company. Letter dated September 8, 1999 from Gail Ito, Chevron Products Company, to Jim Nyarady, ARB, regarding "Written Comments for ARB's SCM for Architectural Coatings". (Chevron, 1999)

29. Traffic Marking Coatings

Product Category Description:

Traffic marking coatings are used to provide visible markings on streets, highways, curbs, berms, driveways, parking lots, sidewalks, and airport runways. Traffic stripes or lines are longitudinal centerlines or lane lines that separate traffic lanes, and longitudinal lines on the edges of the roadways. Pavement markings are transverse markings such as word and symbol markings, limit lines indicating stop lines, crosswalk lines, shoulder markings, parking stall markings, and railroad grade crossing markings (Caltrans, 1999). The most common colors are white, yellow, black, and blue.

Table VI-38 below summarizes our estimate of sales and VOC emissions from the traffic marking coatings category.

Table VI-38
Traffic Marking Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons per day)
Solvent-Based***	46	885,126	290	1.09
Water-Based	115	1,998,244	124	0.93
Total	161	2,883,370	154	2.02

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
****** Grams VOC per liter of coating, less water and exempt compounds.
*** Includes 100 percent solid coatings.

Product Use and Marketing:

Traffic marking coatings are sold in hardware stores and do-it-yourself centers. They are also purchased by contract by governments, contractors who apply coatings throughout for governments, and private businesses (NPCA, 1997). Typical users include state and local highway maintenance crews, striping contractors, municipalities, shopping center management, airport contractors, and plant maintenance personnel.

Product Formulation:

Traffic coatings are formulated to adhere to asphalt, concrete, or bricks. The most important requirements of traffic coatings are that they withstand wear from vehicular traffic and from weather, are fast drying, and are highly visible both in daylight and at night. Airport runway coatings must meet government specifications, and are highly reflective, long lasting, and durable enough to withstand jet exhaust, high-speed aircraft, and heavy loads (NPCA, 1997).

There are three general types of traffic coatings: liquids, thermoplastics, and tapes. Glass beads are added into liquid coatings immediately after application (glass beads are included in the manufacture of thermoplastic coatings and tapes). Without these round beads, which reflect light back to the source, traffic marking coatings would not be visible at night. A pressurized spray nozzle embeds about 70 percent of the beads into the coating so that as the coatings wear, new embedded beads come to the surface (Hacker, 1995).

Solvent-based coatings have been used for traffic marking for decades, and consist of alkyd or chlorinated rubber coatings. They dry as the solvent evaporates and the resins oxidize. To speed up drying, they are usually sprayed hot and under pressure using conventional spray equipment. Solvent-based coatings are low in cost and can be applied in a variety of weather conditions, but they need to be frequently applied in high-traffic areas (Hacker, 1995). These coatings have a solids content ranging from 45 percent to 55 percent, typically with a wet film thickness of 15 mils and a dry film thickness of seven to eight mils (South Coast AQMD, 1996).

Water-based coatings are latex emulsions that contain pigments, additives, and usually organic co-solvent, and consist of approximately 50 percent solids by volume. Water-based traffic marking coatings are typically more durable and therefore more cost-effective than solvent-based coatings (South Coast AQMD, 1996).

Two-component traffic marking systems include polyester, urethanes, and epoxy coatings. These coatings are used in high-traffic areas where traffic disruption and application crew safety are of concern, or in inaccessible locations. Thermoplastic traffic marking coatings are made from resins, plasticizers, pigments, and glass beads. These are heat-applied coatings that are melted at 400^{o}F and extruded or sprayed using special equipment that mixes the coating during heating to prevent burning. The coatings are typically 30-125 mils thick, which provides a long lasting coating. Because of the heating required, this technology is not available during winter in cold climate areas (Hacker, 1995; NPCA, 1997). Some solvent-based traffic coatings have been reformulated using acetone to comply with the traffic coating VOC limit in the South Coast AQMD rule and the National Rule.

<u>Proposed VOC Limit and Basis for Recommendation</u>:

The proposed VOC limit of 150 g/l is technologically and commercially feasible by the January 1, 2003, effective date based on: complying marketshare; the technology assessments performed by the ARB, the South Coast AQMD in 1996, and the U.S. EPA prior to the completion of the National Rule (U.S. EPA, 1998); a review of product literature; and discussions with one of the largest users of traffic coatings in California.

The 1998 ARB Architectural Coatings Survey included data for traffic coatings submitted by 22 manufacturers covering 161 different products, which included water-based, solvent-based, two-component epoxies, and 100 percent solid formulations. The survey indicated that 69 percent of the total 1996 sales were water-based formulations, with a sales-weighted average

VOC content of 124 g/l. The average VOC content of the solvent-based formulations was 290 g/l .

The South Coast AQMD (1996) performed a technology assessment of traffic marking coatings in developing its 1996 amendments to Rule 1113. The 1998 ARB survey and the South Coast AQMD staff survey indicate that compliant traffic coatings are commercially available and are being used by local governments, Caltrans, and professional contractors. Manufacturers of traffic coatings indicate development and commercial introduction of acetone-based, solvent-based formulations is under way, to add to the water-based and 100 percent solids coatings already being used.

Caltrans is a large user of traffic marking coatings. All coatings used by Caltrans are water-based or thermoplastic, except for those used in extreme northwest California, where damp, cool weather conditions require solvent-based coatings. However, to comply with the National Rule limit of 150 g/l that is in effect statewide, these solvent-based coatings are being replaced by acetone-based coatings. The thermoplastic coatings used by Caltrans are 100 percent solids, and are used on new pavement. Caltrans specifications require that water-based traffic coatings dry thoroughly within 20 minutes of application, while thermoplastics must be tack-free within 2-10 minutes, depending on the pavement surface temperature. The maximum VOC content of Caltrans' water-based coatings is 150 g/l (Gipson, 1999; Caltrans, 1999).

Reformulation to achieve compliance with this limit has largely already been accomplished, as described above. Users will be switching to water-based, thermoplastic, acetone-based, or two-component coatings throughout California, not only in districts with architectural coating rules, but also in other areas now subject to the National Rule limit of 150 g/l.

As shown in Table VI-39, over 53 percent of the market complied with the proposed VOC limit in 1996.

Table VI-39
Traffic Marking Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons per day)
150	107	53.40	0.00***

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.
*** The proposed limit is identical to the National Rule limit. Accordingly, no additional reductions will occur from the proposed SCM limit. However, the national limit will result in 0.36 tons per day reduction in the non-South Coast AQMD portion of the State.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Gipson, Mitch. Caltrans. Personal communication with ARB staff. December 13, 1999. (Gipson, 1999)

State of California Department of Transportation (Caltrans). Standard Specifications, July 1999. http://www.dot.ca.gov/hq/esc/oe/specifications/std_specs. (Caltrans, 1999)

Hacker, L. Traffic Marking Materials, in *Paint and Coating Testing Manual*, 14^{th} edition. J.V. Koleske, ed. ASTM Manual MNL17. 1995. (Hacker, 1995)

National Paint and Coatings Association (NPCA). *Paint and Coatings "2000": Review and Forecast,* 2^{nd} edition. 1997. (NPCA, 1997)

South Coast AQMD. "Draft Staff Report for Proposed Amendments to Rule 1113 – Architectural Coatings." September 26, 1996. (South Coast AQMD, 1996)

U.S. EPA. "National Volatile Organic Compound Emission Standards for Architectural Coatings - Background for Promulgated Standards." EPA-453/R-98-0006b. (U.S. EPA, 1998)

30. Waterproofing Concrete/Masonry Sealers

Product Category Description:

Waterproofing concrete/masonry sealers are clear or pigmented film forming coatings formulated for sealing concrete and masonry to provide resistance against water, alkalis, acids, ultraviolet light, and staining. Penetration of moisture can cause staining, efflorescence, spalling, dusting, and weathering of concrete. (South Coast AQMD, 1999)

Table VI-40 below summarizes our estimate of sales and VOC emissions from the waterproofing concrete/masonry sealers coatings category.

Table VI-40
Waterproofing Concrete/Masonry Sealers*

	Number of Products**	Category Sales (gallons/year)***	Sales Weighted Average VOC (g/l)**, ****	VOC Emissions (excluding South Coast AQMD) (tons/day)***
Solvent-Based	161	184,907	358	0.41
Water-Based	114	136,095	307	0.05
Total	175	321,002	336	0.46

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Represents all waterproofing products reported; survey did not differentiate between concrete/masonry and wood waterproofing sealers.
*** Estimate based on concrete to wood product ratio of 30:70 provided by South Coast AQMD.
**** Grams VOC per liter of coating, less water and exempt compounds.

Product Use and Marketing:

Typical uses include a variety of commercial, industrial, and residential applications. Masonry building surfaces, sidewalks, driveways, block walls, brick patios, and transportation related structures such as bridges and overpasses are a few of the many surfaces that may benefit from the use of a waterproofing concrete/masonry sealer. Waterproofing concrete/masonry sealers are sold in hardware stores, home improvement centers, and paint stores and direct to large, commercial or government jobs.

Product Formulation:

These coatings rely on a variety of resin technologies, with recent developments in acrylic emulsion formulations and acetone-based formulations. (South Coast AQMD, 1999) Conventional alkyd coating formulations do not lend themselves to concrete/masonry applications due to their inherent incompatibility with the prevailing alkalinity of the substrate.

Clear and opaque sealers are combined in this category since many opaque sealers penetrate the substrate and perform the same function as clear sealers.

There are two basic types of waterproofing sealers, continuous (film-forming) and discontinuous (non-film-forming), however, this category only applies to the continuous type. Continuous sealers protect by forming a film barrier to prevent water intrusion. Many conventional coating formulations are capable of providing this type of protection while possessing additional performance attributes. Continuous sealers, by nature, are typically not vapor permeable.

Acrylic lacquer formulations are commonly used to seal tile and masonry surfaces to provide a clear, high performance, coating. These coatings are generally desired for the aesthetically appealing "wet look" that they provide.

<u>Proposed VOC Limit and Basis for Recommendation</u>:

The proposed VOC limit for waterproofing concrete/masonry sealers is 400 g/l, effective January 1, 2003. The proposed VOC limit is technologically and commercially feasible by the January 1, 2003, effective date based on our review of the literature and trade journals, complying marketshare, and information provided by manufacturers or resin suppliers.

Industry has provided comments pertaining to the performance of low VOC waterproofing products on concrete/masonry surfaces, especially concrete tilt-up buildings, and transportation-related structures such as bridges and overpasses. Therefore, staff proposes to split the waterproofing sealer category by creating two new sub-categories, one for concrete/masonry and one for wood. The proposed VOC limit for waterproofing concrete/masonry sealers is the same as that currently in most district rules for all waterproofing sealers. This proposal is consistent with current South Coast AQMD Rule 1113 requirements.

Table VI-41 below summarizes our estimates for this category of the number of products that comply with the proposed VOC limit and their associated marketshare. No emission reductions would be realized if the limit were implemented in the non-South Coast AQMD portions of the State, since the proposed limit of 400 g/l is the most common current district limit.

Table VI-41
Waterproofing Concrete/Masonry Sealers*

Proposed VOC Limit (g/l)**	Number of Complying Products***	Complying Marketshare (%) by Volume***	Emission Reductions (excluding South Coast AQMD) (tons/day)
400	138	95.2	0

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.
***** Represents all waterproofing products reported, survey did not differentiate between concrete/masonry and wood waterproofing sealers.

Literature Searches

Staff has conducted extensive searches for waterproofing concrete/masonry sealers that meet the proposed VOC limit of 400 g/l and found numerous manufacturers that offer complying products. The following products discussed are in addition to those multi-surface products discussed under waterproofing wood sealers.

Hydrozo, Inc. markets a product called ENVIROSEAL™ Double 7, a high performance, clear, penetrating water repellent sealer designed to provide long-term protection for vertical masonry and concrete block wall surfaces. It is an aqueous blend of silane and organic and inorganic oligomers with a VOC content of less than 175 g/l. (ENVIROSEAL™, 1999)

Zehrung Corp. makes Zerepel WB for Masonry, a clear, penetrating waterproofing sealer for above grade masonry surfaces with a VOC content of less than 250 g/l. A water resistant barrier is formed by the chemical reaction between Zerepel WB and the masonry substrate. The formulation penetrates beneath the surface and will not leave a film to yellow, crack, or peel. It is coatable and promotes adhesion when used as a sealer. (Zerepel, 1999)

Textured Coatings of America makes XL-70¨ BRIDGE•COTE, which is a Vinyl Toluene/Acrylic Copolymer (VTACL) coating system. This system uses a one coat, high build, single component coating. The product is recommended for damp, green uncured or cured masonry surfaces such as: bridges, concrete walls, columns, spandrels, medians, dividers, curbs, and old concrete. The manufacturer has reformulated this product to meet the proposed 400 g/l VOC level. (TCA, 2000)

Glaze-N-Seal has reformulated their high performance acrylic lacquer sealer to incorporate the use of exempt solvents in order to comply with the 400 g/l limit. Glaze-N-Seal also markets lower VOC water based sealers. Although the reformulation of their acrylic lacquer sealer resulted in increased manufacturing costs, it was necessary to meet performance demands that can not be met by their water based products. (GNS, 2000)

Other manufacturers of waterproofing concrete/masonry sealers that comply with the proposed limit include H&C, Flood Company, Okon, Behr, DOW Corning, Gloucester, Seal Krete, and Conspec. The VOC content of these coatings range from 8 g/l to 400 g/l.

Harlan Study

In 1995, Harlan Associates, under contract with the ARB, performed testing on waterproofing sealers for concrete substrates. (ARB, 1995)

Seven of the eight coatings tested complied with the proposed 400 g/l VOC limit. One of these sealers was solvent-based, while the remaining seven were water-based coatings. The results of the tests on waterproofing sealers for concrete indicated equivalent or superior performance by all of the complying sealers relative to the non-complying sealer for application, appearance, accelerated weathering and water repellency. Four of the complying sealers displayed equivalent water adsorption performance relative to the non-complying sealer. The initial appearance and appearance after 300 hours of accelerated weathering of all the sealers showed no change in the color of the concrete. Five of the seven water-based sealers are considered to be low-solids coatings with less than 120 g/l VOC, calculated as the actual VOC content. (Cowen, 1999)

NTS Study

National Technical Systems (NTS), under contract with the South Coast AQMD, tested four concrete waterproofing sealers. All coatings tested were compliant with the 400 g/l proposed limit. ARB staff analysis concludes that, overall, the low-VOC coatings exhibited similar or superior performance compared to the higher-VOC coatings in the tests performed, which included freeze/thaw stability, water penetration, and water repellency. (NTS, 1999)

<u>Issues</u>:

1. Issue: Industry has indicated that low VOC (< 250 g/l) coatings do not perform well on concrete/masonry surfaces, especially concrete tilt-up buildings and transportation related structures such as bridges and overpasses. The South Coast AQMD has created a new category for waterproofing concrete/masonry sealers with a 400 g/l limit.

Response: Staff's initial investigation of this issue did not reveal information substantiating such low performance. However, after subsequent review of comments the ARB received on this category, and additional information industry provided related to this category, staff is proposing a 400 g/l limit for waterproofing concrete/masonry sealers.

REFERENCES

Air Resources Board. Final Report, Contract No. 92-339. "Testing of Architectural and Industrial Maintenance Coatings." Harlan and Associates, Inc. February, 1995. (ARB, 1995)

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Cowen, Stan. Ventura County Air Pollution Control District. Communication with ARB Staff. October, 1999. (Cowen, 1999)

Glaze-N-Seal, Product Data Sheets. (GNS, 2000)

Hydrozo, Inc. Product Data Sheets. (ENVIROSEAL™, 1999)

National Technical Systems. "Phase II Assessment Study of Architectural Coatings." under contract with the South Coast AQMD, data available as of June 1999. (NTS, 1999)

South Coast AQMD. Draft Staff Report. “Proposed Amendments to Rule 1113 – Architectural Coatings.” May 14, 1999. (South Coast AQMD, 1999)

Textured Coatings of America, Comments on the Draft Program EIR and supporting technical data. (TCA, 2000)

United States Environmental Protection Agency. “Final Rule: National Volatile Organic Compound Emission Standards for Architectural Coatings.” 40 CFR part 59, subpart D. 63 FR 48848. September 11, 1998. (U.S. EPA, 1998)

Zehrung Corp. Product Data Sheets. (Zerepel, 1999)

31. Waterproofing Wood Sealers

Product Category Description:

Waterproofing wood sealers are products designed and recommended for application to wood substrates for the primary purpose of preventing the penetration of water. They are clear or pigmented, film forming or non-film forming, compounds that are formulated to protect the substrate from moisture damage. Penetration of moisture can cause splitting, staining, and warping of wood. Use of a waterproofing sealer can prevent these problems, as well as maintain the wood's true color and grain. (South Coast AQMD, 1999)

Table VI-42 below summarizes our estimate of sales and VOC emissions from the waterproofing wood sealers coatings category.

Table VI-42
Waterproofing Wood Sealers*

	Number of Products**	Category Sales (gallons/year)***	Sales Weighted Average VOC (g/l)**, ****	VOC Emissions (excluding South Coast AQMD) (tons/day)***
Solvent-Based	161	431,449	358	0.97
Water-Based	114	317,555	307	0.12
Total	175	749,004	336	1.08

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Represents all waterproofing products reported; survey did not differentiate between concrete/masonry and wood waterproofing sealers.
*** Estimate based on concrete to wood product ratio of 30:70 provided by South Coast AQMD.
**** Grams VOC per liter of coating, less water and exempt compounds.

Product Use and Marketing:

Typical uses include a variety of commercial, industrial, and residential applications. Wood fences, decks, awnings, and patio furniture are a few of the many surfaces that may benefit from the use of a waterproofing sealer. Waterproofing sealers are sold in hardware stores, home improvement centers, and paint stores.

Product Formulation:

These coatings rely on a variety of resin technologies, with recent developments in acrylic emulsion formulations and acetone-based formulations. (South Coast AQMD, 1999). Clear and opaque sealers are combined in this category since many opaque sealers penetrate the substrate and perform the same function as clear sealers.

There are two basic types of waterproofing sealers, continuous (film-forming) and discontinuous (non-film-forming). Continuous sealers protect by forming a film barrier to prevent water intrusion. Many conventional coating formulations are capable of providing this type of protection while possessing additional performance attributes. Continuous sealers, by nature, are typically not vapor permeable.

There are also two basic types of discontinuous waterproofing sealers, nonsilicone impregnating sealers and silicone-based sealers. Typical nonsilicone impregnating sealers are wax, silicate and stearate technology based. These technologies repel water by physically filling the pores of the substrate, and are also, by nature, typically not vapor permeable.

Silicone-based waterproofing sealers remain permeable to water vapor. There are many types of silicone-based sealers including siliconates, linear silicones, silanes and siloxanes. Silanes and siloxanes are known for their excellent penetrating and abrasion resistance qualities.

Generally, nonsilicone based products will block water vapor but degrade when exposed to UV light, and silicone products provide excellent UV stability but are vapor permeable. Therefore, both the type of substrate and the desired performance characteristics are critical parameters in choosing the appropriate waterproofing sealer for any specific application.

Proposed VOC Limit and Basis for Recommendation:

The proposed VOC limit for waterproofing wood sealers is 250 g/l, effective January 1, 2003. The proposed VOC limit is technologically and commercially feasible by the January 1, 2003, effective date based on our review of the literature and trade journals, complying marketshare, and information provided by manufacturers or resin suppliers.

Table VI-43 below summarizes our estimates for this category of the number of products that comply with the proposed VOC limit, their associated marketshare, and the emission reductions that would be realized if the limit were implemented in the non-South Coast AQMD portions of the State.

Table VI-43
Waterproofing Wood Sealers*

Proposed VOC Limit (g/l)**	Number of Complying Products***	Complying Market Share (%) by Volume***	Emission Reductions (excluding South Coast AQMD) (tons/day)****
250	95	12.8	0.39

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.
******* Represents all waterproofing products reported; survey did not differentiate between concrete/masonry and wood waterproofing sealers.
******** Estimate based on concrete to wood product ratio of 30:70 provided by South Coast AQMD.

Literature Searches

Staff has conducted extensive searches for waterproofing wood sealers that meet the proposed VOC limit of 250 g/l and found numerous manufacturers that have commercialized products available.

Behr Process Corp. currently markets two products with VOC contents below the proposed limit. Behr No. 2-85 Low Voc Multi-Surface Waterproofing Sealer is a transparent acrylic latex formulation with 211 g/l VOC. Plus 10 Elastomeric Waterproofing Paint is a 100 percent acrylic elastic latex formulation with 81 g/l VOC. (Behr, 1999)

DOW Corning Corporation has developed a new, patented, water-based water repellent technology whose components include silicone-based materials, an organic resin and an organic wax. They claim the resultant product protects wood longer, and promotes beading better than other commercially available solvent and water-based products. The VOC content is below 100 g/l. (MPC, 1998)

Gloucester Co., Inc. markets a product called PHENOSEAL® Liquid Waterproofing (PLW) with a VOC content of 97 g/l. PLW is a clear penetrating sealer made from an acrylic copolymer, in formulation with other proprietary components, intended for use on wood, masonry, concrete, and other porous building materials. It helps prevent moisture damage by penetrating and sealing the subsurface pores in the treated material. PLW generally allows transmission of water vapor through a sealed surface. PLW-treated surfaces may be coated with oil or water-based coatings after the cure is complete. (PHENOSEAL®, 1999)

Seal Krete, Inc. has a product called Seal Krete® Waterproofing Sealer which is a water-based, acrylic sealer with a VOC content of less than 8 g/l. It is recommended for both concrete and wood. (Seal Krete®, 1999)

Other manufacturers of waterproofing sealers that comply with the proposed limit include the Flood Company, Okon, and Conspec. The VOC content of these coatings range from 27 g/l to 250 g/l. (South Coast AQMD, 1999)

Harlan Study

In 1995, Harlan Associates, under contract with the ARB, performed testing on waterproofing wood sealers. (ARB, 1995)

Three of the seven products tested comply with proposed VOC limit of 250 g/l. Two of these sealers were solvent-based, while the remaining five were water-based coatings. The results of the tests on waterproofing wood sealers indicated equivalent or superior performance by the complying sealers relative to the non-complying sealer for application, appearance, accelerated weathering and water repellency.

Four of the five water-based sealers tested are considered to be “low-solids coatings” with less than 120 g/l VOC. The VOC limits in the proposed SCM for low-solids coatings are calculated on an actual basis rather than using the traditional less water, less exempt compound basis. This low-solids calculation has been accepted by the U.S. EPA. The actual VOC for these coatings is much lower than the VOC content, less water. For example, one coating has a VOC content, less water, of 343 g/l, while the actual VOC is only 77 g/l.

The initial appearance and appearance after 300 hours of accelerated weathering of the coated wood show similar performance by the water-based and solvent-based sealers. The initial appearance was superior in two of the water-based samples; these were the only two coatings that showed no change in color of the surface. The accelerated weathering was equivalent for most of the samples.

The initial water repellency of all of the coatings was excellent, except for one of the water-based sealers that had good water repellency. The water repellency of the coatings after 300 hours of accelerated weathering was good for all coatings tested except the non-complying sealer and one of the water-based sealers that had fair water repellency. (Cowen, 1999)

NTS Study

National Technical Systems (NTS), under contract with the South Coast AQMD, tested six waterproofing wood sealers. Three of the six coatings tested were compliant with the 250 g/l proposed limit. ARB staff analysis concludes that, overall, the low-VOC coatings exhibited similar or superior performance compared to the higher-VOC coatings in the tests performed, which included freeze/thaw stability, water penetration, and water repellency. (NTS, 1999)

Issues: No comments were received about waterproofing wood sealers, and to our knowledge there are no unresolved issues.

REFERENCES

Air Resources Board. Final Report, Contract No. 92-339. "Testing of Architectural and Industrial Maintenance Coatings." Harlan and Associates, Inc. February, 1995. (ARB, 1995)

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Behr Process Corp. Product Data Sheets. (Behr, 1999)

Cowen, Stan. Ventura County Air Pollution Control District. Communication with ARB Staff. October, 1999. (Cowen, 1999)

Gloucester Co., Inc. Product Data Sheets. (PHENOSEAL®, 1999)

Modern Paint and Coatings. Nov. 1998. (MPC, 1998)

National Technical Systems. "Phase II Assessment Study of Architectural Coatings." under contract with the South Coast AQMD, data available as of June 1999. (NTS, 1999)

Seal Krete, Inc. Product Data Sheets. (Seal Krete®, 1999)

South Coast AQMD. Draft Staff Report. "Proposed Amendments to Rule 1113 – Architectural Coatings." May 14, 1999. (South Coast AQMD, 1999)

United States Environmental Protection Agency. "Final Rule: National Volatile Organic Compound Emission Standards for Architectural Coatings." 40 CFR part 59, subpart D. 63 FR 48848. September 11, 1998. (U.S. EPA, 1998)

B. COATING CATEGORIES FOR WHICH THE PROPOSED VOC LIMITS ARE GENERALLY CONSISTENT WITH DISTRICT RULES

We are proposing VOC limits for the following 16 coating categories that are generally consistent with the VOC limits in California's district architectural coatings rules, including the South Coast AQMD's Rule 1113. The discussions for each of these coating categories includes: 1) product category description; 2) discussion of the proposed volatile organic compound (VOC) limit, and our rationale for the proposed limit; and 3) if applicable, a discussion of the issues associated with the proposed VOC limit, as raised by industry. The product categories are listed in alphabetical order.

1. Bond Breakers

Product Category Description:

Bond breakers are coatings that are applied between layers of concrete to prevent bonding of the first layer to the second layer. Coatings in this category are similar to form release compounds, except that form release compounds prevent bonding of the concrete to a non-concrete form (TRG/ARB, 1989). The first coat of a bond breaker also helps cure the concrete (U.S. EPA, 1998).

Table VI-44 below summarizes our estimate of the sales and VOC emissions from the bond breakers category.

Table VI-44
Bond Breakers*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	PD	PD	750	~0.00
Water-Based	PD	PD	345	0.02
Total	PD	PD	345	0.02

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected Data.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 350 g/l VOC limit for bond breakers effective January 1, 2003. This proposed VOC limit is technologically and commercially feasible based on: the high complying marketshare; the limit in current district rules; and the fact that most district architectural coating rules have had the same limit for several years. We also note that no adverse comments were received about the proposed limit.

Districts that regulate bond breakers (all districts except the Bay Area, Butte, Colusa, Feather River, and Monterey districts where the category is exempt) have a VOC limit of 350 g/l. Based on the recommendation of the 1989 SCM, the VOC limit for bond breakers of 350 g/l went into effect in district rules in September 1990 (TRG/ARB, 1989).

The U.S. EPA's National Architectural Coatings Rule limit of 600 g/l. However, this limit is found in the upper range of VOC content limits in existing state rules (none of the rules has a limit higher than 600 g/l) (U.S. EPA, 1998). We recommend that the VOC limit for bond breakers remain at 350 g/l at this time, which is consistent with current district rules.

Table VI-45
Bond Breakers*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
350	PD	PD	0.00

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
PD =Protected Data.

<u>**Issues**</u>**:**

1. Issue: No comments were received on bond breakers, and we know of no unresolved issues with this category.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Technical Review Group and Air Resources Board (TRG/ARB). "ARB-CAPCOA SCM for Architectural Coatings, Technical Support Document." July, 1989. (TRG/ARB, 1989)

United States Environmental Protection Agency (U.S. EPA). "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards." EPA-453/R-98-006b. August, 1998. (U.S. EPA, 1998)

2. Concrete Curing Compounds

Product Category Description:

Concrete curing compounds are coatings that are applied to fresh concrete to retard moisture evaporation. These coatings are used in road construction to provide moisture retention during curing, to help with design strength and other properties. Concrete curing compounds are designed to meet a number of ASTM specifications, including ASTM C-309, Type 1, 1D, and 2; Class A (U.S. EPA, 1998).

The U.S. EPA determined that concrete curing compounds, as well as other concrete curing products, may be underrepresented in the national Architectural Coatings Survey. One commenter explained that this is because concrete curing products are made by the construction industry, not coating manufacturers (U.S. EPA, 1998). They may also be underrepresented in the ARB's 1998 Architectural Coatings Survey for the same reason.

Table VI-46 below summarizes our estimate of the sales and VOC emissions from the concrete curing compounds category.

Table VI-46
Concrete Curing Compounds*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	10	11,820	677	0.05
Water-Based	37	399,298	180	0.19
Total	47	411,118	195	0.24

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 350 g/l VOC limit for concrete curing compounds effective January 1, 2003. This proposed VOC limit is technologically and commercially feasible based on: the high complying marketshare; the limit in current district rules and the National Rule; and the fact that most district architectural coating rules have had the same limit for several years. We also note that no adverse comments were received about the proposed limit.

All district rules except one have a VOC limit of 350 g/l for concrete curing compounds (Butte County has a VOC limit of 800 g/l). In addition to the California districts, Arizona, Massachusetts, New Jersey, and New York have a 350 g/l limit (U.S. EPA, 1998).

The U.S. EPA's National Architectural Coatings Rule also has a VOC limit of 350 g/l. All but one commenter argued that the limit is achievable (U.S. EPA, 1998).

We recommend that the VOC limit remain at 350 g/l at this time, the same as in current district rules, state rules, and the National Rule. The survey shows that there is about 95 percent compliance at 350 g/l, and this category is already heavily dominated by water-based formulations.

Table VI-47
Concrete Curing Compounds*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons per day)
350	36	95.10	0.00

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

Issues:

1. Issue: No comments were received on concrete curing compounds, and we are unaware of any unresolved issues.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

United States Environmental Protection Agency (U.S. EPA). "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards." EPA-453/R-98-006b. August 1998. (U.S. EPA, 1998)

3. **Dry Fog Coatings**

Product Category Description:

Dry fog coatings, also called dry fall coatings or mill white coatings, are formulated so that when sprayed onto a substrate, the overspray droplets dry before they contact the floor or other surfaces. The coatings are designed to dry after falling 8 to 10 feet, depending on the formulation and the weather conditions. The use of dry fog coatings minimizes the amount of masking and covering of surfaces that are not to be coated, and the dried coating can simply be swept up for easy cleanup. The definition clarifies that these coatings are to be applied by spraying, not by brush or roller, since the quick-drying characteristics of dry fog coatings would not be necessary with non-spray application techniques (TRG/ARB, 1989).

Table VI-48 below summarizes our estimate of the sales and VOC emissions from the dry fog coatings category. As shown, dry fog coatings are available as both water-based and solvent-based products, with the lower VOC water-based products accounting for the majority of sales.

Table VI-48
Dry Fog Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	24	76,661	367	0.17
Water-Based	27	126,241	182	0.09
Total	51	202,902	252	0.26

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 400 g/l VOC limit for dry fog coatings effective January 1, 2003. This proposed VOC limit is technologically and commercially feasible based on: the high complying marketshare; the limit in current district rules and the National Rule; the fact that most district architectural coating rules have had the same limit for several years; and a review of product literature on coatings included in this category. We also note that no adverse comments were received about the proposed limit.

The VOC limit of 400 g/l for dry fog coatings is found in the all district rules (except Bay Area, Butte, Colusa, Feather River, and Monterey, where the category is exempt). The U.S. EPA's National Architectural Coatings Rule also specifies a VOC limit of 400 g/l. National survey data showed that 84 percent of dry fog coatings sales were at or below 400 g/l. Arizona, Kentucky, New York, New Jersey, Massachusetts, Rhode Island, and the California districts have the same limit. The U.S. EPA concluded that the evidence shows that dry fog coatings at or below 400 g/l perform acceptably well (U.S. EPA, 1998).

We recommend that the VOC limit for dry fog coatings remain at 400 g/l at this time, the same as in current district rules, state rules, and the National Rule. There is almost 97 percent compliance at 400 g/l.

Table VI-49
Dry Fog Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons per day)
400	46	96.60	0.00

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

Issues:

1. Issue: No comments were received on dry fog coatings and, to our knowledge, no unresolved issues remain.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Technical Review Group and Air Resources Board (TRG/ARB). "ARB-CAPCOA SCM for Architectural Coatings, Technical Support Document." July 1989. (TRB/ARB, 1989)

United States Environmental Protection Agency (U.S. EPA). "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards." EPA-453/R-98-006b. August 1998. (U.S. EPA, 1998)

4. <u>Fire-Retardant Coatings - Clear</u>

Product Category Description:

Fire-retardant coatings are used to bring building and construction materials into compliance with federal, State and local building code requirements. The coatings must be fire tested and rated for their ability to retard ignition and flame spread. Both the coatings and the testing agency must be approved by building code officials. Clear fire-retardant coatings include, but are not limited to, clear varnishes and sealers. Fire-retardant coatings used on wood shingles are pressure-applied into the wood in a factory (Ho, 1999), and therefore, are not subject to the architectural coating rule.

Most fire-retardant coatings work by suppressing flame through intumescence, which means they become plastic and puff up on exposure to flame or excessive heat, solidifying into a foam about fifty times as thick as the coating film. This foam insulates the substrate from the flame (LeSota, 1995).

Fire-retardant coatings reduce flame spread on the surface of a material. Fire-retardant coatings are tested in a fire test chamber using ASTM Method E 84, "Standard Test Method for Surface Burning Characteristics of Building Materials." ASTM Method E 84 is used for testing of interior building materials, not those used on the exterior of buildings (Ho, 1999). This method requires that a 25 foot panel of the substrate coated with the fire-retardant coating be exposed to flame for ten minutes. The retarding of flame spread and smoke development are measured, and the coating receives a flame spread rating equating to Class A, B, or C building materials (Bratcher and Alvarez, 1996).

California building codes specify three classes of building materials (which correspond to the Class A, B, and C materials mentioned above), each with a range of possible flame spread indices. The following table summarizes this information (California Building Code, 1998).

Flame-Spread Classification

Building Material Qualified by:	
Class	Flame Spread Index
I	0-25
II	26-75
III	76-200

The California Building Code is based on the Uniform Building Code of the International Conference of Building Code Officials (ICBO), while building codes in the eastern half of the U.S. are usually based on the fire hazard classifications of the National Fire Protection Association (NFPA) (Woods, 1999).

The definition used in the SCM is essentially the National Rule definition, except that we have removed the language pertaining to fire-resistant. During our research on the fire-retardant category, we found that a separate category for fire-resistant coatings was needed because these two categories are quite different in the mode of action, the materials protected, and the test methods used.

The fire-retardant coatings definition in the SCM also differs significantly from the definition used in district rules and the 1989 SCM. These district definitions describe fire-retardant coatings as those that have a flame spread index of less than 25 when tested in accordance with ASTM Designation E 84-87, using Douglas fir as the substrate. This definition is limiting in several ways.

The definition used in district rules specifies a flame spread index of less than 25, but as seen in the table above, this limits the classification of the building materials to Class I (Class A in the NFPA classification). The California Building Code allows Class II and III materials (Class B and C in the NFPA classification) to be used in some applications, for example where the materials are protected on both sides by sprinkler systems (California Building Code, 1998).

The districts' rule definition restricts the flame spread testing to Douglas fir. This is limiting because it precludes testing and certification of fire-retardant coatings on other building materials such as acoustical tiles, drywall, plywood, etc. Manufacturers of fire-retardant coatings are required to test and register their products with the State Fire Marshal's Office, and testing must be on the variety of substrates that the manufacturer claims the coating can be used on, not just Douglas fir (Woods, 1999).

The coatings are tested by a variety of testing laboratories. Each building inspection agency has its own list of approved laboratories for each type of building material (Woods, 1999). In California, most building code officials at the local level use the approved testing laboratories list of the State Fire Marshal (Ho, 1999). These laboratories are further subdivided into those who are qualified and equipped to conduct certain tests and examinations (State Fire Marshal, 1998). The proposed definition does not restrict the choice of testing agencies to a single laboratory such as Underwriters Laboratory. The term "approved laboratory" is used in the industry to imply a lab acceptable to a code official (Hopper, 1999). The term "testing agency" was chosen for the proposed definition based on the terminology used in the California Building Code.

Manufacturers submit their coatings for testing on certain specified building materials to the testing laboratory. The laboratory determines the flame spread and smoke density ratings. The test results are then submitted to the State Fire Marshal for review. If approved, the State Fire Marshal lists the product in its listing service or registry. The manufacturer must pay a fee to register the product in the listing service, and the listing has an expiration date. Both the fire-retardant chemical and the fire-retardant coating must be registered by the State Fire Marshal (Ho, 1999). Architects, contractors, and others who use these coatings have access to the listing of approved coatings.

The reference to federal building codes in the proposed definition is included because federal facilities such as office buildings, courthouses, prisons, hospitals, and military bases are subject to the federal requirements in the NFPA codes, whereas the California requirements are based on the ICBO codes (Woods, 1999).

The test method is important in defining fire-retardant products. The test method for flame spread index is referenced in the Test Methods section of the rule for information purposes. ASTM Designation E-84 is referenced, but the California Building Code references UBC Standard 8-1, which is virtually identical to the ASTM method. Individual testing laboratories also have their own flame spread tests; for example, Underwriters Laboratories uses UL 723, which is virtually the same as ASTM Method E-84 (Hopper, 1999).

Table VI-50 below summarizes our estimate of sales and VOC emissions from the clear fire-retardant coatings category.

Table VI-50
Clear Fire-Retardant Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	0	0	N/A	N/A
Water-Based	PD	PD	22	~0.00
Total	PD	PD	22	~0.00

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected Data.

<u>Proposed VOC Limit and Basis for Recommendation</u>:

We are proposing a 650 g/l VOC limit for clear fire-retardant coatings effective January 1, 2003. This proposed VOC limit is technologically and commercially feasible based on: the high complying marketshare; the limit in current district rules; the fact that most district architectural coating rules have had the same limit for several years; a review of product literature on coatings included in this category; and discussions with manufacturers. We also note that no adverse comments were received about the proposed limit.

The VOC limit of 650 g/l for clear fire-retardant coatings is found in all district rules (except Bay Area, Butte County, Colusa County, and Feather River, which exempt this category, and Monterey and Placer County, which do not have a category for fire-retardant coatings).

The National Rule VOC limit for clear fire-retardant/resistive coatings is 850 g/l. However, the U.S. EPA does not provide rationale for this VOC limit (U.S. EPA, 1998).

We recommend that the VOC limit for clear fire-retardant coatings remain at 650 g/l at this time, the same as in the 1989 SCM and all current district rules. There is 100 percent compliance at this limit.

Table VI-51
Clear Fire-Retardant Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
650	PD	100	0.00

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
PD = Protected Data.

<u>Issues</u>:

1. Issue: No unresolved issues remain with this category.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Bratcher, C. and M. Alvarez. "Buying Time with Coatings Technology: Fire-Protective Coatings Reduce Flame Spread." Modern Paint and Coatings. November 1996. (Bratcher and Alvarez, 1996)

California Building Code. Chapter 8, Interior Finishes. 1998. (California Building Code, 1998)

Ho, Ben, Deputy State Fire Marshal. Personal communication with ARB staff. November 29, 1999. (Ho, 1999)

Hopper, Howard. Underwriters Laboratory. Personal communication with ARB staff. October 8, 1999. (Hopper, 1999)

LeSota, Stanley, ed. *Coatings Encyclopedic Dictionary*. Federation of Societies for Coatings Technology. 1995. (LeSota, 1995)

United States Environmental Protection Agency (U.S. EPA). "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards." EPA-453/R-98-006b. August 1998. (U.S. EPA, 1998)

Woods, John. Deputy State Fire Marshal. Personal communication with ARB staff. October 21, 1999. (Woods, 1999)

5. Fire-Retardant Coatings – Opaque

Product Category Description:

Fire-retardant coatings are described in the previous section on clear fire-retardant coatings. Opaque fire-retardant materials include, but are not limited to, coatings with flat or non-flat finishes and primers.

Table VI-52 below summarizes our estimate of sales and VOC emissions from the opaque fire- retardant coatings category. As shown, both solvent-based and water-based products are available, with the lower VOC water-based products accounting for the majority of sales.

Table VI-52
Opaque Fire-Retardant Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	20	10,297	267	0.02
Water-Based	37	45,912	46	0.01
Total	57	56,209	86	0.03

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 350 g/l VOC limit for opaque fire-retardant coatings effective January 1, 2003. This proposed VOC limit is technologically and commercially feasible based on: the high complying marketshare; the limit in current district rules; the fact that most district architectural coating rules have had the same limit for several years; a review of product literature on coatings included in this category; and discussions with manufacturers. We also note that no adverse comments were received about the proposed limit.

The VOC limit of 350 g/l for opaque fire-retardant coatings is found in all district rules (except Bay Area, Butte County, Colusa County, and Feather River, which exempt this category, and Monterey and Placer County, which do not have a category for fire-retardant coatings).

The National Rule VOC limit for opaque fire-retardant/resistive coatings is 450 g/l. However, the U.S. EPA does not provide a rationale for this VOC limit (U.S. EPA, 1998).

We recommend that the VOC limit for opaque fire-retardant coatings remain at 350 g/l at this time, the same as in the 1989 SCM and all district rules. There is virtually 100 percent compliance at this limit.

Table VI-53
Opaque Fire-Retardant Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
350	53	99.80	0.00

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

Issues:

1. **Issue:** No unresolved issues remain on this category.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

United States Environmental Protection Agency (U.S. EPA). "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards." EPA-453/R-98-006b. August 1998. (U.S. EPA, 1998)

6. Form Release Compounds

Product Category Description:

Form release compounds are products designed for use on concrete forms to prevent freshly poured concrete from sticking to the form. The forms may be wood, metal, or other material other than concrete. They are used extensively in the building industry in concrete pouring operations (TRG/ARB, 1989).

A commenter on the National Rule speculated that concrete form release compounds may be underrepresented in the national Architectural Coatings Survey because they are made by the construction industry, not coating manufacturers (U.S. EPA, 1998). They may also be underrepresented in the ARB's 1998 Architectural Coatings Survey for the same reason.

Table VI-54 below summarizes our estimate of sales and VOC emissions from the form release compounds category. Sales were only 10,000 gallons in the 1993 survey, compared to 80,000 gallons in the 1998 survey.

Table VI-54
Form Release Compounds*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	9	11,025	247	0.02
Water-Based	4	72,218	2	~0.00
Total	13	83,243	34	0.02

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 250 g/l VOC limit for form release compounds effective January 1, 2003. This proposed VOC limit is technologically and commercially feasible based on: the high complying marketshare; the limit in current district rules; and the fact that most district architectural coating rules have had the same limit for several years. We also note that no adverse comments were received about the proposed limit.

The form release compounds category appears in a few district rules: El Dorado, Imperial, Kern, Placer, Sacramento, San Diego, San Joaquin, Santa Barbara, and Ventura, all with a 250 g/l VOC limit. The category falls under the default limit of 250 g/l in the remaining districts.

In the 1989 SCM, the form release compounds category was created to separate these coatings (at a VOC limit of 250 g/l) from bond breakers (at 750 g/l effective September 1989, lowering to 350 g/l in September 1990). At that time, it was estimated that form release compounds were used in larger quantities than bond breakers (TRG/ARB, 1989).

The VOC limit for form release compounds in the U.S. EPA's National Architectural Coatings Rule is 450 g/l. The National Rule limit is found in the upper range of VOC content limits in existing state rules (U.S. EPA, 1998).

We recommend that the VOC limit for form-release compounds remain at 250 g/l at this time, the same as in current district rules.

Table VI-55
Form Release Compounds*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
250	PD	PD	0.00

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
PD = Protected Data.

<u>Issues</u>:

1. Issue: No comments were received on form release compounds, and we are unaware of any remaining issues.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Technical Review Group and Air Resources Board (TRG/ARB). "ARB-CAPCOA SCM for Architectural Coatings, Technical Support Document." July 1989. (TRG/ARB, 1989)

United States Environmental Protection Agency (U.S. EPA). "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards." EPA-453/R-98-006b. August 1998. (U.S. EPA, 1998)

7. Graphic Arts Coatings

Product Category Description:

Graphic arts coatings or sign coatings are products designed for hand-application by artists using brushes or rollers. They are used on indoor or outdoor signs or murals and include lettering enamels, poster colors, copy blockers, and bulletin enamels. A coating used on the structural components of billboards is not included in the definition. Most billboard signs are now pre-printed and are pasted to the billboard on-site.

The 1989 SCM clarified which graphic arts coatings were subject to architectural coating rules. This was necessary because, depending on the district in which the coating is applied, what substrate is being used, and where they are applied, graphic arts coatings could be subject to metal parts and products, wood products, plastic parts and products, or architectural coatings rules. The definition was designed to address the needs of sign painters without allowing high VOC coatings to be used for jobs not legitimately requiring sign coatings. To be an architectural coating, the sign would have to be coated after installation (TRG/ARB, 1989). Similarly, U.S. EPA clarified that if the coating is applied to an erected billboard, the coating used on the sign portion of the billboard would be classified as graphic arts, while the coating used on the steel supporting beams of the billboard would be an industrial maintenance coating (U.S. EPA, 1998).

Table VI-56 below summarizes our estimate of sales and VOC emissions from the graphic arts coating category.

Table VI-56
Graphic Arts Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based***	PD	PD	628	0.03
Water-Based	PD	PD	10	~0.00
Total	108	40,366	122	0.03

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
****** Grams VOC per liter of coating, less water and exempt compounds.
*** Includes 100 percent solid coatings.
PD = Protected Data.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 500 g/l VOC limit for graphic arts coatings effective January 1, 2003. This proposed VOC limit is technologically and commercially feasible based on: the high complying marketshare; the limit in current district rules; and the fact that most district architectural coating rules have had the same limit for several years. We also note that no adverse comments were received about the proposed limit.

All districts that have a graphic arts category in their architectural coating rules have a 500 g/l VOC limit. This category is exempt in the Bay Area, Butte County, Colusa County, Feather River, and Monterey districts. The VOC limit in the U.S. EPA's National Architectural Coatings Rule is 500 g/l. National survey data showed that 96 percent of the coatings were 500 g/l or below. Massachusetts, New York, New Jersey, and Rhode Island are at 450 g/l, while Kentucky and the California districts are at 500 g/l (U.S. EPA, 1998)

In earlier versions of the SCM, we proposed lowering the VOC limit for graphic arts coatings to 150 g/l, based on survey data. There is a large waterborne or 100 percent solids component of the survey data that may be non-architectural or may represent sign coatings other than those included in the definition. Based on comments and minimal emission reductions, we changed the proposed VOC limit to match that of district rules and the National Rule.

We recommend that the VOC limit for graphic arts coatings remain at 500 g/l at this time, the same as in current district rules and the National Rule. There is 81 percent compliance at the proposed 500 g/l limit.

Table VI-57
Graphic Arts Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
500	18	81.20	0.00

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

Issues:

1. Issue: There are no known unresolved issues with this category.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Technical Review Group and Air Resources Board (TRG/ARB). "ARB-CAPCOA SCM for Architectural Coatings, Technical Support Document." July 1989. (TRG/ARB, 1989)

United States Environmental Protection Agency (U.S. EPA). "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards." EPA-453/R-98-006b. August 1998. (U.S. EPA, 1998)

8. Magnesite Cement Coatings

Product Category Description:

Magnesite cement coatings are designed for use on magnesite cement decking to protect the magnesite cement substrate from erosion by water.

Magnesite is a naturally occurring mineral composed of magnesium carbonate. For decades, exterior and interior floors have been made from magnesite because it is lightweight, stronger than concrete, water-resistant, non-combustible, and long-lasting (Magnesite, undated). Since the 1970s, newer materials have replaced magnesite cement in new construction. However, there is still a demand for magnesite cement for repair and retrofit of old magnesite cement (Armstrong, 1999).

Magnesite floors are laid using a formulation containing magnesium oxychloride cement and inert fillers. Clear and pigmented sealers are used to protect these magnesite floors, decks, and stairs from the weather, and to cover older surfaces that are discolored, patched, or worn (Magnesite Flooring System, undated). Magnesium oxychloride is highly alkaline and prevents adhesion of most coatings applied to it. The only successful magnesite cement coatings are acrylic lacquers. Coatings other than acrylic lacquers have failed within a week due to delamination (TRG/ARB, 1989).

Table VI-58 below summarizes our estimate of sales and VOC emissions from the magnesite cement coatings category.

Table VI-58
Magnesite Cement Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	PD	PD	590	0.14
Water-Based	PD	PD	0	~0.00
Total	5	37,501	589	0.14

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected Data.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 450 g/l VOC limit for magnesite cement coatings effective January 1, 2003. This proposed VOC limit is technologically and commercially feasible based on: the limit in current district rules; and the fact that most district architectural coating rules have had the same limit for several years: discussions with a major manufacturer who has recently developed a complying product; and a technology assessment performed by the South Coast AQMD in 1996. We also note that no adverse comments were received about the proposed limit.

The VOC limit for magnesite cement coatings in most district rules is 450 g/l. The Mojave Desert and San Diego districts have a VOC limit of 600 g/l, and several districts do not list this category in their table of standards. The VOC limit in the U.S. EPA's National Architectural Coatings Rule is 600 g/l.

The South Coast AQMD examined magnesite coatings in its 1996 amendments to Rule 1113. At that time, an interim VOC limit of 600 g/l was established, and as of January 1, 1999, a VOC limit of 450 g/l is now in effect (South Coast AQMD, 1996). In November 1998, a major manufacturer indicated that after many years of reformulation, they could meet the 450 g/l limit. There are some limitations in using the coating in hot weather, however, which are handled by applying the coating at night (Armstrong, 1999).

We recommend that the VOC limit for magnesite cement coatings remain at 450 g/l at this time, the same as in current district rules.

Table VI-59
Magnesite Cement Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
450	PD	PD	0.00

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
PD = Protected Data.

Issues:

1. Issue: No comments were received regarding magnesite cement coatings, and to our knowledge there are no unresolved issues.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Armstrong, Alan. Hills Brothers Chemical. Personal communication with ARB staff.

October 25, 1999. (Armstrong, 1999)

"Magnesite Flooring System." Undated. http://desertbrand.com/mfs.htm. (Magnesite Flooring System, undated)

"The Many Faces of Desert Brand Magnesite." Undated. http://www.sealers.ffb.htm. (Magnesite, undated)

South Coast AQMD. "Draft Staff Report for Proposed Amendments to Rule 1113 – Architectural Coatings." September 26, 1996. (South Coast AQMD, 1996)

Technical Review Group and Air Resources Board (TRG/ARB). "ARB-CAPCOA SCM for Architectural Coatings, Technical Support Document." July 1989. (TRG/ARB, 1989).

9. Mastic Texture Coatings

Product Category Description:

Mastic texture coatings are products used to cover and conceal holes, cracks, and surface irregularities. These coatings are applied in a single coat, with the dry film at least 10 mils thick. These coatings are highly viscous water-based or solvent-borne coatings used by homeowners or contractors for interior and exterior masonry (U.S. EPA, 1998). The definition in the 1989 SCM includes a film thickness specification to identify that these coatings are high-build coatings (TRG/ARB, 1989).

Table VI-60 below summarizes our estimate of sales and VOC emissions from the mastic texture coatings category.

Table VI-60
Mastic Texture Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	PD	PD	223	0.08
Water-Based	PD	PD	79	0.07
Total	56	299,727	118	0.15

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected Data.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 300 g/l VOC limit for mastic texture coatings effective January 1, 2003. This proposed VOC limit is technologically and commercially feasible based on: the high complying marketshare; the limit in current district rules; the fact that most district architectural coating rules have had the same limit for several years; a review of product literature on coatings included in this category; and comments justifying this limit based on performance requirements. We also note that no adverse comments were received about the proposed limit.

All district rules that include a category for mastic texture coatings have a VOC limit of 300 g/l. This category is exempt in the Bay Area, Butte County, Colusa County, Feather River, and Monterey districts. The VOC limit in the U.S. EPA's National Architectural Coatings Rule is also 300 g/l.

Table VI-61
Mastic Texture Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
300	56	100	0.00

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

<u>Issues</u>:

1. Issue: There are no known unresolved issues with this category.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Technical Review Group and Air Resources Board (TRG/ARB). "ARB-CAPCOA SCM for Architectural Coatings, Technical Support Document." July 1989. (TRG/ARB, 1989)

United States Environmental Protection Agency (U.S. EPA). "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards." EPA-453/R-98-006b. August 1998. (U.S. EPA, 1998)

10. **Metallic Pigmented Coatings**

Product Category Description:

Metallic pigmented coatings are products that contain at least 48 grams of elemental metal pigment per liter of coating, as applied. This metal content is equivalent to 0.4 pounds of metal per gallon of coating. South Coast AQMD Method 318-95, "Determination of Weight Percent Elemental Metal in Coatings by X-Ray Diffraction," is used to determine the metallic content of the coating.

Metallic pigmented coatings produce a dry film that has a metallic appearance. This effect is produced by incorporating fine flakes of various metals (e.g., copper, bronze, aluminum) to the coating. The aluminum can be leafing or nonleafing. Leafing means that the metal is in the form of thin flat flakes that align themselves so that they appear to be floating on or near the surface of the coating (LeSota, 1995).

In the U.S. EPA rulemaking, issues were raised about the inclusion of zinc-rich coatings in the metallic pigmented coating category. Zinc-rich coatings are applied to structural steel beams to prevent corrosion during the construction of large buildings. Zinc-rich coatings are lower in VOC than metallic pigmented coatings because the zinc content of the dry film can be 50 percent or higher. U.S. EPA concluded that creating a separate category for zinc-rich coatings was not warranted, and these coatings fit under the metallic pigmented category (U.S. EPA, 1998).

Inorganic zinc-rich primers are considered metallic pigmented coatings because the elemental zinc particles in the film are held to the surface of the substrate through a non-organic silicate binder (LeSota, 1995). Organic zinc-rich primers are also considered metallic pigmented coatings because elemental zinc powder is used, along with an organic binder such as an epoxy or urethane that holds the pigment to the film (Sherwin-Williams, undated). The pigment zinc oxide (ZnO) does not contain elemental zinc (LeSota, 1995) and thus does not qualify as a source of zinc for metallic pigmented coatings. Aluminum roof coatings are considered metallic pigmented coatings, as are asphalt aluminum roof coatings as long as they have 48 grams of elemental metal pigment per liter of coating, as applied. Bituminous coatings are excluded from the metallic pigmented coating definition in the National Rule, but they have the same VOC limit of 500 g/l.

Table VI-62 below summarizes our estimate of sales and VOC emissions from the metallic pigmented coatings category.

Table VI-62
Metallic Pigmented Coatings*

	Number of Products	Category Sales (gallons/ year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	119	272,965	456	0.77
Water-Based	6	119,862	137	0.04
Total	125	392,827	358	0.81

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 500 g/l VOC limit for metallic pigmented coatings effective January 1, 2003. This proposed VOC limit is technologically and commercially feasible based on: the high complying marketshare; the limit in current district rules and the National Rule; the fact that most district architectural coating rules have had the same limit for several years; and a review of product literature on coatings included in this category. We also note that no adverse comments were received about the proposed limit.

Every district rule with a metallic pigmented category has a VOC limit of 500 g/l. This category is exempt in the Bay Area, Butte County, Colusa County, Feather River, and Monterey districts. The National Rule VOC limit is also 500 g/l, and includes coatings formulated with zinc pigment. Kentucky, New York, New Jersey, Massachusetts, Rhode Island, and some of the California districts have 500 g/l limits. The national survey showed that 90 percent of these coatings had VOC contents from 300-500 g/l (U.S. EPA, 1998).

In earlier versions of the SCM, we had proposed excluding zinc from the definition of metallic pigmented coatings because zinc-rich primers, which would fall under this category, have a VOC content limit lower than 500 g/l. We are now proposing that the definition include coatings containing elemental zinc, which is consistent with the National Rule and South Coast AQMD Rule 1113. Further, we have proposed that the most restrictive VOC limit section of the SCM does not apply to metallic pigmented coatings, as has been the case for years in most district rules. Thus, a coating containing the metallic content required by the definition need meet only the 500 g/l VOC limit of metallic pigmented coatings, even though it overlaps with another category.

We recommend that the VOC limit for metallic pigmented coatings remain at 500 g/l at this time, the same as in current district rules and the National Rule. The survey shows 98 percent compliance at this limit, even with solvent-based coatings.

Table VI-63
Metallic Pigmented Coatings*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
500	98	98.30	0.00

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

Issues:

1. **Issue:** The proposed definition restricts this category to metallic coatings not including zinc metallic coatings. With the introduction of the lower limits, this limitation is unreasonable, and the zinc exclusion should be removed.

Response: We agree, and have removed the exclusion of zinc from the definition.

2. **Issue:** We manufacture a zinc-rich coating containing zinc powder that contains 95 percent zinc in the dried film and is applied in the field. Zinc is the densest and most difficult metal to formulate into coatings. We urge you to change your definition to include zinc.

Response: We agree with the change in the definition. The coating described would be considered a metallic pigmented coating.

3. **Issue:** The higher limit for the asphaltic aluminum coating is appropriate because they are the best product for increasing reflectance on black asphaltic roofing surfaces.

Response: The National Rule definition for metallic pigmented excludes bituminous coatings, but we have not proposed similar language, in keeping with the long-standing definition used in California. We agree that this asphaltic aluminum roof coating would be considered a metallic pigmented coating.

4. **Issue:** The definition for metallic pigmented coatings exempts zinc as a metal, which would essentially eliminate organic and inorganic zinc-rich primers. We request that you change this definition to agree with South Coast AQMD Rule 1113 and the National AIM Rule definitions.

Response: We agree with the change in the definition to include elemental zinc metal. We also agree that organic and inorganic zinc-rich primers are included in the definition of metallic pigmented coating.

5. **Issue:** The proposed definition for metallic pigmented coatings excludes zinc. This is surprising since virtually all other regulatory bodies have included zinc. Zinc-rich coatings at 250 g/l have not been proven for field application. Water-based inorganic zinc (which has close to zero VOC) is considered by a majority of applicators and specifiers to be unsuited for field application.

Response: We modified the definition to include zinc-rich coatings as suggested.

6. **Issue:** High-temperature metallic coatings shouldn't be penalized because they can be used at high temperature. The use of metallic pigments requires a higher limit because of the metal. The metallic pigmented definition excludes zinc, while the South Coast AQMD and National Rule include zinc.

Response: We have made the requested change to the definition of metallic pigmented coatings. The exception under the Most Restrictive VOC Limit section in the SCM specifies that high-temperature metallic pigmented coatings are subject to the VOC limit for metallic pigmented coatings at 500 g/l.

7. **Issue:** There are a lot of metallic coatings that contain powdered zinc, copper, bronzes based on zinc, and combinations of copper/aluminum/zinc pigments. Pigment is defined in the National Rule to include corrosion inhibition, but pigment is not defined in the SCM. Zinc-rich primers have VOC contents of roughly 340-420 g/l. Zinc-rich primers should be in their own category or in the metallic pigmented category.

Response: The definition of pigment in the National Rule refers to finely ground, insoluble powder that is used for color, corrosion inhibition, and other specific purposes. Thus, zinc in zinc-rich primers would fall under the definition of pigment because they are used for corrosion inhibition, and the coating would be considered a metallic pigmented coating. The decorative metals such as copper and bronze described by the commenter would also be pigments, thus including these coatings in the metallic pigmented coating category. Although some zinc-rich primers have a VOC content considerably less than the 500 g/l limit of metallic pigmented coatings, we are still including them in the metallic pigmented category.

8. **Issue:** Inorganic zinc and zinc containing coatings have always been treated as industrial maintenance (IM) coatings in the South Coast AQMD, and that's the way they've been reported as well. Metallic coatings contained pure elemental metal, but zinc oxide was included in IM because they didn't qualify as pure metal. Metallic pigmented coatings were originally a decorative coating, so decorative may need to be in the definition.

Response: The commenter is referring to an earlier version of the SCM where zinc coatings were excluded from the definition of metallic pigmented. We have modified the metallic pigmented coating definition to include zinc, consistent with district rules. In the exceptions to the most restrictive VOC limit of current district rules, where a metallic coating is used as primer/sealer/undercoater, roof, high-temperature, or industrial maintenance coatings, the higher limit (i.e., metallic pigmented) applies. We do not believe any clarification is required for zinc-rich coatings; the amount of elemental metal should be the deciding factor in determining whether a coating is a metallic pigmented coating, not the type of metal. Zinc oxide is not an elemental metal, and its presence does not make a coating a metallic pigmented coating. We disagree that metallic pigmented coatings are purely decorative. To comply with the definition of metallic pigmented coatings, the amount and the form of the metal are the determining factors, not the function of the metal in the coating.

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

LeSota, Stanley (ed.). *Coatings Encyclopedic Dictionary.* Federation of Societies for Coatings Technology, 1995. (LeSota, 1995)

Sherwin-Williams Company. Sherwin-Williams Pro-Tips. Inorganic and Organic Zinc Primers. http://www.sherwin.com/Builders/pro-tips/coldweather/primers.asp. Undated. (Sherwin-Williams, undated).

United States Environmental Protection Agency (U.S. EPA). "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards." EPA-453/R-98-006b. August 1998. (U.S. EPA, 1998)

11. Pre-Treatment Wash Primers

Product Category Description:

Pre-treatment wash primers are wash coats used prior to the application of primer or topcoat. They must contain at least 0.5 percent acid, by weight, and are applied to bare metal surfaces to provide corrosion resistance and to promote adhesion of subsequent topcoats. Pre-treatment wash primers are often used on aluminum and galvanized metal surfaces (TRG/ARB, 1989).

These coatings provide excellent adhesion when applied to clean alloys, ferrous, or nonferrous surfaces, partially due to a reaction with the substrate. They also impart a corrosion resistant film that is a good surface for the application of coatings. These primers form very thin films, and are similar to etching solutions. The etched surface may be primed for maximum protection (LeSota, 1995).

Table VI-64 below summarizes our estimate of sales and VOC emissions from the pre-treatment wash primers category.

Table VI-64
Pre-Treatment Wash Primers*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	PD	PD	716	0.00
Water-Based	PD	PD	248	0.04
Total	30	71,940	252	0.04

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected Data.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 420 g/l VOC limit for pre-treatment wash primers effective January 1, 2003. This proposed VOC limit is technologically and commercially feasible based on: the limit in current district rules; and the fact that most district architectural coating rules have had the same limit for several years. ~~We also note that no adverse comments were received about the proposed limit.~~

The most common district VOC limit for pre-treatment wash primers is 420 g/l. This limit is in the following districts: Imperial, Kern, Sacramento, San Joaquin, Santa Barbara, and Ventura districts. El Dorado and Placer districts have a VOC limit of 675 g/l, while Antelope

Valley, Mojave, San Diego, and South Coast have a limit of 780 g/l. The remaining districts do not include a category for pre-treatment wash primers.

The 1989 SCM set the VOC limit at 780 g/l, effective September 1989, and a future-effective limit of 420 g/l VOC limit in September 1994 (TRG/ARB, 1989).

A variety of district coating rules (e.g., Bay Area Rule 8-43, Surface Coating of Marine Vessels; Sacramento Rule 451, Surface Coatings of Miscellaneous Metal Parts and Products; San Joaquin Rule 4603, Surface Coating of Metal Parts and Products; and Ventura Rule 74.12, Surface Coating of Metal Parts and Products) have categories for pre-treatment wash primers, with a VOC limit of 420 or less.

The VOC limit in the U.S. EPA's National Architectural Coatings Rule is 780 g/l. However, we recommend that the VOC limit for pre-treatment wash primers remain at 420 g/l at this time, the same as most district architectural coating rules and several other district metal coating rules. Although the South Coast AQMD has a higher limit than that proposed in the SCM, the statewide emission reductions are still virtually zero.

Table VI-65
Pre-Treatment Wash Primers*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
420	PD	PD	0.00

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
PD = Protected Data.

<u>Issues</u>:

1. Issue: <u>Are there any pre-treatment wash primers at 420 g/l that work?.</u>

Response: <u>A majority of the marketshare in this category is for complying products; since they are sold, we must assume they work. Sherwin-Williams makes two water-based wash primers with VOC contents less than 200 g/l. Cardinal Industrial Finishes has formulated a two-component wash primer specifically to meet the 420 g/l limits in California districts. The 420 g/l limit has been in effect in many district rules since 1994, and the same limit is in effect in a variety of district metal parts and marine vessel rules.</u>

REFERENCES

Air Resources Board. Final Report. "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

LeSota, Stanley (ed.). *Coatings Encyclopedic Dictionary*. Federation of Societies for Coatings Technology. 1995. (LeSota, 1995)

Technical Review Group and Air Resources Board (TRG/ARB). "ARB-CAPCOA SCM for Architectural Coatings, Technical Support Document." July 1989. (TRG/ARB, 1989)

12. Sanding Sealers (Non-Lacquer)

Product Category Description:

Sanding sealers are clear coatings applied to bare wood to seal the wood and provide a coat that can be sanded smoothly. This category does not include lacquer-type sanding sealers. The application of a sanding sealer to wood provides a first coat that is quite hard, and seals or fills the wood, but it does not conceal the wood grain (LeSota, 1995). Lacquer sanding sealers are included in the lacquer category because they perform essentially like lacquers (U.S. EPA, 1998).

The sanding sealer category was added to the 1989 SCM by the direction of our Board at its May 12, 1989 hearing. The definition specified that these coatings are to be used prior to the application of varnish, and that they must be labeled accordingly (ARB, 1989). We are proposing the use of the U.S. EPA's National Architectural Coatings Rule definition because it is more descriptive of the function of sanding sealers and does not direct which topcoat must be used. The definition does, however, clarify that lacquer sanding sealers are to be included in the lacquer category.

In general, non-lacquer sanding sealers are water-based acrylics or urethanes, and are recommended for use with water-based stains and polyurethane varnishes. In general, solvent-based lacquer sanding sealers are used in conjunction with solvent-based stains and clear lacquer or alkyd topcoats. There are exceptions to these statements, however.

Table VI-66 below summarizes our estimate of sales and VOC emissions from the non-lacquer sanding sealers category.

Table VI-66
Sanding Sealers (Non-Lacquer)*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	26	110,767	665	0.46
Water-Based	5	5,166	281	~0.00
Total	31	115,933	648	0.46

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 350 g/l VOC limit for non-lacquer sanding sealers effective January 1, 2003. This proposed VOC limit is technologically and commercially feasible based on: the limit in current district rules; the fact that most district architectural coating rules have had the same limit for several years; and the fact that several complying water-based products were reported in the survey. We also note that no adverse comments were received about the proposed limit.

Several districts have a VOC limit for sanding sealers of 350 g/l (Antelope, Imperial, Kern, Sacramento, San Joaquin, Santa Barbara, and South Coast), while others have a 550 g/l limit (Mojave and San Diego). Three other districts (El Dorado, Placer, and Ventura) have a 350 g/l limit for non-lacquer sanding sealers. The VOC limit in the U.S. EPA's National Architectural Coatings Rule is 550 g/l.

We recommend that the VOC limit for non-lacquer sanding sealers remain at 350 g/l at this time, the same as in most of the district rules. In contrast to current district rules, we are recommending that the sanding sealers category represent only non-lacquer products because non-lacquer sanding sealers are usually recommended for use with varnishes, while lacquer sanding sealers are used with lacquer topcoats.

Table VI-67
Sanding Sealers (Non-Lacquer) *

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
350	5	4.50	0.00

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

Issues:

1. Issue: We can not make sanding sealers and a number of other categories of the quality, application flexibility and chemical composition safety our customers expect at the very low limits currently proposed.

Response: The 350 g/l VOC limit has been in effect in most of the district rules for many years, and the survey and our technical analysis shows that there are a number of complying products with acceptable performance characteristics.

2. **Issue:** Since you have a limit for waterproofing sealers and for sanding sealers, what about waterproofing wood sanding sealers? It is a waterproofing sealer as well as a sanding sealer.

Response: The SCM specifies where there are two or more uses for the product, the lowest VOC content limit applies, i.e., the 250 g/l waterproofing wood sealer limit.

REFERENCES

Air Resources Board. Final Report, "1998 Architectural Coatings Survey Results." September, 1999. (ARB, 1999)

Air Resources Board. ARB-CAPCOA SCM for Architectural Coatings, letter to Air Pollution Control Officers. July 7, 1989. (ARB, 1989).

LeSota, Stanley (ed.). *Coatings Encyclopedic Dictionary*. Federation of Societies for Coatings Technology. 1995. (LeSota, 1995)

United States Environmental Protection Agency (U.S. EPA). "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards." EPA-453/R-98-006b. August 1998. (U.S. EPA, 1998)

13. Shellac – Clear

Product Category Description:

Shellacs can be clear or opaque and are formulated with the resinous secretions of the lac beetle, *Laccifer lacca*. Shellac coatings are designed to form a uniform coat regardless of how many layers are applied. Each layer of shellac that is applied partially dissolves the previous coat. Shellac Coatings are products, which contain alcohol and dry by evaporation without a chemical reaction. It is for this reason that shellacs are also easily removed.
(Angelo Brothers, 1965; Martin, undated)

Clear shellac coatings are designed to protect the substrate with a durable, protective film that allows full and total transmission of light. Clear shellac coatings are typically sold as bleached or natural. Shellac coatings, in which pigment is artificially added, are considered opaque shellacs (See Shellac – Opaque). (Hoyas, 1999; Zinsser, 1996)

Clear shellacs were a regulated category in the 1989 SCM and the U.S. EPA regulates them in the National Rule. According to the U.S. EPA, the majority of state rules define shellac broadly as a coating formulated with natural resins with nitrocellulose resins excluded to avoid overlap with the lacquer category.(TRG/ARB, 1989; U.S. EPA, 1998) While we understand the U.S. EPA's rationale for their definition of shellac, we do not believe that this is an appropriate change for the SCM. District rules have defined shellac as proposed in the SCM for at least the past ten years. In addition to California, several other states use the proposed SCM definition as well. We believe that the U.S. EPA definition may increase emissions in this category, may cause confusion to the consumers, and will be difficult to enforce because of the inherent problems associated in defining "natural resin." Shellacs have always been specific to the lac beetle. Due to the limited availability of lac beetles, potential use of shellac as a quick-dry primer, general-purpose primer and clear wood finish is minimized.

Using the U.S. EPA definition would expand the availability of high VOC products, and may potentially reduce the emission reductions in two other categories: 1) quick-dry primers, sealers, and undercoaters; and 2) primers, sealers, and undercoaters. Outside of California, these alcohol-thinned, non-laccifer lacca, natural resin products are marketed as quick-dry primers, sealers, and undercoaters; or primers, sealers, and undercoaters. We believe that there are acceptable alternatives to these products in the quick-dry, specialty, or general primers, sealers, and undercoaters categories.

Table VI-68 below summarizes our estimate of sales and VOC emissions from the shellac-clear coatings category.

Table VI-68
Shellac - Clear*

	Number of Products	Category Sales (gallons/ year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	PD	PD	614	0.11
Water-Based	0	0	N/A	N/A
Total	PD	PD	614	0.11

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
****** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected Data.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a VOC limit of 730 g/l for clear shellacs effective January 1, 2003. This proposed VOC limit is technologically and commercially feasible by the effective date based on the complying marketshare, the limit in current district rules, and the length of time that these limits have been in effect. The proposed limit is consistent with the 1989 SCM, district rules, and the National Rule. The ARB survey data show 100 percent compliance with the proposed limit.

Table VI-69
Shellac - Clear*

Proposed VOC Limit (g/l)**	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
730	PD	100	0.00

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
PD = Protected Data.

Issues:

1. Issue: The commenters urge CARB not to modify the definition of shellac in the current or future versions of air control measures. The commenters state that the U.S. EPA has allowed the category of shellac to be reinterpreted, to become confused and to become a "loophole" for manufacturers wishing to violate the spirit of the original CARB regulations put forth many years ago.

Response: We agree with the commenter and have, therefore, changed the shellac definition back to its previous wording. Shellacs shall include only those coatings that are solely formulated with the resinous secretions of the lac beetle (L*accifer lacca*), which is how shellac has been defined for hundreds of years. The proposed definition is consistent with the 1989 SCM's shellac definition, and is the most common shellac definition found in the California districts' architectural coatings rules. Since the shellac category has been regulated for many years and the VOC limit is relatively high, it is important that we limit the definition so that our emission reductions are not compromised. Coatings containing other natural resins may continue to use the most applicable coating category, just as they have in the past. We believe that any substantial change to the definition will not only confuse consumers, but also may reduce our estimated emission reductions.

2. **Issue:** The commenter urges the ARB to return to the original definition of shellac. If not, the commenter believes this change in the shellac definition will result in a number of unintended consequences, all of which will certainly increase the amount of VOC emissions, both near and long term.

Response: We agree with the commenter and have changed the shellac definition back to its previous wording. See response to Issue 1.

3. **Issue:** Both in person and in writing, we have requested language uniformity with the National AIM VOC Rule. By changing the definition for shellac we feel you have created a monopolistic situation for the users of paint in California. This does not lead to less air pollution; rather it leads to a more costly less available single product source for extreme stain blocking needs.

Response: We disagree with the commenter. We do not believe that it is appropriate to change the definition to include all natural resins. Shellacs were broken out of the lacquer category many years ago to address the unique formulation. Outside of California, these other natural resin products are marketed as quick-dry primers, sealers, and undercoaters; or primers, sealers, and undercoaters. There are acceptable alternatives to these products in the quick-dry, specialty, or general primers, sealers, and undercoaters categories. Changing the shellac definition may reduce the emission reductions and sales in the quick-dry and general primers, sealers, and undercoaters categories and increase sales and emissions in the revised shellac category. Currently, cost and availability limit shellac coatings sales. The high cost of the coating makes it prohibitive for use as a general primer, sealer, and undercoater.

4. **Issue:** For shellac, ARB reverted to the older definition in SCM and district rules, where shellac is limited to the secretions of the lac beetle. We spent a lot of time in the national negotiations making the federal folks aware that the one resin was not the only substance in the world that performed the function of sealing in alcohol. Functionality and product quality is not limited to lac beetle resin.

Response: We disagree. Please see response to Issue 3.

REFERENCES

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Martin, James W. "Shellac." William Zinsser & Co., Inc., Somerset, NJ. Undated. (Martin, undated)

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Wm. Zinsser & Co., Inc. Bulls Eye Shellac Product Information Bulletin, 3/96 Z2324 03IS 3000. Somerset, NJ. (Zinsser, 1996)

14. Shellac - Opaque

Product Category Description:

Shellacs can be clear or opaque and are formulated with the resinous secretions of the lac beetle, *Laccifer lacca*. Shellac coatings are designed to form a uniform coat regardless of how many layers are administered. Each coating layer partially dissolves the previous coat and dries to form one thicker coat. Shellac coatings are products, which use ethyl alcohol as the primary solvent and dry by evaporation without a chemical reaction. It is for this reason that shellacs are also easily removed. (Angelo Brothers, 1965; Martin, undated)

Opaque shellac coatings are designed to protect the substrate with a durable, protective film. This film layer does not allow full and total transmission of light. Opaque shellac coatings are typically white and are rarely tinted. Shellac coatings in which any pigment is artificially added are considered opaque shellacs. (Hoyas, 1999; Zinsser, 1999; Zinsser,1995)

Opaque (pigmented) shellacs were a regulated category in the 1989 SCM and the U.S. EPA regulates them in the national rule. According to the U.S. EPA, the majority of state rules define shellac broadly as a coating formulated with natural resins, with nitrocellulose resins excluded to avoid overlap with the lacquer category. Although the definitions may change from state to state, all state rules reviewed have 550 g/l limit for opaque shellacs. For a more detailed discussion on the definition of shellac, please see the Clear Shellac discussion for additional information. (TRG/ARB, 1989; U.S. EPA, 1998)

Table VI-70 below summarizes our estimate of sales and VOC emissions from the shellac - opaque coatings category.

Table VI-70
Shellac - Opaque*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	PD	PD	534	0.41
Water-Based	0	0	N/A	N/A
Total	PD	PD	534	0.41

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
****** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected Data.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a VOC limit of 550 g/l for opaque shellacs effective January 1, 2003. This proposed VOC limit is technologically and commercially feasible by the effective date based on the following items: the complying marketshare; the limit in current district rules; and the length of time that these limits have been in effect.

This proposed limit is consistent with the 1989 SCM, district rules, and the National Rule. Certain applications of shellac require thinning to meet customer needs. Although the sales weighted average for opaque shellac is near the proposed limit of 550 g/l, 100 percent of the market complies with the proposed limit, even with recommended thinning.

Table VI-71
Shellac - Opaque*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
550	PD	100	0.00

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
PD = Protected Data.

Issues:

1. Issue: Please see previous section on clear shellacs.

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Wm. Zinsser & Co., Inc. B-I-N Primer-Sealer Stain-Killer Product Information 09IS Z3876 7/99 5M. Sommerset, NJ. (Zinsser, 1999)

Wm. Zinsser & Co., Inc. B-I-N Primer-Sealer Z1514 1/95 09SS. Sommerset, NJ. (Zinsser, 1995)

15. Varnishes

Product Category Description:

Varnishes are clear or semi-transparent coatings that may contain a small amount of pigment to color the surface, or to control the final sheen or gloss of the finish. The varnish category excludes lacquers and shellacs, which dry by evaporation. Varnishes used on floors are subject to the varnish VOC limit rather than the floor coating VOC limit.

The definition in the proposed SCM is essentially the same as that in the U.S. EPA's National Architectural Coatings Rule definition. The definition used in the 1989 SCM defines varnishes simply as clear wood finishes formulated with various resins to dry by chemical reaction on exposure to air. We believe that the National Rule definition is more descriptive of the characteristics of the finished film, which distinguishes varnishes from shellacs and lacquers. The distinguishing characteristics of shellacs and lacquers are their ingredients, lac beetle exudate and cellulosic or synthetic resins, respectively. Varnishes are commonly made with alkyds, urethanes, polyurethanes, phenols, and modified resin systems, and they are characterized by a hard film that can be formulated to resist abrasion, chemicals, acids, alkalis, alcohol, steam, hot grease, salt water, gasoline, or solvents.

The primary criticisms of varnishes are their tendency to dry slowly and to yellow (TRG/ARB, 1989). Varnishes yellow because they are made with oils that naturally yellow as they age, although some oils yellow less than others. In some woods, the yellowing can enhance the richness of the wood (Marino). In general, water-based polyurethanes yellow less than oil-based varnishes. The drying times vary greatly depending on the formulation, but in general it is true that varnishes dry-to-recoat more slowly than lacquers.

Table VI-72a below summarizes our estimate of sales and VOC emissions from the varnish coatings category.

Table VI-72a
Clear Varnishes*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	257	445,397	463	1.29
Water-Based	84	172,031	260	0.11
Total	341	617,428	406	1.40

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.

Table VI-72b
Semitransparent Varnishes*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	67	100,292	459	0.29
Water-Based	23	61,917	296	0.05
Total	90	162,209	396	0.34

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 350 g/l VOC limit for varnishes effective January 1, 2003. This proposed VOC limit is technologically and commercially feasible based on: the complying marketshare; the limit in current district rules; the fact that most district architectural coating rules have had the same limit for several years; and the results of performance testing in the Harlan study. We also note that no adverse comments were received about the proposed limit.

All districts except one have a VOC limit for varnishes of 350 g/l (Butte County has a VOC limit of 650 g/l.).

The National Rule VOC limit is 450 g/l. Rules in Kentucky, Massachusetts, New Jersey, New York, and Rhode Island have a limit of 450 g/l, Arizona and California districts (except Butte County) have a limit of 350 g/l, and Texas has a limit of 540 g/l. The national survey showed that 30 percent of sales were below 450 g/l. Varnishes recommended for floor coatings are subject to the varnish VOC limit (U.S. EPA, 1998).

From the sales weighted average survey data in Tables VI-68a and VI-68b above, it appears that only the water-based varnishes comply with the 350 g/l VOC limit. However, in Tables VI-72a and VI-72b below, it can be seen that roughly 50 percent of the marketshare complies with the 350 g/l VOC limit. The complying products include both water-based and solvent-borne products.

The ARB survey data show that in varnishes overall (a composite of clear and semi-transparent), about 30 percent of the water-based products and 18 percent of the solvent-borne products comply with the 350 g/l VOC limit that has been in effect in district rules for many years. There are differences in compliance between clear and semi-transparent varnishes, however. In water-based coatings, 28 percent of the clear varnishes comply, while 38 percent of the semitransparent varnishes comply. In solvent-borne coatings, 13 percent of the semitransparent varnishes comply, compared to 20 percent of the clear varnishes.

The 1995 Harlan Associates study (Harlan, 1995; Cowan, 1998) provides some insights on the performance of two water-based and three solvent-borne varnishes. Varnishes have not yet replaced lacquers as the product of choice for professional painters. The main advantages claimed for the use of lacquers rather than varnishes in the past include clarity, non-yellowing, quick drying and ease of touch-up. Except for ease of touch-up, many of the differences between lacquers and varnishes have narrowed with newer products. Test data shows that, in general, dry times are longer for varnishes than lacquers, but the two complying water-based varnishes dried faster than the solvent-borne products. Similarly, the differences between the high-VOC varnish and the other low VOC varnishes are small. Equivalent characteristics include hardness, application, appearance, flexibility, and gloss. Overall, the abrasion resistance of the low-VOC varnishes was superior to the high-VOC varnish tested. Similarly, the adhesive properties and resistance to water stains of the low-VOC varnishes were superior to the high-VOC varnish. The dry time for two of the low-VOC varnishes was shorter than the high VOC varnish, while the other two low-VOC varnishes did not have any grain raising problems. Sometimes, these coatings are applied as a system, with the stain followed by a sanding sealer and varnish topcoat. Thus, grain raising would not be a concern for this type of coating operation. Long-term testing was not conducted in the Harlan study, so no conclusions can be drawn about the yellowing tendency of each product. However, overall the low VOC products tested were at least as good as the high VOC product.

We recommend that the VOC limit for clear and semitransparent varnishes remain at 350 g/l at this time, the same as in most district rules. There are an adequate number of complying products in water-based and solvent-borne, clear and semitransparent varnishes, to justify these limits. Also, this limit has been in effect in the three largest districts since September 1987 (TRG/ARB, 1989). We cannot justify recommending a relaxation of the rule for the 17 districts that have the 350 g/l VOC limit.

Table VI-73a
Clear Varnishes*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
350	146	47.60	0.00

***** Based on ARB's 1998 Architectural and Industrial Maintenance Coatings Survey (ARB, 1998).

** Grams VOC per liter of coating, less water and exempt compounds.

Table VI-73b
Semitransparent Varnishes*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
350	28	51.50	0.00

***** Based on ARB's 1998 Architectural and Industrial Maintenance Coatings Survey (ARB, 1998).

** Grams VOC per liter of coating, less water and exempt compounds.

Issues:

1. Issue: There are no known unresolved issues with this category.

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16. Wood Preservatives

Product Category Description:

Wood preservatives are products designed to protect exposed wood from decay or insect attack. Wood preservatives do not form films, but rather penetrate the wood (U.S. EPA, 1998; LeSota, 1995). These coatings are registered with both the U.S. EPA under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the California Department of Pesticide Regulation (DPR). Because of the time required for product registration under FIFRA, the U.S. EPA provided an additional six months for compliance with the VOC limits (U.S. EPA, 1998).

Based on a workshop comment, we are changing the definition of wood preservatives to clarify that the coating, rather than just the preservative chemical, must be registered with the U.S. EPA and DPR. In fact, both the coating and the chemical must be registered (Saldana, 1999). This was the intent of the 1989 SCM (TRG/ARB, 1989), and does not represent a change in strategy or interpretation. Further, in the 1989 SCM and district rules, this category was subdivided into below ground wood preservatives, clear and semitransparent wood preservatives, and opaque wood preservatives. We are proposing to collapse all wood preservatives into a single category.

Table VI-74a-71d below summarizes our estimate of sales and VOC emissions from the wood preservatives categories.

Table VI-74a
Below Ground Wood Preservatives*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	PD	PD	352	0.01
Water-Based	PD	PD	350	~0.00
Total	PD	3,549	350	0.01

* Based on ARB's 1998 Architectural and Industrial Maintenance Coatings Survey (ARB, 1998).
** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected Data.

Table VI-74b
Clear Wood Preservatives*

	Number of Products	Category Sales (gallons/ year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	8	157,119	141	0.14
Water-Based	12	67,123	102	0.02
Total	20	224,242	129	0.16

* Based on ARB's 1998 Architectural and Industrial Maintenance Coatings Survey (ARB, 1998).
** Grams VOC per liter of coating, less water and exempt compounds.

Table VI-74c
Semitransparent Wood Preservatives*

	Number of Products	Category Sales (gallons/ year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	12	138,757	390	0.34
Water-Based	13	7,163	218	~0.00
Total	25	145,920	382	0.34

* Based on ARB's 1998 Architectural and Industrial Maintenance Coatings Survey (ARB, 1998).
** Grams VOC per liter of coating, less water and exempt compounds.

Table VI-74d
Opaque Wood Preservatives*

	Number of Products	Category Sales (gallons/ year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast AQMD) (tons/day)
Solvent-Based	PD	PD	658	~0.00
Water-Based	PD	PD	132	~0.00
Total	PD	PD	140	~0.00

* Based on ARB's 1998 Architectural and Industrial Maintenance Coatings Survey (ARB, 1998).
** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected Data.

Proposed VOC Limit and Basis for Recommendation:

We are proposing a 350 g/l VOC limit for wood preservatives effective January 1, 2003. This proposed VOC limit is technologically and commercially feasible based on: the high complying marketshare; the limit in current district rules; and the fact that most district architectural coating rules have had the same limit for several years. We also note that no adverse comments were received about the proposed limit.

As mentioned above, there are three categories of wood preservatives currently in most district rules, all with the same VOC limit. Below ground wood preservatives have a 350 g/l VOC limit in all districts except Mojave and San Diego, where they have a 600 g/l limit. Below ground wood preservatives are exempt in the Bay Area, Butte County, Colusa County, Feather River, and Monterey districts. Clear and semitransparent wood preservatives have a 350g/l VOC limit in all districts except Butte County (700 g/l). Opaque wood preservatives have a 350 g/l limit in all districts except Butte (650 g/l).

In the 1989 SCM, the clear and semitransparent wood preservatives had a 350 g/l VOC limit. The category for below ground wood preservatives was established with a VOC limit of 600 g/l. Three years later, in 1992, the SCM consolidated below ground wood preservatives and opaque wood preservatives with a VOC limit of 350 g/l. The three years was provided to reformulate below ground wood preservatives and to allow registration of the products under FIFRA and the California Department of Food and Agriculture (now DPR). Commenters claimed that registration could take up to two years (TRG/ARB, 1989).

The National Rule VOC limit is 550 g/l for below ground wood preservatives, 550 g/l for clear and semitransparent wood preservatives, and 350 g/l for opaque wood preservatives. Several states (Kentucky, Massachusetts, New Jersey, New York, Rhode Island) have 550 g/l limit for clear and semitransparent wood preservatives, while California districts (except Butte County) and Arizona have a 350 g/l limit (U.S. EPA, 1998).

Because all wood preservatives categories have been at 350 g/l in most district rules since 1992, we recommend collapsing all wood preservatives categories (i.e., clear, semitransparent, opaque, and below ground) into one category known as wood preservatives, with a VOC limit of 350 g/l. The survey showed that there is high compliance in all types of wood preservatives, and the function and registration process is similar for each. Also, since this limit has been in effect in most districts, we do not believe additional time for registration is needed.

Table VI-75a
Below Ground Wood Preservatives*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
350	PD	PD	0.00

* Based on ARB's 1998 Architectural and Industrial Maintenance Coatings Survey (ARB, 1998).

PD = Protected Data.

Table VI-75b
Clear Wood Preservatives*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
350	16	94.70	0.00

* Based on ARB's 1998 Architectural and Industrial Maintenance Coatings Survey (ARB, 1998).

** Grams VOC per liter of coating, less water and exempt compounds.

Table VI-75c
Semitransparent Wood Preservatives*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
350	20	74.10	0.00

* Based on ARB's 1998 Architectural and Industrial Maintenance Coatings Survey (ARB, 1998).

Table VI-72d
Opaque Wood Preservatives*

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
350	PD	PD	0.00

***** Based on ARB's 1998 Architectural and Industrial Maintenance Coatings Survey (ARB, 1998).
PD = Protected Data.

<u>Issues</u>:

1. Issue: No known unresolved issues remain with this category.

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C. CATEGORIES NOT PROPOSED FOR INCLUSION IN THE SCM

The following 16 coating categories are not included in the proposed SCM, but are included in the U.S. EPA's national architectural coatings rule. The discussion of each of these coating categories includes: 1) a product category description; 2) a rational for not including the product category in the proposed SCM; and 3) if applicable, a discussion of the issues associated with the category, as raised by industry. The product categories are listed in alphabetical order.

With the exception of anti-graffiti coatings, these categories are not generally included in any of California's district architectural coatings regulations. The products under these categories are currently either: (1) subject to other coating categories in district regulations; (2) sold only under the small container exemption; or (3) not sold in California (at least in areas with architectural coatings rules). Nevertheless, we researched each of these categories because they were included in the U.S. EPA's architectural coatings regulation, and because in many cases these products will be subject to lower VOC limits under the proposed SCM compared to current district regulations. In researching these categories we considered a variety of factors, including: (1) the VOC limit they would be subject to under the proposed SCM; (2) the potential for reformulation as demonstrated by similar products already complying with the VOC limits in the proposed SCM; (3) the availability of products that do not fall under the category as defined in the national rule, but fulfill the same basic function at a lower VOC content; and (4) the extent to which products under the category are used in California. As explained in the following sections, we do not believe it is necessary to incorporate a new category and VOC limit for any of these categories.

1. <u>Anti-graffiti Coatings</u>

<u>Product Category Description</u>:

Anti-graffiti coatings, as defined in the U.S. EPA's architectural coatings regulation, are clear or opaque high performance coatings formulated and recommended for application to interior and exterior architectural structures such as walls, doors, partitions, fences, signs, and murals to deter adhesion of graffiti and to resist repeated scrubbing and exposure to harsh solvents, cleansers, or scouring agents used to remove graffiti (U.S. EPA, 9/11/98). Notwithstanding this definition, anti-graffiti products are available as both permanent *and* sacrificial coatings. Permanent anti-graffiti products are generally two-part polyurethane coatings that resist repeated scrubbing and exposure to harsh solvents, cleansers, or scouring agents, as mentioned in the U.S. EPA's definition. Sacrificial products, on the other hand, provide a layer on top of the substrate that can be removed with hot water or other cleansers if graffiti is applied (Sinak, 12/15/99, telephone conversation; Genesis Coatings, 12/13/99; Spectratone, 12/15/99). The sacrificial products are then applied over the affected area to renew the coating.

As shown in the table below, the anti-graffiti coatings that reported in the ARB's Architectural Coatings Survey include both solvent-borne and water-borne coatings, with the solvent-borne coatings accounting for the majority of emissions. According to the ARB's Architectural Coatings Survey, about 2,573 gallons of anti-graffiti coatings were sold in 1996.

Table VI-76
Anti-Graffiti Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast) (tons/day)
Solvent-Based	PD	PD	605	~0.00
Water-Based	PD	PD	92	~0.00
Total	4	2,573	225	~0.00

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
****** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected data.

Rationale for Not Including Product Category in the SCM:

In the U.S. Environmental Protection Agency's national Architectural and Industrial Maintenance Rule, the permanent (not sacrificial) anti-graffiti coatings are regulated as a separate category with a 600 g/l VOC limit. However, in the ARB's SCM, anti-graffiti coatings would be classified as either: (1) industrial maintenance coatings with a 250 gram/liter VOC limit; or (2) as general flat or non-flat coatings with a 100 or 150 gram/liter VOC limit, respectively. Permanent anti-graffiti coatings would generally be classified as industrial maintenance coatings ~~(unless they are designed for residential use)~~ because they are designed to resist repeated scrubbing and exposure to harsh solvents, cleansers, or scouring agents. Sacrificial anti-graffiti coatings ~~(or permanent anti-graffiti coatings for residential use)~~ would generally be classified under the flat or non-flat coatings categories because they do not meet the criteria of an industrial maintenance coating.

We do not believe it is necessary to create a separate category with a higher VOC limit for anti-graffiti coatings because there are numerous manufacturers that currently produce products that comply with the proposed limits in the SCM (Sinak, 12/15/99, telephone conversation; Textured Coatings of America, 12/13/99; Aquarius Coatings, 9/98; Genesis Coatings, 12/13/99; Spectratone, 12/15/99). In addition, the sales-weighted average VOC content of the anti-graffiti products reported in the ARB's survey is 225 g/l (ARB, 9/99). The complying products include both permanent and sacrificial products, and many of these products have a VOC content at or near zero. We also note that some of the complying products are approved for use by the California Department of Transportation (CalTrans, 12/21/99; Sinak, 12/15/99, product literature).

Issues:

1. Issue: Anti-graffiti coatings go on apartment buildings, but if they are classified as industrial maintenance coatings, they would be prohibited under industrial maintenance restrictions in residential areas. With small volumes for these coatings, it will not be economically feasible for manufacturers to reformulate, and it will not produce significant emission reductions.

Response: The prohibition on the use of industrial maintenance products in residential applications (in Section 3.6 of the proposed SCM) has been removed. Therefore, permanent antigraffiti products for use in residential applications, such as apartment buildings, will generally be subject to the 250 g/l VOC limit for industrial maintenance coatings. ~~There are numerous anti-graffiti products, both permanent and sacrificial, that currently meet the 100 and 150 g/l VOC limits proposed for flat and nonflat coatings. Many of these products are zero, or near-zero VOC water-based products. These products could be used on apartment buildings and other residential areas~~. While each manufacturer will need to evaluate whether it is economically justified to reformulate higher VOC products to the proposed levels, many have already found it feasible to formulate low-VOC products, as demonstrated by the numerous complying formulations offered on the market.

2. Issue: Anti-graffiti coatings should be included in the SCM at VOC limit of 600 g/l. This limit is needed for permanent anti-graffiti coatings based on solvent-borne polyurethane chemistry. Permanent coatings allow cleaning of subsequently applied graffiti for surfaces that cannot be repainted, such as murals. After cleaning, the anti-graffiti system does not need to be reapplied, and also reduces the repainting, and thereby reduces VOC emissions over time. The volumes sold are very small, and averaging is not possible with our product line.

Response: ~~As mentioned above, there are numerous permanent anti-graffiti coatings. These products are generally water-based two-part polyurethane coatings.~~ There are numerous permanent anti-graffiti products on the market that meet the applicable 250 g/l VOC limit proposed in the SCM, and offer the benefits mentioned by the commenter. Many of these products are zero VOC, or near-zero VOC, water-based two-part polyurethane coatings.

3. Issue: Anti-graffiti should be a separate category. There are sacrificial coatings, but the high performance ones are made with highly reactive urethane to get the cross-linking and reduce porosity and need 600 g/l. The true way to measure an anti-graffiti coating is to let graffiti cook in the sun for 7-10 days and try to clean without residue. Anti-graffiti systems are also available as a primer, clear coat, and colored coat, but not a clear coat—could this definition be worded to include an anti-graffiti system for water tanks with 340 g/l limit for each individual product

Response: As mentioned above, there are numerous permanent anti-graffiti coatings on the market that comply with the applicable ~~proposed~~ 250 g/l VOC limit ~~limits for flat and nonflat coatings.~~ These coatings are generally two-part urethane systems, except that they are water-based instead of solvent-based. We do not have any specific information on the ease of removal of baked-on graffiti as mentioned by the commenter. We also do not have any information to justify changing the anti-graffiti definition or limit as proposed by the commenter.

REFERENCES

Aquarius Coatings, Incorporated. Product Data Sheet for Armaglaze 6000. September, 1998. (Aquarius Coatings, 9/98)

Air Resources Board. 1998 Architectural Coatings Survey Results. September, 1999. (ARB, 9/99)

California Department of Transportation. Approved Coatings for Graffiti Abatement. Facsimile dated December 21, 1999. (CalTrans, 12/21/99)

Genesis Coatings, Incorporated. Product Data Sheets for GCP 1000 and Graffiti Melt. Facsimile dated 12/13/99. (Genesis Coatings, 12/13/99)

Sinak Corporation. Product literature on Sinak GPS and Topcoat-17. Facsimile dated December 15, 1999. (Sinak, 12/15/99, product literature)

Sinak Corporation. Telephone conversation with ARB staff. December 15, 1999. (Sinak, 12/15/99, telephone conversation)

Spectratone Company. Telephone conversation with ARB staff. December 15, 1999. (Spectratone, 12/15/99)

Textured Coatings of America, Incorporated. Telephone conversation with ARB staff. December 13, 1999. (Textured Coatings of America, 12/13/99)

United States Environmental Protection Agency. National Volatile Organic Compound Emission Standards for Architectural Coatings. 40 CFR Part 59, Subpart D, 63 FR 48848. September 11, 1998. (U.S. EPA 9/11/98)

2. Calcimine Recoater Coatings

Product Category Description:

Calcimine recoaters, as defined in the U.S. EPA's architectural coatings regulation, are flat solvent-borne coatings formulated and recommended specifically for recoating calcimine coated ceilings and other calcimine coated substrates (U.S. EPA, 9/11/98). Calcimine (or "powdered distemper" in Britain) is a water-thinned coating composed primarily of calcium carbonate and glue. Calcimine coatings are found in Victorian and Early American homes, especially on ceilings. Calcimine *recoaters* are light, puffy, gel-like coatings made of limed vegetable oils. They prevent peeling of old calcimine ceilings because they are solvent-based (calcimine is water soluble) and light (heavier coatings may cause calcimine to disbond). These coatings prevent the need to scrape off all the old calcimine coating prior to recoating.

We are not aware of any sales of calcimine recoaters in California. We are only aware of one manufacturer of these coatings. This manufacturer stated that these products are unique to the New England area (California Products Corporation, 12/10/99).

Rationale for Not Including Product Category in the SCM:

A category for calcimine recoaters was added to the U.S. EPA's national architectural coatings rule, with a VOC limit for 475 g/l. However, we do not believe it is necessary to include this category in the proposed SCM. As mentioned above, these coatings are not generally used in California. Also, no district rules include a category with a higher VOC limit for calcimine recoaters. This indicates that these coatings are not used in California because they generally contain a VOC content of 450 to 465 g/l (USEPA, 8/98), and the VOC limit for flat coatings is 250 g/l or lower in California's district rules.

REFERENCES

California Products Corporation. Telephone conversation with ARB staff. December 10, 1999. (California Products Corporation, 12/10/99).

United States Environmental Protection Agency. National Volatile Organic Compound Emission Standards for Architectural Coatings. 40 CFR Part 59, Subpart D, 63 FR 48848. September 11, 1998. (U.S. EPA, 9/11/98)

United States Environmental Protection Agency. "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards." EPA-453/R-98-006b. August 1998. (USEPA, 8/98)

3. Chalkboard Resurfacer Coatings

Product Category Description:

Chalkboard resurfacer coatings, as defined in the U.S. EPA's architectural coatings regulation, are products formulated and recommended for application to chalkboards to restore a suitable surface for writing with chalk (U.S. EPA, 9/11/98). Chalkboard resurfacers represent very low sales in California according to our Architectural Coatings Survey. The products reported in the survey are waterborne, with a sales-weighted average VOC content of 220 g/l.

Table VI-77
Chalkboard Refinisher Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast) (tons/day)
Solvent-Based	0	0	N/A	0
Water-Based	PD	PD	220	~0.00
Total	PD	PD	220	~0.00

***** Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
****** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected data.

Rationale for Not Including Product Category in the SCM:

Chalkboard resurfacers were provided with a separate category in the U.S. EPA's national architectural coatings regulation, with a 450 g/l VOC limit. However, in the ARB's SCM, we believe these coatings would generally be classified as industrial maintenance coatings with a 250 g/l VOC limit. This is because these products are generally for nonresidential use and are subjected to frequent heavy abrasion from writing with chalk and subsequent erasing. We believe the 250 g/l limit is appropriate because the sales-weighted average VOC content for these products as reported in the ARB's Architectural Coatings Survey is 220 g/l. There are no air pollution control agencies in California that provide a separate category with a higher VOC limit for these products in their rules.

REFERENCES

Air Resources Board. 1998 Architectural Coatings Survey Results. September, 1999. (ARB, 9/99)

United States Environmental Protection Agency. National Volatile Organic Compound Emission Standards for Architectural Coatings. 40 CFR Part 59, Subpart D, 63 FR 48848. September 11, 1998. (U.S. EPA, 9/11/98)

4. Concrete Curing and Sealing Compounds

Product Category Description:

Concrete curing and sealing compounds form a membrane, or a thin pliable layer of tissue, that covers the concrete surface to reduce the loss of water during the hardening process. They also seal old and new concrete to provide resistance against dirt, liquid, alkalis, acids, and ultraviolet light, while providing adhesion promotion qualities (U.S. SECG). This category includes three types of coatings: concrete curing, concrete sealing, and concrete curing and sealing compounds, which can provide both proper curing and long term protection.

Membrane curing compounds are the most common type of concrete curing compounds used for keeping moisture in the concrete to maintain satisfactory moisture content and temperature during curing, so that the concrete may develop the desired strength and hardness. These compounds are low in cost and can easily be brushed or sprayed on immediately after the concrete is laid without worrying about marring the surface (U.S. EPA BID).

Concrete sealing compounds provide a glossy film on concrete slabs to make them resistant to liquid and dirt impregnation. Sealing compounds are designed to keep moisture out of the concrete, especially in the first year when the concrete is curing and gaining strength. They also seal concrete against alkali, acid, ultraviolet light, and promote adhesion. Concrete curing and sealing compounds are used on buildings for long-term protection, aesthetics, and durability in addition to curing (U.S. EPA BID).

One coating company's product literature states that their acrylic copolymer emulsion blend cures concrete and provides a protective coating for interior and exterior concrete including terrazzo surfaces (marble or stone chips set in mortar), and has a VOC content of 325 g/l. The product also claims to provide a clear membrane for new or existing concrete, hardens new concrete by promoting a proper cure for increased abrasion resistance, and can be used on industrial floor slabs, parking garages, warehouses, walls and columns, interior and exterior concrete surfaces, passenger and freight terminals. The literature also states that the drying time of the product is less than one hour under laboratory conditions, 4-6 hours for foot traffic, and 6-10 hours for wheel traffic. (Euclid Chemical)

Rationale for Not Including Product Category in the SCM:

For almost 10 years, most of California's district rules have had a VOC limit of 350 g/l for the concrete curing compounds. Concrete curing and sealing compounds were included as a separate category in the U.S. EPA's national architectural coatings regulation, but it is not found in any state rules as a separate category. It was given a 700 g/l VOC limit in the national regulation. However, in the ARB's SCM, we believe these coatings are already covered under two architectural coating categories as: (1) concrete curing compounds with a 350 g/l VOC limit, or (2) waterproofing concrete/masonry sealers with a ~~250~~ 400 g/l VOC limit.

We believe these limits are appropriate as explained in the sections on concrete curing compounds (see section B, #2 Concrete Curing Compounds) and waterproofing sealers (see section A, ~~#28~~ 31 Waterproofing Concrete/Masonry Sealers). For example, the ARB's 1998 Architectural and Industrial Maintenance Coatings Survey, shows that the concrete curing compound category has a 95 percent compliance at the proposed 350 g/l level, and that this category is heavily dominated by water-based formulations. We also note that there are a number of water-based products on the market that advertise optimum protection for the curing and sealing of concrete (SealTight). ~~Additionally, the waterproofing sealer coatings category shows numerous complying products currently on the market at the proposed 250 g/l VOC limit.~~

Issues:

1. Issue: One company requested the National Rule limit of 700 g/l, because in warm, dry weather, compressive strength of concrete is considerably lower when a concrete curing compound (350 g/l VOC) is used, as compared to concrete prepared with a curing and sealing compounds (700 g/l VOC).

Response: Concrete curing compounds have had a VOC limit of 350 g/l in most district rules for almost 10 years. As explained in this section, there are a number of formulation technologies available that can meet the 350 g/l concrete curing compound limit while providing the needed curing and sealing of the concrete. Thus, staff does not think this category with a 700 g/l is warranted.

REFERENCES

Euclid Chemical Company. REZ-Seal VOX Product Literature from the Euclid Chemical Company's internet website. Http://www.euclidchemical.com. (Euclid Chemical)

United States Environmental Protection Agency. *Small Entity Compliance Guide*, National Volatile Organic Compound Emission Standards for Architectural Coatings. July 1999. (U.S. SECG)

United States Environmental Protection Agency (U.S. EPA). "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards," EPA-453/R-98-006b. August 1998. (U.S. EPA BID)

W. R. Meadows. SealTight Products Literature from W. R. Meadows' internet website. Http://www.wrmeadows.com. (SealTight)

5. <u>**Concrete Protective Coatings**</u>

<u>Product Category Description</u>:

Concrete protective coatings are products designed to protect concrete from spalling (fragment, flaking, or chipping) in freezing temperatures by protecting against water and chloride ion intrusion. Exposed concrete structures require protection from extreme weather conditions and salt spray that can break down concrete and deteriorate the structure. Water itself causes freeze/thaw damage and can be a dirt carrier, which can require expensive cleaning. In addition to water, substances dissolved in water, especially chloride compounds (from road salt) are more harmful than the freeze/thaw effects. Both chloride and sulfate ions carried by water chemically cause expansive forces that degrade rebar- and lime-containing construction materials. For example, the high alkalinity of new concrete protects steel rebars against corrosion, but as concrete ages, carbonation occurs, and the alkalinity of the concrete is lowered. Alkaline protection is lost and water-carrying chloride ions penetrate, causing steel to corrode. Coatings and sealers play an important role in extending the useful life of many structures by protection from these elements (PCI, 9/96).

These coatings are applied in a single coat, but produce a high-build layer over concrete, plaster, or other cement-like surfaces. They can be applied without a primer over form oils or uncured concrete. This category was included in the national survey under "high performance coatings." However, these coatings meet the definition of the waterproofing concrete/masonry sealers category in the SCM, which states, <u>"*a clear or pigmented film-forming coating that is labeled and formulated for sealing concrete and masonry to provide resistance against water, alkalis, acids, ultraviolet light, and staining.*"</u> ~~*"a coating labeled as and formulated for application to a porous substrate for the primary purpose of preventing the penetration of water."*~~

<u>Rationale for Not Including Product Category in the SCM</u>:

Concrete protective coatings were provided with a separate category in the U.S. EPA's national architectural coatings regulation, with ~~an 350~~ <u>a 400</u> g/l VOC limit. However, in the ARB's SCM, we believe these coatings are basically covered under the waterproofing concrete/masonry sealer coating category with a ~~250~~ <u>400</u> g/l proposed VOC limit.

As a regulated category, only Oregon and Kentucky have this category with a VOC limit of 400 g/l in both states. Since this category was added to the final National Rule after the ARB 1998 Architectural and Industrial Maintenance Coatings Survey was completed, no data was collected on this specific category. However as discussed previously our survey did include the waterproofing sealers category, and based on this survey data, literature searches, and testing results, ARB does not believe it is necessary to have a separate category for the concrete protective coatings because the waterproofing sealers coatings' formulations can provide the protection needed.

Issues:

1. Issue: One company requested a category for concrete protective coatings at 400 g/l, because the lower VOC products cannot penetrate form oil and release agent materials, provide the required adhesion, and provide long-term protection without requiring recoating.

Response: ~~Staff is aware of numerous waterproofing sealer products that meet the proposed VOC limit of 250 g/l (see A, #28 Waterproofing Sealers). In addition, we believe the lower VOC products will adhere well with proper surface preparation. As with all coatings, the surface needs to be properly prepared prior to application of a coating for optimal performance. Thus, ARB does not believe it is necessary to have a separate category for these coatings.~~ Since the release of the Draft Program EIR, the proposed VOC limit for the waterproofing concrete/masonry sealer category has been reestablished at 400 g/l (see A, #28 Waterproofing Concrete/Masonry Sealers). As stated above, we believe these coatings are basically covered under this category, and that it is not necessary to have a separate category for these coatings.

REFERENCES

Paint & Coatings Industry, "*Silicone, Waterborne Penetrating Sealers Protect Mineral-Based Construction Materials*," September 1996, Volume XII, Number 8. (PCI, 9/96)

United States Environmental Protection Agency. *Small Entity Compliance Guide*, National Volatile Organic Compound Emission Standards for Architectural Coatings. July 1999. (U.S. EPA SECG)

United States Environmental Protection Agency (U.S. EPA). "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards," EPA-453/R-98-006b. August 1998. (U.S. EPA BID)

6. Concrete Surface Retarder Coatings

Product Category Description:

Concrete surface retarders are products designed to alter concrete hydration of freshly poured concrete. They are used to prolong the set time of the concrete, which allows for easy removal of the retarded mortar with a stiff brush and flushing with water to expose the aggregate. This produces an attractive exposed finish. At the job site, concrete surface retarders are used in the production of exposed aggregate finishes, to prevent hardening at a desired surface depth by altering the cement's hydration (U.S. EPA BID).

The liquid retarding ingredients include extender pigments, resin, and solvent that chemically interact with the concrete to prevent hardening where the retarder is applied on the surface (U.S. EPA SECG). Typically, concrete surface retarders are given 14-72 hours to affect the concrete system, after which time the non-hardened cement surface and the retarding liquid is either sacrificially brushed, blown, or washed away to give an architecturally pleasing surface of expose aggregate.

In addition to the liquid concrete surface retarders, some products consist of non-toxic, coated paper. The retarder paper produces the same altering affect for the concrete system as the liquid products. The paper requires no disposal problem or formwork clean-up, and is heat and abrasion resistant. Retarder paper can be used for patio slabs or architectural panels. The use of these paper products can be one-quarter of the cost of liquid retarders, and are available in varying strengths for a variety of aggregate sizes (Benton-Chemie).

Rationale for Not Including Product Category in the SCM:

This category is included in the U.S. EPA's architectural coatings national rule, with a VOC limit of 780 g/l. New Jersey and Texas do not regulate surface retarders because they do not believe they meet the definition of a coating. After investigating these products, ARB also concluded that they do not meet the definition of a coating. As noted above, these products are sacrificed by brushing or washing away, after they have affected the concrete system and do not create a hardened film. They are used only in the process of creating an exposed aggregate finish and are not part of the finished product.

Issues:

1. Issue: ARB received no comments on this category.

REFERENCES

Benton-Chemie, USA, Corporation. Retarder Paper Literature from Benton-Chemie's internet webiste. Http://www.betonchemieusa.com/RETARD.HTML. (Benton-Chemie)

United States Environmental Protection Agency. *Small Entity Compliance Guide*, National Volatile Organic Compound Emission Standards for Architectural Coatings. July 1999. (U.S. EPA SECG)

United States Environmental Protection Agency (U.S. EPA). "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards," EPA-453/R-98-006b. August 1998. (U.S. EPA BID)

7. Conversion Varnish Coatings

Product Category Description:

Conversion varnish, as defined in the U.S. EPA's architectural coatings regulation, is a clear, acid curing coating with an alkyd or other resin blended with amino resins and supplied as a single component or two-component product. The film formation is the result of an acid-catalyzed condensation reaction, affecting a transetherification at the reactive ethers of the amino resins (U.S. EPA, 9/11/98). These coatings are often referred to as "swedish finishes" and reportedly range in VOC content from 535 to 725 g/l (EPA, 8/98). These coatings are typically used for professional application to wood flooring.

Sales and emissions information for conversion varnishes is not available since the ARB's Architectural Coatings Survey did not include a separate category for these products.

Rationale for Not Including Product Category in the SCM:

Conversion varnishes were provided with a separate category in the U.S. EPA's national architectural coatings regulation, with a 725 g/l VOC limit. However, in the ARB's SCM, these coatings would be classified as varnishes with a 350 g/l VOC limit. We believe the 350 g/l VOC limit is appropriate because durable clear varnishes suitable for wood flooring are available at or below 350 grams VOC per liter. According to the ARB's Architectural Coatings Survey, nearly half of the clear varnish category is currently at or below the 350 g/l VOC level. Many of these products are suitable for wood flooring applications (Benjamin Moore, 1/6/00; Kelly-Moore, 12/97; Valspar, 1/6/00). There are no air pollution control agencies in California that provide a separate category with a higher VOC limit for conversion varnishes in their architectural coatings rules.

REFERENCES

Benjamin Moore & Company. Telephone conversation with ARB staff. January 6, 2000. (Benjamin Moore, 1/6/00).

Kelly-Moore Paint Company. Product Information Sheet for 2090 Series – Kel-Thane II. December, 1997. (Kelly-Moore, 12/97)

United States Environmental Protection Agency. "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards." EPA-453/R-98-006b. August 1998. (USEPA, 8/98)

United States Environmental Protection Agency. National Volatile Organic Compound Emission Standards for Architectural Coatings. 40 CFR Part 59, Subpart D, 63 FR 48848. September 11, 1998. (U.S. EPA, 9/11/98)

Valspar Corporation. Telephone Conversation with ARB staff. January 6, 2000. (Valspar, 1/6/00)

8. Extreme High Durability Coatings

Product Category Description:

Extreme high durability coatings, as defined in the U.S. EPA's national architectural coatings regulation, are air-dried coatings, including fluoropolymer-based coatings, that are formulated and recommended for touch-up of precoated architectural aluminum extrusions and panels (U.S. EPA, 9/11/98). These coatings must meet the weathering requirements of the American Architectural Manufacturer's Association (AAMA) specification 605-98, Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels, Section 7.9. Section 7.9 establishes performance standards for color retention, chalk resistance, gloss retention, and resistance to erosion, for test panels subjected to Florida exposure for five years. Factory applied finishes to architectural aluminum extrusions and panels are often designed to meet all the performance standards of AAMA specification 605-98 (which has now been superceded by more stringent performance standards in AAMA 2605-98).

Follow up conversations with the manufacturers that reported extreme high durability coatings in the ARB's Architectural Coatings Survey revealed that all the products reported in the category were miscategorized (Spraylat, 12/9/99; Conco Paint, 12/9/99; Futura, 1/6/00), and would generally fall under the industrial maintenance category. In addition, the only known manufacturer of these products did not report any sales in California.

Rationale for Not Including Product Category in the SCM:

Extreme high durability coatings were provided with a separate category in the U.S. EPA's national architectural coatings regulation, with an 800 g/l VOC limit. Under the proposed SCM, these products would generally be classified as industrial maintenance coatings with a 250 gram/liter VOC limit. We believe this is appropriate because extreme high durability coatings are designed for "exterior exposure of metal structures and structural components," one of the criteria that qualify a coating as an industrial maintenance coating. We believe high performance industrial maintenance coatings meeting the proposed 250 g/l VOC limit can be used for architectural aluminum applications. ~~If extreme high durability coatings were to be sold for residential uses, they would generally be subject to the nonflat coatings limit with a 150 gram/liter VOC limit. However, we believe the high cost of these products (approximately $280/gallon – K&L, 12/9/99) makes them unlikely for residential uses.~~ As mentioned above, we do not believe these products are currently sold in California. We also note that since these products are designed for touch-up, the exempt one liter or smaller containers would probably be used. There are no air pollution control agencies in California that provide a separate category with a higher VOC limit for these products in their architectural coatings rules.

REFERENCES

Conco Paint. Telephone conversations with ARB staff. December 9, 1999 (Conco Paint, 12/9/99).

Futura Coatings. Telephone conversation with ARB staff. January 6, 2000. (Futura, 1/6/00)

Keeler and Long. Telephone conversation with ARB staff. December 9, 1999. (K&L, 12/9/99)

Spraylat Corporation. Telephone conversation with ARB staff. December 9, 1999. (Spraylat, 12/9/99).

United States Environmental Protection Agency. National Volatile Organic Compound Emission Standards for Architectural Coatings. 40 CFR Part 59, Subpart D, 63 FR 48848. September 11, 1998. (U.S. EPA, 9/11/98)

9. Heat Reactive Coatings

Product Category Description:

As defined in the U.S. EPA's architectural coatings regulation, heat reactive coatings are high performance phenolic-based coatings requiring a minimum temperature of 191°C (375°F) to 204°C (400°F) to obtain complete polymerization or cure (U.S. EPA, 9/11/98). These coatings are formulated and recommended for commercial and industrial use to protect substrates from degradation and maintain product purity in which one or more of the following extreme conditions exist:

1) continuous or repeated immersion exposure of 90 to 98 percent sulfuric acid, or oleum;
2) continuous or repeated immersion exposure to strong organic solvents;
3) continuous or repeated immersion exposure to petroleum processing at high temperatures and pressures; and
4) continuous or repeated immersion exposure to food or pharmaceutical products which may or may not require high temperature sterilization.

As shown in Table VI-78, the heat reactive coatings reported in the ARB's Architectural Coatings Survey are solvent-based products with a sales weighted average VOC content of 378 grams VOC per liter of coating.

Table VI-78
Heat Reactive Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast) (tons/day)
Solvent-Based	PD	PD	378	~0.00
Water-Based	0	0	N/A	N/A
Total	PD	PD	378	~0.00

* Based on ARB's 1998 Architectural and Industrial Maintenance Coatings Survey (ARB, 9/99).
** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected data.

Rationale for Not Including Product Category in the SCM:

In the U.S. Environmental Protection Agency's national Architectural and Industrial Maintenance Rule, heat reactive coatings are regulated as a separate category with a 420 g/l VOC limit. However, we do not believe it is necessary to include a separate category for these products in the ARB's SCM. These products are not generally applied in the field to stationary structures (Heresite). These products are designed to be cured at 375 to 400°F as stated in the definition. This generally means that metal products are coated and baked in an oven in original equipment manufacturing applications. As such, these coatings would generally be subject to district miscellaneous metal parts rules rather than architectural coatings rules. We also note that industrial maintenance coatings meeting the 250 g/l VOC limit are available for chemical storage tanks and other applications where chemical resistance is needed. No district architectural coatings rules include a separate category with a higher limit for these coatings.

REFERENCES

Air Resources Board. 1998 Architectural Coatings Survey Results. September, 1999. (ARB, 9/99)

Heresite Protective Coatings, Incorporated. Telephone conversations with ARB staff. December 9, 1999. (Heresite)

United States Environmental Protection Agency. National Volatile Organic Compound Emission Standards for Architectural Coatings. 40 CFR Part 59, Subpart D, 63 FR 48848. September 11, 1998. (U.S. EPA, 9/11/98)

10. Impacted Immersion Coatings

Product Category Description:

Impacted immersion coatings are high-performance industrial maintenance products designed to be applied to steel structures subject to immersion in turbulent, debris-laden water. The impacted immersion coatings are specifically resistant to high-energy impact damage caused by floating ice or debris (U.S. EPA SECG). They are typically used in industrial, commercial, or institutional settings for use on immersed parts of bridges, dams, locks, oil rig stations, and power plants.

Rationale for Not Including Product Category in the SCM:

This category was included in the U.S. EPA's National Architectural and Industrial Maintenance Rule with a VOC limit of 450 g/l. Impacted immersion coatings are regulated under the ARB's SCM as industrial maintenance coatings because they are immersed in water, wastewater, or chemical solutions. Impacted immersion coatings were not included as a separate category in the ARB 1998 Architectural and Industrial Maintenance Coatings Survey; therefore, no data was collected on this category.

We do not believe a separate category is necessary because they can be reformulated to the 250 g/l limit using the technology for other industrial maintenance coatings. Our research has shown that some current solvent-free epoxies offer excellent surface wetting and penetration, characteristics that make them ideal for maintenance of pitted steel and eroded concrete (JPLC, 11/99).

Issues:

1. Issue: ARB did not receive any comments on the impacted immersion coatings. There are no known unresolved issues with this category

REFERENCES

Journal of Protective Coatings & Linings, "*Epoxy Systems for Power Station Conduits, Penstocks, and Cooling Water Intakes*," November 1999, Volume 16, Number 11. (JPLC, 11/99)

United States Environmental Protection Agency. *Small Entity Compliance Guide*, National Volatile Organic Compound Emission Standards for Architectural Coatings. July 1999. (U.S. EPA SECG)

United States Environmental Protection Agency (U.S. EPA), "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards," EPA-453/R-98-006b, August 1998. (U.S. EPA BID)

11. Nonferrous Ornamental Lacquer Coatings

Product Category Description:

Nonferrous ornamental metal lacquers and surface protectant (or "nonferrous ornamental lacquers"), as defined in the U.S. EPA's architectural coatings regulation, are clear coatings formulated and recommended for application to ornamental architectural metal substrates (bronze, stainless steel, copper, brass, and anodized aluminum) to prevent oxidation, corrosion, and surface degradation. (U.S. EPA, 9/11/98)

Sales and emissions information for nonferrous ornamental lacquers is not available since the ARB's Architectural Coatings Survey did not include a separate category for these products.

Rationale for Not Including Product Category in the SCM:

Nonferrous ornamental lacquers were provided with a separate category in the U.S. EPA's national architectural coatings regulation, with an 870 g/l VOC limit. However, in the ARB's SCM, we believe these coatings would generally be classified as ~~either: (1)~~ rust preventive coatings with a 400 g/l VOC limit~~, if they are for residential use; or (2) industrial maintenance coatings with a 250 g/l VOC limit, if they are for nonresidential use~~. Due to the extremely high VOC limit established for these products, it is unlikely that they are used in areas of California subject to architectural coatings rules (except under the small size container exemption). There are no air pollution control agencies in California that provide a separate category with a higher VOC limit for these products in their architectural coatings rules.

REFERENCES

United States Environmental Protection Agency. National Volatile Organic Compound Emission Standards for Architectural Coatings. 40 CFR Part 59, Subpart D, 63 FR 48848. September 11, 1998. (U.S. EPA, 9/11/98)

12. Nuclear Coatings

Product Category Description:

Nuclear coatings, as defined in the U.S. EPA's architectural coatings regulation, are protective coatings formulated and recommended to seal porous surfaces such as steel (or concrete) that otherwise would be subject to intrusion by radioactive materials (U.S. EPA, 9/11/98). These coatings must be resistant to long-term (service life) cumulative radiation (per ASTM Method D 4082-89), relatively easy to decontaminate, and resistant to various chemicals to which the coatings are likely to be exposed (per ASTM Method D 3912-80). Nuclear coatings as defined can be used in both Level I (containment) and Level II (noncontainment) areas.

ASTM Method D 4082-89, Standard Test Method for Effects of Gamma Radiation on Coatings for Use in Light-Water Nuclear Power Plants, is designed to provide a uniform test to assess the suitability of coatings, used in nuclear power facilities, under continuous readiation exposure for the projected 40-year lifetime of the facilities, including radiation during a DBA (design basis accident). The test method specifies procedures for exposing sample coatings applied to steel panels and concrete blocks to gamma radiation under specified conditions, and then checking for various coating defects.

ASTM Method D 3912-80 (Reapproved 1989), Standard Test Method for Chemical Resistance of Coatings Used in Light-Water Nuclear Power Plants, is designed to measure the chemical resistance of coatings used in light-water nuclear power plants. The test method specifies procedures for immersing sample coatings applied to steel panels and concrete blocks in various test solutions commonly used in nuclear power facilities.

There are two nuclear power facilities operating in California that utilize nuclear coatings in maintenance and repair operations: (1) the Diablo Canyon site near Avila Beach (San Luis Obispo County), and (2) the San Onofre site near San Clemente (San Diego County). The Diablo Canyon site is operated by the Pacific Gas and Electric Company, and the San Onofre site is operated by the Southern California Edison Company and San Diego Gas and Electric Company.

As shown in the table below, the nuclear coatings that reported in the ARB's Architectural Coatings Survey include both solvent-borne and water-borne coatings. According to the ARB's Architectural Coatings Survey, about 700 gallons of nuclear coatings were sold in 1996, resulting in VOC emissions of less than one ton per year.

Table VI-80
Nuclear Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast) (tons/day)
Solvent-Based	PD	PD	248	~0.00
Water-Based	PD	PD	46	~0.00
Total	4	697	50	~0.00

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
****** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected data.

<u>Rationale for Not Including Product Category in the SCM</u>:

In the U.S. Environmental Protection Agency's national Architectural and Industrial Maintenance Rule, nuclear coatings are regulated as a separate category with a 450 g/l VOC limit. U.S. EPA based this limit on the 400 g/l limit for nuclear coatings in the shipbuilding and ship repair national emission standards for hazardous air pollutants (which includes a thinning exemption for coatings applied in cold weather). However, in the ARB's SCM, nuclear coatings would generally be classified as industrial maintenance coatings with a 250 g/l VOC limit.

We do not believe it is necessary to create a separate category with a higher VOC limit for nuclear coatings because there are currently products available that comply with the proposed 250 g/l limit in the SCM. The complying products include primers and surfacers (Carboline 893; K&L Nos. 6129 and 6548-S) and topcoats (Carboline 890; K&L Nos. 4500, 5000, and 9600 N). The complying products include products for both concrete (Carboline 890 and 893; K&L 6548-S, 4500, 5000 – floors only, and 6129 – floors only) and steel (Carboline 890 and 893; and K&L 4500, 9600 N, and 5000 – floors only). Discussions with personnel at California's nuclear power facilities indicate that the nuclear coatings they use are below 250 g/l (Southern California Edison, 1/6/00), or that they primarily use low VOC products and can use exempt quart for the occasions when a product above 250 g/l may be needed (Pacific Gas and Electricity, 1/13/00). We also note that the sales-weighted average VOC content of these coatings, as reported in the ARB's Architectural Coatings Survey is 50 g/l. No districts currently include a separate category with a higher VOC limit for nuclear coatings in their architectural coatings rules.

<u>Issues</u>:

1. Issue: We believe there is a need for nuclear coatings as defined in the National Rule. Our research shows that an average nuclear power plant will use up to 500 gallons per year on maintenance of Level 1 and Level 2 areas. The worst case would be if a plant completely repainted all these areas, which would require approximately 4,000 gallons per unit. This is an unusual occurrence and not normally expected through the life of the plant.

Response: Although the nuclear coatings category is not large, we do not believe a separate category with a higher VOC limit is necessary. As discussed above, we have identified several complying products that meet the 250 g/l VOC limit for industrial maintenance coatings.

2. **Issue:** Although the survey reveals that there are low VOC nuclear coatings, you can't assume that they can be used in all areas. Nuclear coatings for steel are not low VOC. The cost for getting a coating certified is enormous, and at those small volumes, there is no point in reformulating.

Response: As discussed above, nuclear coatings that are below the 250 gram/liter level are available for both concrete and steel, and California's nuclear power facilities are primarily purchasing these low VOC products. We realize that the volumes of nuclear coatings sold are not large and that some manufacturers will need to evaluate whether it is cost-effective to reformulate their products that are currently above 250 g/l. However, at least one manufacturer reported developing a low VOC nuclear coating in 1983 specifically for California due to VOC regulations (K&L, 12/7/99), indicating that it is not necessarily economically infeasible to invest in lower VOC nuclear formulations. We also note that if a manufacturer chooses not to reformulate certain higher VOC products, it is expected that customers will purchase more of the manufacturer's existing complying products, or more of a competitor's complying products, resulting in economic benefits to manufacturers offering these lower VOC products. Manufacturers may also choose to offer the product in the exempt smaller containers, for the few occasions where a California customer specifies a product above 250 g/l VOC.

REFERENCES

Air Resources Board. 1998 Architectural Coatings Survey Results. September, 1999. (ARB, 9/99)

Carboline Company. Product Data Sheets for Carboline 890 dated 1/29/99, and 893 dated 8/20/98. (Carboline 890 and 893)

Keeler and Long, Incorporated. Website http:// www.ppgaf.com/k&l/ssu/ssu1.htm. Printed 11/23/99. (K&L Nos. 4500, 5000, 9600 N, 6129 and 6548-S)

Keeler & Long, Incorporated. Telephone conversation with ARB staff. December 7, 1999. (K&L, 12/7/99)

Pacific Gas and Electricity. Telephone conversation with ARB staff. January 13, 2000. (Pacific Gas and Electricity, 1/13/00)

Southern California Edison. Electronic mail to ARB staff. January 6, 2000. (Southern California Edison, 1/6/00)

United States Environmental Protection Agency. National Volatile Organic Compound Emission Standards for Architectural Coatings. 40 CFR Part 59, Subpart D, 63 FR 48848. September 11, 1998. (U.S. EPA, 9/11/98)

13. Repair and Maintenance Thermoplastic Coatings

Product Category Description:

Repair and maintenance thermoplastic coatings, as defined in the U.S. EPA's architectural coatings regulation, are industrial maintenance coatings that have vinyl or chlorinated rubber as the primary resin and are recommended solely for the repair of existing vinyl or chlorinated rubber coatings without the full removal of the existing coating system (U.S. EPA, 9/11/98).

As shown in the table below, the repair and maintenance thermoplastic coatings reported in the ARB's Architectural Coatings Survey have a sales-weighted average VOC content of less than 1 gram VOC per liter. To protect the confidentiality of proprietary data, sales or other information cannot be provided for this category.

Table VI-77
Repair and Maintenance Thermoplastic Coatings*

	Number of Products	Category Sales (gallons/year)	Sales Weighted Average VOC (grams/liter)**	VOC Emissions (excluding South Coast) (tons/day)
Solvent-Based	PD	PD	<1	~0.00
Water-Based	PD	PD	159	~0.00
Total	PD	PD	<1	~0.00

* Based on ARB's 1998 Architectural Coatings Survey Results Final Report (ARB, 1999).
** Grams VOC per liter of coating, less water and exempt compounds.
PD = Protected data.

Rationale for Not Including Product Category in the SCM:

In the U.S. Environmental Protection Agency's national Architectural and Industrial Maintenance Rule, repair and maintenance thermoplastic coatings are regulated as a separate category with a 650 g/l VOC limit. However, in the ARB's SCM, these coatings would generally be classified as industrial maintenance coatings with a 250 gram/liter VOC limit. We do not believe it is necessary to create a separate category with a higher VOC limit for repair and maintenance thermoplastic coatings because the sales weighted average VOC content of the products reported in the ARB's survey indicate that current products are well below this VOC level. Only two manufacturers reported products in this category in the ARB's Architectural Coatings Survey. One manufacturer said that their products were actually for original equipment manufacturer (OEM) applications, not architectural coatings (Simpsons Coating Group). We also note that no district rules currently contain a separate category with a higher VOC limit for these products.

REFERENCES

Air Resources Board. 1998 Architectural Coatings Survey Results. September, 1999. (ARB, 9/99)

Simpsons Coating Group. Telephone conversation with ARB staff. December 15, 1999. (Simpsons Coating Group)

United States Environmental Protection Agency. National Volatile Organic Compound Emission Standards for Architectural Coatings. 40 CFR Part 59, Subpart D, 63 FR 48848. September 11, 1998. (U.S. EPA, 9/11/98)

14. Stain Controller Coatings

Product Category Description:

Stain controller coatings, as defined in the U.S. EPA's architectural coatings regulation, are conditioners or pretreament coatings formulated and recommended for application to wood prior to the application of a stain in order to prevent uneven penetration of the stain (U.S. EPA, 9/11/98). These products may be called wood conditioners, prestains, or washcoats. They are often recommended for soft woods such as pine, which are more likely to absorb stains unevenly.

Sales and emissions information for stain controllers is not available since the ARB's Architectural Coatings Survey did not include a separate category for these products. According to the one manufacturer, over 97 percent of the total sales for these coatings are exempt under the small container exemption (USEPA, 8/98).

Rationale for Not Including Product Category in the SCM:

Stain controllers were provided with a separate category in the U.S. EPA's national architectural coatings regulation, with an 720 g/l VOC limit. However, in the ARB's SCM, these coatings would generally be classified as low solids coatings with a VOC content limit of 120 g/l, *including water and exempt compounds.* We believe that this is appropriate because lower VOC water-based technology is available for these products. Several district architectural coatings and wood products coating rules in California specify a 120 g/l VOC limit for these products or related low-solids coatings. In addition, as mentioned above, these products are primarily sold in smaller, exempt containers. Finally, no district architectural coatings rule in California contains a separate category with a higher VOC limit for these products.

Issues:

1. Issue: This category was included in an early draft rule submitted by NPCA for Reg-Neg. It is a low-volume, specialty niche coating that it is not cost-effective to reformulate. These coatings would have to be very low solids to accept stain, but the use of water as a solvent would raise the grain of wood. It was added to the final version of the National Rule. The National Rule limit is 720 g/l.

Response: We do not believe it is necessary to provide a separate category with a 720 g/l VOC limit for these products. These products are currently complying with the 120 g/l VOC limit for low solids coatings in many areas of California, or they are only sold in small containers. Water-based formulations may require some sanding after application in cases were grain raising occurs, or a solvent-based product sold in one liter or smaller container sizes may be used. However, we note that some solvent-based products also recommend sanding after application (Benjamin Moore).

REFERENCES

Benjamin Moore and Company. Product Information Sheet for Benwood Wood Conditioner 236. September, 1999.

United States Environmental Protection Agency (U.S. EPA), "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards," EPA-453/R-98-006b, August 1998.

United States Environmental Protection Agency. National Volatile Organic Compound Emission Standards for Architectural Coatings. 40 CFR Part 59, Subpart D, 63 FR 48848. September 11, 1998. (U.S. EPA, 9/11/98)

15. <u>Thermoplastic Rubber Coatings and Mastics</u>

Product Category Description:

Thermoplastic rubber coatings and mastics ("thermoplastic rubber coatings"), as defined in the U.S. EPA's architectural coatings regulation, are products formulated and recommended for application to roofing or other structural surfaces and that incorporate no less than 40 percent by weight of thermoplastic rubbers in the total resin solids, and may also contain other ingredients including, but not limited to, fillers, pigments, and modifying resins (U.S. EPA, 9/11/98).

Follow up conversations with the manufacturers that reported thermoplastic rubber coatings in the ARB's Architectural Coatings Survey revealed that all the products reported in the category were miscategorized (Fine Line Paint, 1/12/00). The only known manufacturers of these products do not currently sell them in California.

Rationale for Not Including Product Category in the SCM:

Thermoplastic rubber coatings were provided with a separate category in the U.S. EPA's national architectural coatings regulation, with a 550 g/l VOC limit. However, in the ARB's SCM, these coatings would generally be classified as roof coatings with 250 g/l VOC limit. We believe that this is appropriate because lower VOC elastomeric latex or bituminous roof coatings, described elsewhere in this Chapter, are available that provide the same basic function. We also note that these products are not currently being sold in California. Finally, no district architectural coatings rule in California contains a separate category with a higher VOC limit for these products.

Issues:

1. Issue: A category with a 550 g/l VOC content limit should be provided for thermoplastic rubber and mastic coatings, as recognized in the national AIM rule. Alternatively, we suggest the expansion of the metallic pigmented coating category to also include highly reflective coating.

Response: We do not believe it is necessary to create a separate category with a higher VOC limit for these products because currently used bituminous and latex roofing products are available at less than half the VOC content of a 550 g/l thermoplastic rubber material. We also do not believe it is appropriate to modify the metallic pigmented coating category to include products that contain no metal.

2. Issue: Our thermoplastic rubber products are more durable, and result in less emissions over time than comparable bituminous roof products.

Response: We have no data to substantiate that thermoplastic rubber roofing products outlast their bituminous counterparts. We also note that latex roofing products are available.

3. **Issue:** Our thermoplastic rubber products work in situations where water-based or bituminous products fail. For example, they adhere well to single-ply membranes and adhere well when exposed to ponding water.

Response: We have no data to substantiate these performance claims. Also, since thermoplastic rubber products are not used in California, we assume that other roofing products can be used to address these situations.

REFERENCES

Fine Line Paint. Telephone conversation with ARB staff. January 12, 2000.
(Fine Line Paint, 1/12/00)

United States Environmental Protection Agency. National Volatile Organic Compound Emission Standards for Architectural Coatings. 40 CFR Part 59, Subpart D, 63 FR 48848. September 11, 1998. (U.S. EPA, 9/11/98)

16. Zone Marking Coatings

Product Category Description:

Zone marking coatings are products designed for use for marking and stripping driveways, parking lots, sidewalks, curbs, airport runways, or other traffic surfaces. The U.S. EPA established the zone marking coatings as a separate category from the traffic marking coatings. Under the U.S. EPA definition, the zone marking products have a size restriction requiring the product category to be sold or distributed in five gallon containers or smaller. Since the zone marking coatings have a higher VOC limit that traffic marking coatings, the restriction in size was established to discourage the use of these coatings in large-scale applications, such as those for general traffic markings intended for public roads and highways. (U.S. EPA SECG)

Rationale for Not Including Product Category in the SCM:

Zone marking coatings are included in U.S. EPA's architectural coatings national rule, with a 450 g/l VOC limit. However, this category does not appear in any state rules. Zone marking coatings are regulated under the ARB's SCM as traffic marking coatings, which the SCM defines as, "*a coating formulated and recommended for marking and striping street, highways, or other traffic surfaces including, but not limited to, curbs, berms, driveways, parking lots, sidewalks, and airport runways.*" We do not believe a separate category is necessary because these coatings can be reformulated to the 150 g/l limit using the technology for traffic marking coatings. Zone marking coatings were not included in the ARB 1998 Architectural and Industrial Maintenance Coatings Survey; therefore, no data was collected on this category. However, ARB did request data on the traffic marking coating category, which includes the zone marking coatings by definition.

The ARB 1998 survey data for traffic coatings was based on information submitted by 30 manufacturers covering 189 different products. These products included water-based, solventborne, and 100 percent solid formulations. The survey indicated that the 1990 sales for water-based formulations (for traffic coating products) to be over a million gallons, with an average VOC content of 121 g/l, well below the proposed limit. This indicates a 53 percent complying marketshare for traffic marking coatings at the proposed 150 g/l VOC level.

Although no single traffic marking material is the most desirable in all applications, a combination of low- and zero-VOC-emitting marking materials can provide the performance necessary for highway safety. Water-based zone marking paints are available and the durability is comparable with that of other solventborne marking paints. One traffic line and marking product's literature states that it has a 45 g/l VOC content (Kelly-Moore). It also describes the product as durable, abrasion resistant flat acrylic finish for marking lanes, parking lots, industrial road traffic lanes, curbs, or areas on concrete or asphalt surfaces. Other typical low-VOC traffic marking coatings that meet the 150 g/l limit include coatings formulated as acetone-based solventborne coatings, epoxies, thermoplastics, permanent markers, and polyester tapes (U.S. EPA BID). In addition, the overall annualized costs of using water-based and zero-VOC coatings are lower than their solventborne counterparts. Compliant traffic coatings are commercially available and are being used by local governments, and Cal Trans, as well as professional contractors at all levels (U.S. EPA BID). In addition, various tests by national government agencies have concluded that once dry, water-based coatings are at least equally durable as solventborne coatings (MPC, 1995).

Issues:

1. Issue: ARB did not receive any comments on this category. There are no known unresolved issues with this category.

REFERENCES

Goff, Alex. Modern Paint and Coatings. "Traffic Coatings Anticipate EPA Regulations." July 1995. (MPC, 1995)

Kelly-Moore Paint Company. Product Literature for 1450-Latex Traffic Line and Marking Paint.

United States Environmental Protection Agency. *Small Entity Compliance Guide*, National Volatile Organic Compound Emission Standards for Architectural Coatings. July 1999. (U.S. EPA SECG)

United States Environmental Protection Agency (U.S. EPA). "National Volatile Organic Compound Emission Standards for Architectural Coatings – Background for Promulgated Standards," EPA-453/R-98-006b. August 1998. (U.S. EPA BID)

VII.

ENVIRONMENTAL IMPACTS

A. SUMMARY OF ENVIRONMENTAL IMPACTS

Both the California Environmental Quality Act (CEQA) and ARB policy require the ARB to evaluate the potential adverse environmental impacts of proposed projects. For the proposed architectural coatings SCM, we prepared a formal environmental impact report (EIR)(ARB, 2000). The EIR includes an analysis of environmental impacts that could potentially result from the implementation throughout California (excluding the South Coast Air Quality Management District (South Coast AQMD)) of architectural coatings rules based on the proposed SCM. The South Coast AQMD has already adopted the same or more stringent limits for most of the categories in the proposed SCM in its architectural coatings rule. Staff investigated in detail the potential for environmental impacts in six main areas: air quality; water demand and quality; public services; transportation and circulation; solid and hazardous waste; and health hazards. The analysis concluded that implementing the proposed SCM would have no significant adverse impacts in any of those areas, but would have a net air quality benefit. The findings of the EIR are summarized in more detail below.

Air Quality Impacts

The adoption and implementation of the proposed SCM on a statewide basis (excluding the South Coast AQMD) is expected to produce substantial, long-term, VOC emission reductions. VOCs are regulated because they contribute to the formation of both ozone and PM_{10}. Numerous VOCs have also been identified as toxic air contaminants and are regulated through the ARB's Toxic Air Contaminant Control Program. Implementation of the proposed VOC content limits in the SCM will result in VOC emission reductions of approximately 10 tons per day statewide (excluding the South Coast AQMD) beginning in 2003, a net air quality benefit.

Some companies in the architectural coatings industry have claimed that lowering the VOC content of coatings results in increased VOC emissions for a variety of reasons: increased coating thickness; more thinning; more topcoats; more touch-ups; more priming; more frequent recoating; more substitution with higher VOC coatings; and greater reactivity. Basically, these companies claim that new formulations result in more coating use, resulting in an overall increase in VOC emissions for a specific area covered, or over time. Industry also asserts that more reactive solvents will be used in compliant formulations than those used in existing coatings, thus contributing to increased ozone formation. All of these assertions were analyzed in depth in the EIR. The analysis reveals that overall, the SCM will achieve significant VOC emission reductions and that the claimed adverse impacts will not occur.

Another claim made by some companies is that increased application of acetone-based coatings has the potential to increase objectionable odors. However, acetone used as a replacement for other traditional solvents may have fewer odor impacts because it has a higher odor threshold than many other solvents currently used in coatings. Given that the SCM allows sufficient time for manufacturers to develop compliant coatings and solve any odor problems associated with reformulated coatings, no significant adverse odor impacts are expected from lowering the VOC content limits.

Impacts on Water Resources

Impacts on water resources are divided into two categories – water demand and water quality. The potential for increased water demand from the manufacturing and use of compliant water-based coatings was evaluated in the EIR. The analysis concluded that water demand impacts associated with the SCM will be insignificant. The analysis revealed that while there is insufficient capacity in some hydrologic regions of California to meet current and projected water demand, the increased water demand associated with implementation of the SCM is *de minimis*. Furthermore, the various water providers throughout the State are currently exploring various strategies for increasing water supplies and maximizing the use of existing supplies. Options include storage of water from existing sources, use or storage of water unused by other states or agricultural agencies, and advance delivery of water to irrigation districts.

The SCM is also not expected to adversely impact water quality. First, use of exempt solvents (solvents not considered to be VOCs, such as acetone and Oxsol 100) is expected to result in equivalent or fewer water quality impacts than currently used solvents (such as toluene, xylenes, mineral spirits, and methyl ethyl ketone), since the exempt solvents are less toxic. Second, because currently available compliant coatings are already using water-based technology, no additional water quality impacts from future compliant water-based coatings are expected. The current manufacturing and clean-up practices associated with water-based coatings are not expected to change as a result of the SCM. Lastly, the SCM is not expected to promote the use of compliant coatings formulated with hazardous solvents that could create adverse water quality impacts.

Impacts on Public Services

The EIR examined the potential for increased maintenance at public facilities due to implementing the SCM. Infrastructure needs at public facilities are not expected to be impacted due to more frequent touchups to maintain facility appearance, equipment, or safety. Implementation of the SCM is also not expected to result in the need for new or altered public facilities.

The increased use of exempt solvents or other replacement solvents as a result of implementing the SCM will not result in any significant increased need for fire protection. Although acetone, which is flammable, is expected to be used to reformulate a limited number of coatings (e.g., lacquers), it is unlikely that implementation of the SCM will substantially increase the future use of acetone throughout California. Many conventional solvents are as flammable as acetone, so there would be no net change or possibly a reduction in the hazard consequences from replacing some conventional solvents with acetone. Furthermore, future compliant coatings materials are expected to be less hazardous than some currently used materials, so accidental releases would be expected to pose a lower risk to responding firefighters.

Impacts on Transportation/Circulation

The potential additional vehicle trips caused by the increased disposal of compliant coatings due to the possibility of shorter shelf or pot lives or lesser freeze-thaw capabilities were evaluated in the EIR. The analysis concluded that transportation/circulation impacts associated with the SCM will be insignificant.

Impacts on Solid Waste/Hazardous Waste

The solid waste/hazardous waste analysis examined increased disposal of compliant coatings due to the possibility of shorter shelf or pot lives or lesser freeze-thaw capabilities. The analysis concluded that solid waste/hazardous waste impacts associated with the SCM will be insignificant.

Hazards

Any increase in accidental releases of future compliant coatings materials would be expected to result in a concurrent reduction in the number of accidental releases of existing coatings materials. Further, it is anticipated that resin manufacturers and coatings formulators will continue the trend of using less hazardous solvents such as Texanol, Oxsol 100, and propylene glycol in their compliant coatings. It is expected that future compliant coatings will contain less hazardous materials, or nonhazardous materials, as compared to conventional coatings, resulting in a net benefit. Therefore, hazard impacts associated with the proposed SCM will be insignificant.

The human health impacts analysis examined the potential increased long-term (carcinogenic and chronic) and short-term (acute) human health impacts associated with the use of various replacement solvents in compliant coating formulations. The analysis concluded that the general public would not be exposed to long-term health risks due to the application of compliant coatings. Furthermore, long-term exposures of professional coating applicators to more toxic replacement solvents such as diisocyanates are reduced by following the coatings manufacturers', Occupational Safety and Health Administration's (OSHA), and American Conference of Governmental Industrial Hygienists' (ACGIH) required and recommended safety procedures. Additionally, many resin manufacturers and coating formulators are replacing more toxic solvents such as monomeric diisocyanates, ethylene glycol monobutyl ether, etc., with less toxic solvents such as polymeric diisocyanates, Texanol, and propylene glycol, further reducing the long-term human health risks from the use of compliant coatings.

Staff also evaluated the use of low- or zero-VOC, two-component, industrial maintenance (IM) systems containing diisocyanate compounds. Based on actual field monitoring data and the chemistry of the two-component systems, staff has determined their use would not expose the public at large to significant acute human health impacts. Test data show that the concentrations of diisocyanate compounds emitted during the application of these IM systems are below established health protective thresholds. For acute exposure to applicators, the use of the same safety procedures to reduce long-term health effects will also reduce short-term health effects associated with the use of replacement solvents. Although toluene diisocyanate (TDI), which is classified as a carcinogen, could be used in low-VOC, two-component IM coatings, adverse impacts are not expected because application of IM coatings occurs primarily in industrial settings where sufficient safety equipment and procedures are in place to prevent significant exposures. Also, the application of these coating systems will be for maintenance (touch-up and repair) or repaint purposes, lasting only a few days to weeks, and occurring on an intermittent basis (once every two years to every 10 years or more). Based on these intermittent exposures, increased cancer risks are negligible. Furthermore, the coatings industry is moving away from using TDI to using noncarcinogens such as hexamethylene diisocyanate (HDI) and methylene bisphenyl diisocyanate (MDI) to formulate low-VOC, two-component coatings.

Lastly, staff evaluated the potential for exposure to crystalline silica as a result of increased sandblasting of surfaces prior to application of low-VOC coatings. Implementation of the SCM is not anticipated to result in the need for increased sandblasting or other surface preparation techniques. Moreover, State law restricts outdoor abrasive blasting throughout California. Under title 17, CCR, abrasive blasting may not be performed outdoors unless specified techniques and/or materials are used. Those techniques and materials minimize the emission of fine particulate matter from blasting operations, and thus minimize public exposure to inhalable particles.

The EIR concluded that the general public as well as coating applicators will not be exposed to significant long-term or short-term human health risks as a result of implementation of the SCM.

<u>Other Environmental Impacts</u>

ARB staff has reaffirmed that there will be no significant impacts to the following environmental resources in California as a result of implementing the SCM:

- Land Use and Planning
- Population and Housing
- Geophysical
- Biological Resources
- Energy and Mineral Resources
- Noise
- Aesthetics
- Cultural Resources
- Recreation

CEQA requires Program EIRs to address the potential for irreversible environmental changes, growth-inducing impacts, and inconsistencies with regional plans. Consistent with CEQA, additional analysis of the proposed project confirms that it will not result in irreversible environmental changes or the irretrievable commitment of resources, foster economic or population growth or the construction of new housing, or overall be inconsistent with regional plans.

REFERENCES

Air Resources Board (ARB). “Final Program Environmental Impact Report – Suggested Control Measure for Architectural Coatings.” May 2000 (ARB, 2000).

VIII.

ECONOMIC IMPACTS

A. INTRODUCTION

Elements of the Analysis

This chapter discusses the economic impacts we anticipate from implementation of the proposed limits. In general, economic impact analyses are inherently imprecise by nature, especially given the unpredictable behavior of companies in a highly competitive market. While we quantified the economic impacts to the extent feasible, some projections are necessarily qualitative or semi-quantitative and based on general observations about the architectural and industrial maintenance (AIM) coatings industry. This impacts analysis, therefore, serves to provide a general picture of the economic impacts that typical businesses subject to the proposed limits might encounter; we recognize that individual companies may experience impacts different than those projected in this analysis.

The overall projected impacts are summarized first, followed by a more detailed discussion of specific aspects of the economic impacts in the sections listed below:

(B) Annual Costs and the Cost-Effectiveness of the Proposed Limits;
(C) Economic Impacts on California Businesses;
(D) Potential Impacts on California State or Local Agencies;
(E) Potential Impacts on California Consumers; and
(F) Mitigation of Potential Impacts through Additional Regulatory Flexibility.

It is important to note that we conducted the economic impacts analysis despite the fact that the analysis is not required under the California Administrative Procedure Act (APA) for suggested control measures such as the staff's proposal. The analysis uses methodologies and assumptions similar to those used to support adoption of the 1999 SCAQMD Rule 1113 and the 1998 U.S. EPA National AIM Coatings Rule. Moreover, the analysis uses virtually the same methodology adopted by the Board in approving all consumer product rulemakings since 1990 (ARB; 1990; ARB, 1991; ARB, 1997; ARB, 1999). However, this analysis differs somewhat from the analyses used in the SCAQMD and U.S.EPA rulemakings in that additional details regarding the projected costs and cost-effectiveness are presented for each of the categories from which we are projecting non-SCAQMD emission reductions, rather than on an aggregate basis.

The economic impacts analysis was prepared in consultation with ARB's Economic Studies Section (ESS) of the Research Division. The ESS is staffed with professionals who carry out a broad range of assignments for the ARB and other organizations, including the Governor's Office; Cal/EPA boards, offices, and departments (BDOs); and local air pollution control agencies. The section manages extramural research contracts; develops methodologies; collects, analyzes and distributes economic and financial data; conducts economic and financial analyses, including the economic impacts analyses of the Board's regulations; oversees the economic impact analyses of the regulations promulgated by all Cal/EPA BDOs; and carries out other related tasks as needed by the ARB. The ESS staff hold Ph.D., J.D., M.B.A., M.A., and B.S. degrees in economics, business, chemical engineering, microbiology, and environmental resource science. Members of the ESS have taught economics, accounting, finance, and computer science at the university level; have given invited talks and presented technical papers to major universities, academic associations, and government agencies; and have worked in the private sector in credit analysis, accounting, auditing, production control, environmental consulting, and business law.

Summary of Economic Impacts

Our analysis shows that the cost-effectiveness of the proposed limits is similar to the cost-effectiveness of the SCAQMD's Rule 1113 and the existing consumer product regulations (Phase I-II and the Mid-Term Measures I-II), as well as other existing ARB regulatory programs. We estimate the overall cost-effectiveness of the proposed SCM ranges from $2.70 to $3.90 per pound of VOC reduced, with an average of $3.20 per pound of VOC reduced in current dollars. This cost-effectiveness is comparable in magnitude to those reported for other ARB consumer product regulations and measures, which generally have fallen within a range of no cost to about $6.90 per pound of VOC reduced.

Overall, most manufacturers or marketers of architectural coatings would be able to absorb the cost of the proposed SCM with no significant adverse impacts on their profitability. This finding is indicated by the staff's estimated change in "return on owner's equity" (ROE) analysis. The analysis found that the overall change in ROE ranges from negligible to a decline in ROE of about 2 percent, with an average change in ROE of about 1 percent. A decrease of 10 percent in ROE indicates a potentially significant impact on profitability. Because the proposed SCM would not alter significantly the profitability of most businesses, we do not expect a noticeable change in employment; business creation, elimination or expansion; and business competitiveness in California. We also found no significant adverse fiscal impacts on any local or State agencies.

To project the maximum potential impacts on consumers, we assume the opposite scenario relative to the business impacts analysis. That is, rather than determining whether businesses can absorb all costs incurred and not have a significant impact on their profitability, we assume for the consumer impacts analysis that manufacturers and retailers pass on all the costs to the consumers by raising the price of those coatings that need to be reformulated. With this assumption, we project a maximum producer cost increase ranging from $1.20 to $1.70 per reformulated gallon, with an average of about $1.40 per gallon. Based on an assumed 4X multiplier (i.e., the distributor doubles the purchase price from the manufacturer, and the retailer doubles the purchase price from the distributor), this range translates to a maximum retail price increase of about $4.80 to $6.80 per reformulated gallon, with an average of about $5.60 per gallon. With an average retail price ranging from $18.50 per gallon of noncompliant coating (calculated from "typical noncomplying" formulations with a 4X multiplier) to about $50 per gallon of noncompliant coating (indicated by midpoint of actual street prices from staff's retail shelf survey), the maximum potential increase would equate to a 12% to 30% retail price increase for reformulated coatings. We anticipate the majority of retail price increases, if any, would occur in the industrial maintenance and other commercial coating applications.

For ordinary consumers, the projected maximum impacts would be less than the impacts shown above. This is because ordinary consumers buy mainly flat and nonflat coatings (such as household wall paint, the majority of consumer purchases). For ordinary household consumers, we project no increase in retail price for a typical reformulated flat paint at $17.00 per gallon and a maximum potential increase of about $3.70 for a typical reformulated nonflat paint at $17.80 per gallon (a 21% increase). It should be noted that consumers who do not wish to purchase these reformulated coatings would still be able to buy the currently available complying coatings at significantly lower prices. The competition from these existing compliant coatings will likely constrain any price increases for the reformulated coatings. In other words, most manufacturers would not be able to pass on all their costs to the consumers as we assumed in this analysis, thereby making the actual retail price increases likely to be less than our projections.

General Approach

While the proposed Table of Standards shows numerous categories, we focused the cost impacts analysis on the eleven coating categories from which we are projecting emission reductions outside of the SCAQMD. As shown later in this section, we also calculated the gallons of noncomplying coatings in each of the 11 categories for the non-SCAQMD areas.

The economic impacts analysis consists of several main parts. First, we calculated the total non-SCAQMD annual costs of the proposal. A sensitivity analysis was conducted to determine the impacts on the annual costs from assumed changes to resin costs, the primary variable influence on raw material costs. The projected annual costs then become the inputs for determining the three main outputs of the analysis: the cost-effectiveness, the business impacts, and the consumer impacts. The cost-effectiveness is presented to compare the proposal's cost-efficiency in reducing a pound of VOC relative to the cost-efficiency of other rules and control measures adopted by the districts and the ARB. The business impacts analysis employs the scenario under which all costs incurred to meet the proposal are absorbed by the manufacturers and marketers. On the other hand, the consumer impacts analysis operates under the hypothetical regime where all costs incurred to meet the proposal are passed on to the consumers in the form of per-gallon price increases. These two parts of the analysis represent the boundaries of expected impacts, with the actual regulatory impacts from the proposal probably falling somewhere between these two extremes (i.e., some costs are absorbed, with the remaining costs passed on to consumers). Thus, the actual business impacts and producer/retail price increases will likely be less than predicted in this analysis.

Sources and Treatment of Cost Data

The cost analysis relies on various sources of information. For cost information specific to manufacturers in each coating category, we relied primarily on industry responses to the December 1999 ARB Economic Impacts Survey. We sent this survey to all entities in the ARB's AIM coatings mailing list, including the 152 companies that sell regulated AIM coatings in California. From this group, we received responses from 25 manufacturers, ultimately using the cost data from 23 respondents (15% sample rate). This survey elicited manufacturers' best estimates of the costs for meeting the proposal, including their estimates of the nonrecurring and recurring costs involved. We also relied on certain cost information and assumptions contained in the rulemaking records for the 1998 U.S. EPA National AIM Coatings Rule and the 1999 SCAQMD Rule 1113 adoptions. These rulemaking records were also used to define the boundary conditions in the sensitivity analysis conducted for this proposal.

The December 1999 ARB Economic Impacts Survey was intentionally open-ended so manufacturers could report all reasonably expected costs they believe they would incur as a result of reformulating products for sale in non-SCAQMD areas in California (ARB, 1999c). However, this does not mean that we accepted all data submitted; per-coating line reformulation cost data from two of the 25 respondents shown in Table VIII-1 were 3 to 10 times those of the other respondents, even for categories where we would expect reformulation costs to be fairly low because of the technologies involved (e.g., flat coatings). Because of this, our analysis did not use the outlier cost data from those two respondents. The outlier data notwithstanding, we have confidence in projecting the remaining cost data submitted to all of the companies with noncompliant coatings because the other 23 responses (15% of the population of affected manufacturers) include a variety of large, medium, and small manufacturers. The survey responses provided a good sampling of products from all 11 categories, covering 558 product lines (8.3% of the total 6,728 estimated noncompliant coating lines) and about 7.3 million gallons (23% of the total statewide noncompliant gallons).

Table VIII-1. 1999 Economic Impact Survey Respondents

1	Alco-NVC, Inc.	14	Lord Corp.
2	Ameron International	15	Masterchem Industries
3	Amteco, Inc.	16	Pacific Polymers, Inc.
4	Deft, Inc.	17	R.J. McGlennon Co., Inc.
5	Dexter Corp.	18	Sherwin-Williams Co.
6	Dow Corning Corp.	19	Symplastics, Inc.
7	Dudick, Inc.	20	Textured Coatings
8	Egyptian Lacquer	21	United Gilsonite Laboratories
9	Hempel Coatings (USA)	22	Valspar Corp.
10	ICI Paints	23	Western Colloid Products dba WCNC Corp.
11	Ingels, Inc.	24	William Zinsser
12	Jones Blair Company	25	Wood-Kote
13	Kelley Technical Coatings		

To determine the cost impacts from changes in raw materials, we relied primarily on spot prices reported in *Chemical Market Reporter* (CMR, 2000) and aggregate ingredient prices reported in the 1997 U.S. Economic Census for Standard Industrial Classification (SIC) 2851 (U.S. Census, 1999). In addition to conservatively using spot prices rather than lower contract prices, we also used the highest shown spot price in those situations when a price range was reported. For other ingredients not shown in these two sources, we used prices reported confidentially by individual coating manufacturers or in literature provided by known coatings experts (e.g., J.A. Gordon, Jr. and R.A. McNeill, *A Condensed Comprehensive Course in Coatings Technology*, 1992). Finally, in those infrequent cases where no price information was available for an ingredient, we applied a default value of $1.50 per pound, which is higher than most of the ingredients used in the raw materials costs analysis, including the resin costs.

B. ANNUAL COSTS AND THE COST-EFFECTIVENESS (C.E.) OF THE PROPOSED LIMITS

Introduction

In the following analysis, we present the anticipated annual costs and cost-effectiveness of the proposed new limits. Determining the proposal's cost-effectiveness allows us to compare the efficiency of the proposed limits in reducing a pound of VOC relative to other existing regulatory programs. To do this, we applied a well-established methodology for converting compliance costs, both nonrecurring and recurring costs, to an annual basis. We then report the ratio of the annual costs to the annual emission reductions in terms of "dollars (to be) spent per pound of VOC reduced." To put the proposal's cost-effectiveness into proper perspective, we compare the results of our analysis with the cost-effectiveness of other ARB regulations and control measures.

Methodology

As noted previously, the cost-effectiveness of a limit is generally defined as the ratio of total dollars to be spent to comply with the limit (as an annual cost) to the mass reduction of the pollutant(s) to be achieved by complying with that limit (in annual pounds). Annual costs include annualized nonrecurring costs (e.g., total research and development (R&D), product and consumer testing, equipment purchases/modifications, one-time distributional/marketing changes, etc.) and annual recurring costs (e.g., increases or decreases in raw material costs, labeling, packaging, recordkeeping & reporting, etc.). Thus, the cost-effectiveness is calculated according to the following general equations:

$$\textit{Cost-Effectiveness} = \frac{\textit{Annualized Nonrecurring Costs} + \textit{Annual Recurring Costs}}{\textit{Annual Emission Reductions}}$$

where,

$$\textit{Annualized Nonrecurring Costs} = \textit{CRF} \text{ x} \sum (\textit{Nonrecurring Costs})$$

$$Cost\ Recovery\ Factor\ (CRF) = \frac{i(i+1)^n}{(i+1)^n - 1}$$

i = discount rate, assumed 10%
n = project horizon, assumed 5 years

$$Annual\ Recurring\ Costs = Non\text{-}Raw\ Material\ Costs + Raw\ Material\ Costs$$

In this analysis, we essentially treated each proposed limit as a separate, stand-alone regulation independent of the other limits. This means we calculate the annual costs and the cost-effectiveness of each limit independent of all the other limits. This approach, approved by the Air Resources Board when it approved the Mid-Term Measures regulation in 1997 (ARB, 1997), represents an expansion and upgrade of previous analyses conducted by the ARB staff in which groups of product categories were evaluated collectively for cost-effectiveness (ARB, 1989; ARB, 1990; ARB, 1991, ARB, 1995). The approach used in this proposal is also significantly different from standardized cost-effectiveness analyses conducted for stationary sources, mobile sources, and other regulated entities. In the typical analysis for those sources, only the cost-effectiveness for the entire regulation is reported, rather than the cost-effectiveness for separate requirements of the regulation (e.g., *see* ARB, 1998). With four sensitivity runs for each of the 11 categories, we ultimately conducted 44 individual cost-effectiveness analyses for this report.

We believe treating each proposed limit as a separate regulation is appropriate for several reasons. First, this approach prevents very cost-effective limits (e.g., those with large emission reductions coupled with low costs) from “masking” relatively cost-ineffective limits. Such cost-ineffective limits can then be evaluated for possible elimination or substitution by other proposed limits that are more cost-effective. Another reason for treating each limit independent of the others is that each limit is, in reality, generally independent of all the other limits. For example, the limit for swimming pool coatings probably has little or no relationship with the limit for flat coatings. For these reasons, our approach for treating each limit separately for cost-effectiveness calculations provides a more conservative and realistic analysis.

As shown earlier, we annualized the nonrecurring costs (i.e., one-time fixed costs such as R&D, equipment purchases, etc.) using the Capital Recovery Method, which is the recommended approach under California Environmental Protection Agency (Cal/EPA) guidelines. Using this method, we multiply the estimated total fixed costs to comply with each proposed limit by the Capital Recovery Factor (CRF) to convert these future costs into discounted, equal annual payments in current dollars over the selected project horizon (i.e., the projected useful life of the investment) (Cal/EPA, 1996). We then sum the annualized fixed costs with the annual recurring costs (subtracting out any cost savings due to changes in raw material costs) and divide that sum by the annual emission reductions to calculate the cost-effectiveness of each limit.

Assumptions

There are four key assumptions we used in calculating total annual costs, two of which are based on the rulemaking documentation used to support the 1998 U.S. EPA National AIM Coatings Rule, while a third assumption is based on the rulemaking documentation for the 1999 SCAQMD amendment of Rule 1113 and comments received from industry representatives.

The first and most important assumption is that manufacturers will need to incur reformulation costs to meet the proposed SCM limits for all their product lines. That is, we assumed that manufacturers will have to "start from scratch" when determining how to comply with the proposed limits. In reality, however, this is unlikely to be the case because the proposed limits mirror all of the existing 2002 limits in Rule 1113 (except for swimming pool repair). Thus, the vast majority of manufacturers are already conducting R&D and taking other steps necessary to meet the SCAQMD limits; for those manufacturers, compliance in air districts that choose to adopt the staff's proposal should require few, if any, additional steps and capital expenditures. Because of this assumption, we believe its is highly likely that we substantially overestimated the costs for the proposed SCM.

The second assumption we used is the U.S. EPA's assumption that, for a typical company, about one-third of its product lines are sufficiently similar enough to each other that no additional reformulation of that one-third is required to meet the limit (U.S. EPA, 1998, at 2-312). That is, once the manufacturer reformulates one of the products in the one-third group, it can transfer that technology to the remaining products in the one-third group. The remaining two-thirds of the typical company's product lines are then assumed to require a separate and independent reformulation for each line within that group. A review of the ARB's 1998 Architectural Coatings Database confirms this assumption for many companies, leading us to conclude that the assumption is valid.

The third main assumption is that the actual costs to reformulate are likely to be 1/3 to 1/5 that of the reported costs (*Id.*, at 2-307). In its rulemaking docket, the U.S. EPA stated that it started with a reformulation cost of $250,000 per coating line, which it ultimately downgraded to $87,000 per coating line based on comments received from industry. However, the U.S. EPA then stated its belief that even the $87,000 per coating line figure was probably higher than the true costs to reformulate by a factor of 3 to 5. When it used $80,000 per reformulation in its recent Rule 1113 amendment, the SCAQMD also indicated that its estimate was probably higher than true costs. This was because the $80,000 figure was reported for a coating category that was expected to be among the most difficult to reformulate. (SCAQMD, 1999b)

Interestingly, our 1999 Economic Impacts Survey appears to confirm both statements. From our survey, we calculate an average, per-coating line reformulation cost of about $25,000 to meet the staff's proposal, which is about 3.2 to 3.5 times lower than the figures reported by the SCAQMD and the U.S. EPA, respectively. An alternative explanation for the $25,000 average reformulation cost from our survey is that the survey respondents have to reformulate to meet the SCAQMD Rule 1113 limits anyway and were simply reporting additional costs to market and distribute those products throughout the rest of California. For those manufacturers that already distribute products outside the SCAQMD, the additional costs to market and distribute products for the rest of the State that were reformulated to meet the SCAQMD rule may not be significant. Thus, the 1999 Economic Impacts Survey and the fact that most manufacturers already have to reformulate to meet the SCAQMD limits provide a good foundation for applying a 1/3 multiplier against the reported reformulation costs.

The fourth main assumption is that the resin costs for complying coatings will increase by a certain level. Resin costs are the primary influence on raw materials cost for most coatings and, because there are a variety of resins with differing costs, resins have the most variable impact on raw materials cost. The resin portion of a coating typically represents about 20% to 50% or more of the total raw materials cost of a gallon of coating (*see* Appendix F).

Technically, our analysis does not require an assumption of increased prices for the resin. This is because the typical complying formulations shown in Appendix F reflect existing technologies, as discussed in Chapter IV of this report and in the attached Environmental Impacts Report. Because the technologies already exist to comply with the limits (ARB, 2000), estimating the cost impacts from raw material changes only requires using the current prices for ingredients in typical noncomplying and complying coatings and then determining the difference in overall per-gallon costs for the complete coating. Resin prices may rise in the short run, due to a lack of production capacity sufficient to meet the demand. However, prices will come down when production capacity is expanded to meet the increased demand.

Despite our belief that an assumption of increased resin price is not needed for our analysis, we nevertheless decided to perform a sensitivity analysis using various assumed increases in the resin costs for the complying coatings to account for the possibility that manufacturers will use re-engineered, higher-cost resins in their reformulated coatings, at least in the short term. With current ingredient prices as the baseline scenario, we conducted complete cost-effectiveness calculations at 10%, 20%, and 50% assumed increases in compliant resin costs. The 10% and 20% assumed resin price increases are consistent with the socioeconomic impacts analysis conducted by the SCAQMD and confidential comments provided by some manufacturers. To be conservative, we use the 20% resin price increase assumption wherever we refer to the "average" cost-effectiveness of each limit and the overall cost-effectiveness. The 50% assumed resin price increase is intended as an extreme upper boundary for purposes of the sensitivity analysis and is not suggested by any information available to staff as reflective of projected actual resin prices when the proposed limits become effective.

Additional secondary assumptions we made include assuming a project horizon of 5 years and a discount rate of 10% throughout the project horizon. The 5-year project horizon is appropriate because that is the generally-accepted project horizon used in cost analyses involving chemical processing industries. In addition, 5 years is the number of years for a project horizon generally recommended by Cal/EPA when conducting a cost-effectiveness analysis (Cal/EPA, 1996, *supra*). With regard to the discount rate, Cal/EPA recommends 2% plus the current yield for a U.S. Treasury Note of similar maturity to the project horizon (*Id.*), which in recent years has been about 8% altogether. To be conservative, we use 10% as the discount rate, which inflates annual costs relative to an 8% discount rate.

Results

Tables VIII-2 through VIII-5 show calculational inputs, results from the 1999 Economic Impacts Survey, estimated annual regulatory costs, and the cost-effectiveness of the proposed limits on both an individual limit and overall basis (using the 20% resin price increase assumption). Table VIII-6 compares the estimated cost-effectiveness for the staff's proposal with the cost-effectiveness of the 2002 (interim) limits in the SCAQMD Rule 1113 and with other VOC-reduction measures recently adopted by the Board. As shown in Table VIII-6, the average $3.20 per pound VOC reduced overall cost-effectiveness of the proposed limits compares favorably with the cost-effectiveness of similar regulations. Moreover, the cost-effectiveness of the individual proposed limits ($0 to $7.65 per pound of VOC reduced) is consistent with the individual cost effectiveness of the SCAQMD Rule 1113 interim limits ($0.50 to $5.60 per pound of VOC reduced) and the individual consumer product limits ($0 to $7.10 per pound of VOC reduced). Thus, even with the assumption that resin prices will increase by 20%, the proposed limits are clearly cost-effective.

Table VIII-2. Various Inputs for Cost Calculations

Coating Category	Proposed Limit g/L	Emission Reductions Tons/Day (A)	Estimated # Products Non-compliant (B)	Estimated # Gallons per Year Non-compliant (C)	Product Lines To be Reformulated Based on USEPA's 2:3 Ratio [FNa] (D) = (B) x (2/ 3)
Flats	100	1.39	1,258	8,728,589	839
Industrial Maintenance	250	2.95	1,818	1,530,729	1,212
Lacquer	550	1.03	212	299,631	141
Multicolor	250	0.01	9	7,553	6
Non-flat (low & medium-gloss)	150	1.17	1,713	4,014,795	1,142
Primers, Sealers, Undercoaters (PSU)	200	0.64	361	747,561	241
Quick Dry Enamel	250	0.99	154	476,559	103
QuickDryPSU	200	1.00	131	526,095	87
Stains	250	0.64	986	587,390	657
Swimming Pool Repair	340	0.03	6	6,861	4
WaterProofing Sealers	250	0.39	80	355,495	53
	SUM	10.24	6,728	17,281,258	4485

FNa: Assumes that, for a typical company, a third of its product lines are similar enough to each other to not require Reformulation, while the remaining 2/3 would require new formulations.
U.S. EPA, August 1998 (citing data from AIM industry received during the reg-neg process).

Table VIII-3. Nonrecurring Costs from 1999 ARB Economic Impact Survey

Coating Category	ARB Survey-Reported Nonrecurring Cost to Reformulate Dollars per Product Line	ARB Survey-Reported Nonrecurring Cost to Reformulate Dollars
	(E)	(F) = (E) x (D)
Flats	$4,821	$4,042,803
Industrial Maintenance	$39,541	$47,923,808
Lacquer	$47,306	$6,685,950
Multicolor	$25,098	$150,586
Non-flat (low & medium-gloss)	$27,661	$31,589,025
Primers, Sealers, Undercoaters (PSU)	$128,618	$30,953,980
Quick Dry Enamel	$359,000	$36,857,333
QuickDryPSU	$36,733	$3,208,044
Stains	$11,916	$7,832,926
Swimming Pool Repair	$14,333	$57,333
WaterProofing Sealers	$36,429	$1,942,857

Source: December 1999 ARB Economic Impacts Survey

Table VIII-4. Calculated Annual Costs

Coating Category	Annualized Nonrecurring Cost [FNb] Dollars per Year	Annual Recurring Costs (Non-Raw Material) [FNd] Dollars per Year	Annual Recurring Costs (Raw-Materials) [FNf] (from Appendix F) Dollars per Year	Total Annual Costs Dollars per Year
	(G) = (F) x CRF / 3 [FNc]	(H) = (RC/Line)x(D)/3 [FNc, FNe]	(I) = ($/gal) x (C)	(J) = (G) + (H) + (I)
Flats	$355,494	$63,898	($726,219)	($306,826)
Industrial Maintenance	$4,214,060	$9,945,927	($2,132,306)	$12,027,681
Lacquer	$587,912	$715,500	($104,421)	$1,198,991
Multicolor	$13,241	$0	$7,436	$20,677
Non-flat (low & medium-gloss)	$2,777,702	$856,858	$99,567	$3,734,127
Primers, Sealers, Undercoaters (PSU)	$2,721,861	$2,951,201	($2,100,049)	$3,573,013
Quick Dry Enamel	$3,240,957	$62,741	($433,478)	$2,870,220
QuickDryPSU	$282,091	$12,809	($476,747)	($181,847)
Stains	$688,769	$1,466,528	($1,154,809)	$1,000,488
Swimming Pool Repair	$5,041	$644	$12,504	$18,190
WaterProofing Sealers	$170,840	$257,406	($570,215)	($141,969)
SUM	$15,057,969	$16,333,512	($7,578,737)	$23,812,744
Discount Rate (i), %	10.00%		Grand Total Annual Costs ($/Yr)	$23,812,744
Project Horizon (n), yrs	5			
Cost Recovery Factor (CRF)	0.26380			

Table VIII-5. Calculated Cost-Effectiveness and Maximum Per-Gallon Cost Increases

Coating Category	Individual Cost-Effectiveness for Each Limit Dollars per Pound VOC Reduced	Cost Increase Per Gallon [FNg] Dollars per Gallon
	(J) / [(A) x 365 x 2000]	(J) / (C)
Flats	($0.30)	($0.04)
Industrial Maintenance	$5.59	$7.86
Lacquer	$1.59	$4.00
Multicolor	$2.83	$2.74
Non-flat (low & medium-gloss)	$4.37	$0.93
Primers, Sealers, Undercoaters (PSU)	$7.65	$4.78
Quick Dry Enamel	$3.97	$6.02
QuickDryPSU	($0.25)	($0.35)
Stains	$2.14	$1.70
Swimming Pool Repair	$0.83	$2.65
WaterProofing Sealers	($0.50)	($0.40)

	Cost-Effectiveness (C.E.) [FNh]	**Cost Increase [FNi, FNj]**	
OVERALL RESULTS	$3.19 Per Lb VOC Reduced	$1.38 Per Gallon	29.9% Change from Base

Table VIII-6. Cost-Effectiveness of Proposed Limits vs. Similar Control Programs

Regulation or Control Measure	Overall Cost-Effectiveness (Dollars per Pound VOC Reduced)	Per-Limit Cost-Effectiveness (Dollars per Pound VOC Reduced)
2000 AIM Suggested Control Measure [FNk]	$3.20	net savings to $7.65
SCAQMD Rule 1113 (2002 Limits) [FNl]	$2.45	$0.50 to 5.60
1989 AIM Suggested Control Measure [FNm]	net savings to $6.90	Not Determined
Aerosol Coating Products [FNn]	$2.85 to $3.20	Not Determined
Mid-Term Measures II Cons. Products [FNo]	$0.40	$0.00 to $6.30
Mid-Term Measures I Cons. Products [FNp]	$0.25	$0.00 to $7.10
Phase II Consumer Products [FNq]	<$0.01 to $1.10	Not Determined
Phase I Consumer Products [FNr]	net savings to $1.80	Not Determined

Sensitivity Analysis

As noted earlier, we conducted a sensitivity analysis with four different runs, one baseline and three assumed increases in resin prices. Resin price was selected for the sensitivity runs because it is generally considered to be the major variable in raw material costs. As Table VIII-7 shows, even with an extreme assumption of 50% increase in compliant resin price, the overall and individual cost-effectiveness of the proposed limits are still consistent with the cost-effectiveness values projected for Rule 1113 and other ARB regulations shown earlier in Table VIII-6.

Table VIII-7. Cost-Effectiveness of Proposed Limits Under Sensitivity Analysis

Coating Category	Cost-Effectiveness (Dollars per Pound VOC Reduced) for Each Assumed Increase in Compliant Resin Prices			
	Baseline RCM = 1.0	10% Increase RCM = 1.10	20% Increase RCM = 1.20	50% Increase RCM = 1.50
Flats	($1.64)	($0.97)	($0.30)	$1.71
Industrial Maintenance	$5.37	$5.48	$5.59	$5.91
Lacquer	$1.59	$1.59	$1.59	$1.59
Multicolor	$2.55	$2.69	$2.83	$3.26
Non-flat (low & medium-gloss)	$3.13	$3.75	$4.37	$6.23
Primers, Sealers, Undercoaters (PSU)	$7.36	$7.50	$7.65	$8.08
Quick Dry Enamel	$3.77	$3.87	$3.97	$4.28
QuickDryPSU	($0.47)	($0.36)	($0.25)	$0.08
Stains	$2.04	$2.09	$2.14	$2.30
Swimming Pool Repair	$0.48	$0.65	$0.83	$1.36
WaterProofing Sealers	($0.72)	($0.61)	($0.50)	($0.16)

Overall Cost-Effectiveness	$2.72	$2.96	$3.19	$3.88

RCM = Resin Cost Multiplier; multiplied against baseline compliant resin cost to get assumed increased price (see App. F)

Note: "Lacquer" is not affected under sensitivity analysis because no significant modification of nitrocellulose resin is expected.

Footnotes

FNa: Assumes that, for a typical company, a third of its product lines are similar enough to each other to not require Reformulation, while the remaining 2/3 would require new formulations. U.S. EPA, August 1998 (citing data from AIM industry received during the reg-neg process).
FNb: Non-Recurring Costs (NRC) include one-time research and development (R&D), marketing, distributional, Equipment purchase/modifications, etc.
FNc: Based on USEPA's belief that the $87,000 per product line estimate for the national AIM rulemaking is probably 3 to 5 times greater than actual costs. USEPA, 1998.
FNd: Recurring Costs (Non-Raw Material) include packaging, labeling, and other ongoing costs not related to raw material changes. No data reported for Multicolor Coatings.
FNe: Recurring Costs (Non-Raw Material) per Line taken from cost data reported in the ARB's 1999 Economic Impacts Survey.
FNf: Recurring Costs (Raw Material) are the increase/decrease in cost of going from the typical noncomplying to the typical complying formulations shown in Appendix F.
FNg: Producer price increase if total annual costs were passed on by spreading all costs over total annual noncompliant gallons.
FNh: Grand total annual costs divided by total annual emission reductions (7,475,200 lbs VOC reduced/yr).
FNi: Overall "cost increase per gallon" equals total annual costs divided by total non-SCAQMD, noncompliant gallons.
FNj: Overall "cost increase per gallon" expressed as a percentage relative to the baseline noncomplying cost per gallon for each of the 11 categories as shown in App. F.
FNk: Values reported using 20% assumed increase in compliant resin cost
FNl: in 1998 dollars; SCAQMD, 1999, at 5 (App. F, Socio-Economic Impact Assessment)
FNm: in 1998 dollars; ARB, 1989 (1989 AIM Suggested Control Measure)
FNn: in 1998 dollars; ARB, 1995 (Aerosol Coating Regulation)
FNo: in 1998 dollars; ARB, 1999 (Mid-Term Measures II Regulation)
FNp: in 1998 dollars; ARB, 1997 (Mid-Term Measures I Regulation)
FNq: in 1998 dollars; ARB, 1991 (Consumer Products Phase II Regulation)
FNr: in 1998 dollars; ARB, 1990 (Consumer Products Phase I Regulation)

Cost Recovery Factor (CRF) = $[i\ (1 + i)^n] / [(1 + i)^n - 1]$

Values in “( )” are negative (indicates potential cost savings).

C. ECONOMIC IMPACTS ON CALIFORNIA BUSINESSES

Legal Requirements

Technically, an economic impacts assessment is not legally required for the staff's proposal. 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. Because the staff's proposal is a Suggested Control Measure (SCM) rather than an administrative regulation, the business impacts assessment is not required. However, we have decided to conduct the normally-required business impacts assessment to provide the Board and local air districts a comprehensive evaluation of the potential cost impacts.

Similarly, we also evaluated the SCM's potential impacts to State and local agencies. Normally, 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.

Moreover, we evaluated the costs of alternatives for the SCM. Had the proposal been a regulation, Health and Safety Code section 57005 would have required 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.

Potential Impact on California Businesses

The staff's analysis shows that most affected businesses would be able to absorb the costs of the proposed SCM with no significant adverse impacts on their profitability. However, the proposed SCM may impose economic hardship on some businesses with small or no margin of profitability. These businesses, if hard pressed, can seek relief under the variance provision of the local air districts for extensions to their compliance dates. Such extensions may provide sufficient time to minimize the cost impacts to these businesses. Also, the averaging plan under development will provide flexibility by allowing emissions averaging between coating lines, which may help these businesses mitigate their costs. Because the proposed amendments would not alter significantly the profitability of most businesses, we do not expect a noticeable change in employment; business creation, elimination or expansion; and business competitiveness in California.

Discussion

This portion of the economic impact 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 1998 ARB Architectural Coatings Survey (Survey), and the staff's cost-effectiveness analysis discussed earlier in this chapter.

Affected Businesses

Any business that manufactures or markets architectural and industrial maintenance (AIM) coatings would potentially be affected by the proposed SCM. Also potentially affected are businesses that supply resins, exempt solvents, other ingredients and equipment to these manufacturers or marketers, or distribute, sell or use AIM coatings. The focus of this analysis, however, will be on manufacturers or marketers because these businesses would be directly affected by the proposed SCM.

AIM coatings are manufactured or marketed by 152 companies nationwide, of which 52 are based in California, according to the 1998 ARB Survey. These companies generated about $7 billion in national sales in 1997, of which an estimated $870 million was in California (NPCA, 1999a-c). The bulk of this sales volume was generated by a few companies; ten manufacturers account for 75% of the volume, with the remaining 142 companies accounting for the other 25% (ARB, 1999b).

The architectural coatings companies marketed an estimated total of about 48.2 million gallons of paints and coatings in California outside the SCAQMD in 1996, of which 30.9 million gallons was compliant and 17.3 million gallons was noncompliant (*Id.*). California based companies accounted for 66 percent of compliant gallons and 58 percent of noncompliant gallons of paints and coatings marketed in California as shown in Table VIII-8 (*Id.*).

Table VIII-8. Gallons of Compliant and Noncompliant AIM Coatings Marketed in California outside the South Coast Air Quality Management District

Product Type	**California Firms**		**Non-California Firms**		**Total**	
Compliant Gallons	20,377,806	66%	10,497,658	34%	30,875,464	100%
Noncompliant Gallons	10,023,130	58%	7,258,128	42%	17,281,258	100%
Total	30,400,936 gallons		17,755,786 gallons		135 firms (selling outside SCAQMD)	
Firms	52		100		152 (firms selling in all of CA)	

All affected categories of paints and coatings are classified under Standard Industrial Classification (SIC) 2851 or new North American Industry Classification System (NAICS) 325510. A list of these categories is provided in Table VIII-9. The product category with the most percentage of noncompliant gallons is quick dry enamel; followed by waterproofing sealers, lacquer, industrial maintenance, quick dry PSU, swimming pool repair, flats, stains, nonflats, multicolor, and PSU.

Table VIII-9. Affected Coating Categories and Estimated Non-SCAQMD Gallons

Category	Non-SCAQMD Gallons		% of Total
	Compliant	Noncompliant	Noncompliant
Flats	8,057,159	8,728,589	52
Industrial Maintenance	595,284	1,530,729	72
Lacquer	48,777	299,631	86
Multicolor	14,623	7,533	34
Non-flat (low & medium-gloss)	6,836,002	4,014,795	37
Primers, Sealers, Undercoaters (PSU)	2,127,674	747,561	26
Quick Dry Enamel	145	476,559	100
Quick Dry PSU	283,282	526,095	65
Stains	662,376	587,390	47
Swimming Pool Repair	5,176	6,861	57
WaterProofing Sealers	53,120	355,495	87

Study Approach

Of the 152 manufacturers or marketers of AIM coatings included in the ARB's 1998 Survey, a total of 135 companies manufactured or marketed noncompliant paints and coatings in California outside SCAQMD in 1996. This study covers these affected businesses. The approach used in evaluating the potential economic impact of the proposed SCM on these businesses is outlined as follows:

(1) A sample of three representative businesses of different sizes was selected from the list of 135 affected businesses based on the size of their sales and quantity of noncompliant paints and coatings they manufactured or marketed.
(2) Compliance cost was estimated for each of these businesses.
(3) Estimated cost was adjusted for federal and State taxes.
(4) The three-year average ROE was calculated, where data were available, for each of these businesses by averaging their ROEs for 1997 through 1999 (Dun and Bradstreet, 2000). 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 businesses. 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, 1990; ARB, 1991; ARB, 1995; ARB, 1998). This threshold is consistent with the thresholds used by the United States Environmental Protection Agency and others.

Assumptions

The ROEs before and after the subtraction of the adjusted compliance costs were calculated for each size business using financial data for 1997 through 1999. The calculations were based on the following assumptions:

(1) Selected businesses are representative of affected businesses;
(2) All affected businesses were subject to the highest federal and State corporate tax rates of 35 percent and 8.835 percent respectively; and
(3) Affected businesses are not able to increase the prices of their products, nor can they lower their costs of doing business through short-term cost-cutting measures.

Given the limitation of available data, staff believes these assumptions are reasonable for most businesses at least in the short run; however, they may not be applicable to all businesses.

Results

Typical California businesses are affected by the proposed SCM to the extent that the additional costs imposed by the proposed requirements would change their profitability. A detailed discussion and analysis of these costs is provided in the cost-effectiveness section of this report. According to the staff’s cost analysis, the costs of reformulating a gallon of noncompliant architectural coating will range from about $1.30 to $1.70, with a weighted average of about $1.40.

Using ROE to measure profitability, we found that the average ROE of sample businesses in the AIM coatings industry declined by about 1.1 percent as shown in Table VIII-10. This represents a minor change in the average profitability of sample businesses.

Table VIII-10. Changes in Return on Owner's Equity (ROEs) for Typical Businesses in Architectural & Industrial Maintenance Coatings Industry

Size	ΔROE
Small	1.69%
Medium	1.49%
Large	0.06%
Average	**1.08%**

Note: "Δ" means change or difference; all ΔROEs shown are negative (i.e., shows a decline in profitability)

As shown in Table VIII-10, the projected change in profitability of typical businesses in the AIM coatings industry varied widely. The predicted decline in profitability of sample businesses ranged from a high of about 1.69 percent for a small business to a low of 0.06 percent for a large business. This variation in the impact of the proposed SCM can be attributed mainly to the following factors. First, large businesses incur higher costs due to the quantity of noncompliant paints and coatings they manufacture or market. For instance, the estimated annualized costs for affected businesses ranged from a high of about $288,000 to a low of about $3,842. Second, small businesses are usually dependent more financially on affected products than large businesses. Finally, the performance of businesses may differ from year to year. Hence, the average 1997 through 1999 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.

Potential Impact on Suppliers

Companies which supply resins, solvents, other chemicals and equipment for use in reformulating AIM coatings would potentially benefit from the proposed SCM as they experience an increase in demand for their products. On the other hand, those companies that supply raw materials for existing noncompliant paints and coatings may experience a decline in demand for their products.

Distributors and retailers may be adversely impacted if the increased costs of coatings dampen demand for architectural coatings. They may also be burdened by the task of ensuring that noncompliant products are not sold past the allowable “sell-through period.” However, given the over three-year lead time before the proposed limits become effective and the proposed three-year sell through period, distributors and retailers should have ample time to make the appropriate adjustments in their operations to minimize any such impacts.

Potential Impact on Employment

The proposed SCM is not expected to cause a noticeable change in California employment and payroll. According to the 1997 Economic Census, California employment in the paint and allied products industry (NAICS 325510/SIC 2851, which includes establishments engaged in manufacturing paints, varnishes, lacquers, enamels and shellac, putties, wood fillers and sealers, paint and varnish removers, paint brush cleaners and allied paint products) was 4,651 in 1997, or about 9 percent of the national employment in the industry. This also represents only about 0.2 percent of the total manufacturing jobs in California. These employees working in 180 establishments generated about $180 million in payroll, accounting for less than 0.3 percent of total California manufacturing payroll in 1997. Sixty establishments had 20 employees or more; the rest had less than 20 employees each.

The employment in the paint and coating industry is unlikely to change significantly as a result of the proposed SCM. This is because the proposed SCM, if adopted by the districts, applies only to about 55 percent of the California market for AIM coatings. Thus, its impact will be even smaller than indicated above. In addition, as shown above, affected manufacturers or marketers would be able to absorb the reformulation costs with no significant impact on their profitability.

Potential Impact on Business Creation, Elimination or Expansion

The proposed SCM should 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 local districts’ variance provision may be warranted.

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

Potential Impact on Business Competitiveness

The proposed SCM should have no significant impact on the ability of California businesses to compete with businesses in other states. Because the proposed measures would apply to all businesses that manufacture or market architectural coatings 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 152 companies involved in manufacturing or marketing architectural coatings, 52 are located in California. These companies manufactured or marketed only 10 out of 110 noncompliant coating lines.

The competitiveness of small businesses is not likely to be adversely affected by the fact that larger manufacturers can lower their costs through averaging or because of their economies of scale. This is because smaller businesses in this industry tend to cater to niche markets that are based on competitive factors other than price, thereby making such businesses less sensitive to prices set by larger manufacturers. As noted earlier, 75% of the total sales volume of coatings in California is sold by only 10 manufacturers, while the other 142 manufacturers sell 25% of the remaining sales volume. Thus, a small portion of the market is comprised of many small and medium businesses, which sell coatings on the basis of coating specialization, brand loyalty, customer service, warranties, and other non-price related factors. A more detailed discussion of how niche-based small manufacturers generally do not compete with larger manufacturers is provided in the staff report for the Alternative Control Program for Consumer Products (ARB, 1994).

Nonetheless, the proposed measures may have an adverse impact on the competitive position of some small, marginal businesses in California if these businesses lack resources to develop commercially acceptable products in a timely manner. As stated above, such impacts can be mitigated to a degree with a justifiable compliance extension under the local districts' variance provision, or through additional regulatory flexibility afforded by the averaging program currently under development.

D. POTENTIAL IMPACTS ON CALIFORNIA STATE OR LOCAL AGENCIES

We have identified no State or local agency that would be adversely affected by the proposed new limits. The California Prison Authority (PIA), which manufactures or markets some products for use in State service, is the only agency we are aware of that makes consumer products and goods. However, the PIA manufactures none of the AIM coatings that are subject to the proposed new limits (PIA, 2000). In addition, those State or local agencies that use AIM coatings in their ordinary course of business will have the same variety of coatings available to purchase as any other industrial, commercial, or household consumer in California. Thus, the proposed SCM should have no adverse impacts on State or local agencies.

E. POTENTIAL IMPACTS ON CALIFORNIA CONSUMERS

The potential impact of the proposed SCM on consumers depends on whether it would change the price or performance attributes of noncompliant products that are reformulated to meet the limits. Currently, there are no noticeable differences between the market prices for compliant and noncompliant products. Within the same coating categories, compliant and noncompliant coatings are basically interchangeable. Given the availability of good substitute products, it is unlikely that affected businesses will be able to pass on the cost increases to consumers at least in the short run. In the long run, however, if businesses are unable to bring down their costs of doing business, they would pass their cost increases on to consumers. In such a case, we estimate an maximum potential increase of about $5.60 per gallon. As Table VIII-11 shows, the retail price of affected AIM coatings varies widely, ranging from around $3 per gallon to $100 per gallon or more. Thus, a $5.60 per gallon maximum potential increase would represent about 12 percent in product price increases relative to the retail midpoint price of about $50 across all the affected categories.

Table VIII-11. Typical Retail Prices of Affected AIM Coatings

Category	Price Range (current dollars per gallon)
Flats	$3 to $30
Industrial Maintenance	$34 to $100+
Lacquer	$18 to $25
Multicolor	$36 to $91
Nonflats (low & medium gloss)	$3 to $35
Primers, Sealers, Undercoaters (PSU)	$9 to $31
Quick Dry Enamel	$25 to $35
Quick Dry PSU	$3 to $25
Stains	$4 to $36
Swimming Pool Repair	$35 to $85
Waterproofing Sealers	$10 to $30

Source: On-site and telephone retail price surveys conducted by ARB staff in Sacramento and various CA locations, Jan.-March 2000.

However, it is important to note that the most individual consumers buy mainly flats and nonflat paints. From the cost-effectiveness analysis presented earlier in this chapter, prices for flats and nonflats are not expected to change noticeably as a result of the proposed SCM. This is because the reformulation of this category does not impose a significant technical challenge to the paint and coating manufacturers. Thus, for most household consumers who purchase coatings such as flat wallpaint, the SCM should have negligible impact on the prices such consumers encounter.

With regard to performance impacts, the proposed SCM limits are unlikely to alter the performance attributes of noncompliant products. This is because there are currently compliant products in the market that have acceptable performance attributes. Indeed, some compliant products represent significant shares in many of their respective categories. Also, staff worked diligently with stakeholders to develop the proposed SCM. As discussed elsewhere in this report, the new proposed limits have been carefully developed to address the industry’s concerns regarding the product performance. Thus, consumers should see little or no differences in coating performance relative to currently-available coatings.

F. MITIGATION OF POTENTIAL IMPACTS THROUGH ADDITIONAL REGULATORY FLEXIBILITY

As noted earlier, businesses may be able to mitigate their cost impacts with a justified variance from local district enforcement of the SCM to extend their compliance dates. Manufacturers and marketers may also be able to reduce their costs by implementing an approved averaging plan pursuant to the averaging program currently under development; the general benefits of emissions averaging across product lines are described in more detail elsewhere in the literature (e.g., *see* ARB, 1994a, at VI.8—VI.24). Finally, with over 3 years to reformulate and an additional 3 years of allowable sell-through to eliminate noncompliant inventory, businesses should have ample time to make the necessary plans and adjustments in their operations to minimize the impacts from the SCM.

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IX.

FUTURE ACTIVITIES

In addition to the current revisions proposed for the SCM, staff has identified several long-term efforts for architectural coatings. Brief discussions of these proposed long-term efforts follow.

A. DEVELOPMENT OF FINAL VOC LIMITS

If the Board approves the proposed SCM, staff will begin investigating the final VOC limits of South Coast AQMD Rule 1113 for possible incorporation into a future SCM revision. The affected categories include floor coatings; high-temperature coatings; industrial maintenance coatings; flats; non-flats; lacquers; primers, sealers, and undercoaters; quick-dry enamels; recycled coatings; rust preventative coatings; specialty primers, sealers, and undercoaters; and quick-dry primers, sealers, and undercoaters. It is staff's intent to continue our working relationships with the districts, U.S. EPA, and industry as this process evolves.

B. REACTIVITY-BASED LIMITS

Staff expects to also explore the development of mandatory reactivity-based limits, as opposed to mass-based VOC limits, in the future. Successful development of such limits relies heavily on receiving detailed, product-specific ingredient data from the next architectural coatings survey.

C. ARCHITECTURAL COATINGS SURVEY

Staff currently anticipates beginning another architectural coatings survey in 2001 to 2002. Staff expects to build off of the work undertaken for the 1998 survey to further improve the next survey. We will need to revise what data are collected to get better emission estimates and ingredient data. Improved ingredient data, specifically product-specific data, is needed in order to determine the feasibility of mandatory reactivity-based limits for architectural coatings.

D. TECHNOLOGY ASSESSMENTS OF PROPOSED LIMITS

As part of this current SCM effort, staff is committed to conducting technology assessments for each coating category with lower proposed future limits one year prior to the effective date of the lowered limits. The affected categories include flat, non-flat (including quick-dry enamels), lacquer, floor, industrial maintenance, primers, sealers, and undercoaters (including quick-dry primers, sealers, and undercoaters), stains, waterproofing sealers, and multi-color coatings. We are convinced that the proposed limits are feasible, based on all the evidence that we examined. The reason we are committing to these additional technology assessments is that this is standard practice for the ARB, and we want to make sure that unanticipated problems do not arise.

E. STATEWIDE CONSUMER EDUCATION PROGRAM

A critical part of reducing emissions from architectural coatings is the education of consumers that their decisions and actions regarding the use of coatings may impact their local air pollution. Staff believes that a statewide public education program to assist consumers in making decisions about what products to use and when to paint would help improve the effectiveness of architectural coatings rules. Pamphlets such as the South Coast AQMD's *Painter's Guide to Clean Air* are one such example. By its nature, a public education program would need to be a long-term project, but we believe it is a valuable approach.

F. FURTHER EXTRAMURAL RESEARCH

ARB has sponsored about a dozen architectural coating extramural research studies over the past 20 years. The following are areas that could warrant further extramural research in the next few years.

1. Reactivity of VOCs Used in Architectural Coatings

Further research into the reactivity of VOCs commonly used in architectural coatings may be warranted, both for VOCs that we currently do not have data for, as well as for VOCs for which we need improved data. The results of the 1998 architectural coatings survey will help identify candidate VOCs. These data could then be used if mandatory reactivity-based limits are introduced into the SCM. It is relevant to point out that funds have recently been provided, as part of the U.S. EPA's budget, to develop a large-scale environmental chamber that can be used for such research.

2. Thinning and Clean-Up Solvent Study

The ARB's emission inventory for architectural coatings includes an estimate of how much solvent is used in thinning and in cleaning-up after the application of solvent-based coatings. Currently, ARB estimates that one pint of solvent is used per gallon of solvent-based paint for thinning and clean-up. This value is derived from information gathered before the 1984 survey.

The 1998 survey will help with estimating the amount of thinning recommended by the manufacturers, but other information is needed to update the estimate for solvent used for clean-up. It is envisioned that this study would involve phone and field surveys of painting contractors in order to determine an updated thinning and clean-up factor, which may include clean-up of equipment with both solvent-based and water-based coatings.

Currently, the estimate of emissions from thinning and clean-up are a significant portion of the emissions, ranging from 10 to 15 percent of the total architectural coatings emissions. Updating the thinning and clean-up emission factor would therefore improve the emission estimate for architectural coatings overall.

It is important to point out that by undertaking this study, ARB staff does not believe excessive thinning of architectural coatings is taking place, as discussed in Chapter I and in the Draft Program EIR. This study is simply to update the estimate used in our emissions inventory to account for solvent used for clean-up and for manufacturer's recommended thinning, which district rules require must not result in an exceedance of applicable VOC limits.

This project has been proposed, and funded. It is anticipated to be undertaken in 2000.

3. Alternative VOC Test Methods

The current U.S. EPA test method for calculating VOC contents analytically (Method 24) has limitations when trying to analyze very-low VOC coatings, as well as two-component type coatings, for VOC contents. Research could be undertaken to develop an approvable test method using other available approaches, such as gas chromatography/mass spectrometry. This would allow for more accurate analyses of VOC contents for very low-VOC coatings, thereby improving compliance determinations. This may also help address the VOC contributions from the tinting of coatings at the retail level, which is a concern to some districts.

In addition, such an alternative test method may facilitate the reporting of VOC contents as percent VOC by weight of a coating, instead of the current form of grams of VOC per liter of coating, less water and exempt solvents. This would be more consistent with the way that VOC contents are calculated for consumer products and aerosol coatings.

4. Performance Studies

Performance and durability studies on architectural coatings are an important element in the setting of regulatory limits. As the VOC limits continue to get tighter, the need increases for further research on the performance of very low and near zero VOC products. We envision that this research can be done in cooperation with industry.

G. VOC CALCULATION FOR WATER-BASED COATINGS

Since the 1970s, the U.S. EPA rules and guidance documents have required that VOC content of coatings be determined less water and exempt compounds. This approach is contained in all local district architectural coatings rules. The basis for this approach relates the mass of VOC emitted to the volume of VOC and the solids in the coating, and thus to the coverage and emissions potential. The justification for this calculation is that it is necessary to prevent a manufacturer from simply watering down paints to meet the VOC limit.

We believe that re-examining the need for this calculation is warranted and as a long-term effort, intends to work with U.S. EPA, the districts, and the industry to examine the need for the "less water and exempts" approach.

Appendix A:

Proposed Suggested Control Measure
for Architectural Coatings.

Draft 5/22/00 compared to 2/11/00

xxx 2000

California Air Resources Board (ARB)
Suggested Control Measure for Architectural Coatings

RULE _____ ARCHITECTURAL COATINGS

1. APPLICABILITY

1.1 Except as provided in subsection 1.2, this rule is applicable to any person who supplies, sells, offers for sale, or manufactures any architectural coating for use within the District, as well as any person who applies or solicits the application of any architectural coating within the District.

1.2 This rule does not apply to:

1.2.1 Any architectural coating that is sold or manufactured for use outside of the District or for shipment to other manufacturers for reformulation or repackaging.
1.2.2 Any aerosol coating product.
1.2.3 Any architectural coating that is sold in a container with a volume of one liter (1.057 quart) or less.

2. DEFINITIONS

2.0 Adhesive: Any chemical substance that is applied for the purpose of bonding two surfaces together other than by mechanical means.

2.1 Aerosol Coating Product: A pressurized coating product containing pigments or resins that dispenses product ingredients by means of a propellant, and is packaged in a disposable can for hand-held application, or for use in specialized equipment for ground traffic/marking applications.

2.2 Antenna Coating: A coating labeled ~~as~~ and formulated exclusively for application to equipment and associated structural appurtenances that are used to receive or transmit electromagnetic signals.

2.3 Antifouling Coating: A coating labeled ~~as~~ and formulated for application to submerged stationary structures and their appurtenances to prevent or reduce the attachment of marine or freshwater biological organisms. To qualify as an antifouling coating, the coating must be registered with both the U.S. EPA under the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. Section 136, *et seq.*) and with the California Department of Pesticide Regulation.

2.4 Appurtenance: Any accessory to a stationary structure coated at the site of installation, whether installed or detached, including but not limited to: bathroom and kitchen fixtures; cabinets; concrete forms; doors; elevators; fences; hand railings; heating equipment, air conditioning equipment, and other fixed mechanical equipment or stationary tools; lampposts; partitions; pipes and piping systems; rain gutters and downspouts; stairways, fixed ladders, catwalks, and fire escapes; and window screens.

2.5 Architectural Coating: A coating to be applied to stationary structures and their appurtenances at the site of installation, to portable buildings at the site of installation, to pavements, or to curbs. Coatings applied in shop applications or to non-stationary structures such as airplanes, ships, boats, railcars, and automobiles, and adhesives are not considered architectural coatings for the purposes of this rule.

2.6 Bitumens: Black or brown materials including, but not limited to, asphalt, tar, pitch, and asphaltite that are soluble in carbon disulfide, consist mainly of hydrocarbons, and are obtained from natural deposits or as residues from the distillation of crude petroleum or coal.

2.7 Bituminous Roof Coating: A coating which incorporates bitumens that is labeled ~~as~~ and formulated exclusively for roofing ~~that incorporates bitumens~~.

2.8 Bituminous Roof Primer: A primer which incorporates bitumens that is labeled and formulated exclusively for roofing.

2.~~8~~ 9 Bond Breaker: A coating labeled ~~as~~ and formulated for application between layers of concrete to prevent a freshly poured top layer of concrete from bonding to the layer over which it is poured.

2.~~9~~ 10 Clear Brushing Lacquers: Clear wood finishes, excluding clear lacquer sanding sealers, formulated with nitrocellulose or synthetic resins to dry by solvent evaporation without chemical reaction and to provide a solid, protective film, which are intended exclusively for application by brush, and which are labeled as specified in subsection 4.1.5.

2.11~~0~~ Clear Wood Coatings: Clear and semi-transparent coatings, including lacquers and varnishes, applied to wood substrates to provide a transparent or translucent solid film.

2.12~~1~~ Coating: A material applied onto or impregnated into a substrate for protective, decorative, or functional purposes. Such materials include, but are not limited to, paints, varnishes, sealers, and stains.

2.13~~2~~ Colorant: A concentrated pigment dispersion in water, solvent, and/or binder that is added to an architectural coating after packaging in sale units to produce the desired color.

2.14~~3~~ Concrete Curing Compound: A coating labeled ~~as~~ and formulated for application to freshly poured concrete to retard the evaporation of water.

2.15~~4~~ Dry Fog Coating: A coating labeled ~~as~~ and formulated only for spray application such that overspray droplets dry before subsequent contact with incidental surfaces in the vicinity of the surface coating activity.

2.16~~5~~ Exempt Compound: A compound identified as exempt under the definition of Volatile Organic Compound (VOC), subsection 2.60 ~~57~~. Exempt compounds content of a coating shall be determined by U.S. EPA Method 24 or South Coast Air Quality Management District (SCAQMD) Method 303-91 (Revised February 1993), incorporated by reference in subsection 6.5.10.

2.17~~6~~ Faux Finishing Coating: A coating labeled and formulated as a stain or glaze to create artistic effects including, but not limited to, dirt, old age, smoke damage, and simulated marble and wood grain.

2.18~~7~~ Fire-Resistive Coating: An opaque coating labeled ~~as~~ and formulated to protect the structural integrity by increasing the fire endurance of interior or exterior steel and other structural materials, that has been fire tested and rated by a testing agency approved by building code officials for use in bringing assemblies of structural materials into compliance with federal, state, and local building code requirements. The fire-resistive coating and the testing agency must be approved by building code officials. The fire-resistant coating shall be tested in accordance with ASTM Designation E 119-98, incorporated by reference in subsection 6.5.2.

2.19~~8~~ Fire-Retardant Coating: A coating labeled ~~as~~ and formulated to retard ignition and flame spread, that has been fire tested and rated by a testing agency approved by building code officials for use in bringing building and construction materials into compliance with federal, state and local building code requirements. The fire-retardant coating and the testing agency must be approved by building code officials. The fire-retardant coating shall be tested in accordance with ASTM Designation E 84-99, incorporated by reference in subsection 6.5.1.

2.20~~19~~ Flat Coating: A coating that is not defined under any other definition in this rule and that registers gloss less than 15 on an 85-degree meter or less than 5 on a 60-degree meter according to ASTM Designation D 523-89 (1999), incorporated by reference in subsection 6.5.3.

2.21~~0~~ Floor Coating: An opaque coating that is labeled ~~as~~ and formulated for application to flooring, including, but not limited to, decks, porches, steps, and other horizontal surfaces which may be subject to foot traffic. ~~, for the purposes of abrasion resistance.~~

2.22~~1~~ Flow Coating: A coating labeled and formulated exclusively for use ~~that is used~~ by electric power companies or their subcontractors ~~exclusively~~ to maintain the protective coating systems present on utility transformer units.

2.23~~2~~ Form-Release Compound: A coating labeled ~~as~~ and formulated for application to a concrete form to prevent the freshly poured concrete from bonding to the form. The form may consist of wood, metal, or some material other than concrete.

2.24~~3~~ Graphic Arts Coating or Sign Paint: A coating labeled ~~as~~ and formulated for hand-application by artists using brush or roller techniques to indoor and outdoor signs (excluding structural components) and murals including lettering enamels, poster colors, copy blockers, and bulletin enamels.

2.25~~-4~~ High-Temperature Coating: A high performance coating labeled ~~as~~ and formulated for application to substrates exposed continuously or intermittently to temperatures above 204°C (400°F).

2.26~~5~~ Industrial Maintenance Coating: A high performance architectural coating, ~~excluding floor coatings but~~ including primers, sealers, undercoaters, intermediate coats, and topcoats, formulated for application to substrates exposed to one or more of the following extreme environmental conditions listed in subsections 2.26~~5~~.1 through 2.26~~5~~.5, and labeled as specified in subsection 4.1.4:

2.26~~5~~.1 Immersion in water, wastewater, or chemical solutions (aqueous and non-aqueous solutions), or chronic exposure of interior surfaces to moisture condensation;
2.26~~5~~.2 Acute or chronic exposure to corrosive, caustic or acidic agents, or to chemicals, chemical fumes, or chemical mixtures or solutions;
2.26~~5~~.3 Repeated exposure to temperatures above 121°C (250°F);
2.26~~5~~.4 Repeated (frequent) heavy abrasion, including mechanical wear and repeated (frequent) scrubbing with industrial solvents, cleansers, or scouring agents; or
2.26~~5~~.5 Exterior exposure of metal structures and structural components.

2.27~~6~~ Lacquer: A clear or opaque wood coating, including clear lacquer sanding sealers, formulated with cellulosic or synthetic resins to dry by evaporation without chemical reaction and to provide a solid, protective film.~~ Lacquer stains are considered stains, not lacquers.~~

2.28~~7~~ Low Solids Coating: A coating containing 0.12 kilogram or less of solids per liter (1 pound or less of solids per gallon) of coating material.

2.29~~8~~ Magnesite Cement Coating: A coating labeled ~~as~~ and formulated for application to magnesite cement decking to protect the magnesite cement substrate from erosion by water.

2.30~~29~~ Mastic Texture Coating: A coating labeled ~~as~~ and formulated to cover holes and minor cracks and to conceal surface irregularities, and is applied in a single coat of at least 10 mils (0.010 inch) dry film thickness.

2.31~~0~~ Metallic Pigmented Coating: A coating containing at least 48 grams of elemental metallic pigment per liter of coating as applied (0.4 pounds per gallon), when tested in accordance with SCAQMD Method 318-95, incorporated by reference in subsection 6.5.4.

2.32~~1~~ Multi-Color Coating: A coating that is packaged in a single container and that exhibits more than one color when applied in a single coat.

2.33~~2~~ Nonflat Coating: A coating that is not defined under any other definition in this rule and that registers a gloss of 15 or greater on an 85-degree meter and 5 or greater on a 60-degree meter according to ASTM Designation D 523-89 (1999), incorporated by reference in subsection 6.5.3.

2.34 Nonflat - High Gloss Coating: A nonflat coating that registers a gloss of 70 or above on a 60 degree meter according to ASTM Designation D 523-89 (1999), incorporated by reference in subsection 6.5.3.

2.35 Nonindustrial Use: Nonindustrial use means any use of architectural coatings except in the construction or maintenance of any of the following: facilities used in the manufacturing of goods and commodities; transportation infrastructure, including highways, bridges, airports and railroads; facilities used in mining activities, including petroleum extraction; and utilities infrastructure, including power generation and distribution, and water treatment and distribution systems.

2.36~~3~~ Post-Consumer Coating: A finished coating that would have been disposed of in a landfill, ~~as a solid waste,~~ having completed its usefulness to a consumer, and does not include manufacturing wastes.

2.37~~4~~ Pre-Treatment Wash Primer: A primer that contains a minimum of 0.5 percent acid, by weight, when tested in accordance with ASTM Designation D 1613-96, incorporated by reference in subsection 6.5.5, that is labeled ~~as~~ and formulated for application directly to bare metal surfaces to provide corrosion resistance and to promote adhesion of subsequent topcoats.

2.38~~5~~ Primer: A coating labeled ~~as~~ and formulated for application to a substrate to provide a firm bond between the substrate and subsequent coats.

2.39~~6~~ Quick-Dry Enamel: A nonflat coating that is labeled as specified in subsection 4.1.8 and that is ~~and~~ formulated to have the following characteristics:

2.396.1 Is capable of being applied directly from the container under normal conditions with ambient temperatures between 16 and 27°C (60 and 80°F);

2.396.2 When tested in accordance with ASTM Designation D 1640-95, incorporated by reference in subsection 6.5.6, sets to touch in 2 hours or less, is tack free in 4 hours or less, and dries hard in 8 hours or less by the mechanical test method; and

2.396.3 Has a dried film gloss of 70 or above on a 60 degree meter.

2.4037 Quick-Dry Primer, Sealer, and Undercoater: A primer, sealer, or undercoater that is dry to the touch in 30 minutes and can be recoated in 2 hours when tested in accordance with ASTM Designation D 1640- 95, incorporated by reference in subsection 6.5.6.

2.41 38 Recycled Coating: An architectural coating formulated such that not less than 50 percent of the total weight consists of secondary and post-consumer coating, with not less than 10 percent of the total weight consisting of post-consumer coating.

2.4239 Residence: Areas where people reside or lodge, including, but not limited to, single and multiple family dwellings, condominiums, mobile homes, apartment complexes, motels, and hotels.

2.430 Roof Coating: A non-bituminous coating labeled as and formulated exclusively for application to exterior roofs for the primary purpose of preventing penetration of the substrate by water or reflecting heat and reflecting ultraviolet radiation. Metallic pigmented roof coatings which qualify as metallic pigmented coatings shall not be considered to be in this category, but shall be considered to be in the metallic pigmented coatings category.

2.441 Rust Preventative Coating: A coating formulated exclusively for nonindustrial use in or on a residence to prevent the corrosion of metal surfaces and labeled as specified in subsection 4.1.6.

2.452 Sanding Sealer: A clear wood coating sealer labeled as and formulated for application to bare wood to seal the wood and to provide a coat that can be sanded to create a smooth surface for subsequent applications of coatings. A sanding sealer that also meets the definition of a lacquer is not included in this category, but is included in the lacquer category.

2.463 Sealer: A coating labeled as and formulated for application to a substrate for one or more of the following purposes: to prevent subsequent coatings from being absorbed by the substrate, or to prevent harm to subsequent coatings by materials in the substrate.

2.47~~4~~ Secondary Coating (Rework): A fragment of a finished coating or a finished coating from a manufacturing process that has converted resources into a commodity of real economic value, but does not include excess virgin resources of the manufacturing process.

2.48~~5~~ Shellac: A clear or opaque coating formulated solely with the resinous secretions of the lac beetle (*Laciffer lacca*), thinned with alcohol, and formulated to dry by evaporation without a chemical reaction.

2.49~~6~~ Shop Application: Application of a coating to a product or a component of a product in or on the premises of a factory or a shop as part of a manufacturing, production, or repairing process (e.g., original equipment manufacturing coatings).

2.50~~47~~ Solicit: To require for use or to specify, by written or oral contract.

2.51~~48~~ Specialty Primer, Sealer, and Undercoater: A coating labeled as specified in subsection 4.1.7 and that is formulated for application to a substrate to seal fire, smoke or water damage; to condition excessively chalky surfaces, or to block stains. An excessively chalky surface is one that is defined as having a chalk rating of four or less as determined by ASTM Designation D 4214-98, incorporated by reference in subsection 6.5.7.

2.52~~49~~ Stain: A clear, semitransparent, or opaque ~~wood~~ coating labeled ~~as~~ and formulated to change the color of a surface but not conceal the grain pattern or texture. ~~, including lacquer stains.~~

2.53~~0~~ Swimming Pool Coating: A coating labeled ~~as~~ and formulated to coat the interior of swimming pools and to resist swimming pool chemicals.

2.54~~1~~ Swimming Pool Repair and Maintenance Coating: A rubber based coating labeled ~~as~~ and formulated to be used over existing rubber based coatings for the repair and maintenance of swimming pools.

2.55~~2~~ Temperature-Indicator Safety Coating: A coating labeled and formulated as a color-changing indicator coating for the purpose of monitoring the temperature and safety of the substrate, underlying piping, or underlying equipment, and for application to substrates exposed continuously or intermittently to temperatures above 204°C (400°F).

2.56~~3~~ Tint Base: An architectural coating to which colorant is added after packaging in sale units to produce a desired color.

2.57~~4~~ Traffic Marking Coating: A coating labeled ~~as~~ and formulated for marking and striping streets, highways, or other traffic surfaces including, but not limited to, curbs, berms, driveways, parking lots, sidewalks, and airport runways.

2.58~~5~~ Undercoater: A coating labeled ~~as~~ and formulated to provide a smooth surface for subsequent coatings.

2.59~~6~~ Varnish: A clear or semi-transparent wood coating, excluding lacquers and shellacs, formulated to dry by chemical reaction on exposure to air. Varnishes may contain small amounts of pigment to color a surface, or to control the final sheen or gloss of the finish.

2.60~~57~~ Volatile Organic Compound (VOC): Any volatile compound containing at least one atom of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, and excluding the following:

2.60~~57~~.1 methane;
methylene chloride (dichloromethane);
1,1,1-trichloroethane (methyl chloroform);
trichlorofluoromethane (CFC-11);
dichlorodifluoromethane (CFC-12);
1,1,2-trichloro-1,2,2-trifluoroethane (CFC-113);
1,2-dichloro-1,1,2,2-tetrafluoroethane (CFC-114);
chloropentafluoroethane (CFC-115);
chlorodifluoromethane (HCFC-22);
1,1,1-trifluoro-2,2-dichloroethane (HCFC-123);
2-chloro-1,1,1,2-tetrafluoroethane (HCFC-124);
1,1-dichloro-1-fluoroethane (HCFC-141b);
1-chloro-1,1-difluoroethane (HCFC-142b);
trifluoromethane (HFC-23);
pentafluoroethane (HFC-125);
1,1,2,2-tetrafluoroethane (HFC-134);
1,1,1,2-tetrafluoroethane (HFC-134a);
1,1,1-trifluoroethane (HFC-143a);
1,1-difluoroethane (HFC-152a);
cyclic, branched, or linear completely methylated siloxanes;
the following classes of perfluorocarbons:

(A) cyclic, branched, or linear, completely fluorinated alkanes;
(B) cyclic, branched, or linear, completely fluorinated ethers with no unsaturations;
(C) cyclic, branched, or linear, completely fluorinated tertiary amines with no unsaturations; and
(D) sulfur-containing perfluorocarbons with no unsaturations and with the sulfur bonds only to carbon and fluorine; and

2.60~~57~~.2 the following low-reactive organic compounds which have been exempted by the U.S. EPA:
acetone;
ethane;
parachlorobenzotrifluoride (1-chloro-4-trifluoromethyl benzene);
perchloroethylene; and
methyl acetate.

2.61~~58~~ VOC Content: The weight of VOC per volume of coating, calculated according to the procedures specified in subsection 6.1.

2.62~~59~~ Waterproofing Wood Sealer: A coating labeled ~~as~~ and formulated for application to a ~~porous~~ wood substrate for the primary purpose of preventing the penetration of water.

2.63 Waterproofing Concrete/Masonry Sealer: A clear or pigmented film-forming coating that is labeled and formulated for sealing concrete and masonry to provide resistance against water, alkalis, acids, ultraviolet light, and staining.

2.64~~0~~ Wood Preservative: A coating labeled ~~as~~ and formulated to protect exposed wood from decay or insect attack, that is registered with both the U.S. EPA under the Federal Insecticide, Fungicide, and Rodenticide Act (7 United States Code (U.S.C.) Section 136, *et seq.*) and with the California Department of Pesticide Regulation.

3. STANDARDS

3.1 **VOC Content Limits:** Except as provided in subsections 3.2, ~~and~~ 3.3, and 3.8, no person shall:~~, within the District,~~ (i) manufacture, blend, or repackage for sale within the district~~,~~; (ii) supply, sell, or offer for sale within the district; ~~sell, apply,~~ or (iii) solicit for ~~the~~ application or apply within the district, ~~of~~ any architectural coating with a VOC content in excess of the corresponding limit specified in Table 1, after the specified effective date in Table 1.

3.2 **Most Restrictive VOC Limit:** If anywhere on the container of any architectural coating, or any label or sticker affixed to the container, or in any sales, advertising, or technical literature supplied by a manufacturer or anyone acting on their behalf, any representation is made that indicates that the coating meets the definition of or is recommended for use for more than one of the coating categories listed in Table 1, then the most restrictive VOC content limit shall apply. This provision does not apply to the coating categories specified in subsections 3.2.1 through 3.2.~~13~~14.

3.2.1 Lacquer coatings (including lacquer sanding sealers ~~but excluding lacquer stains~~).

3.2.2 Metallic pigmented coatings.

3.2.3 Shellacs.

3.2.4 Fire-retardant coatings.

3.2.5 Pretreatment wash primers ~~that also meet the definition for industrial maintenance coatings are subject only to the VOC content limit in Table 1 for pretreatment wash primers~~.

3.2.6 Industrial maintenance coatings.

3.2.7 Low-solids coatings.

3.2.8 Wood preservatives.

3.2.9 High temperature coatings.

3.2.10 Temperature-indicator safety coatings.

3.2.11 Antenna coatings.

3.2.12 Antifouling coatings.

3.2.13 Flow coatings.

3.2.14 Bituminous roof primers.

3.3 **Sell-Through of Coatings:** A coating manufactured prior to the effective date specified for that coating in Table 1 may be sold, supplied, or offered for sale for up to three years after the specified effective date. In addition, a coating manufactured before the effective date specified for that coating in Table 1 may be applied at any time, both before and after the specified effective date, so long as the coating complied with the standards in effect at the time the coating was manufactured. This subsection 3.3 does not apply to any coating that does not display the date or date-code required by subsection 4.1.1.

3.4 **Painting Practices:** All architectural coating containers used to apply the contents therein to a surface directly from the container by pouring, siphoning, brushing, rolling, padding, ragging or other means, shall be closed when not in use. These architectural coating containers include, but are not limited to, drums, buckets, cans, pails, trays or other application containers. Containers of any VOC-containing materials used for thinning and cleanup shall also be closed when not in use. ~~"Not in use" includes, but is not limited to, any interruption, delay, completion of transfer of the contents, or termination of the application.~~

3.5 **Thinning:** No person who applies or solicits the application of any architectural coating shall apply a coating that is thinned to exceed the applicable VOC limit specified in Table 1.

~~3.6 **Industrial Maintenance Coatings:** Any person who applies or solicits the application of any architectural coating within the District shall follow the manufacturer's recommendation regarding the application of industrial maintenance coatings as described in subsection 4.1.4. Effective January 1, 2004, no person who applies or solicits the application of any architectural coating shall apply an industrial maintenance coating in or on a residence as defined in subsection 2.39 or in or on areas of industrial, commercial, or institutional facilities not exposed to the extreme environmental conditions identified in subsection 2.25, such as office space and meeting rooms.~~

3.6~~7~~ **Rust Preventative Coatings:** Effective January 1, 2004, no person shall apply or solicit the application of any rust preventative coating for industrial use, unless such a rust preventative coating complies with the industrial maintenance coating VOC limit specified in Table 1.

3.78 **Coatings Not Listed in Table 1:** For any coating that does not meet any of the definitions for the specialty coatings categories listed in Table 1, the VOC content limit shall be determined by classifying the coating as a flat coating or a nonflat coating, based on its gloss, as defined in subsections 2.2019, and 2.332, and 2.34 and the corresponding flat or nonflat VOC limit shall apply.

3.8 **Industrial Maintenance Coatings:**

3.8.1 After January 1, 2004, a manufacturer, seller, or user may petition the APCO to apply an industrial maintenance coating with a VOC content up to 340 g/l if all of the following conditions are met:

3.8.1.1 The industrial maintenance coating is to be applied in a district located within the North Central Coast, San Francisco Bay Area, or North Coast Air Basins.

3.8.1.2 The petition submitted to the APCO contains the following information, as applicable: job requirements and description, volume of coating, maximum VOC content, and a certification that a complying coating meeting the job performance requirements is not available.

3.8.1.3 If the APCO grants written approval, such approval shall contain volume and VOC limit conditions. Until written approval is granted by the APCO and received by the petitioner, all provisions of this rule shall apply.

3.8.2 The APCO shall not approve any petition under subsection 3.8.1 if the approvals previously granted by the APCO during the calendar year, when combined with the petition under consideration, would result in excess VOC emissions for that calendar year which would be greater than 5 percent of the annual emission reduction achieved within the district from implementing the January 1, 2004, VOC limit for industrial maintenance coatings.

3.8.3 This provision shall not apply to industrial maintenance coatings that are for retail sale.

4. CONTAINER LABELING REQUIREMENTS

4.1 Each manufacturer of any architectural coating subject to this rule shall display the information listed in subsections 4.1.1 through 4.1.8~~7~~ on the coating container (or label) in which the coating is sold or distributed.

4.1.1 **Date Code:** The date the coating was manufactured, or a date code representing the date, shall be indicated on the label, lid, or bottom of the container. If the manufacturer uses a date code for any coating, the manufacturer shall file an explanation of each code with the Executive Officer of the ARB.

4.1.2 **Thinning Recommendations:** A statement of the manufacturer's recommendation regarding thinning of the coating shall be indicated on the label or lid of the container. This requirement does not apply to the thinning of architectural coatings with water. If thinning of the coating prior to use is not necessary, the recommendation must specify that the coating is to be applied without thinning.

4.1.3 **VOC Content:** Each container of any coating subject to this rule shall display either the maximum or the actual VOC content of the coating, as supplied, including the maximum thinning as recommended by the manufacturer. VOC content shall be displayed in grams of VOC per liter of coating. VOC content displayed shall be calculated using product formulation data, or shall be determined using the test methods in subsection 6.2. The equations in subsection 6.1 shall be used to calculate VOC content.

4.1.4 **Industrial Maintenance Coatings:** In addition to the information specified in subsection 4.1.1, 4.1.2, and 4.1.3, each manufacturer of any industrial maintenance coating subject to this rule shall display on the label or lid of the container in which the coating is sold or distributed one or more of the descriptions listed in subsections 4.1.4.1 through 4.1.4.3~~4~~.

4.1.4.1 "For industrial use only."
4.1.4.2 "For professional use only."
4.1.4.3 "Not for residential use" or "Not intended for residential use."
~~4.1.4.4 "This coating is intended for use under the following condition(s):" (Include each condition in subsections 4.1.5.4.1 through 4.1.5.4.5 that applies to the coating.)~~

~~4.1.4.4.1 Immersion in water, wastewater, or chemical solutions (aqueous and nonaqueous solutions), or chronic exposure of interior surfaces to moisture condensation;~~

~~4.1.4.4.2 Acute or chronic exposure to corrosive, caustic, or acidic agents, or to chemicals, chemical fumes, or chemical mixtures or solutions;~~

~~4.1.4.4.3 Repeated exposure to temperatures above 121°C (250°F);~~

~~4.1.4.4.4 Repeated (frequent) heavy abrasion, including mechanical wear and repeated (frequent) scrubbing with industrial solvents, cleaners, or scouring agents; or~~

~~4.1.4.4.5 Exterior exposure of metal structures and structural components.~~

4.1.5 **Clear Brushing Lacquers:** Effective January 1, 2003, the labels of all clear brushing lacquers ~~each container of this category~~ shall prominently display the statements ~~explicit label instructions that the product is formulated~~ "~~f~~For brush application only," and ~~that~~ "This product must not be thinned or sprayed." ~~thinning and/or spraying is not permitted.~~

4.1.6 **Rust Preventative Coatings:** Effective January 1, 2003, the labels of all rust preventative coatings shall prominently display ~~include~~ the statement "For Metal Substrates Only" ~~prominently displayed~~.

4.1.7 **Specialty Primers, Sealers, and Undercoaters:** Effective January 1, 2003, the labels of all specialty primers, sealers, and undercoaters shall prominently display one or more of the descriptions listed in subsection 4.1.7.1 through 4.1.7.5.

4.1.7.1 ~~"~~For blocking stains ~~only~~.~~"~~
4.1.7.2 ~~"~~For fire-damaged substrates ~~only~~.~~"~~
4.1.7.3 ~~"~~For smoke-damaged substrates ~~only~~.~~"~~
4.1.7.4 ~~"~~For water-damaged substrates ~~only~~.~~"~~
4.1.7.5 ~~"~~For excessively chalky substrates ~~only~~.~~"~~

4.1.8 **Quick Dry Enamels:** Effective January 1, 2003, the labels of all quick dry enamels shall prominently display the words "Quick Dry" and the dry hard time.

4.1.9 **Non-flat - High Gloss Coatings:** Effective January 1, 2003, the labels of all non-flat - high gloss coatings shall prominently display the words "High Gloss."

5. REPORTING REQUIREMENTS

5.1 **Clear Brushing Lacquers:** Each manufacturer of clear brushing lacquers shall, on or before April 1 of each calendar year beginning in the year 2004, submit an annual report to the Executive Officer of the ARB. The report shall specify the number of gallons of clear brushing lacquers sold in the State during the preceding calendar year, and shall describe the method used by the manufacturer to calculate State sales.

5.2 **Rust Preventative Coatings:** Each manufacturer of rust preventative coatings shall, on or before April 1 of each calendar year beginning in the year 2004, submit an annual report to the Executive Officer of the ARB. The report shall specify the number of gallons of rust preventative coatings sold in the State during the preceding calendar year, and shall describe the method used by the manufacturer to calculate State sales.

5.3 **Specialty Primers, Sealers, and Undercoaters:** Each manufacturer of specialty primers, sealers, and undercoaters shall, on or before April 1 of each calendar year beginning in the year 2004, submit an annual report to the Executive Officer of the ARB. The report shall specify the number of gallons of specialty primers, sealers, and undercoaters sold in the State during the preceding calendar year, and shall describe the method used by the manufacturer to calculate State sales.

5.4 **Toxic Exempt Compounds:** For each architectural coating that contains perchloroethylene or methylene chloride, the manufacturer shall, on or before April 1of each calendar year beginning with the year 2004, report to the Executive Officer of the ARB the following information for products sold in the State during the preceding year:

5.4.1 the product brand name and a copy of the product label with legible usage instructions;
5.4.2 the product category listed in Table 1 to which the coating belongs;
5.4.3 the total sales in California during the calendar year to the nearest gallon;
5.4.4 the volume percent, to the nearest 0.10 percent, of perchloroethylene and methylene chloride in the coating.

5.5 **Recycled Coatings:** Manufacturers of recycled coatings must submit a letter to the Executive Officer of the ARB ~~Air Resources Board~~ certifying their status as a Recycled Paint Manufacturer. The manufacturer shall, on or before April 1 of each calendar year beginning with the year 2004, submit an annual report to the Executive Officer of the ARB. The report shall include, for all recycled coatings, the total number of gallons distributed in the State ~~California~~ during the preceding year, and shall describe the method used by the manufacturer to calculate State distribution.

5.6 **Bituminous Coatings:** Each manufacturer of bituminous roof coatings or bituminous roof primers shall, on or before April 1 of each calendar year beginning with the year 2004, submit an annual report to the Executive Officer of ARB. The report shall specify the number of gallons of bituminous roof coatings or bituminous roof primers sold in the State during the preceding calendar year, and shall describe the method used by the manufacturer to calculate State sales.

6. COMPLIANCE PROVISIONS AND TEST METHODS

6.1 **Calculation of VOC Content:** For the purpose of determining compliance with the VOC content limits in Table 1, the VOC content of a coating shall be determined by using the procedures described in subsection 6.1.1 or 6.1.2, as appropriate. The VOC content of a tint base shall be determined without colorant that is added after the tint base is manufactured.

6.1.1 With the exception of low solids coatings, determine the VOC content in grams of

VOC per liter of coating thinned to the manufacturer's maximum recommendation, excluding the volume of any water and exempt compounds. Determine the VOC content using equation 1 as follows:

$$\text{VOC Content} = \frac{(W_s - W_w - W_{ec})}{(V_m - V_w - V_{ec})} \qquad \textbf{(1)}$$

Where:

VOC content	= grams of VOC per liter of coating
W_s	= weight of volatiles, in grams
W_w	= weight of water, in grams
W_{ec}	= weight of exempt compounds, in grams
V_m	= volume of coating, in liters
V_w	= volume of water, in liters
V_{ec}	= volume of exempt compounds, in liters

6.1.2 For low solids coatings, determine the VOC content in units of grams of VOC per liter of coating thinned to the manufacturer's maximum recommendation, including the volume of any water and exempt compounds. Determine the VOC content using equation 2 as follows:

$$\text{VOC Content}_{ls} = \frac{(W_s - W_w - W_{ec})}{(V_m)} \qquad \textbf{(2)}$$

Where:

VOC content_{ls}	= the VOC content of a low solids coating in grams of VOC per liter of coating
W_s	= weight of volatiles, in grams
W_w	= weight of water, in grams
W_{ec}	= weight of exempt compounds, in grams
V_m	= volume of coating, in liters

6.2 **VOC Content of Coatings:** To determine the physical properties of a coating in order to perform the calculations in subsection 6.1, the reference method for VOC content is U.S. EPA Method 24, incorporated by reference in subsection 6.5.11, except as provided in subsections 6.3 and 6.4. An alternative method to determine the VOC content of coatings is SCAQMD Method 304-91 (Revised February 1996), incorporated by reference in subsection 6.5.12. The exempt compounds content shall be determined by SCAQMD Method 303-91 (Revised August 1996), incorporated by reference in subsection 6.5.10. To determine the VOC content of a coating, the manufacturer may use U.S. EPA Method 24 , or an alternative method as provided in subsection 6.3, formulation data, or any other reasonable means for predicting that the coating has been formulated as intended (e.g., quality assurance checks, recordkeeping). However, if there are any inconsistencies between the results of a Method 24 test and any other means for determining VOC content, the Method 24 test results will govern, except when an alternative method is approved as specified in subsection 6.3. The District Air Pollution Control Officer (APCO) may require the manufacturer to conduct a Method 24 analysis.

6.3 **Alternative Test Methods:** Other test methods demonstrated to provide results that are acceptable for purposes of determining compliance with subsection 6.2, after review and approved in writing by the staffs of the District, the ARB, and the U.S. EPA, may also be used.

6.4 **Methacrylate Traffic Marking Coatings:** Analysis of methacrylate multicomponent coatings used as traffic marking coatings shall be conducted according to a modification of U.S. EPA Method 24 (40 CFR 59, subpart D, Appendix A), incorporated by reference in subsection 6.5.13. This method has not been approved for methacrylate multicomponent coatings used for other purposes than as traffic marking coatings or for other classes of multicomponent coatings.

6.5 **Test Methods:** ~~For coatings subject to the provisions of this rule, the following test methods shall be used:~~ The following test methods are incorporated by reference herein, and shall be used to test coatings subject to the provisions of this rule:

6.5.1 **Flame Spread Index:** The flame spread index of a fire-retardant coating shall be determined by ASTM Designation E 84-99, "Standard Test Method for Surface Burning Characteristics of Building Materials," ~~incorporated by reference in~~ (see section 2, Fire-Retardant Coating).

6.5.2 **Fire Resistance Rating:** The fire resistance rating of a fire-resistive coating shall be determined by ASTM Designation E 119-98, "Standard Test Methods for Fire Tests of Building Construction Materials," ~~incorporated by reference in~~ (see section 2, Fire-Resistive Coating).

6.5.3 **Gloss Determination:** The gloss of a coating shall be determined by ASTM Designation D 523-89 (1999), "Standard Test Method for Specular Gloss," ~~incorporated by reference in~~ (see section 2, Flat Coating, Nonflat Coating, Nonflat - High Gloss Coating, and Quick-Dry Enamel).

6.5.4 **Metal Content of Coatings:** The metallic content of a coating shall be determined by SCAQMD Method 318-95, "Determination of Weight Percent Elemental Metal in Coatings by X-Ray Diffraction," SCAQMD "Laboratory Methods of Analysis for Enforcement Samples," ~~incorporated by reference in~~ (see section 2, Metallic Pigmented Coating).

6.5.5 **Acid Content of Coatings:** The acid content of a coating shall be determined by ASTM Designation D 1613-96, "Standard Test Method for Acidity in Volatile Solvents and Chemical Intermediates Used in Paint, Varnish, Lacquer, and Related Products," ~~incorporated by reference in~~ (see section 2, Pre-treatment Wash Primer).

6.5.6 **Drying Times:** The set-to-touch, dry-hard, dry-to-touch, and dry-to-recoat times of a coating shall be determined by ASTM Designation D 1640- 95, "Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature," ~~incorporated by reference in~~ (see section 2, Quick-Dry Enamel and Quick-Dry Primer, Sealer, and Undercoater). The tack-free time of a quick-dry enamel coating shall be determined by the Mechanical Test Method of ASTM Designation D 1640- 95.

6.5.7 **Surface Chalkiness:** The chalkiness of a surface shall be determined using ASTM Designation D 4214-98, "Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films," ~~incorporated by reference in~~ (see section 2, Specialty Primer, Sealer, and Undercoater).

6.5.8 **Exempt Compounds--Siloxanes:** Exempt compounds that are cyclic, branched, or linear completely methylated siloxanes, shall be analyzed as exempt compounds for compliance with section 6 by BAAQMD Method 43, "Determination of Volatile Methylsiloxanes in Solvent-Based Coatings, Inks, and Related Materials," BAAQMD Manual of Procedures, Volume III, adopted 11/6/96, ~~incorporated by reference in~~ (see section 2, Volatile Organic Compound, and subsection 6.2).

6.5.9 **Exempt Compounds--Parachlorobenzotrifluoride (PCBTF)**: The exempt compound parachlorobenzotrifluoride, shall be analyzed as an exempt compound for compliance with section 6 by BAAQMD Method 41, "Determination of Volatile Organic Compounds in Solvent Based Coatings and Related Materials Containing Parachlorobenzotrifluoride," BAAQMD Manual of Procedures, Volume III, adopted 12/20/95, ~~incorporated by reference in~~ (see section 2,Volatile Organic Compound, and subsection 6.2).

6.5.10 **Exempt Compounds:** The content of compounds ~~E~~exempt ~~compounds content~~ under U.S. EPA Method 24 shall be analyzed by SCAQMD Method 303-91 (Revised 1993), "Determination of Exempt Compounds," SCAQMD "Laboratory Methods of Analysis for Enforcement Samples,"~~ incorporated by reference in~~ (see section 2, Volatile Organic Compound, and subsection 6.2).

6.5.11 **VOC Content of Coatings:** The VOC content of a coating ~~is~~ shall be determined by U.S. EPA Method 24 as it exists in appendix A of 40 Code of Federal Regulations (CFR) part 60, "Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings,"~~ 1998, incorporated by reference in~~ (see subsection 6.2).

6.5.12 **Alternative VOC Content of Coatings:** The VOC content of coatings may be analyzed either by U.S. EPA Method 24 or SCAQMD Method 304-91 (Revised 1996), "Determination of Volatile Organic Compounds (VOC) in Various Materials," SCAQMD "Laboratory Methods of Analysis for Enforcement

Samples," ~~incorporated by reference in~~ (see subsection 6.2).

6.5.13 **Methacrylate Traffic Marking Coatings:** The VOC content of methacrylate multicomponent coatings used as traffic marking coatings shall be analyzed by the procedures in 40 CFR part 59, subpart D, appendix A, "Determination of Volatile Matter Content of Methacrylate Multicomponent Coatings Used as Traffic Marking Coatings," (September 11, 1998), ~~incorporated by reference in~~ (see subsection 6.~~2~~4).

Draft 5/22/00 compared to 2/11/00

Table 1
VOC CONTENT LIMITS FOR ARCHITECTURAL COATINGS

Limits are expressed in grams of VOC per liter[a] of coating thinned to the manufacturer's maximum recommendation, excluding the volume of any water, exempt compounds, or colorant added to tint bases. "Manufacturer's maximum recommendation" means the maximum recommendation for thinning that is indicated on the label or lid of the coating container.

Coating Category	Effective 1/1/2003	Effective 1/1/2004
Flat Coatings	100	
Nonflat Coatings	150	
Nonflat - High Gloss Coatings	250	
Specialty Coatings		
Antenna Coatings	530	
Antifouling Coatings	400	
Bituminous Roof Coatings	~~250~~ 300	
Bituminous Roof Primers	350	
Bond Breakers	350	
Clear Wood Coatings • Clear Brushing Lacquers • Lacquers (including lacquer sanding sealers) • Sanding Sealers (other than lacquer sanding sealers) • Varnishes	 680 550 350 350	
Concrete Curing Compounds	350	
Dry Fog Coatings	400	
Faux Finishing Coatings	350	
Fire Resistive Coatings	350	
Fire-Retardant Coatings: • Clear • Opaque	 650 350	
Floor Coatings	~~100~~ 250	
Flow Coatings	420	
Form-Release Compounds	250	
Graphic Arts Coatings (Sign Paints)	500	
High Temperature Coatings	420	

Draft 5/22/00 compared to 2/11/00

Coating Category	Effective 1/1/2003	Effective 1/1/2004
Industrial Maintenance Coatings		250
Low Solids Coatings[b]	120	
Magnesite Cement Coatings	450	
Mastic Texture Coatings	300	
Metallic Pigmented Coatings	500	
Multi-Color Coatings	250	
Pre-Treatment Wash Primers	420	
Primers, Sealers, and Undercoaters	200	
Quick-Dry Enamels	250	
Quick-Dry Primers, Sealers, and Undercoaters	200	
Recycled Coatings	250	
Roof Coatings	250	
Rust Preventative Coatings	400	
Shellacs: • Clear • Opaque	 730 550	
Specialty Primers, Sealers, and Undercoaters	350	
Stains	250	
Swimming Pool Coatings	340	
Swimming Pool Repair and Maintenance Coatings	340	
Temperature-Indicator Safety Coatings	550	
Traffic Marking Coatings	150	
Waterproofing Sealers • Concrete/Masonry • Wood	~~250~~ 400 250	
Wood Preservatives	350	

[a] Conversion factor: one pound VOC per gallon (U.S.) = 119.95 ~~119.82~~ grams VOC per liter.

[b] Units are grams of VOC per liter (pounds of VOC per gallon) of coating, including water and exempt compounds.

Appendix B:

ARB-CAPCOA Suggested Control Measure for Architectural Coatings (May 1989).

May 1989

ARB-CAPCOA Suggested Control Measure for Architectural Coatings

RULE _____ ARCHITECTURAL COATINGS

(a) APPLICABILITY

This rule is applicable to any person who supplies, sells, offers for sale, applies, or solicits the application of any architectural coating, or who manufactures any architectural coating for use within the District.

(b) DEFINITIONS

(1) Appurtenances: Accessories to an architectural structure, including, but not limited to: hand railings, cabinets, bathroom and kitchen fixtures, fences, rain-gutters and down-spouts, window screens, lamp-posts, heating and air conditioning equipment, other mechanical equipment, large fixed stationary tools and concrete forms.

(2) Architectural Coatings: Coatings applied to stationary structures and their appurtenances, to mobile homes, to pavements, or to curbs.

(3) Below-Ground Wood Preservatives: Coatings formulated to protect below-ground wood from decay or insect attack and which contain a wood preservative chemical registered by the California Department of Food and Agriculture.

(4) Bituminous Coatings: Black or brownish coating materials which are soluble in carbon disulfide, which consist mainly of hydrocarbons, and which are obtained from natural deposits or as residues from the distillation of crude oils or of low grades of coal.

(5) Bond Breakers: Coatings applied between layers of concrete to prevent the freshly poured top layer of concrete from bonding to the layer over which it is poured.

(6) Clear Wood Finishes: Clear and semi-transparent coatings, including lacquers and varnishes, applied to wood substrates to provide a transparent or translucent solid film.

(7) Concrete Curing Compounds: Coatings applied to freshly poured concrete to retard the evaporation of water.

(8) Dry Fog Coatings (Mill White Coatings): Coatings formulated only for spray application such that overspray droplets dry before subsequent contact with other surfaces.

(9) Exempt Solvents: Compounds identified as exempt under the definition of Volatile Organic Compounds, Subsection (b) (38).

(10) Fire-Retardant Coatings: Coatings which have a flame spread index of less than 25 when tested in accordance with ASTM Designation E-84-87, "Standard Test Method for Surface Burning Characteristics of Building Material," after application to Douglas fir according to the manufacturer's recommendations.

(11) Form-Release Compounds: Coatings applied to a concrete form to prevent the freshly poured concrete from bonding to the form. The form may consist of wood, metal, or some material other than concrete.

(12) Graphic Arts Coatings (Sign Paints): Coatings formulated for and hand-applied by artists using brush or roller techniques to indoor and outdoor signs (excluding structural components) and murals, including lettering enamels, poster colors, copy blockers, and bulletin enamels.

(13) High-Temperature Industrial Maintenance Coatings: Industrial Maintenance Coatings formulated for and applied to substrates exposed continuously or intermittently to temperatures above 400 degrees Fahrenheit.

(14) Industrial Maintenance Anti-Graffiti Coatings: Two-component clear industrial maintenance coatings formulated for and applied to exterior walls and murals to resist repeated scrubbing and exposure to harsh solvents.

(15) Industrial Maintenance Coatings: High performance coatings formulated for and applied to substrates in industrial, commercial, or institutional situations that are exposed to one or more of the following extreme environmental conditions:

(i) immersion in water, wastewater, or chemical solutions (aqueous and non-aqueous solutions), or chronic exposure of interior surfaces to moisture condensation;
(ii) acute or chronic exposure to corrosive, caustic or acidic agents, or to chemicals, chemical fumes, chemical mixtures, or solutions;
(iii) repeated exposure to temperatures in excess of 250 F;
(iv) repeated heavy abrasion, including mechanical wear and repeated scrubbing with industrial solvents, cleansers, or scouring agents; or
(v) exterior exposure of metal structures.

Industrial Maintenance Coatings are not for residential use or for use in areas of industrial, commercial, or institutional facilities such as office space and meeting rooms.

(16) Lacquers: Clear wood finishes formulated with nitrocellulose or synthetic resins to dry by evaporation without chemical reaction, including clear lacquer sanding sealers.

(17) Magnesite Cement Coatings: Coatings formulated for and applied to magnesite cement decking to protect the magnesite cement substrate from erosion by water.

(18) Mastic Texture Coatings: Coatings formulated to cover holes and minor cracks and to conceal surface irregularities, and applied in a thickness of at least 10 mils (dry, single coat).

(19) Metallic Pigmented Coatings: Coatings containing at least 0.4 pounds of metallic pigment per gallon of coating as applied.

(20) Multi-Colored Coatings: Coatings which exhibit more than one color when applied and which are packaged in a single container and applied in a single coat.

(21) Opaque Stains: All stains that are not classified as semi-transparent stains.

(22) Opaque Wood Preservatives: All wood preservatives not classified as clear or semi-transparent wood preservatives or as below-ground wood preservatives.

(23) Pre-treatment Wash Primers: Coatings which contain a minimum of ½% acid by weight, applied directly to bare metal surfaces to provide necessary surface etching.

(24) Primers: Coatings formulated and applied to substrates to provide a firm bond between the substrate and subsequent coats.

(25) Residential Use: Use in areas where people reside or lodge including, but not limited to single and multiple family dwellings, condominiums, mobile homes, apartment complexes, motels, and hotels.

(25) Roof Coatings: Coatings formulated for application to exterior roofs and for the primary purpose of preventing penetration of the substrate by water, or reflecting heat and reflecting ultraviolet radiation. Metallic pigmented roof coatings which qualify as metallic pigmented coatings shall not be considered to be in this category, but shall be considered to be in the metallic pigmented coatings category.

(27) Sanding Sealers: Clear wood coatings formulated for and applied to bare wood for sanding and to seal the wood for subsequent application of varnish. To be considered a sanding sealer a coating must be clearly labelled as such.

(28) Sealers: Coatings formulated for and applied to a substrate to prevent subsequent coatings from being adsorbed by the substrate, or to prevent harm to subsequent coatings by materials in the substrate.

(29) Semi-Transparent Stains: Coatings formulated to change the color of a surface but not conceal the surface.

(30) Semi-Transparent Wood Preservatives: Wood preservative stains formulated and used to protect exposed wood from decay or insect attack by the addition of a wood preservative chemical registered by the California Department of Food and Agriculture, which change the color of a surface but do not conceal the surface, including clear wood preservatives.

(31) Shellacs: Clear or pigmented coatings formulated solely with the resinous secretions of the lac beetle (laccifer lacca), thinned with alcohol, and formulated to dry by evaporation without a chemical reaction.

(32) Solicit: To require for use or to specify, by written or oral contract.

(33) Swimming Pool Coatings: Coatings formulated and used to coat the interior of swimming pools and to resist swimming pool chemicals.

(34) Swimming Pool Repair Coatings: Chlorinated rubber based coatings used for the repair and maintenance of swimming pools over existing chlorinated rubber based coatings.

(35) Traffic Coatings: Coatings formulated for and applied to public streets, highways, and other surfaces including, but not limited to curbs, berms, driveways, and parking lots.

(36) Undercoaters: Coatings formulated and applied to substrates to provide a smooth surface for subsequent coats.

(37) Varnishes: Clear wood finishes formulated with various resins to dry by chemical reaction on exposure to air.

(38) Volatile Organic Compounds (VOC): Compounds of carbon which may be emitted to the atmosphere during the application of and or subsequent drying or curing of coatings subject to this rule, except methane, carbon monoxide, carbon

dioxide, carbonic acid, metallic carbides or carbonates, ammonium carbonate, 1,1,1-trichloroethane, methylene chloride, trichlorofluoromethane (CFC-11), dichlorodifluoromethane (CFC-12), chlorodifluoromethane (CFC-22), trifluoromethane (CFC-23), trichlorotrifluoroethane (CFC-113), dichlorotetrafluoroethane (CFC-114), and chloropentafluorethane (CFC-115).

(39) Waterproofing Sealers: Colorless coatings which are formulated and applied for the sole purpose of protecting porous substrates by preventing the penetration of water and which do not alter surface appearance or texture.

(c) STANDARDS

(1) Except as provided in Subsections (c) (2), (c) (3), and (c) (4), no person shall, within the District, supply, offer for sale, sell, apply, or solicit the application of any architectural coating which, at the time of sale or manufacture, contains more than 250 grams of volatile organic compounds per liter of coating (less water and exempt solvents, and excluding any colorant added to tint bases), or manufacture, blend, or repackage such a coating for use within the District.

(2) Except as provided in Subsections (c) (3) and (c) (4), no person shall, within the District, supply, offer for sale, sell, apply, or solicit the application of any architectural coating listed in the Table of Standards which contains volatile organic compounds (less water and exempt solvents, and excluding any colorant added to tint bases) in excess of the corresponding limit specified in the table, after the corresponding date specified, or manufacture, blend, or repackage such a coating for use within the district.

Table of Standards
(grams of VOC per liter)

	Effective Dates			
	9/1/84	9/1/89	9/1/92	9/1/94
Below-Ground Wood Preservatives	--	600	350	
Bond Breakers	--	750	350 (9/1/90)	
Clear Wood Finishes				
Lacquer	--	680		
Sanding Sealers		550	350	
Varnish	500	350		
Concrete Curing Compounds	--	350		
Dry Fog Coatings		400		
Fire-Retardant Coatings				
Clear	--	650		
Pigmented	--	350		
Form-Release Compounds	--	250		
Graphic Arts (Sign) Coatings	--	500		
Industrial Maintenance Coatings	--	420	340	
Industrial Maintenance Anti-Graffitti Coatings	--	600	340	
High Temperature Industrial Maintenance Coatings	--	650	550	420
Magnesite Cement Coatings	--	600	450	
Mastic Texture Coatings	--	300		
Metallic Pigmented Coatings	--	500		
Multi-Color Coatings	--	580	420	
Opaque Stains	400	350		
Opaque Wood Preservatives	400	350		
Pre-Treatment Wash Primers	--	780	780	420
Primers Sealers & Undercoaters	400	350		
Roof Coatings	--	300		
Semi-transparent Stains	--	350		
Semi-transparent and Clear Wood Preservatives	--	350		
Shellac				
Clear	--	730		
Pigmented	--	550		
Swimming Pool Coatings	--	650	340 (9/1/92)	
Repair and Maintenance Coatings	--	650	340 (9/1/97)	
Traffic Paints				
Public streets & highways	415	250		
Other surfaces	250	250		
Black traffic coatings	--	250		
Waterproofing Sealers	--	400		

(3) If anywhere on the container of any coating listed on the Table of Standards, on any sticker or label affixed thereto, or in any sales or advertising literature, any representation is made that the coating may be used as, or is suitable for use as a coating for which a lower VOC standard is specified in the table or in Subsection (c) (1), then the lowest VOC standard shall apply. This requirement does not apply to the representation of the following coatings in the manner specified:

(i) High-Temperature Industrial Maintenance Coatings, which may be represented as metallic pigmented coatings for use consistent with the definition of high temperature industrial maintenance coatings;
(ii) Lacquer Sanding Sealers, which may be recommended for use as sanding sealers in conjunction with clear lacquer topcoats;
(iii) Metallic Pigmented Coatings, which may be recommended for use as primers, sealers, undercoaters, roof coatings, or industrial maintenance coatings; and
(iv) Shellacs.

(4) Sale of a coating manufactured prior to the effective date of the corresponding standard in the Table of Standards, and not complying with that standard, shall not constitute a violation of Subsection (c) (2) until three years after the effective date of the standard, nor shall application of such a coating.

(5) All VOC-containing materials shall be stored in closed containers when not in use. In use includes, but is not limited to: being accessed, filled, emptied, maintained or repaired.

(d) ADMINISTRATIVE REQUIREMENTS

(1) Each container of any coating subject to this rule shall display the date on which the contents were manufactured or a code indicating the date of manufacture. Each manufacturer of such coatings shall file with the Air Pollution Control Officer and the Executive Officer of the California Air Resources Board, an explanation of each code.

(2) Each container of any coating subject to this rule shall display a statement of the manufacturer's recommendation regarding thinning of the coating. This recommendation shall not apply to the thinning of architectural coatings with water. The recommendation shall specify that the coating is to be employed without thinning or diluting under normal environmental and application

conditions unless any thinning recommended on the label for normal environmental and application conditions does not cause a coating to exceed its applicable standard.

(3) Each container of any coating subject to this rule and manufactured after (one year from the date of adoption) shall display the maximum VOC content of the coating, as applied, and after any thinning as recommended by the manufacturer. VOC content shall be displayed as grams of VOC per liter of coating (less water and exempt solvent, and excluding any colorant added to tint bases). VOC content displayed may be calculated using product formulation data, or may be determined using the test method in Subsection (f) (1).

(4) Beginning (one year from the date of adoption), the labels of all industrial maintenance coatings shall include the statement "Not for Residential Use," or "Not for Residential Use in California," prominently displayed.

(e) EXEMPTIONS

The requirements of this rule do not apply to:

(1) Architectural coatings manufactured for use outside of the District or for shipment to other manufacturers for repackaging.

(2) Architectural coatings supplied in and applied from containers having capacities of one liter or less, which were offered in containers of such capacities prior to (the date of adoption of this rule).

(3) Architectural coatings sold in non-refillable aerosol containers having capacities of one liter or less.

(4) Emulsion-type bituminous pavement sealers.

(f) TEST METHODS

(1) Volatile Organic Compounds: Measurement of volatile organic compounds in architectural coatings shall be conducted and reported in accordance with EPA Test Method 24 (40 CFR 60, Appendix A), or an equivalent method approved by the air pollution control officer.

Appendix C:

Summary of Current U.S. EPA, SCM, and District Rule VOC Limits.

Summary of California Architectural Coating Rules

Volatile Organic Compound (VOC) Limits (grams per liter)

NOTE: This summary is provided for comparison purposes ONLY and should not be used as a replacement for existing rules.

No attempt was made to merge similar categories among different rules.

Volatile Organic Compund (VOC) limits below are in grams per liter (divide grams/liter by 119.82 to obtain pounds/gallon)

Coating	EPA	CARB	Antelope	Bay Area	Butte	Colusa	El Dorado	Feather River	Imperial	Kern	Mojave	Monterey	Placer	Sacramento	San Diego	San Joaquin	Santa Barbara	South Coast	Ventura
Rule Name or Number	63 FR 176: 48848	SCM	1113	8-3	240	2.26	215	3.15	424	410.1	1113	426	218	442	67	4601	323	1113	74.2
Acrylic Polymers (Industrial Maintenance)			420	420															
Alkyds (Industrial Maintenance)			420	420															
Antenna	530												TBD						
Anti-Fouling	450												TBD						
Anti-Graffiti (Industrial Maintenance)	600	340					340		340	420	600		340	340	600	340	340		340
Bituminous and Mastics	500												TBD						
Bituminous Coating Materials (Industrial Maintenance)			420	420															
Bituminous Roof Coatings																		300 [250 7/1/2002]	
Bond Breakers	600	350	350	E	E	E	350	E	350	350	350	E	350	350	350	350	350	350	350
Calcimine Recoaters	475																		
Catalyzed Epoxy (Industrial Maintenance)			420	420															
Chalkboard Resurfacers	450												350						
Chemical Storage Tank Coatings																		420 [100 7/1/2006]	
Chlorinated Rubber (Industrial Maintenance)			420	420															
Concrete Curing Compounds	350	350	350	350	800	350	350	350	350	350	350	350	350	350	350	350	350	350	350
Concrete Curing and Sealing Compounds	700																		
Concrete Protective	400												TBD						
Concrete Surface Retarders	780																		
Conversion Varnishes	725																		
Dry Fog	400	400	400	E	E	E	400	E	400	400	400	E	400	400	400	400	400	400	400
Enamel Undercoaters				350	550	350		350		350		350				350			
Essential Public Service Coatings																		420 [340 7/1/2002] [100 7/1/2006]	
Extreme High Durability	800												TBD						
Faux Finishing/Glazing (Japans)	700		350															350	
Fire Proofing, Exterior			350															350	
Fire Retardant, Clear		650	650	E	E	E	650	E	650	650	650			650	650	650	650	650	650
Fire Retardant, Pigmented		350	350	E	E	E	350	E	350	350	350			350	350	350	350	350	350
Fire Retardant/Resistive, Clear	850											E	650						
Fire Retardant/Resistive, Opaque	450											E	350						

Coating	EPA	CARB	Antelope	Bay Area	Butte	Colusa	El Dorado	Feather River	Imperial	Kern	Mojave	Monterey	Placer	Sacramento	San Diego	San Joaquin	Santa Barbara	South Coast	Ventura
Rule Name or Number	63 FR 176: 48848	SCM	1113	8-3	240	2.26	215	3.15	424	410.1	1113	426	218	442	67	4601	323	1113	74.2
Flats, Exterior	250	(250)	250 [100 7/1/2001] [50 7/1/2008]	(250)	250	(250)	(250)	(250)	(250)	(250)	(250)	(250)	250	(250)	(250)	(250)	(250)	250 [100 7/1/2001] [50 7/1/2008]	(250)
Flats, Interior	250	(250)	250 [100 7/1/2001] [50 7/1/2008]	(250)	250	(250)	(250)	(250)	(250)	(250)	(250)	(250)	250	(250)	(250)	(250)	(250)	250 [100 7/1/2001] [50 7/1/2008]	(250)
Flats, Specialty				400	650	400	400	400		400		400		400		400	250		
Floor	400												TBD					420 [100 7/1/2002] [50 7/1/2006]	
Flow	650												TBD						
Form Release Compounds	450	250					250		250	250			250	250	250	250	250		250
Graphic Arts (Sign Paints)	500	500	500	E	E	E	500	E	500	500	500	E	500	500	500	500	500	500	500
Heat Reactive	420												TBD						
High Temperature	650												420						
High Temperature (Industrial Maintenance)		420					420		420	420	550			420	650	420	420	[550 7/1/2002] [420 7/1/2006]	420
Impacted Immersion	780												TBD						
Industrial Maintenance	450	340							420	420	420		420	340	420	340	340	420 [250 7/1/2002] [100 7/1/2006]	
Industrial Maintenance Primers and Topcoats					800	420	420	420				420							420
Inorganic Polymers (Industrial Maintenance)			420	420															
Lacquers, Clear		680	550 [275 1/1/2005]	680	800	680	680	680	680	680	680	680		680	680	680	350	550 [275 1/1/2005]	680
Lacquers (Including Lacquer Sanding Sealers)	680												680						
Lacquers, Pigmented			550 [275 1/1/2005]				680											550 [275 1/1/2005]	680
Low Solids Coatings			120	120												120		120	
Low Solids Stains	120						120						120	120					
Low Solids Wood Preservatives	120						120						120						
Magnesite Cement	600	450	450				450		450	450	600		450	450	600	450	450	450	450
Mastic Texture	300	300	300	E	E	E	300	E	300	300	300	E	300	300	300	300	300	300	300
Metallic Pigmented	500	500	500	E	E	E	500	E	500	500	500	E	500	500	500	500	500	500	500
Multi-Color	580	420	250	E	E	E	420	E	420	420	580	E	420	420	580		420	250	420
Nonferrous Ornamental Metal Lacquers and Surface Protectants	870												TBD						

Coating	EPA	CARB	Antelope	Bay Area	Butte	Colusa	El Dorado	Feather River	Imperial	Kern	Mojave	Monterey	Placer	Sacramento	San Diego	San Joaquin	Santa Barbara	South Coast	Ventura
Rule Name or Number	63 FR 176: 48848	SCM	1113	8-3	240	2.26	215	3.15	424	410.1	1113	426	218	442	67	4601	323	1113	74.2
Non Flats, Interior	380	250	250	250	380	250	(250)	(250)	(250)	(250)	(250)	(250)	250	(250)	(250)	(250)	(250)	250 [150 7/1/2002] [50 7/1/2006]	(250)
Non Flats, Exterior	380	250	250	250	380	250	(250)	(250)	(250)	(250)	(250)	(250)	250	(250)	(250)	(250)	(250)	250 [150 7/1/2002] [50 7/1/2006]	(250)
Nuclear	450												TBD						
Pre-Treatment Wash Primers	780	420	780				675		420	420	780		675	420	780	420	420	780	420
Primers and Undercoaters	350												350						
Primers, Sealers, and Undercoaters, General		350	350	350	550	350	350	350	350	350	350	350		350	350	350	350	350 [200 7/1/2002] [100 7/1/2006]	350
Primers, Sealers, and Undercoaters, Specialty				350	550	350	350	350				350							
Quick Dry Enamels	450		400	400	650	400	400	400		400	400	400	400	400	400	400	250	400 [250 7/1/2002] [50 7/1/2006]	400
Quick Dry Primers and Sealers				E						450				450		450			
Quick Dry Primers, Sealers, and Undercoaters	450				E	E		E			450	E	350		525		350	350* [200 7/1/2002] [100 7/1/2006]	E
Recycled Coatings																		250 [100 7/1/2006]	
Repair and Maintenance Thermoplastic	650												650						
Roof	250	300	300	300	500	300	300	300	300	300	300	300	300	300	300	300	300	250	300
Rust Preventative	400												TBD					400 [100 7/1/2006]	
Sanding Sealers		350	350						350	350	550			350	550	350	350	350	
Sanding Sealers (Non-Lacquer)	550						350						350						350
Sealers (Including Clear Wood Sealers)	400												350						
Shellacs, Clear	730	730	730	E	E	E	730	E	730	730	730	E	730	730	730	730	730	730	730
Shellacs, Opaque	550			E	E	E		E				E	550						
Shellacs, Pigmented		550	550	E	E	E	550	E	550	550	550	E		550	550	550	550	550	550
Silicones (Industrial Maintenance)			420	420															
Specialty Primers																		350 [100 7/1/2006]	
Stains, Clear and Semitransparent	550		350										350					350 [250 7/1/2002]	
Stains, Semitransparent		350		350	700	350	350	350	350	350	350	350		350	350	350	350		350
Stains, Opaque	350	350	350	350	650	350	350	350	350	350	350	350	350	350	350	350	350	350 [250 7/1/2002]	350
Stain Controllers	720																		
Swimming Pool, General	600	340	340	E	E	E	340	E	340	340	650	E	340	340	650	340	340	340	340

Coating	EPA	CARB	Antelope	Bay Area	Butte	Colusa	El Dorado	Feather River	Imperial	Kern	Mojave	Monterey	Placer	Sacramento	San Diego	San Joaquin	Santa Barbara	South Coast	Ventura
Rule Name or Number	63 FR 176: 48848	SCM	1113	8-3	240	2.26	215	3.15	424	410.1	1113	426	218	442	67	4601	323	1113	74.2
Swimming Pool Repair & Maintenance		340	650				650		340	600	650			340	650	340	340	650	340
Thermoplastic Rubber and Mastics	550												TBD						
Tile-Like Glaze				E	E	E		E				E							
Traffic	150		150				250				250		250		250			150	250
Traffic, Applied to Other Surfaces		250		250	250	250		250	250	250	250	250		250		250	250		
Traffic, Applied to Public Streets and Highways		250		250	650	250		250	250	250		250		250		250	250		
Traffic, Black Traffic Coatings		250		250	650	250		250	250	250	650	250		250		250	250		
Unique Vehicles (Industrial Maintenance)			420	420															
Urethane Polymers (Industrial Maintenance)			420	420															
Varnishes	450	350	350	350	650	350	350	350	350	350	350	350	350	350	350	350	350	350	350
Vinyl Chloride Polymers (Industrial Maintenance)			420	420															
Waterproof Mastics				300	500	300		300		300		300			300	300			
Water Proofing Sealers		400	400	400	800	400	400	400	400	400	400	400		400	400	400	400		400
Waterproofing Sealers, Wood																		400 [250 7/1/2002]	
Waterproofing Sealers, Concrete/Masonry																		400	
Water Proofing Sealers and Treatments, Clear	600												400						
Water Proofing Sealers and Treatments, Opaque	600												400						
Wood Preservatives, Below Ground	550	350	350	E	E	E	350	E	350	350	600	E	350	350	600	350	350	350	350
Wood Preservatives, Clear and Semitransparent	550	350	350	350	700	350	350	350	350	350	350	350	350	350	350	350	350	350	350
Wood Preservatives, Opaque	350	350	350	350	650	350	350	350	350	350	350	350	350	350	350	350	350	350	350
Zone Marking	450																		
Adopted	Sep 98	May 89	Jul 97	Mar 78	July 79	1979	Sep 94	June 91	Nov 82	Apr 72	Feb 79	May 79	Jun 79	Dec 78	Nov 77	Apr 91	Oct 71	Sep 77	Jun 79
Last Amended				Nov 98	Apr 96	May 91	Sep 94	May 96	Sep 99	May 97	Nov 92	Dec 96	Aug 97	Sep 96	May 96	Sep 97	Jul 96	May 99	Aug 92

Coating	EPA	CARB	Antelope	Bay Area	Butte	Colusa	El Dorado	Feather River	Imperial	Kern	Mojave	Monterey	Placer	Sacramento	San Diego	San Joaquin	Santa Barbara	South Coast	Ventura
Rule Name or Number	63 FR 176: 48848	SCM	1113	8-3	240	2.26	215	3.15	424	410.1	1113	426	218	442	67	4601	323	1113	74.2
Notes:																			
*The specified limit applies unless the manufacturer submits a report pursuant to Rule 1113 (g)(2).																			
Yolo-Solano Rule 2.14, Architectural Coatings, was adopted by the ARB on July 26, 1979 (ARB Resolution 79-63). Some provisions of the rule are outdated.																			
E means that the district rule specifically exempts this category from VOC limits.																			
TBD means the VOC limit will be assigned at a later date, pending adoption of the EPA national rule.																			
District rules (except for Butte) and the ARB SCM state that a coating's VOC limit is 250 grams per liter, with the exception of categories listed in the above table.																			
Parentheses indicate VOC limits that apply due to the 250 grams per liter default provision, but the limits are not specifically stated in the rule.																			
Brackets indicate future effective VOC limits.																			
The EPA rule states that if a coating is not defined in the table above, it falls into the flat or nonflat category based on the gloss level, and the applicable limit applies.																			
I:\Reference Documents\District Rule Summary\Summary.xls																			

Appendix D:

SCM Meeting/Workshops Notices .

P(M. Rooney
Se. .ry for
Environmental
Protection

Air Resources Board

John D. Dunlap, III, Chairman
P.O. Box 2815 · 2020 L Street · Sacramento, California 95812 · www.arb.ca.gov

Pete Wilson
Governor

May 7, 1998

Dear Sir/Madam:

I am writing to invite you to join us on May 27, 1998, in Sacramento, California, for a public consultation meeting to discuss the Air Resources Board's and air pollution control districts' current effort to conduct a technical evaluation of architectural coatings. This evaluation includes a survey of manufacturers who supply coatings in California, as well as an assessment of the technological and economic feasibility of more effective volatile organic compound (VOC) limits for various coating categories. The technical evaluation will form the basis of an update to the 1989 Suggested Control Measure for Architectural Coatings. The purpose of the meeting is to provide introductory information about the technical evaluation and to receive feedback on various concepts that may provide additional flexibility for manufacturers to comply with architectural coatings regulations (see enclosed agenda).

The date, time, and location of the meeting are as follows:

Date:	May 27, 1998
Time:	10:00 a.m. - 3:00 p.m.
Location:	California Air Resources Board 2020 L Street Board Hearing Room, Lower Level Sacramento, California

Some of the flexibility concepts we will discuss are reactivity, averaging, innovative products, and regional limits. We would like to hear your views on how these concepts can be utilized in the addressing emissions in architectural coatings. These concepts are briefly defined below:

- Reactivity describes the propensity of individual VOCs to form ground level ozone.
- Averaging allows compliance with regulations through use of an emissions cap on overall aggregate emissions from a group of products.
- Innovative products may exceed the VOC limit, but through special formulation or packaging, emit less VOC than a product which meets the applicable limit.
- Regional coating limits would allow tailoring of limits to regional conditions.

We hope you will be able to participate in this meeting. Persons with disabilities who require accommodation may contact Ms. Cheryl Young at (916) 323-1069 by May 20, 1998. A telecommunications device for the deaf (TDD) is reachable from phones equipped with a TDD device at (916) 324-9531.

If you have any comments or suggestions you would like to share with us, please do not hesitate to contact me at (916) 322-6020, or Ms. Cheryl Young at (916) 323-1069.

Sincerely,

Dean C. Simeroth, Chief for
Criteria Pollutants Branch

Enclosure

cc: Ms. Cheryl Young
Air Pollution Specialist
Criteria Pollutants Branch

Air Resources Board

P‑ ‑er M. Rooney
‑etary for
Environmental
Protection

John D. Dunlap, III, Chairman
P.O. Box 2815 · 2020 L Street · Sacramento, California 95812 · www.arb.ca.gov

Pete Wilson
Governor

July 24, 1998

Dear Sir/Madam:

This is to inform you of a public workshop to be held to discuss progress in the Air Resources Board's and air pollution control districts' current effort to conduct a technical evaluation of architectural coatings. This evaluation includes a survey of manufacturers who supply coatings in California, as well as an assessment of the technological and economic feasibility of current or future volatile organic compound limits for various coating categories. The technical evaluation will form the basis of an update to the 1989 Suggested Control Measure for Architectural Coatings. An agenda will be mailed prior to the workshop.

The date, time, and location of the meeting are as follows:

Date:	August 20, 1998
Time:	10:00 a.m. - 1:00 p.m.
Location:	California Air Resources Board 2020 L Street Board Hearing Room, Lower Level Sacramento, California

We hope you will be able to participate in this workshop. If you cannot attend, but would like to provide comments, you may contact Mr. Jim Behrmann, Manager, Strategy Evaluation Section, at (916) 322-8273. You may send written comments to Mr. Behrmann, Air Resources Board, Stationary Source Division, P.O. Box 2815, Sacramento, California 95812.

The meeting facility is accessible to persons with disabilities. If accommodation is needed, please contact Ms. Jacqueline Wilson at (916) 327-1493, TDD (916) 342-9531, or (800) 700-8326 for TDD calls outside the Sacramento area, by August 13, 1998.

If you have any questions about the workshop, you may contact me at (916) 322-6020.

Sincerely,

for Dean C. Simeroth, Chief
Criteria Pollutants Branch
Stationary Source Division

Winston H. Hickox
Secretary for Environmental Protection

Air Resources Board

Alan C. Lloyd, Ph.D.
Chairman
2020 L Street • P.O. Box 2815 • Sacramento, California 95812 • www.arb.ca.gov

Gray Davis
Governor

March 10, 1999

Dear Sir/Madam:

I am writing to invite you to a public workshop being held to discuss draft results from the Air Resources Board's (ARB) 1998 Architectural Coatings Survey. The survey results summarize sales, emissions, and volatile organic compound (VOC) data for architectural coatings sold in California in 1996. The survey results are an important part of the ARB's and air pollution control districts' current effort to conduct a technical evaluation of architectural coatings. This evaluation also includes an assessment of the technological and economic feasibility of current or future VOC limits for various coating categories. The technical evaluation will form the basis of an update to the ARB's 1989 Suggested Control Measure for Architectural Coatings.

The date, time, and location of the meeting are as follows:

Date:	March 30, 1999
Time:	1:30 - 4:30 p.m.
Location:	Conference Room GB South Coast Air Quality Management District Headquarters 21865 E. Copley Drive Diamond Bar, CA 91765

This facility is accessible to persons with disabilities. If accommodation is needed please contact Ms. Jacqueline Wilson at (916) 322-6020 by March 23, 1999.

Persons with hearing or speech impairments can contact us by using our Telephone Device for the Deaf (TDD) at (916) 324-9531, or (800) 700-8326 for TDD calls from outside the Sacramento area.

We are holding the workshop at the South Coast District offices to coincide with the District's public consultation meeting on proposed amendments to its architectural coatings rule (Rule 1113), scheduled for March 31, 1999, at the District.

The purpose of our workshop is to solicit comments or questions on the draft survey results. The meeting agenda is enclosed. You may send written comments to Mr. Jim Nyarady, Staff Air Pollution Specialist, at the address shown above. The deadline for written comments is April 2, 1999.

If you would like a copy of the draft survey, please contact Mr. Nyarady at (916) 323-5184. If you have any questions about the workshop, you may contact me at (916) 322-6020.

Sincerely,

Dean C. Simeroth, Chief
Criteria Pollutants Branch
Stationary Source Division

Enclosure

cc: Mr. Jim Nyarady
Staff Air Pollution Specialist
Strategy Evaluation Section
Criteria Pollutants Branch

Winston H. Hickox
Secretary for Environmental Protection

Air Resources Board

Alan C. Lloyd, Ph.D.
Chairman
2020 L Street • P.O. Box 2815 • Sacramento, California 95812 • www.arb.ca.gov

Gray Davis
Governor

May 5, 1999

Dear Sir/Madam:

I am writing to invite you to a public workshop being held to discuss draft proposed changes to the Air Resources Board's (ARB) Suggested Control Measure for Architectural Coatings (SCM). The SCM is the model rule upon which California air pollution control districts' rules have been based. The purpose of the meeting is to receive public comments on the draft volatile organic compound (VOC) limits for several architectural coating categories proposed for revision, as well as changes to the SCM's definitions. The ARB and district staffs are collaborating to harmonize the SCM's provisions with the National Volatile Organic Compound Emission Standards for Architectural Coatings, published by the United States Environmental Protection Agency on September 11, 1998. A previous workshop addressed the ARB's 1998 architectural coatings survey, which summarizes sales, emissions, and VOC data for architectural coatings sold in California in 1996.

The meeting agenda is enclosed. You will receive the proposed SCM changes under separate cover.

The date, time, and location of the meeting are as follows:

Date:	Thursday, June 3, 1999
Time:	10:00 a.m. to 3:00 p.m.
Location:	California State Library Library and Courts Building I, Room 500 914 Capitol Mall Sacramento, California 95814

A map detailing the location of the building and parking facilities is enclosed.

This facility is accessible to persons with disabilities. If accommodation is needed please contact Ms. Jacqueline Wilson at (916) 322-6020 by May 26, 1999.

Persons with hearing or speech impairments can contact us by using our Telephone Device for the Deaf (TDD) at (916) 324-9531, or (800) 700-8326 for TDD calls from outside the Sacramento area.

If you have any questions about the workshop, you may contact me at (916) 322-6020, or Mr. Jim Nyarady, Manager, Strategy Evaluation Section, at (916) 323-8273.

Sincerely,

Jim Nyarady

for Dean C. Simeroth, Chief
Criteria Pollutants Branch
Stationary Source Division

Enclosures

cc: Mr. Jim Nyarady, Manager
Strategy Evaluation Section
Criteria Pollutants Branch

Air Resources Board

Alan C. Lloyd, Ph.D.
Chairman

2020 L Street • P.O. Box 2815 • Sacramento, California 95812 • www.arb.ca.gov

Winston H. Hickox
Secretary for Environmental Protection

Gray Davis
Governor

June 15, 1999

Dear Sir or Madam:

I am writing to invite you to a public workshop being held to discuss draft proposed changes to the Air Resources Board's (ARB) Suggested Control Measure for Architectural Coatings (SCM). The SCM is the model rule upon which California air pollution control districts' rules have been based. The meeting serves two purposes: (1) to receive comments on the second draft of the SCM, and (2) to receive comments on the Notice of Preparation (NOP) and Initial Study for a Draft Program Environmental Impact Report (EIR) for the SCM.

Thus, this public workshop will also serve as a scoping meeting under the California Environmental Quality Act, to allow the public the opportunity to help the ARB identify the range of actions, alternatives, mitigation measures, and significant effects to be analyzed in the Draft Program EIR. The Draft Program EIR will be circulated for public review and comment upon completion. Responses to all comments received on the Draft Program EIR during the public comment period will be included in the Final Program EIR.

The meeting agenda and second draft of the proposed SCM changes are enclosed. Additional changes to the SCM may be presented at the workshop. The NOP has been sent to you under separate cover. As mentioned in the NOP, if you would like a copy of the Initial Study, you may access the ARB's Internet site at **http://www.arb.ca.gov/arch/arch.htm**, or contact the ARB's Public Information Office at the address above, or call the Public Information Office at (916) 322-2990.

At our workshop on June 3, 1999, we presented the first draft of the proposed SCM. At that time we invited interested parties to meet with us individually to discuss concerns specific to your products. You may also make written comments. All comments and requests for meetings should be addressed to Mr. Jim Nyarady, Manager, Strategy Evaluation Section, at the address above. Mr. Nyarady's telephone number is (916) 322-8273 and his electronic mail address is jnyarady@arb.ca.gov. The deadline for written comments on the NOP and Initial Study is July 22, 1999.

The date, time, and location of the meeting are as follows:

Date:	Thursday, July 1, 1999
Time:	10:00 a.m. to 4:00 p.m.
Location:	Air Resources Board Board Hearing Room, Lower Level 2020 L Street Sacramento, California

We look forward to your participation in this workshop. There is no need to notify us regarding your plans to attend. This facility is accessible to persons with disabilities. If accommodation is needed, please contact Ms. Jacqueline Wilson at (916) 322-6020 by June 24, 1999. Persons with hearing or speech impairments can contact us by using our Telephone Device for the Deaf (TDD) at (916) 324-9531, or (800) 700-8326 for TDD calls from outside the Sacramento area.

If you have any questions about the workshop, you may contact me at (916) 322-6020, or Mr. Nyarady.

Sincerely,

Dean C. Simeroth, Chief
Criteria Pollutants Branch
Stationary Source Division

Enclosures

cc: Mr. Jim Nyarady, Manager
Strategy Evaluation Section
Criteria Pollutants Branch

Air Resources Board

Alan C. Lloyd, Ph.D.
Chairman

2020 L Street • P.O. Box 2815 • Sacramento, California 95812 • www.arb.ca.gov

..inston H. Hickox
Secretary for Environmental Protection

Gray Davis
Governor

August 19, 1999

Dear Sir or Madam:

I am writing to invite you to a public workshop being held to discuss draft proposed changes to the Air Resources Board's (ARB) Suggested Control Measure for Architectural Coatings (SCM). The SCM is the model rule upon which California air pollution control districts' rules have been based.

The date, time, and location of the meeting are as follows:

Date:	Wednesday, September 8, 1999
Time:	10:30 a.m. to 3:00 p.m.
Location:	Conference Room GB South Coast Air Quality Management District (SCAQMD) Headquarters 21865 E. Copley Drive Diamond Bar, California 91765

The purpose of the meeting is to receive comments on the third draft of the SCM. The SCM and meeting agenda are enclosed.

The modifications to the SCM reflect changes in our current focus and schedule. The revised draft SCM now contains only the near-term limits (effective in 2002). This will enable us to focus our limited resources on the issues related to achievement of the near-term limits statewide in the affected categories. We intend to address the long-term limits following completion of this project.

The other important change in our strategy is our schedule. Due to the need for more time to fully evaluate all data and concerns that have been raised, we are now planning on bringing the SCM to our Board for approval in April 2000.

We are continuing to meet with interested parties to discuss individual concerns. Interested parties may still provide written comments on the SCM. All comments and requests for meetings should be addressed to Mr. Jim Nyarady, Manager, Strategy Evaluation Section, at the address above. Mr. Nyarady's telephone number is (916) 322-8273 and his electronic mail address is jnyarady@arb.ca.gov.

Unfortunately, only one paint manufacturer to date has shared detailed testing information with us. I strongly encourage individual paint manufacturers, resin manufacturers, and formulators to meet with us. It is our desire to consider all available scientific information on currently available products, and products under development, prior to developing the final proposed SCM limits.

We look forward to your participation in this workshop. There is no need to notify us regarding your plans to attend. This facility is accessible to persons with disabilities. If accommodation is needed, please contact Ms. Jacqueline Wilson at (916) 322-6020 by September 1, 1999. Persons with hearing or speech impairments can contact us by using our Telephone Device for the Deaf (TDD) at (916) 324-9531, or (800) 700-8326 for TDD calls from outside the Sacramento area.

If you have any questions about the workshop, you may contact me at (916) 322-6020, or Mr. Nyarady.

Sincerely,

James F. Nyarady

for Dean C. Simeroth, Chief
Criteria Pollutants Branch
Stationary Source Division

Enclosures

cc: Mr. Jim Nyarady, Manager
Strategy Evaluation Section
Criteria Pollutants Branch

Air Resources Board
Alan C. Lloyd, Ph.D.
Chairman
2020 L Street • P.O. Box 2815 • Sacramento, California 95812 • www.arb.ca.gov

W‥ ston H. Hickox
A ‥cy Secretary

Gray Davis
Governor

November 17, 1999

Dear Sir or Madam:

I am writing to invite you to a public workshop being held to discuss proposed changes to the Air Resources Board's (ARB) Suggested Control Measure for Architectural Coatings (SCM). The SCM is the model rule upon which California air pollution control districts' rules have been based.

The purpose of the workshop is to discuss concepts for the averaging compliance option and to discuss proposed changes to the SCM. The meeting agenda is enclosed. The proposed SCM will be mailed at least 10 days prior to the workshop, and will also be available on our website at: http://www.arb.ca.gov/arch/arch.htm.

The date, time, and location of the workshop are as follows:

Date:	Tuesday, December 14, 1999
Time:	9:00 a.m. to 4:00 p.m.
Location:	Conference Room GB South Coast Air Quality Management District (SCAQMD) Headquarters 21865 E. Copley Drive Diamond Bar, California 91765

At the September 8, 1999, workshop, a request was made for a discussion on how an averaging compliance option would work on a statewide basis. At the workshop we will present an overview of the Alternative Control Plan which is an averaging provision in the ARB's Consumer Product Program. This will be followed by an open discussion of averaging concepts. After the averaging discussion, proposed changes to the SCM will be presented for comment.

We are continuing to meet with interested parties to discuss individual concerns. If you would like to comment on the SCM or schedule a meeting with us, please contact Mr. Jim Nyarady, Manager, Strategy Evaluation Section. Mr. Nyarady's telephone number is (916) 322-8273 and his electronic mail address is jnyarady@arb.ca.gov.

We look forward to your participation in this workshop. There is no need to notify us regarding your plans to attend. This facility is accessible to persons with disabilities. If accommodation is needed, please contact Ms. Kathy Spring at (916) 323-3485 by December 7, 1999. Persons with hearing or speech impairments can contact us by using our Telephone Device for the Deaf (TDD) at (916) 324-9531, or (800) 700-8326 for TDD calls from outside the Sacramento area.

If you have any questions about the workshop, you may contact me at (916) 322-7072, or Mr. Nyarady at (916) 322-8273.

Sincerely,

Barbara Fry for
Janette Brooks, Chief
Air Quality Measures Branch
Stationary Source Division

Enclosure

cc: See next page.

cc: Mr. Jim Nyarady, Manager
Strategy Evaluation Section
Criteria Pollutants Branch

Mr. Dick Baldwin, Chairman
CAPCOA's Architectural Coatings SCM Committee

Air Resources Board

Alan C. Lloyd, Ph.D.
Chairman

2020 L Street • P.O. Box 2815 • Sacramento, California 95812 • www.arb.ca.gov

inston H. Hickox
Agency Secretary

Gray Davis
Governor

February 25, 2000

Dear Sir or Madam:

I am writing to invite you to a public workshop to discuss the Air Resources Board's (ARB) proposed Suggested Control Measure for Architectural Coatings (SCM).

The purpose of the workshop is to discuss and solicit comments on the proposed SCM and on concepts for a voluntary averaging provision. The meeting agenda and the proposed SCM are enclosed.

The date, time, and location of the meeting are as follows:

Date:	Thursday, March 16, 2000
Time:	9:30 a.m. to 12:00 noon
Location:	Board Hearing Room, Lower Level Air Resources Board 2020 L Street Sacramento, California 95814

You may make written comments on the SCM. All comments should be addressed to Mr. Jim Nyarady, Manager, Strategy Evaluation Section, at the address above. Mr. Nyarady's telephone number is (916) 322-8273 and his electronic mail address is jnyarady@arb.ca.gov.

A Draft Program Environmental Impact Report (Draft Program EIR) for the proposed SCM has been released for comments. The comment period for the Draft Program EIR began on February 22, 2000, and ends on April 7, 2000. The Draft Program EIR is available on our website at: http://www.arb.ca.gov/arch/recent.htm.

The language of the proposed SCM that will be discussed at the workshop is the same as the SCM that was included in Appendix A of the Draft Program EIR. To facilitate the discussion, however, the version of the SCM attached to this notice has been formatted to display the revisions that have occurred since the December 1, 1999, version of the proposed SCM.

I strongly encourage you to meet with us to discuss your company's or organization's specific comments and suggestions on the proposed SCM. If you are a coatings or resin manufacturer, I request that you meet and share with us your individual recent and ongoing research and development efforts to develop lower VOC products.

We look forward to your participation in this workshop. There is no need to notify us regarding your plans to attend. This facility is accessible to persons with disabilities. If accommodation is needed, please contact Ms. Kathy Spring at (916) 323-3485 by March 9, 2000. Persons with hearing or speech impairments can contact us by using our Telephone Device for the Deaf (TDD) at (916) 324-9531, or (800) 700-8326 for TDD calls from outside the Sacramento area.

If you have any questions about the workshop, you may contact me at (916) 322-7072, or Mr. Nyarady at the phone number given above.

Sincerely,

for

Janette Brooks, Chief
Air Quality Measures Branch
Stationary Source Division

Enclosures

cc: Mr. Jim Nyarady, Manager
Strategy Evaluation Section
Criteria Pollutants Branch

Appendix E:

South Coast AQMD Phase II Assessment Study of Architectural Coatings by National Technical Systems.

SCAQMD Phase II Assessment Study
of
Architectural Coatings
by
National Technical Systems

(Summarized by the California Air Resources Board)

Objective: Compare performance characteristics of higher VOC coatings with lower VOC coatings via laboratory, field application, and long term exposure tests.

Coating Categories Examined:

1. Industrial Maintenance
   - Primer
   - Topcoat
   - Systems
2. Nonflat - Interior & Exterior
   - Primer
   - Topcoat
   - System
3. Primers, Sealers, & Undercoaters - Interior & Exterior
4. Quick Dry Primers, Sealers, & Undercoaters - Interior & Exterior
5. Quick Dry Enamels - Interior & Exterior
   - Topcoat
   - System
6. Waterproofing Sealers
   - Concrete
   - Wood

Total # of manufactuers or brands - 31
Total # of coatings - 94
Total # of systems - 46
Total # of test panels - 3000+

Comments:

The summary and analysis provided by ARB staff in the following pages represents laboratory testing data available (as of April 2000) from the SCAQMD "Phase II Assessment Study of Architectural Coatings" and their contractor National Technical Systems (NTS). Conclusions are based on the data supplied. The field application and long term exposure tests are currently ongoing.

Members of the Technical Advisory Committee (also referred to as the "TAC")

Name	Company / Organization
Harley Fung	Benjamin Moore & Co
Mike Jaczola Jim Nyarady	CARB
Tim Carmichael	Coalition for Clean Air
Robert Wendoll	Dunn-Edwards
Steve Murphy	Murphy Industrial Coatings
Naveen Berry	SCAQMD
Madelyn Harding	Sherwin-Williams
Alexander Ramig	Sierra Performance Coatings
Yin Aye	Smiland Paint Co
David Leehy	Vista Paints

Manufactuers	# of Coatings in Study	Manufactuers	# of Coatings in Study
Advanced Polymer Sciences	1	Insl-X	1
Ameron Protective Coatings	2	Masterchem	1
Aquarius Coatings	1	Morewear	3
Behr Process	3	OKON, Inc.	1
Benjamin Moore	8	PPA Technologies	3
Coatings Resources Corp.	2	Seal-Krete, Inc.	1
Dunn Edwards	11	Sherwin Williams	7
EMU	1	Sigma Coatings	2
Flood Company	1	Superior Environmental Products	2
Frazee Industries	6	TCA	2
GaLXE-2010	4	Thompson's	1
Gloucester Company	1	Tnemec	7
H&C	2	Vista Paints	4
Hart Polymers	3	X-I-M Products	1
ICI/Devoe	6	Zehrung	2
ICI/Glidden	4		
		Total	**94**

Coating Categories by Section:

The original grouping of data by NTS is shown on the next page. The following represents the coating categories included in the NTS performance study reorganized by category in alphabetical order. Please note that although the coating categories are in alphabetical order, the section numbers are not in numerical order.

Category	Section
Industrial Maintenance	
Primer	1
Topcoat	2
Systems	3
Nonflat - Interior	
Primer	4
Topcoat	6
System	8
Nonflat - Exterior	
Primer	5
Topcoat	7
System	9
Primers, Sealers, & Undercoaters - Interior	4
Primers, Sealers, & Undercoaters - Exterior	5
Quick Dry Primers, Sealers, & Undercoaters - Interior	4
Quick Dry Primers, Sealers, & Undercoaters - Exterior	5
Quick Dry Enamels - Interior	
Primers	4
Topcoat	6
System	8
Quick Dry Enamels – Exterior	
Primers	5
Topcoat	7
System	9
Waterproofing Sealers	
Concrete	10
Wood	11

Original Test Groups or Summaries as Organized by NTS

Industrial Maintenance - Primer (Section 1)
Industrial Maintenance - Topcoat (Section 2)
Industrial Maintenance - System (Section 3)

Nonflat Primer, Quick Dry Primer, and Primer Sealer Undercoater - Interior (Section 4)
Nonflat Primer, Quick Dry Primer, and Primer Sealer Undercoater - Exterior (Section 5)

Nonflat Topcoat and Quick Dry Topcoat - Interior (Section 6)
Nonflat Topcoat and Quickdry Topcoat - Exterior (Section 7)

Nonflat System and Quick Dry System - Interior (Section 8)
Nonflat System and Quick Dry System - Exterior (Section 9)

Water Proofing Sealer – Concrete (Section 10)
Water Proofing Sealer – Wood (Section 11)

Section 1: Industrial Maintenance Primer

Total # manufactuers or brands	11
Single component coatings	8
Multi-component coatings	10
Total # coatings	18

Test Summary

Brushing Properties Wet:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Brushing Properties Dry:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Dry Time - Dry To Touch:
- Low VOC coatings required longer dry times compared to high VOC coatings.

Dry Time - Dry Hard:
- Low VOC coatings required longer dry times compared to high VOC coatings.

Contrast Ratio (Hiding Power):
- Low VOC coatings exhibited lower performance compared to high VOC coatings.

Spreading Rate:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Leveling:
- Low VOC Coatings exhibited similar performance compared to high VOC coatings.

Sag Resistance:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Hiding Wet to Dry Changes:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Taber Abrasion Resistance:
- Low VOC coatings exhibited lower performance compared to high VOC coatings.

Dry Film Thickness:
- Low VOC coatings exhibited slightly higher dry film thicknesses compared to high VOC coatings.

Film Flexibility:

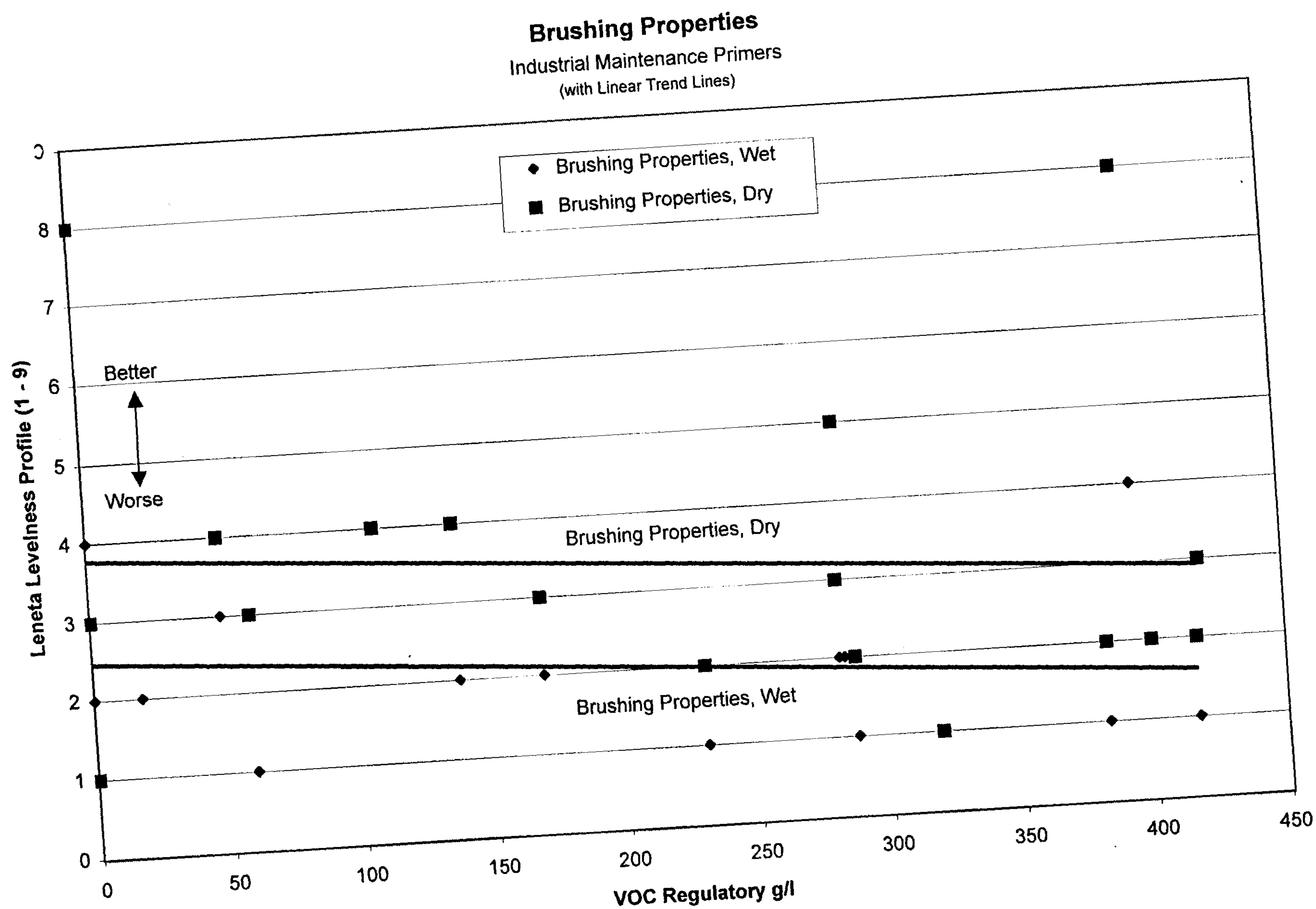
- Fourteen out of 18 coatings passed this test. The four coatings that failed had VOC contents of 0 g/l, 0 g/l, 60 g/l, and 320 g/l.

Comments:

Overall, low VOC coatings exhibited similar performance compared to high VOC coatings.

Industrial Maintenance Primer

Coating Reference Designator	VOC, g/l	Part	Polymer Class	Intended Application	Total
901	108	2	Siloxirane	T	1
920	288	2	Epoxy	P	1
917	417	1	Alkyd	P	1
910	0	2	Epoxy	P	1
902	400	1	Epoxy Ester	P	1
914	0	2	Butadiene-Epoxy	P	1
919	170	2	Epoxy	P	1
933	282	2	Inorganic Zinc Silicate	P	1
932	284	2	Epoxy	T	1
930	419	1	Alkyd	P	1
906	138	1	Acrylic	P	1
904	49	1	Organic Zinc	P	1
908	60	1	Acrylic	P	1
912	0	2	Novolac	P	1
925	395	2	Epoxy	T	1
923	382	1	Alkyd	P	1
922	231	1	Acrylic	T	1
927	320	2	Epoxy	P	1
Grand Total					18

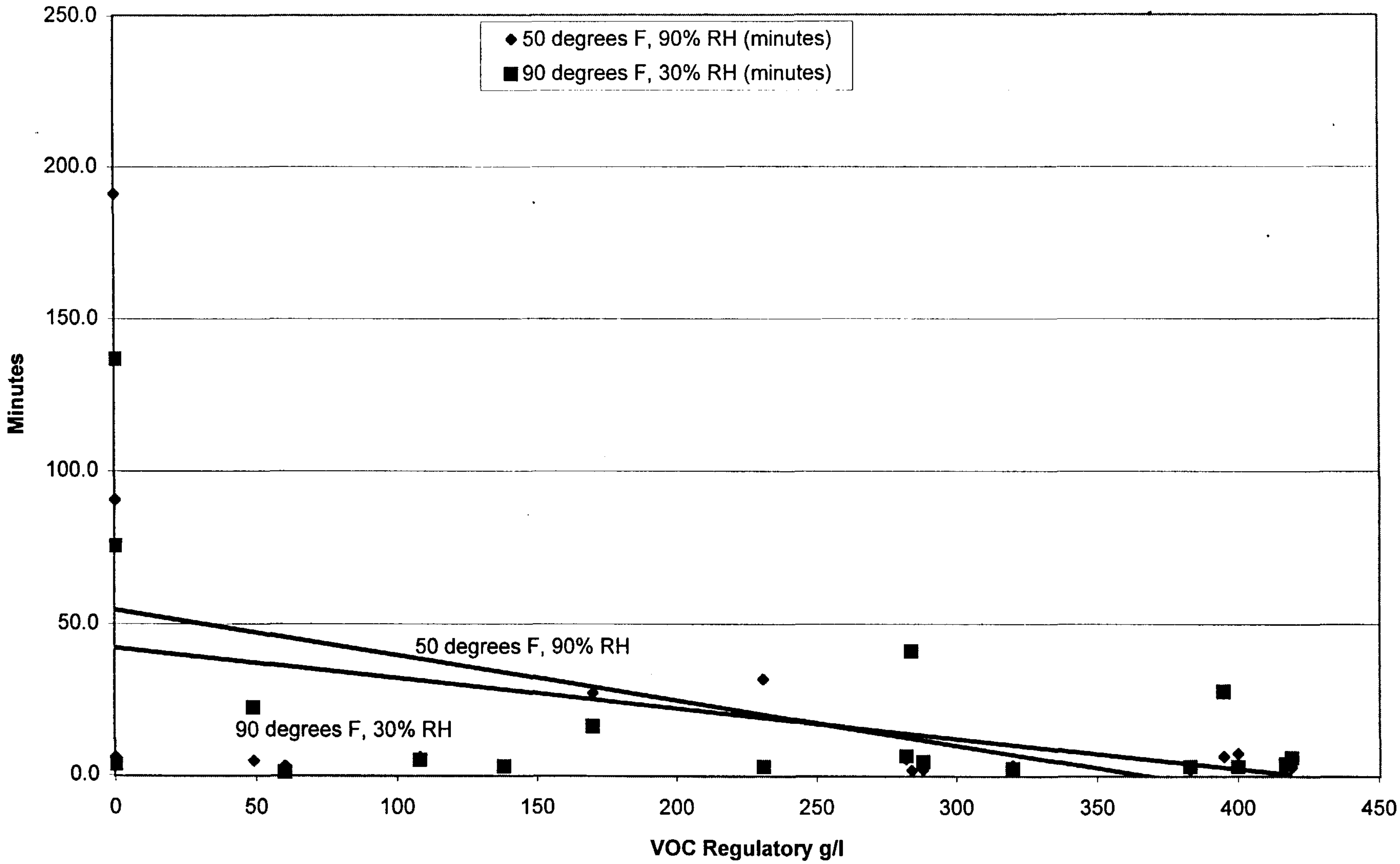


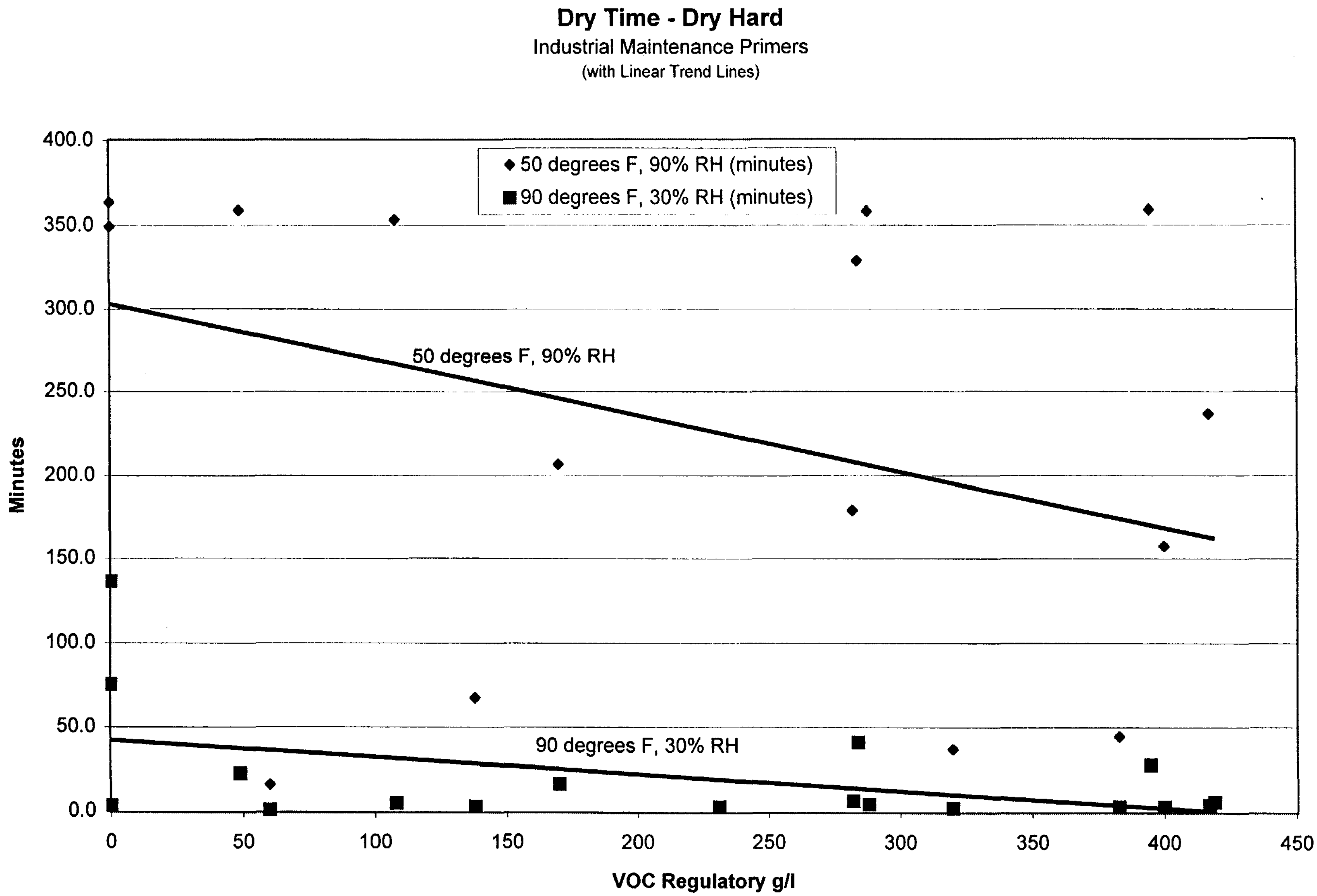
Brushing Properties
Industrial Maintenance Primers
(with Linear Trend Lines)
Brushing Properties, Wet
Brushing Properties, Dry
Better
Worse
Brushing Properties, Dry
Brushing Properties, Wet
Leneta Levelness Profile (1 - 9)
0
1
2
3
4
5
6
7
8
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

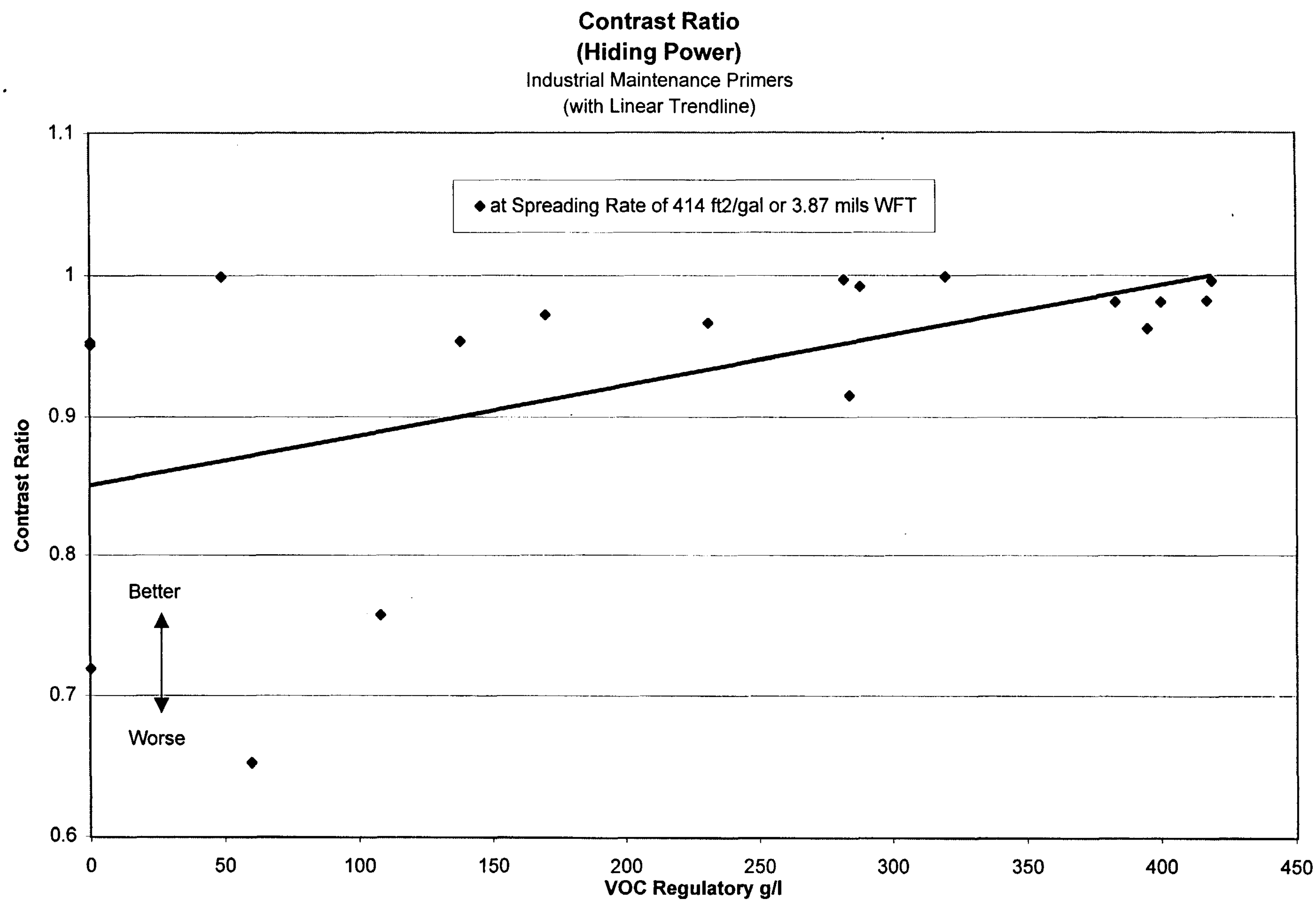
Dry Time - Dry To Touch

Industrial Maintenance Primers

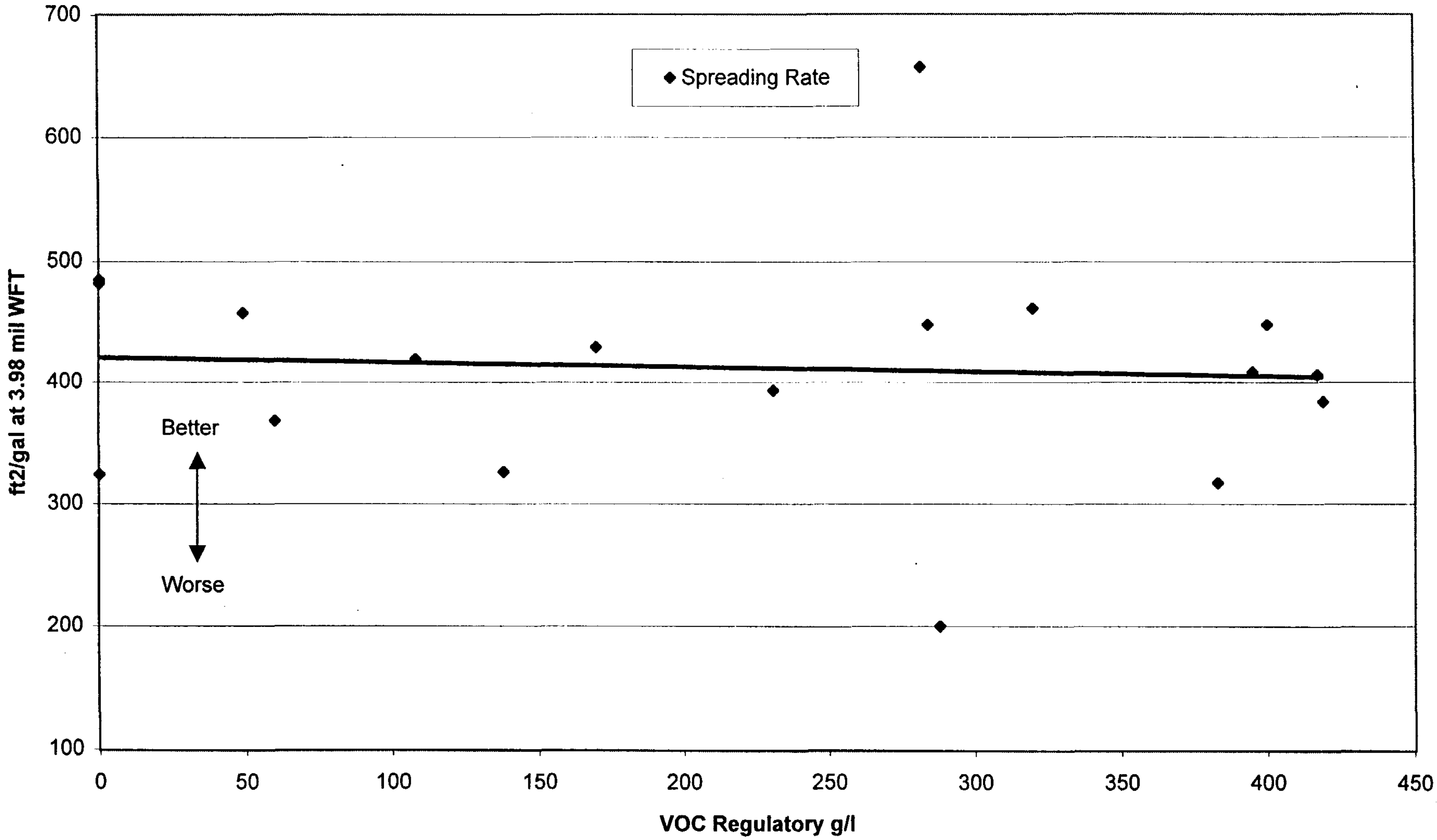
(with Linear Trend Lines)

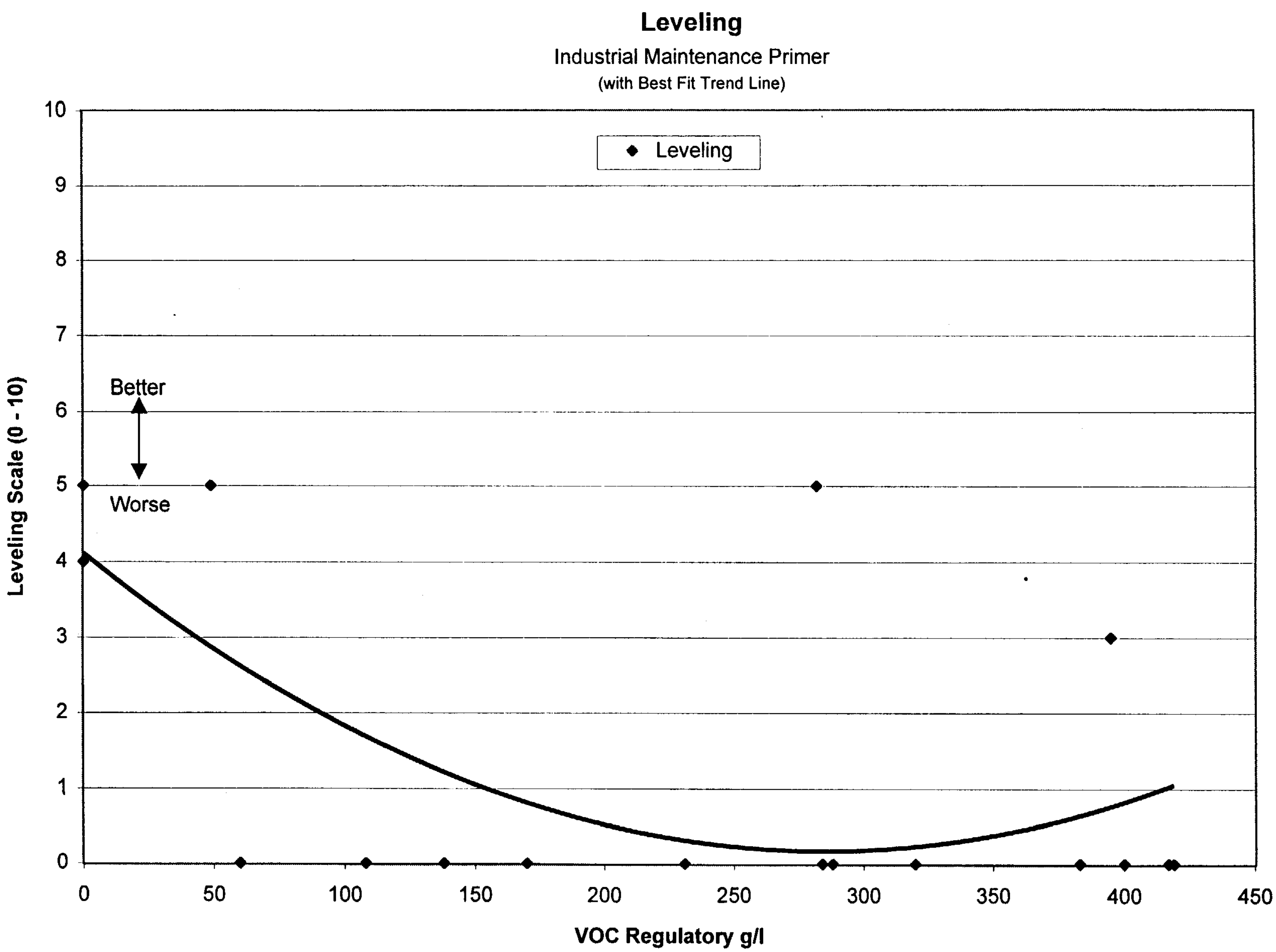


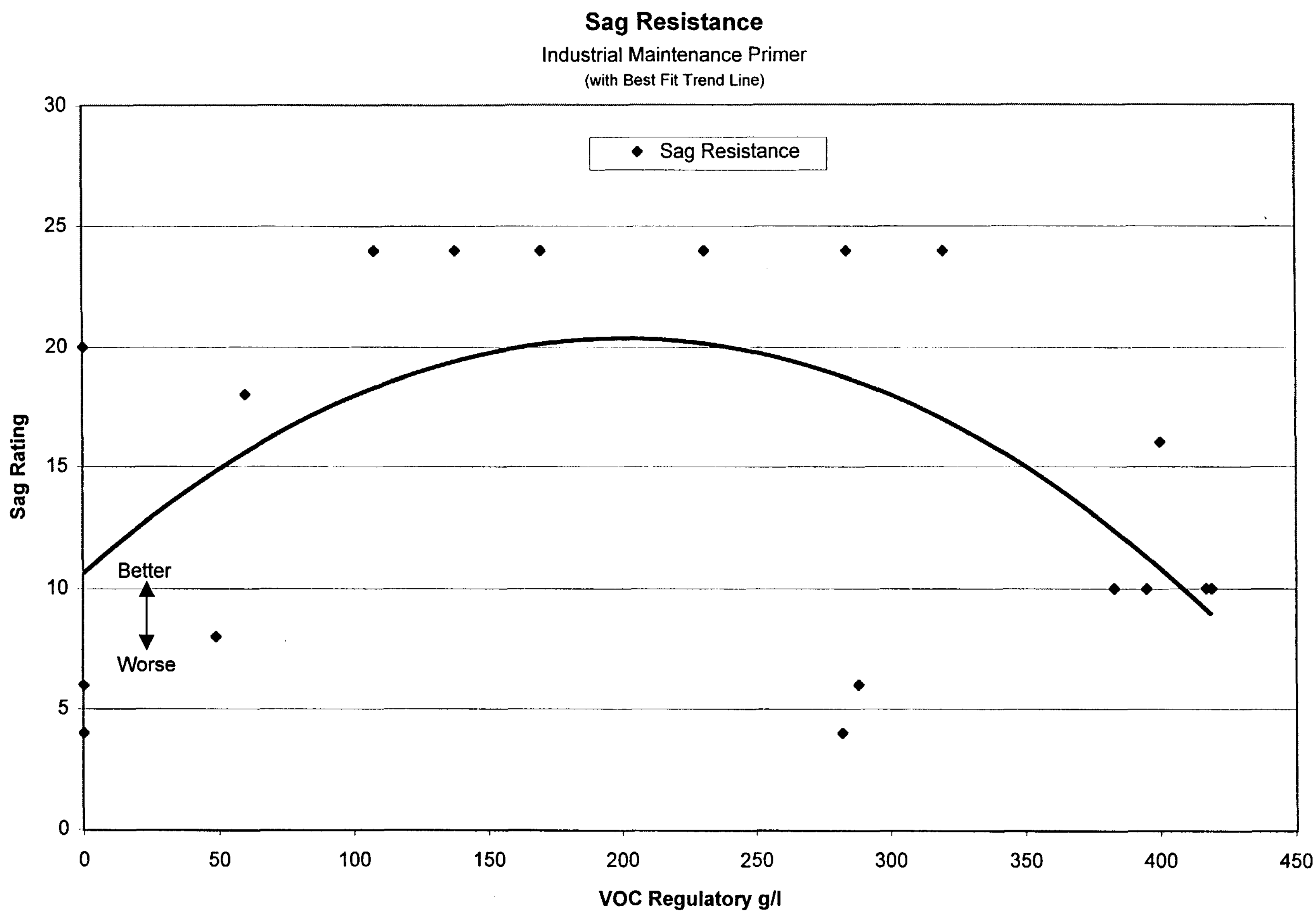

Dry Time - Dry Hard
Industrial Maintenance Primers
(with Linear Trend Lines)
50 degrees F, 90% RH (minutes)
90 degrees F, 30% RH (minutes)
50 degrees F, 90% RH
90 degrees F, 30% RH
Minutes
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

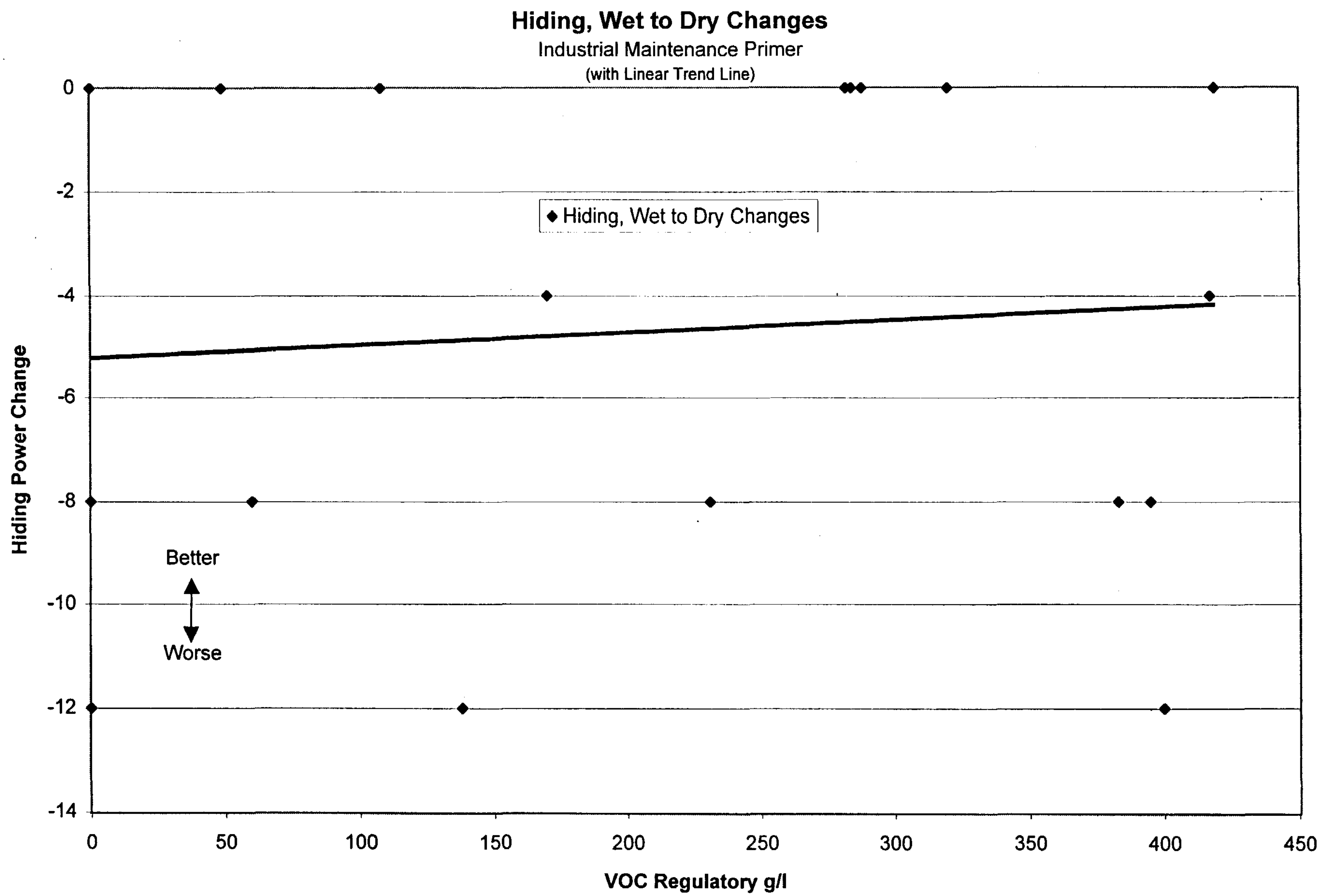

Contrast Ratio
(Hiding Power)
Industrial Maintenance Primers
(with Linear Trendline)
◆ at Spreading Rate of 414 ft2/gal or 3.87 mils WFT
Contrast Ratio
1.1
1
0.9
0.8
0.7
0.6
Better
Worse
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

Spreading Rate
Industrial Maintenance Primers
(with Linear Trendline)

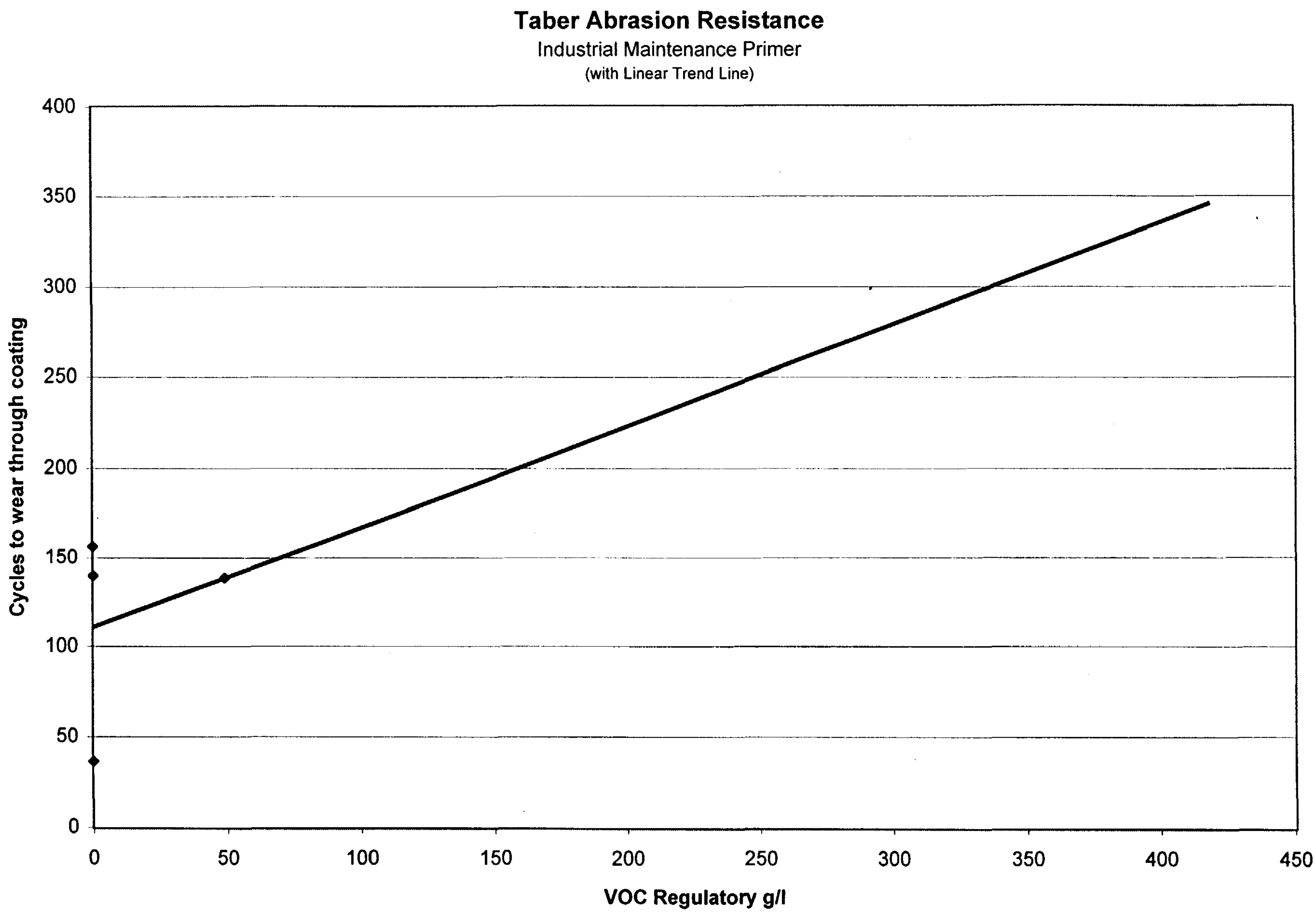


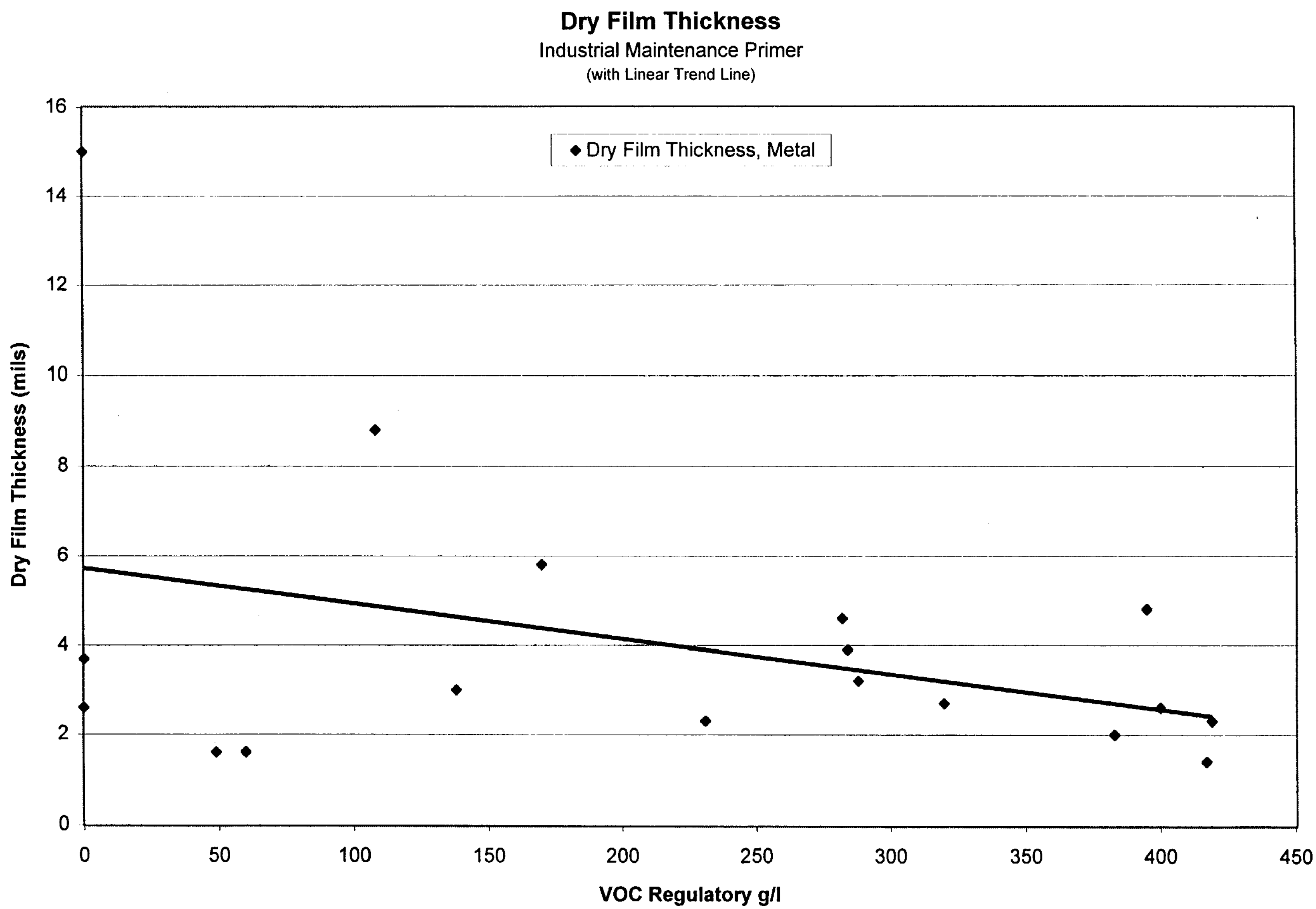

Leveling
Industrial Maintenance Primer
(with Best Fit Trend Line)
Leveling
Better
Worse
Leveling Scale (0 - 10)
VOC Regulatory g/l
10
9
8
7
6
5
4
3
2
1
0
0
50
100
150
200
250
300
350
400
450


Sag Resistance
Industrial Maintenance Primer
(with Best Fit Trend Line)
Sag Resistance
Sag Rating
Better
Worse
VOC Regulatory g/l
0
5
10
15
20
25
30
0
50
100
150
200
250
300
350
400
450



Hiding, Wet to Dry Changes
Industrial Maintenance Primer
(with Linear Trend Line)
◆ Hiding, Wet to Dry Changes
Hiding Power Change
0
-2
-4
-6
-8
-10
-12
-14
Better
Worse
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l


Taber Abrasion Resistance
Industrial Maintenance Primer
(with Linear Trend Line)
Cycles to wear through coating
VOC Regulatory g/l
0
50
100
150
200
250
300
350
400
450


Dry Film Thickness
Industrial Maintenance Primer
(with Linear Trend Line)
Dry Film Thickness, Metal
Dry Film Thickness (mils)
0
2
4
6
8
10
12
14
16
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

Industrial Maintenance Coating Primer (IMCP) Data Table

Protocol Test Number							2.1	2.1	2.2		2.2		3.14	3.14	2.4
Coating Reference Number	Coating Reference Designator	VOC Content	Polymer Class	Nonvolatile by Weight	Coarse Particles	Density	Brushing Properties, Wet	Brushing Properties, Dry	Dry time, Dry to Touch - One Part Coatings		Dry time, Dry Hard - One Part Coatings		Contrast Ratio (Cw) Hiding Power	Spreading Rate	Leveling
Units		g/l		%	Size in Microns	lbs/gal	Leneta Leveleness Profile, 1 - 9	Leneta Leveleness Profile, 1 - 9	50 degrees F, 90% RH (minutes)	90 degrees F, 30% RH (minutes)	50 degrees F, 90% RH (minutes)	90 degrees F, 30% RH (minutes)	at Spreading Rate of 414 ft2/gal or 3.87 mils WFT		Scale, 0-10
910	IMC10	0	Epoxy	61.5	20	10.18	2	<1	90.6	136.5	349.2	337.5	0.952	482	5
912	IMC12	0	Novolac	89.2	97	9.75	4	8	191.1	75.6	349.2	212.7	0.95	324	4
914	IMC14	0	Butadine-Epoxy	66.3	24	9.95	2	3	6.1	3.7	363.2	297.7	0.719	485	5
904	IMC4	49	Epoxy-Polyamide, Zinc-rich	84.3	24	23.65	3	4	4.8	22.5	358.8	304.2	0.999	458	5
908	IMC8	60	Acrylic	60.4	24	12.19	1	3	3.0	1.0	15.9	4.0	0.652	368	0
901	IMC1	108	Siloxirane	95.16	36	12.59	4	4	6.1	5.1	353.2	298.5	0.757	419	0
906	IMC6	138	Acrylic	59.1	64	11.26	2	4	2.5	3.0	67.3	10.5	0.953	326	0
919	IMC19	170	Epoxy	89.2	60	12.82	2	3	27.1	16.5	206.5	48.9	0.972	429	0
922	IMC22	231	Acrylic	59.5	60	12.01	1	2	31.8	3.0	360.0	71.1	0.966	393	0
933	IMC32	282	Inorganic Zinc Silicate	79.4	96	19.01	2	3	5.5	6.6	179.2	155.1	0.997	657	5
932	IMC31	284	Epoxy	73.8	44	11.48	2	5	1.6	41.1	328.9	181.8	0.915	448	0
920	IMC20	288	Epoxy	94.5	72	11.71	1	2	1.9	4.6	358.0	357.1	0.992	200	0
927	IMC26	320	Epoxy	91.5	100	28.53	<1	<1	3.3	2.4	36.9	24.6	0.999	462	0
923	IMC23	383	Alkyd	75.6	26	12.31	1	2	1.9	3.1	44.5	12.4	0.981	317	0
925	IMC25	395	Epoxy	77.3	24	12.5	4	8	6.4	27.9	358.9	263.4	0.962	408	3
902	IMC2	400	Epoxy Ester	74.1	92	11.98	2	2	7.3	3.1	157.3	76.0	0.981	448	0
917	IMC17	417	Alkyd	71.7	60	11.89	1	2	2.8	4.0	236.5	215.2	0.982	406	0
930	IMC29	419	Alkyd	65.4	32	11.49	2	3	2.7	6.0	6.3	20.1	0.996	384	0

Industrial Maintenance Coating Primer (IMCP) Data Table

Protocol Test Number		2.7	2.10								3.2	3.2	3.10	3.9
Coating Reference Number	Coating Reference Designator	Sag Resistance	Hiding, Wet to Dry Changes	Wet Film Thickness			Wet Film/Dry Film/WW & Bar Applicator Gap Relationships			Abrasion Resistance, Taber	Appearance and Finish, Drawdown Charts	Appearance and Finish, Coted Panels	Dry Film Thickness, Metal	Film Flexibility
Units		Notch Clearance in mils		Mils, #30 Rod	Mils, #48 Rod	Mils, #80 Rod	Mils, #30 Rod	Mils, #48 Rod	Mils, # 80 Rod	Wear Index or Cycles to Expose Substrate			mils	pass/fail
910	IMC10	<4	0	4.5	4.5	6.5	2.2	3.3	4.7	N/A	glossy, uneven	satin, yellowed	3.7	Fail
912	IMC12	6	8	4.5	4.5	6.5	3.5	3.7	5.4	N/A	glossy, grainy	gloss, uniform	15	Fail
914	IMC14	20	12	6.5	6.5	10.5	2.8	3.2	4.5	N/A	satin flat, gelled particles	satin flat, gelled particles	2.6	Pass
904	IMC4	8	0	3.5	6.5	7.5	2.2	3.0	4.5	N/A	eggshell, smooth	eggshell, smooth	1.6	Pass
908	IMC8	18	8	5.5	5.5	7.5	2.2	2.3	2.1	N/A	flat, uniform	satin, uniform	1.6	Pass
901	IMC1	>24	0	4.0	5.5	9.5	3.4	4.9	6.0	36.3	semi gloss, grainy	glossy, grainy	8.8	Fail
906	IMC6	>24	12	5.5	6.5	8.5	2.6	2.6	3.5	N/A	matte, smooth	flat, smooth	3	Pass
919	IMC19	>24	4	4.5	4.5	6.5	3.3	3.4	5.4	N/A	satin flat, uniform	satin, uniform	5.8	Pass
922	IMC22	>24	8	4.5	5.0	8.0	1.5	2.1	2.5	156.4	uniform, flat	uniform, flat, w/rust spots	2.3	Pass
933	IMC32	4	0	4.5	4.5	8.5	2.8	3.1	4.6	N/A	uniform, flat	uniform, flat	4.6	Pass
932	IMC31	24	0	3.5	5.5	9.5	1.9	2.9	4.6	139.7	smooth, satin	smooth, satin	3.9	Pass
920	IMC20	6	0	3.5	5.5	8.5	2.2	3.5	4.7	N/A	uniform, flat	uniform, flat	3.2	Pass
927	IMC26	>24	0	4.5	6.5	10.5	4.3	4.2	6.0	N/A	uniform, flat	uniform, flat	2.7	Fail
923	IMC23	10	8	4.5	6.5	8.5	2.4	2.6	3.4	N/A	smooth, matte	smooth, matte	2	Pass
925	IMC25	10	8	3.5	6.5	8.5	2.4	2.9	3.5	138.3	smooth, satin	smooth, satin	4.8	Pass
902	IMC2	16	12	4.5	5.5	7.5	2.1	2.4	3.2	N/A	matte, smooth	eggshell, uniform	2.6	Pass
917	IMC17	10	4	4.5	6.5	8.5	2.0	2.2	3.4	N/A	smooth eggshell	smooth matte	1.4	Pass
930	IMC29	10	0	3.5	4.5	9.5	1.8	2.7	3.8	N/A	smooth, satin	uniform, flat	2.3	Pass

Section 2: Industrial Maintenance Topcoat

Total # manufactuers or brands	11
Single component coatings	6
Multi-component coatings	13
Total # coatings	21

Test Summary

Brushing Properties Wet:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Brushing Properties Dry:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Dry Time - Dry To Touch:
- Low VOC coatings required longer dry times compared to high VOC coatings.

Dry Time - Dry Hard:
- Low VOC coatings required similar dry times compared to high VOC coatings.

Contrast Ratio (Hiding Power):
- Low VOC coatings exhibited slightly lower performance compared to high VOC coatings.

Spreading Rate:
- Low VOC coatings exhibited lower performance compared to high VOC coatings.

Leveling:
- Three Low VOC coatings exhibited similar performance compared to high VOC coatings. Five of the coatings within the 50 g/l to 275 g/l range exhibited poor performance.

Sag Resistance:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Hiding Wet to Dry Changes:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Taber Abrasion Resistance:
- Low VOC coatings exhibited lower performance compared to high VOC coatings.

Dry Film Thickness:
- Low VOC coatings exhibited slightly higher dry film thicknesses compared to high VOC coatings.

Film Flexibility:

- Eighteen out of 21 coatings passed this test. The three coatings that failed had VOC contents of 0 g/l, 0 g/l, and 108 g/l.

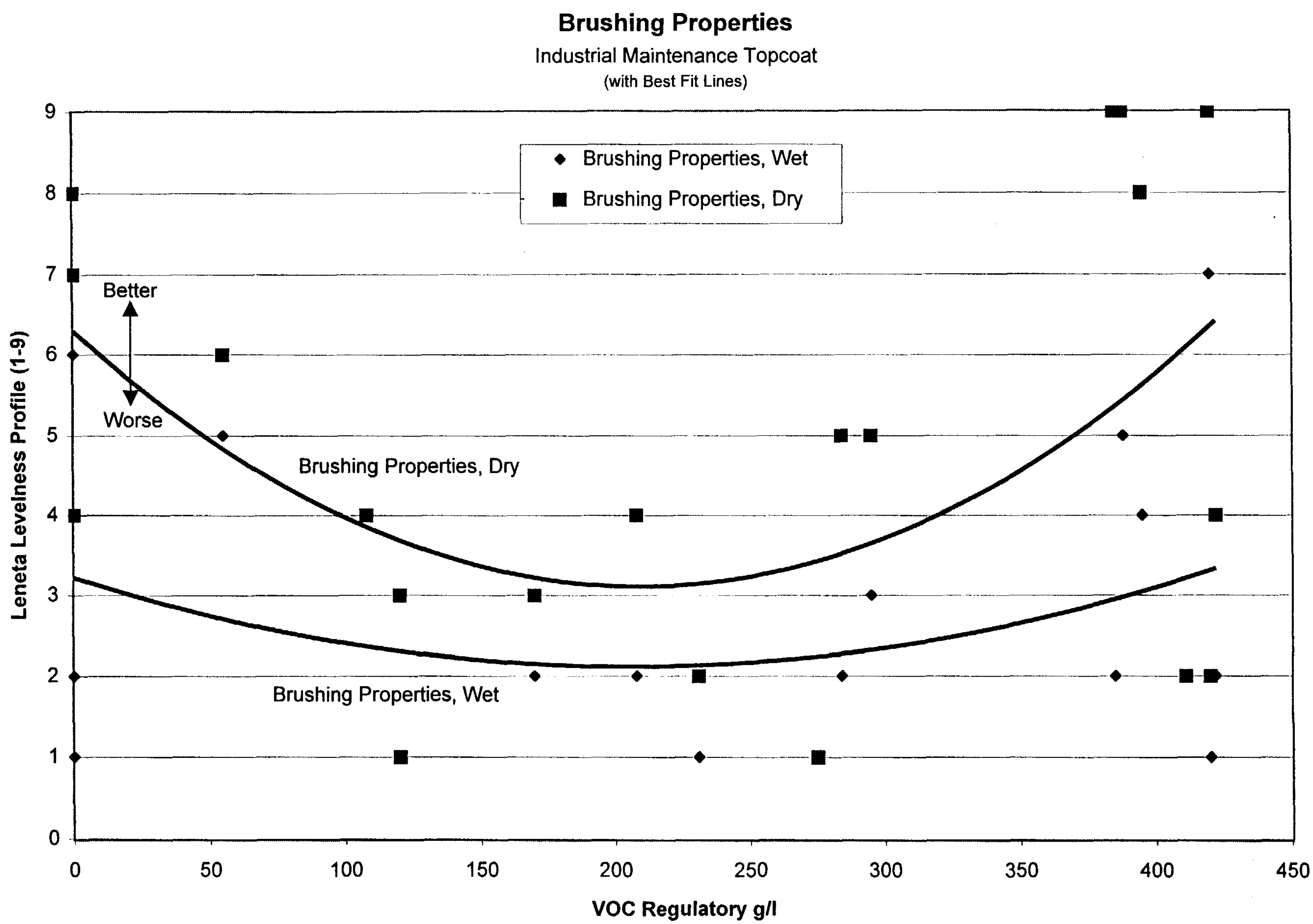
Comments:

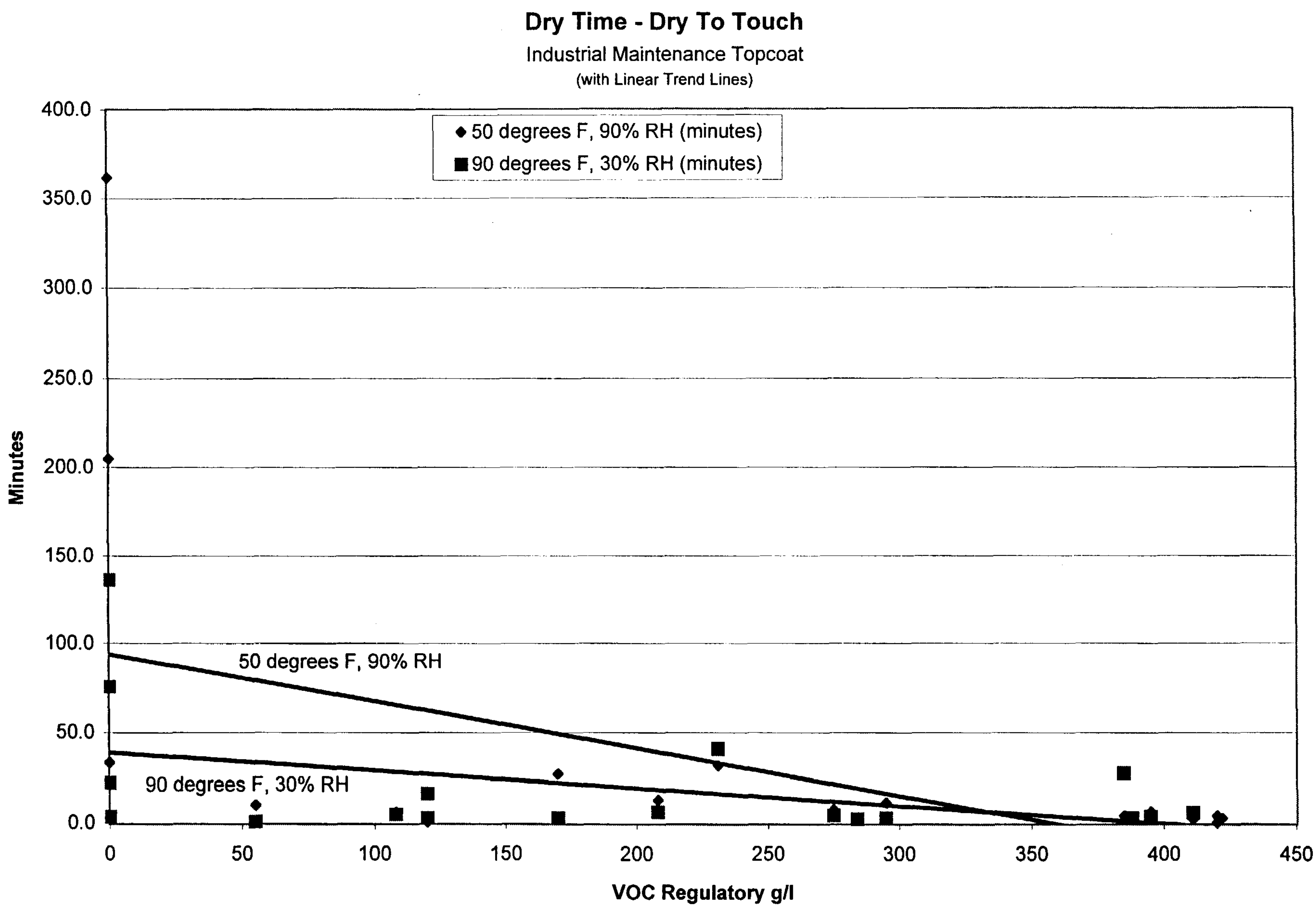
Overall, low VOC coatings exhibited similar performance compared to high VOC coatings.

Industrial Maintenance Topcoat

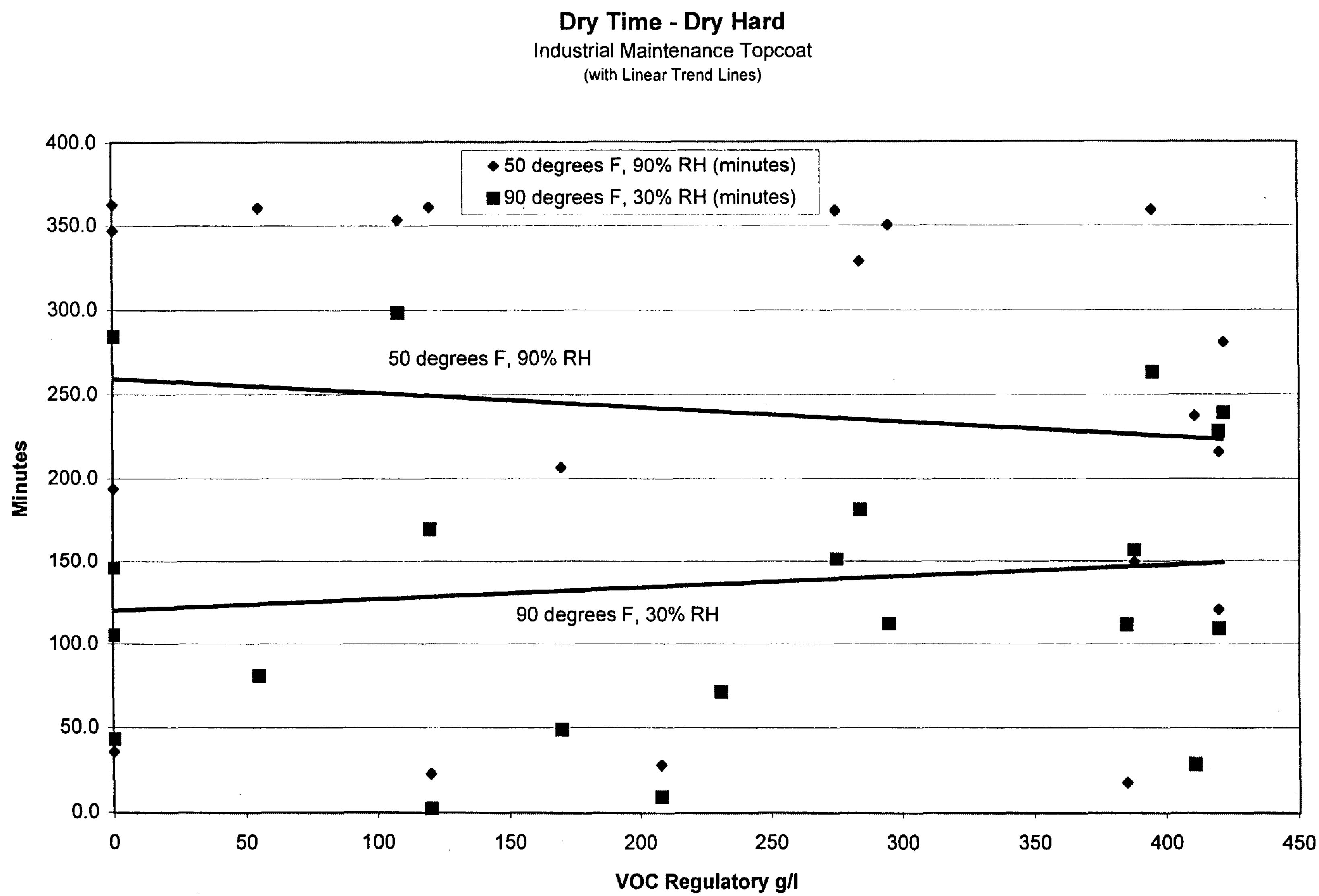
Coating Reference Designator	VOC, g/l	Part	Polymer Class	Intended Application	Total
901	108	2	Siloxirane	T	1
921	120	2	Siloxane	T	1
918	411	1	Urethane Alkyd	T	1
911	0	2	Urethane	T	1
903	420	1	Silicone Alkyd	T	1
10	420	2	Urethane	T	1
915	0	2	Urethane	T	1
916	0	2	Epoxy	T	1
919	170	2	Epoxy	P	1
931	385	1	Alkyd	T	1
932	284	2	Epoxy	T	1
934	388	2	Urethane	T	1
907	208	1	Acrylic	T	1
905	55	2	Urethane	T	1
909	120	1	Acrylic	T	1
913	0	2	Novolac	T	1
925	395	2	Epoxy	T	1
928	275	2	Epoxy	T	1
924	422	1	Alkyd	T	1
922	231	1	Acrylic	T	1
929	295	2	Urethane	T	1
Grand Total					21

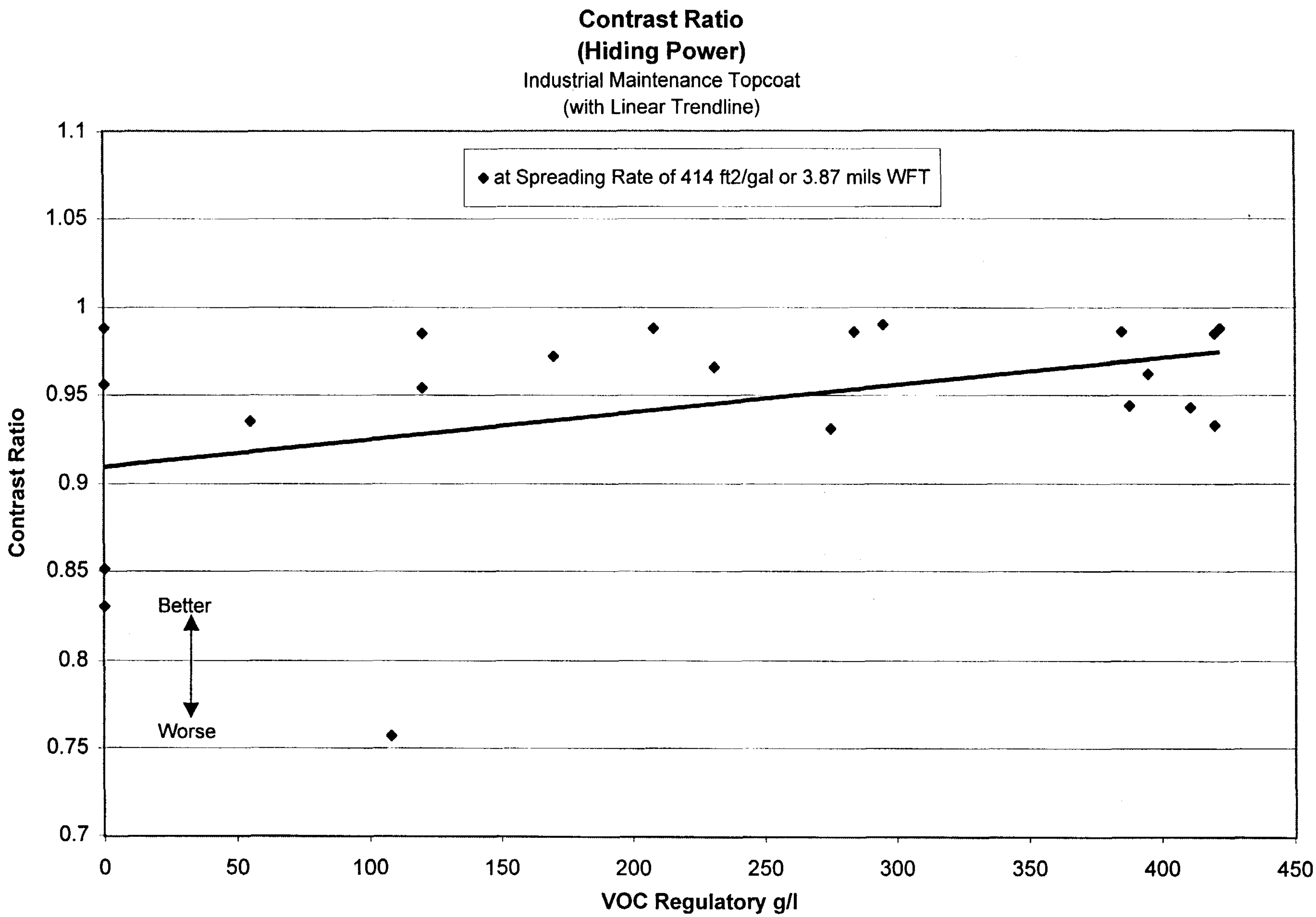
Single component coatings = 6 Multi-component coatings = 13

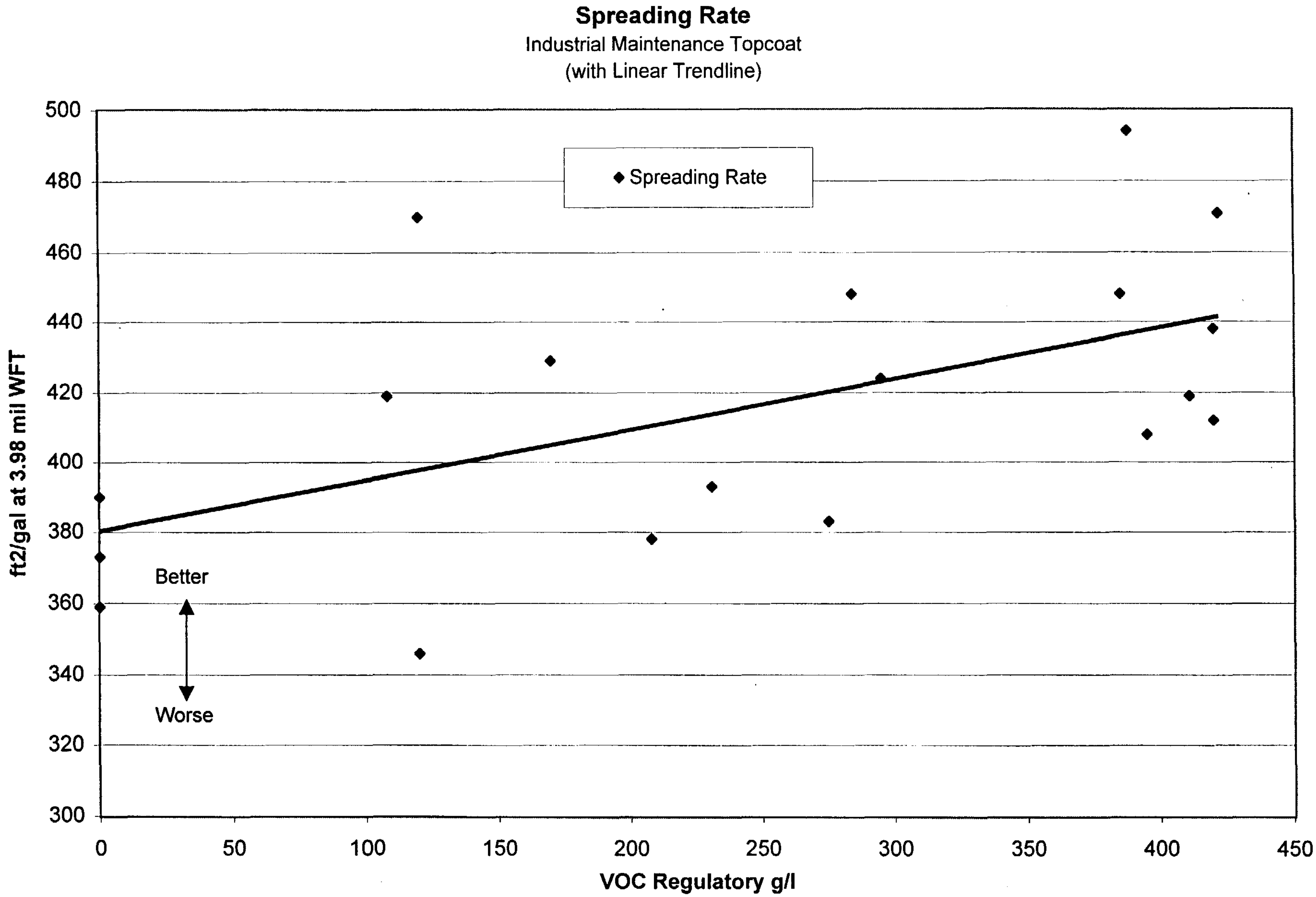

Brushing Properties
Industrial Maintenance Topcoat
(with Best Fit Lines)
Brushing Properties, Wet
Brushing Properties, Dry
Better
Worse
Brushing Properties, Dry
Brushing Properties, Wet
Leneta Levelness Profile (1-9)
VOC Regulatory g/l
0
1
2
3
4
5
6
7
8
9
0
50
100
150
200
250
300
350
400
450

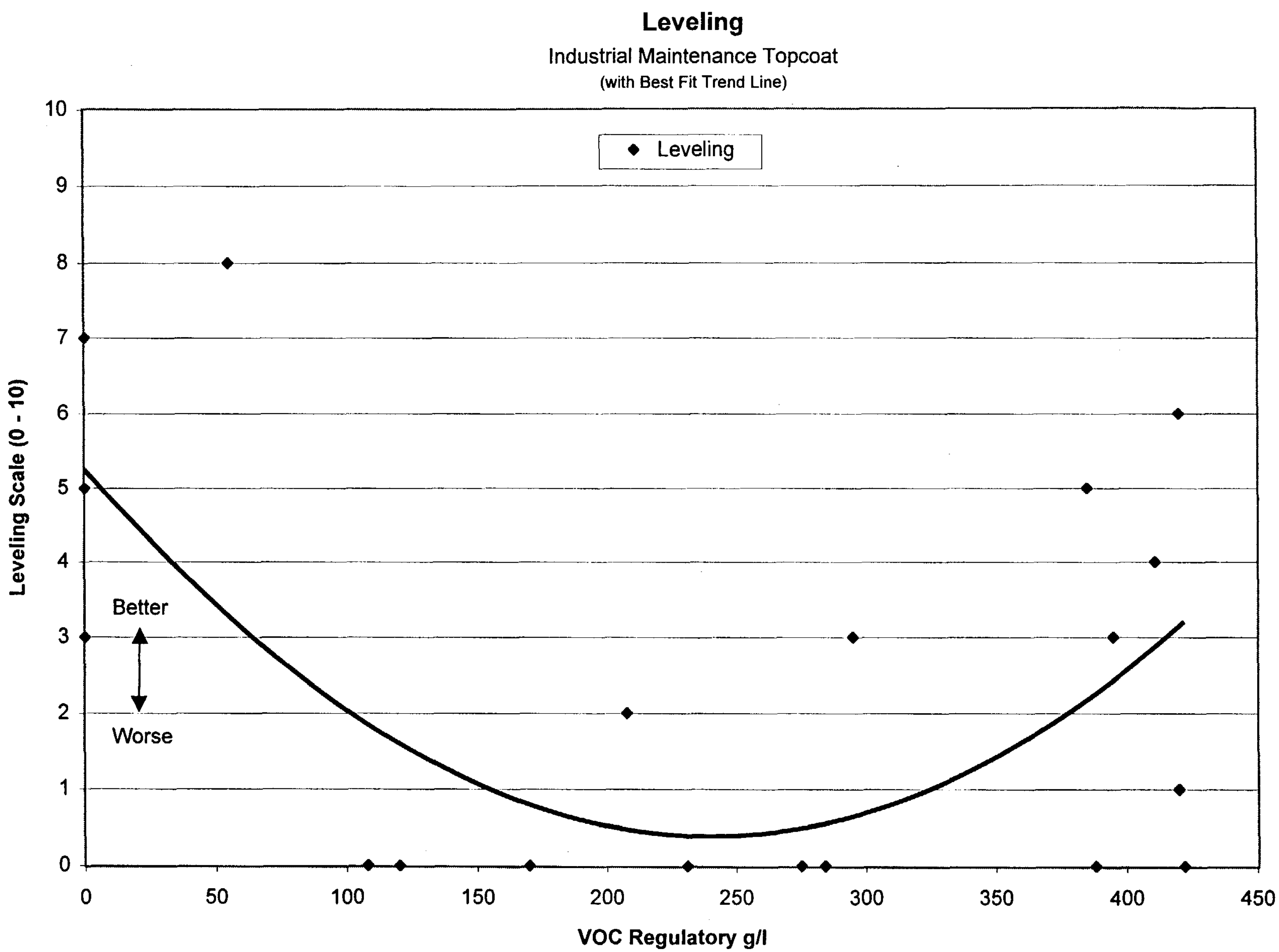


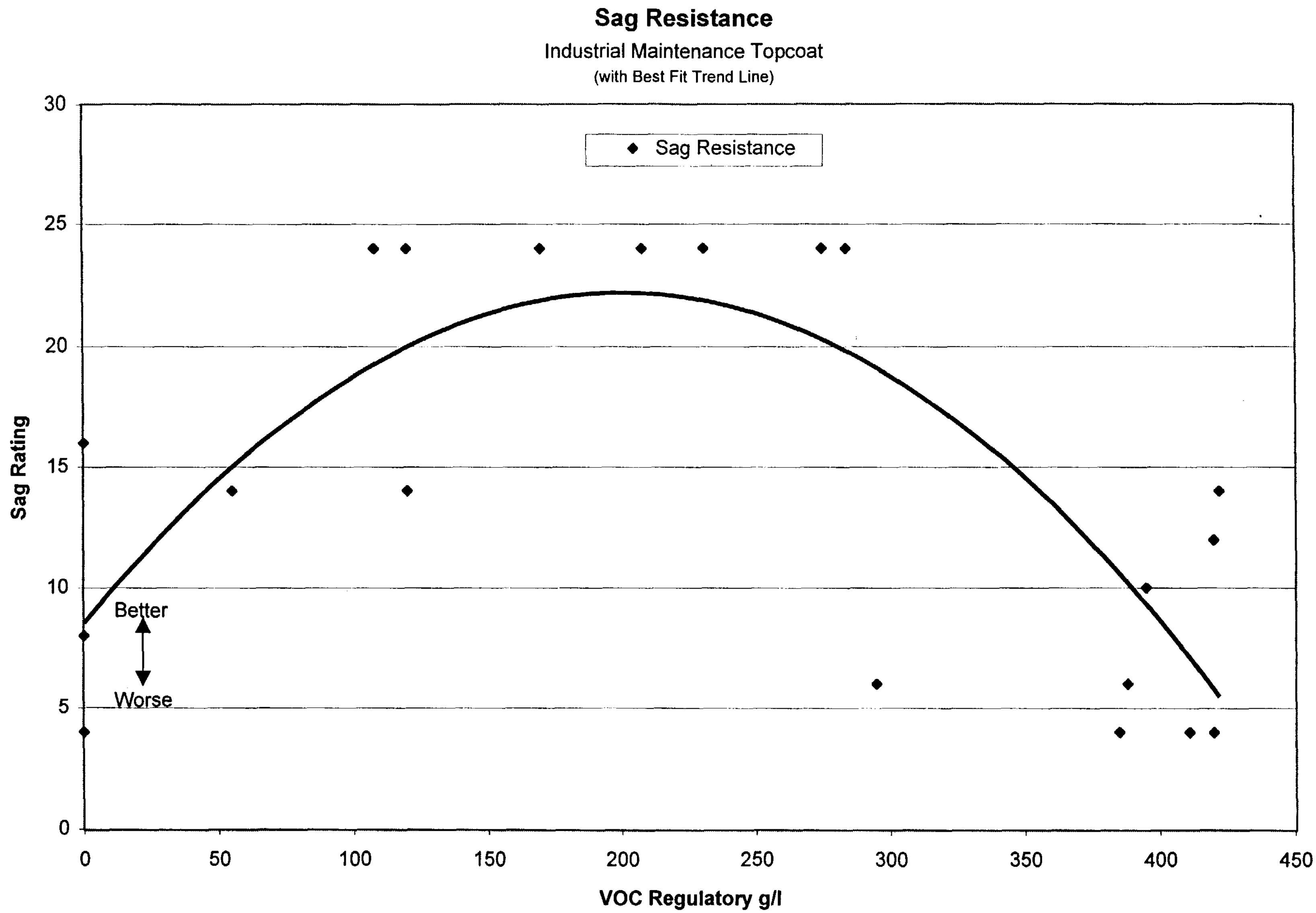
Dry Time - Dry To Touch
Industrial Maintenance Topcoat
(with Linear Trend Lines)
50 degrees F, 90% RH (minutes)
90 degrees F, 30% RH (minutes)
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Minutes
50 degrees F, 90% RH
90 degrees F, 30% RH
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l


Dry Time - Dry Hard
Industrial Maintenance Topcoat
(with Linear Trend Lines)
50 degrees F, 90% RH (minutes)
90 degrees F, 30% RH (minutes)
50 degrees F, 90% RH
90 degrees F, 30% RH
Minutes
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

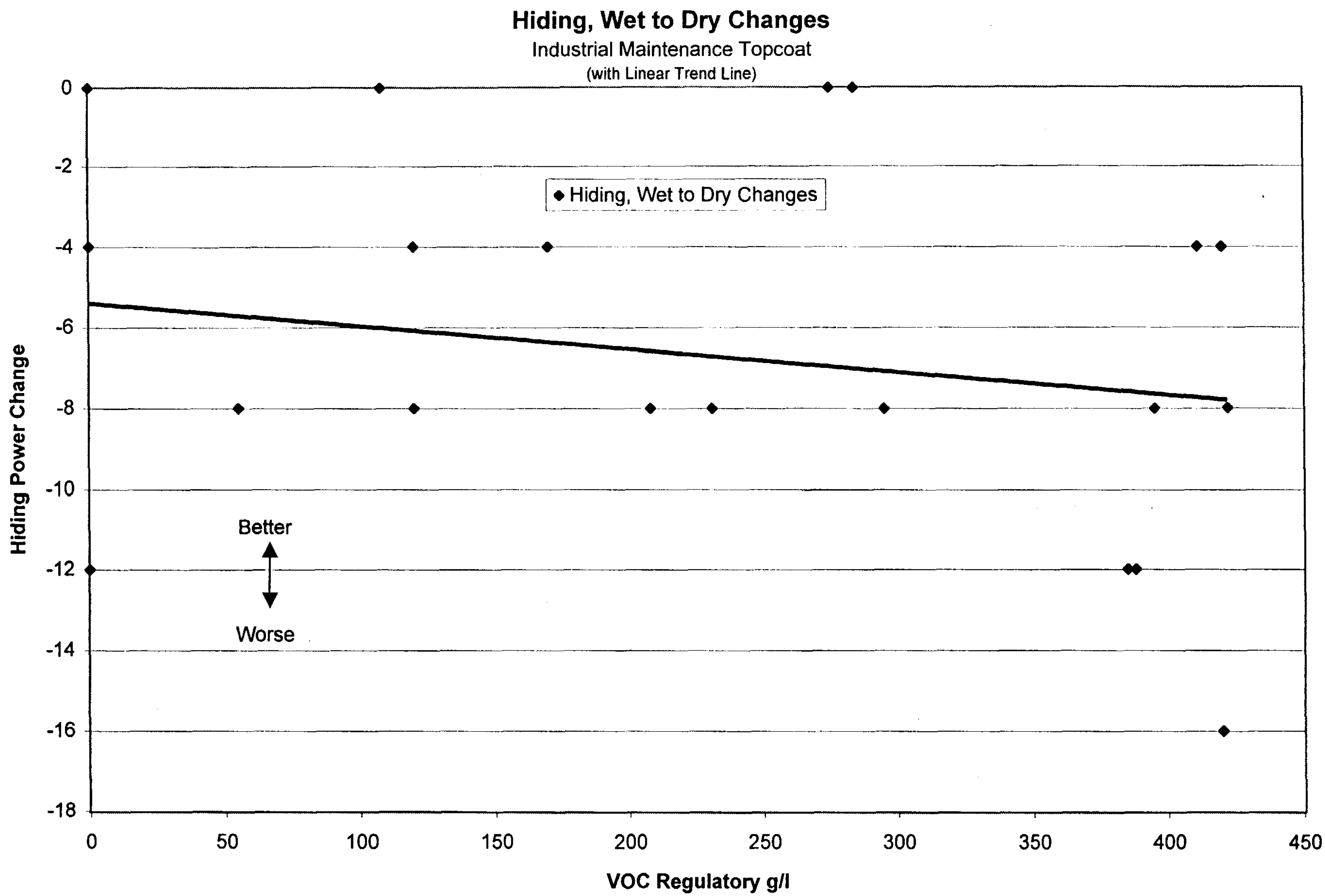

Contrast Ratio
(Hiding Power)
Industrial Maintenance Topcoat
(with Linear Trendline)
at Spreading Rate of 414 ft2/gal or 3.87 mils WFT
Contrast Ratio
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
Better
Worse
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

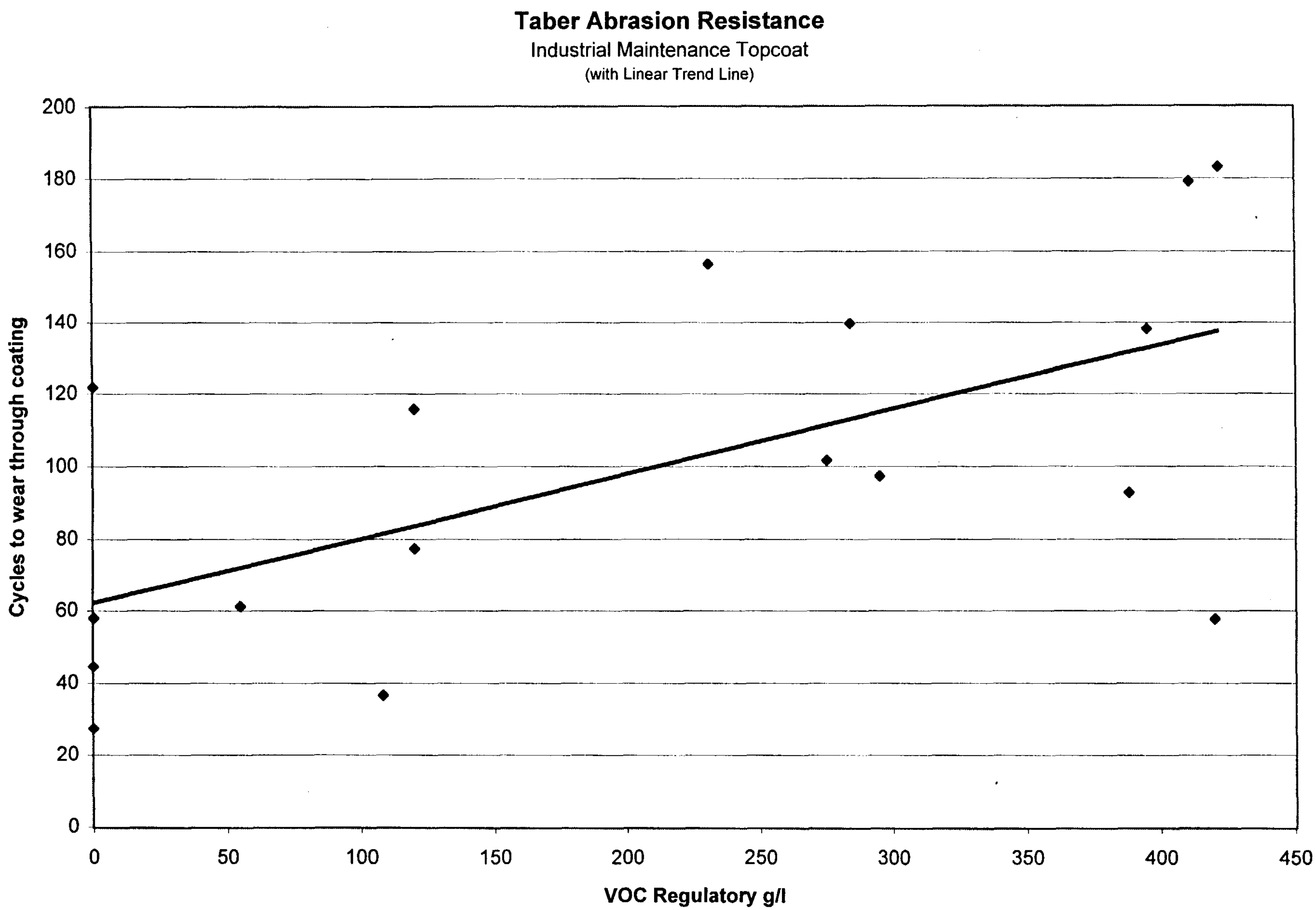

Spreading Rate
Industrial Maintenance Topcoat
(with Linear Trendline)
Spreading Rate
ft2/gal at 3.98 mil WFT
Better
Worse
VOC Regulatory g/l
500
480
460
440
420
400
380
360
340
320
300
0
50
100
150
200
250
300
350
400
450


Leveling
Industrial Maintenance Topcoat
(with Best Fit Trend Line)
Leveling
Better
Worse
Leveling Scale (0 - 10)
VOC Regulatory g/l
0
1
2
3
4
5
6
7
8
9
10
0
50
100
150
200
250
300
350
400
450

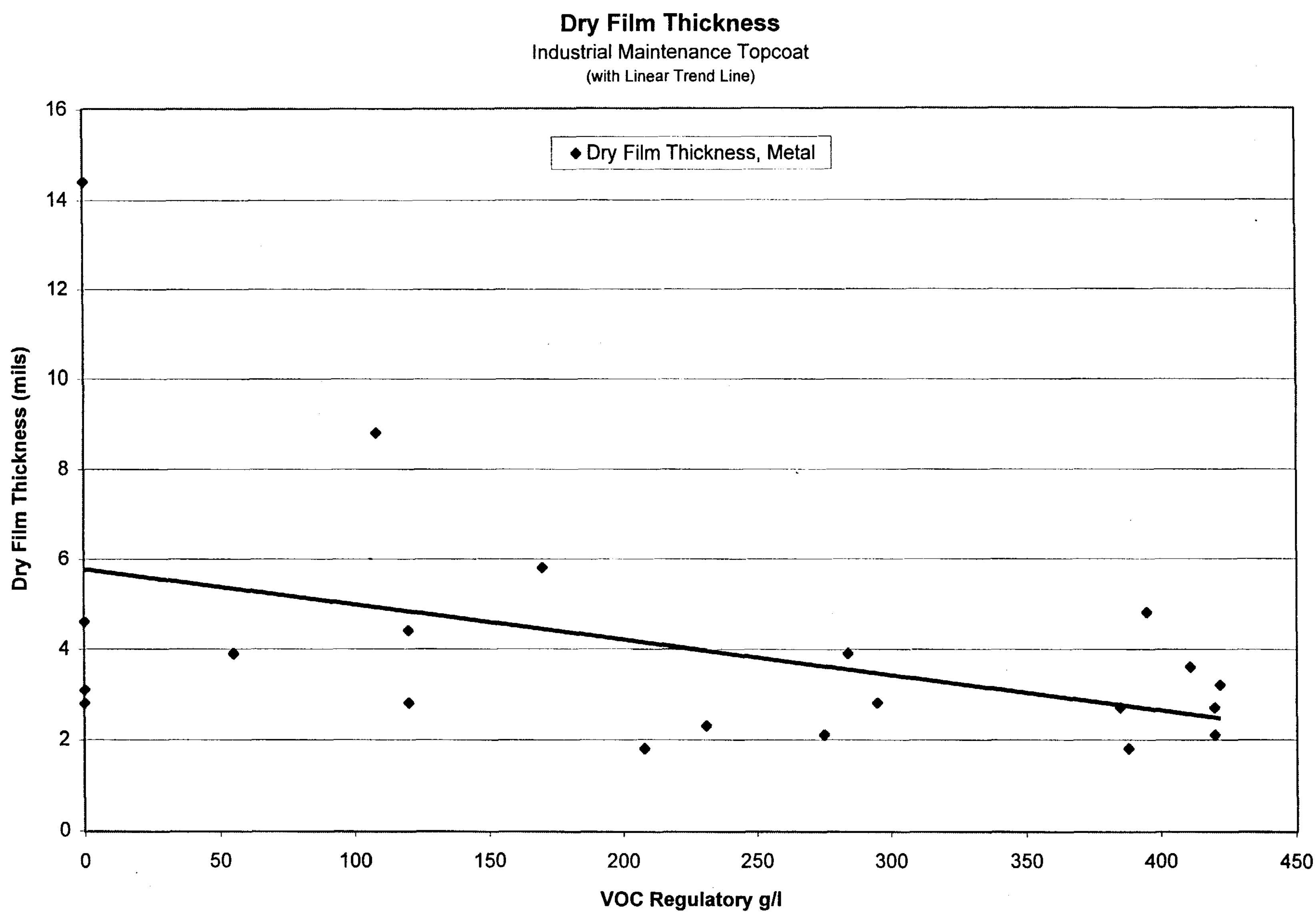


Sag Resistance
Industrial Maintenance Topcoat
(with Best Fit Trend Line)
Sag Resistance
Sag Rating
Better
Worse
VOC Regulatory g/l
0
5
10
15
20
25
30
0
50
100
150
200
250
300
350
400
450


Hiding, Wet to Dry Changes
Industrial Maintenance Topcoat
(with Linear Trend Line)
Hiding, Wet to Dry Changes
Hiding Power Change
Better
Worse
VOC Regulatory g/l
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
50
100
150
200
250
300
350
400
450



Taber Abrasion Resistance
Industrial Maintenance Topcoat
(with Linear Trend Line)
Cycles to wear through coating
200
180
160
140
120
100
80
60
40
20
0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l


Dry Film Thickness
Industrial Maintenance Topcoat
(with Linear Trend Line)
Dry Film Thickness, Metal
Dry Film Thickness (mils)
16
14
12
10
8
6
4
2
0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

Industrial Maintenance Coating Topcoat (IMCT) Data Table

Protocol Test Number							2.1	2.1	2.2		2.2		3.14	3.14	2.4	2.7	2.10			
Coating Reference Number	Coating Reference Designator	VOC Content	Polymer Class	Nonvolatile by Weight	Coarse Particles	Density	Brushing Properties, Wet	Brushing Properties, Dry	Dry time, Dry to Touch - One Part Coatings		Dry time, Dry Hard - One Part Coatings		Contrast Ratio (Cw) Hiding Power	Spreading Rate	Leveling	Sag Resistance	Hiding, Wet to Dry Changes	Wet Film Thickness WW Rod #30	WW Rod #45	WW Rod #60
Units		g/l		%	Size in Microns	lbs/gal	Leneta Levelness Profile, 1 - 9	Leneta Levelness Profile, 1 - 9	50 degrees F, 90% RH (minutes)	90 degrees F, 30% RH (minutes)	50 degrees F, 90% RH (minutes)	90 degrees F, 30% RH (minutes)	at Spreading Rate of 414 ft2/gal or 3.87 mils WFT		Scale, 0-10	Notch Clearance in mils		mils	mils	mils
911	IMC11	0	Urethane	79.2	44	11.83	2	4	33.4	60.0	193.6	146.1	0.956	373	3	8	12	4.5	4.5	9.5
913	IMC13	0	Novolac	95.5	100	12.50	2	8	204.6	135.0	346.8	284.4	0.988	390	5	4	4	3.5	4.5	6.5
915	IMC15	0	Urethane	67.1	67	9.77	6	7	3.0	2.5	35.4	43.0	0.851	not possible	5	16	0	4.5	5.5	7.5
916	IMC16	0	Epoxy	40.2	12	8.98	1	7	361.8	4.9	361.8	105.1	0.83	359	7	4	12	4.5	8.5	12.5
905	IMC5	55	Water-based polyester-urethane	61	0	10.57	5	6	9.9	4.2	360.0	81.0	0.935	not possible	8	14	8	3.6	5.5	8.5
901	IMC1	108	Siloxirane	95.2	36	12.59	4	4	6.1	5.1	353.2	298.5	0.757	419	0	>24	0	4.0	5.5	8.5
909	IMC9	120	Acrylic	47.7	70	9.50	<1	1	2.7	2.1	22.5	2.1	0.954	346	0	>24	8	4.5	6.5	7.5
921	IMC21	120	Siloxane	91.4	28	11.56	3	3	0.6	3.0	360.3	170.1	0.985	470	0	14	4	5.5	5.5	7.5
919	IMC19	170	Epoxy	89.2	60	12.82	2	3	27.1	16.5	206.5	48.9	0.972	429	0	>24	4	4.5	4.5	6.5
907	IMC7	208	Acrylic	47	66	9.88	2	4	13.0	2.4	27.7	9.3	0.988	378	2	>24	8	5.5	6.5	9.5
922	IMC22	231	Acrylic	59.5	60	12.01	1	2	31.8	3.0	360.0	71.1	0.966	393	0	>24	8	4.5	5.0	8.0
928	IMC27	275	Epoxy	81.6	20	13.34	1	1	7.5	4.5	358.5	151.5	0.931	383	0	24	0	4.5	4.5	7.5
932	IMC31	284	Epoxy	73.8	44	11.48	2	5	1.6	41.1	328.9	181.8	0.986	448	0	24	0	3.5	5.5	9.5
929	IMC28	295	Alkyd	79.9	2	11.02	3	5	11.5	19.2	350.2	112.2	0.99	424	3	6	8	4.5	6.5	10.5
931	IMC30	385	Alkyd	68.8	8	10.47	2	9	4.2	3.6	17.7	111.6	0.986	448	5	4	12	4.5	5.5	7.5
934	IMC33	388	Urethane	73.1	16	10.80	5	9	2.2	4.9	149.5	157	0.944	494	0	6	12	4.5	7.5	8.5
925	IMC25	395	Epoxy	77.3	60	12.50	4	8	6.4	27.9	358.9	263.4	0.962	408	3	10	8	3.5	6.5	8.5
918	IMC18	411	Urethane Alkyd	62.4	36	11.87	2	2	2.5	4.0	237.1	28.6	0.943	419	4	4	4	4.5	5.5	8.5
10	Ref	420	Urethane	73.6	0	11.10	7	9	0.3	3.0	120.3	109.2	0.985	438	6	<4	4	4.5	6.5	8.5
903	IMC3	420	Silicone Alkyd	64.7	4	9.83	1	2	4.2	5.5	215.7	228.1	0.933	412	1	12	16	3.5	5.5	7.5
924	IMC24	422	Alkyd	74.4	28	10.12	2	4	2.8	2.2	280.9	239.2	0.988	471	0	14	8	5.5	5.5	8.5

Industrial Maintenance Coating Topcoat (IMCT) Data Table

Protocol Test Number						3.2	3.2	3.10	3.9
Coating Reference Number	Coating Reference Designator	Wet Film/Dry Film/WW & Bar Applicator Gap Relationships			Abrasion Resistance, Taber	Appearance and Finish, Drawdown Charts	Appearance and Finish, Coted Panels	Dry Film Thickness, Metal	Film Flexibility
		WW Rod #30	WW Rod #45	WW Rod #60					
Units		mils	mils	mils	Wear Index or Cycles to Expose Substrate			mils	pass/fail
911	IMC11	2.1	2.8	4.2	44.6	smooth, high gloss	exotherm-rough, gloss	4.6	fail
913	IMC13	2.7	3.7	6.3	57.9	grainy, semigloss	uniform, gloss	14.4	fail
915	IMC15	2.3	3.2	3.2	27.3	smooth, glossy	gelled particles, semigloss	3.1	pass
916	IMC16	1.1	1.4	2.2	121.7	smooth, glossy	smooth, glossy	2.8	pass
905	IMC5	1.6	2.6	3.5	61.1	grainy, semigloss	grainy, glossy	3.9	pass
901	IMC1	3.4	4.9	6.0	36.6	grainy, semigloss	grainy, glossy	8.8	fail
909	IMC9	1.9	2.2	3.0	77.4	uniform, semigloss	uniform, semigloss	2.8	pass
921	IMC21	2.2	2.4	4.7	115.7	smooth, high gloss	uniform, high gloss	4.4	pass
919	IMC19	3.3	3.4	5.4	test not conducted	uniform, satin-flat	uniform, satin	5.8	pass
907	IMC7	1.8	1.9	2.0	112.2/585 cycles	smooth, glossy	smooth, satin	1.8	pass
922	IMC22	1.5	2.1	2.5	156.4	uniform, flat	uniform, flat w/rust spots	2.3	pass
928	IMC27	3.4	3.3	5.2	101.6	smooth, satin	smooth, satin	2.1	pass
932	IMC31	1.9	2.9	4.6	139.7	smooth, satin	smooth, satin	3.9	pass
929	IMC28	2.2	3.2	3.9	97.3	smooth, high gloss	smooth, gloss	2.8	pass
931	IMC30	1.8	2.3	3.3	203.9/700 cycles	uniform, satin	uniform, satin	2.7	pass
934	IMC33	2.4	2.6	3.2	92.7	smooth, high gloss	smooth, high gloss	1.6	pass
925	IMC25	2.4	2.9	3.5	138.2	smooth, satin	smooth, satin	4.8	pass
918	IMC18	1.6	1.7	2.7	179.1	smooth, high gloss	smooth, glossy	3.6	pass
10	Ref	1.2	2.5	3.4	57.6	smooth, high gloss	smooth, glossy	2.1	pass
903	IMC3	1.1	2.1	2.4	197.1/700 cycles	smooth, high gloss	smooth, high gloss	2.7	pass
924	IMC24	1.7	2.0	3.1	183.2	smooth, glossy	uniform, semigloss	3.2	pass

Section 3: Industrial Maintenance System

	1st Coat	2nd Coat	3rd Coat
Total # manufactuers or brands	11	11	5
Single component coatings	9	7	1
Multi-component coatings	11	13	6
Total # coatings	20	20	7

<u>Test Summary</u>

Adhesion to Substrate:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Corrosion Resistance - Blistering:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Corrosion Resistance - Filiform Corrosion:
- Low VOC coatings exhibited marginally better performance compared to high VOC coatings.

Corrosion Resistance - Rust:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Dry Film Thickness:
- Low VOC coatings exhibited higher film thickness compared to high VOC coatings.

Water Resistance (100 °F & 100% RH) - Scratch after two week exposure:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Water Resistance (100 °F & 100% RH) - Gouge after two week exposure:
- Low VOC coatings exhibited marginally better performance compared to high VOC coatings.

Water Resistance (100 °F & 100% RH) - Adhesion tape test after two week exposure:
- Low VOC coatings exhibited similar performance to high VOC coatings.

Industrial Chemical Resistance (7 day exposure) - Bleach:
- Low VOC coatings exhibited marginally lower performance compared to high VOC coatings.

Industrial Chemical Resistance (7 day exposure) - MEK
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Industrial Chemical Resistance (7 day exposure) - Acid

- Low VOC coatings exhibited marginally lower performance compared to high VOC coatings.

Water Resistance (Rust or Blisters after 1000 hr Immersion @ 100 °F):

- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Mar Resistance (Load/Force to mar film in grams):

- Low VOC coatings exhibited better performance compared to high VOC coatings.

Comments:

Overall, low VOC coatings exhibited similar performance compared to high VOC coatings, except one test. In the Mar Resistance test low VOC coatings exhibited better performance compared with their high VOC counterparts. More than half of the 47 coatings used by NTS for the industrial maintenance category were two-component coatings.

Industrial Maintenance System 1st Coat / Primer

Coating Reference Designator	VOC, g/l	Part	Polymer Class	Intended Application	Total
901	108	2	Siloxirane	T	1
920	288	2	Epoxy	P	1
917	417	1	Alkyd	P	1
910	0	2	Epoxy	P	1
902	400	1	Epoxy Ester	P	2
914	0	2	Butadiene-Epoxy	P	2
919	170	2	Epoxy	P	1
933	282	2	Inorganic Zinc Silicate	P	1
932	284	2	Epoxy	T	1
930	419	1	Alkyd	P	1
906	138	1	Acrylic	P	1
904	49	1	Organic Zinc	P	1
908	60	1	Acrylic	P	1
912	0	2	Novolac	P	1
925	395	2	Epoxy	T	1
923	382	1	Alkyd	P	1
922	231	1	Acrylic	T	1
927	320	2	Epoxy	P	1
Grand Total					20

Single component coatings = 9 Multi-component coatings = 11

Industrial Maintenance System 2nd Coat / Mid Coat

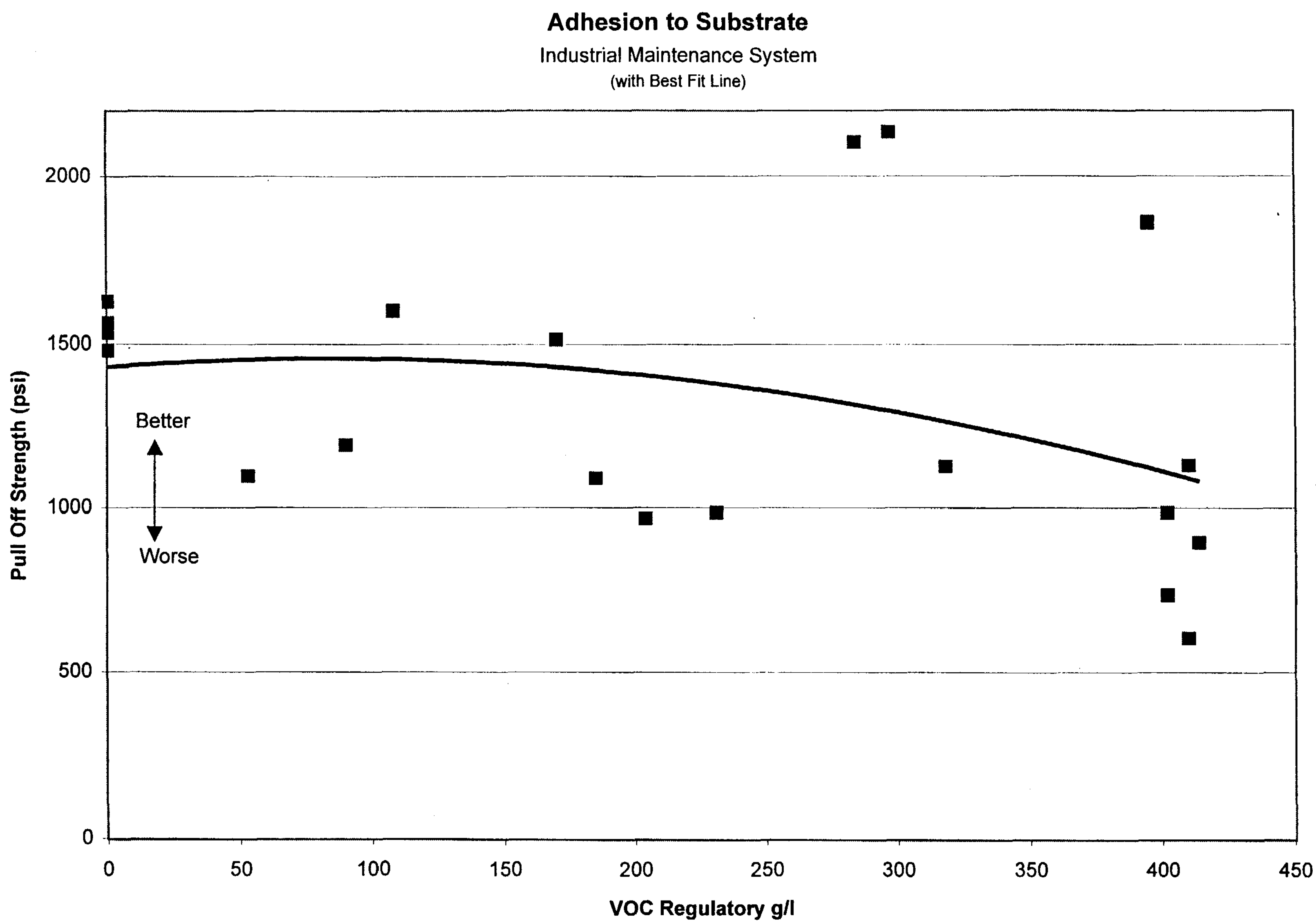
Coating Reference Designator	VOC, g/l	Part	Polymer Class	Intended Application	Total
901	108	2	Siloxirane	T	1
921	120	2	Siloxane	T	1
918	411	1	Urethane Alkyd	T	1
911	0	2	Urethane	T	1
903	420	1	Silicone Alkyd	T	1
10	420	2	Urethane	T	1
915	0	2	Urethane	T	1
916	0	2	Epoxy	T	1
919	170	2	Epoxy	P	1
931	385	1	Alkyd	T	1
932	284	2	Epoxy	T	2
907	208	1	Acrylic	T	1
905	55	2	Urethane	T	1
909	120	1	Acrylic	T	1
913	0	2	Novolac	T	1
925	395	2	Epoxy	T	1
928	275	2	Epoxy	T	1
924	422	1	Alkyd	T	1
922	231	1	Acrylic	T	1
Grand Total					20

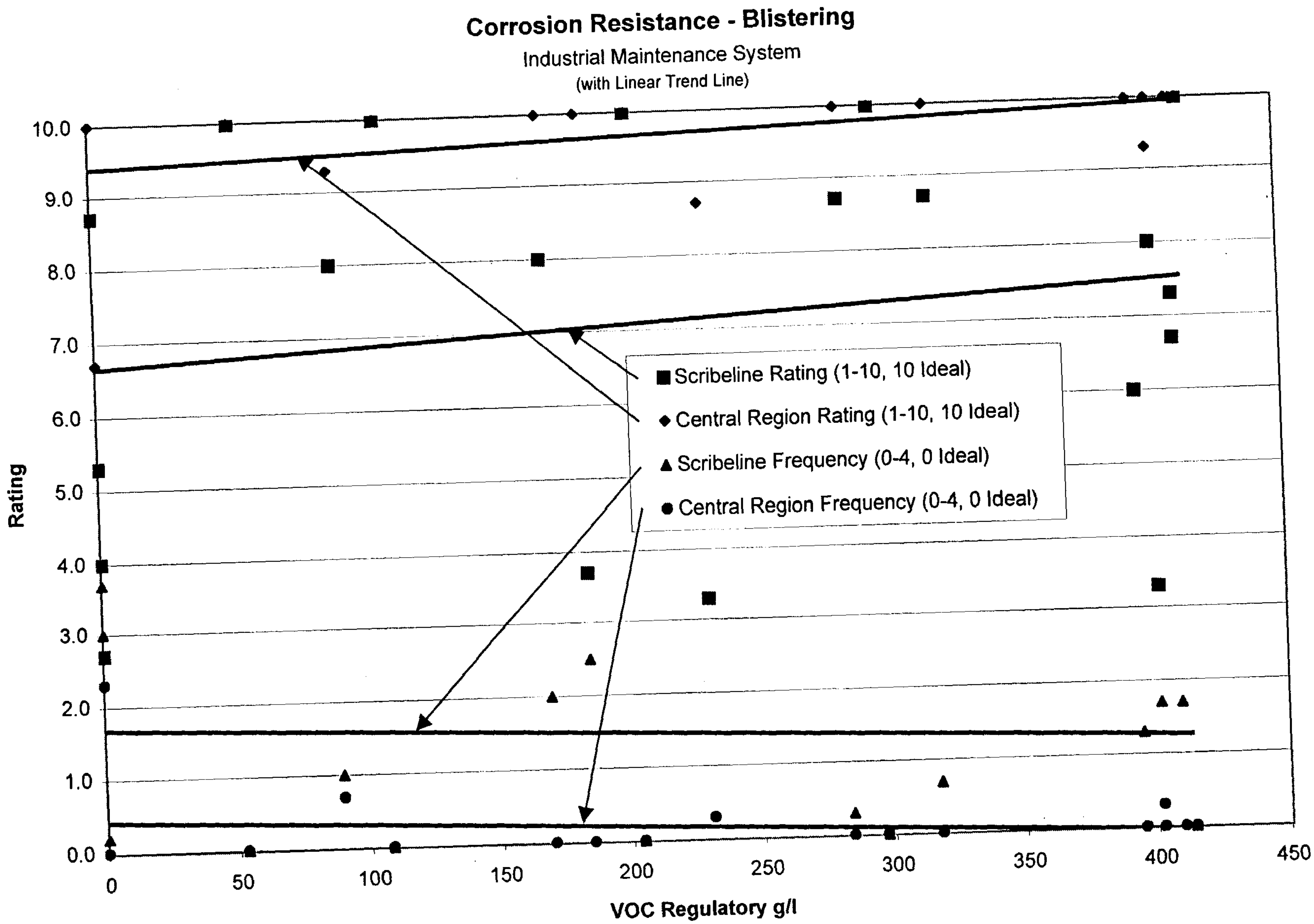
Single component coatings = 7 Multi-component coatings = 13

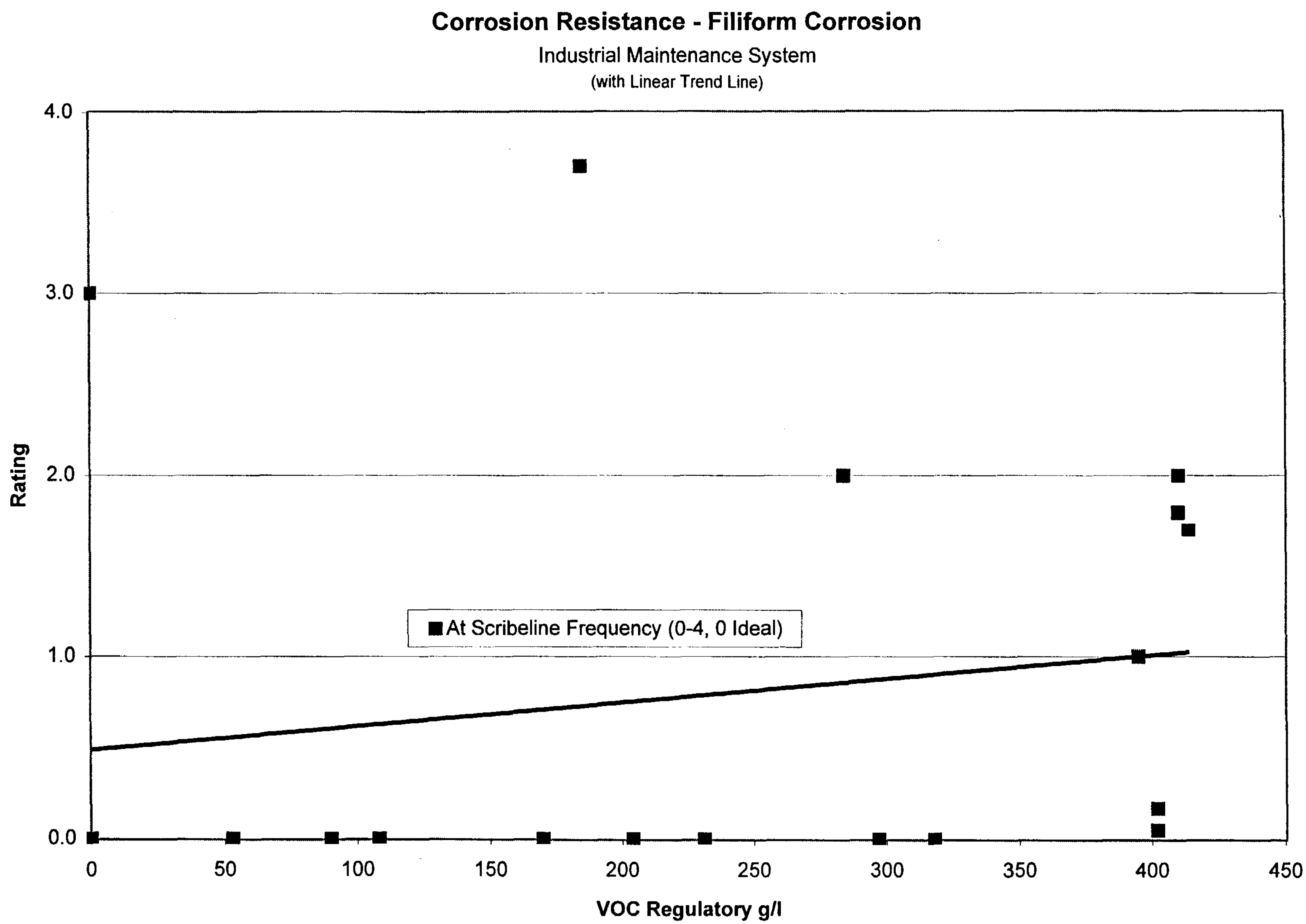
Industrial Maintenance System 3rd Coat / Topcoat

Coating Reference Designator	VOC, g/l	Part	Polymer Class	Intended Application	Total
915	0	2	Urethane	T	1
916	0	2	Epoxy	T	1
934	388	2	Urethane	T	1
907	208	1	Acrylic	T	1
905	55	2	Urethane	T	1
913	0	2	Novolac	T	1
929	295	2	Urethane	T	1
Grand Total					7

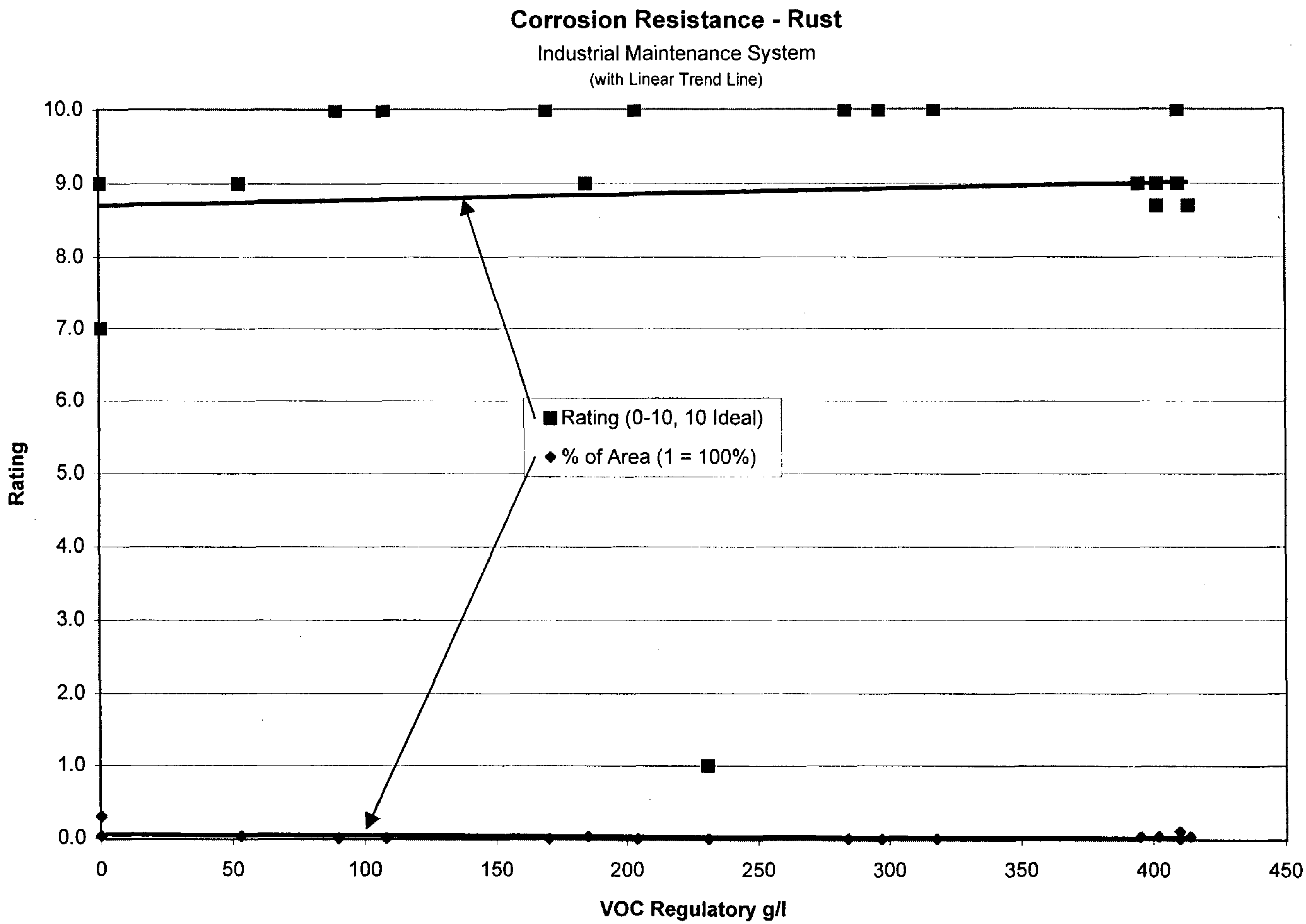
Single component coatings = 1 Multi-component coatings = 6

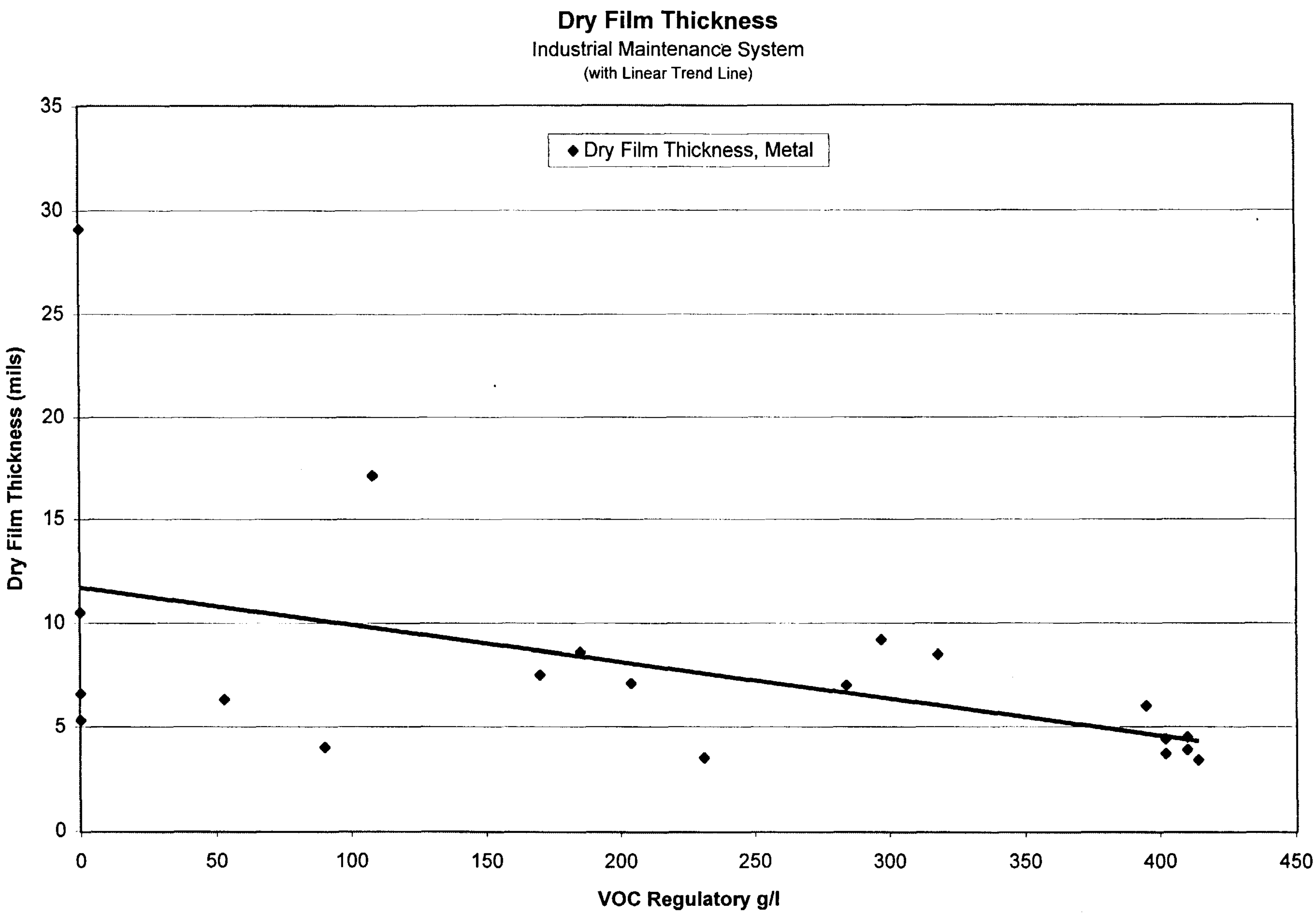

Adhesion to Substrate
Industrial Maintenance System
(with Best Fit Line)
Pull Off Strength (psi)
0
500
1000
1500
2000
Better
Worse
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

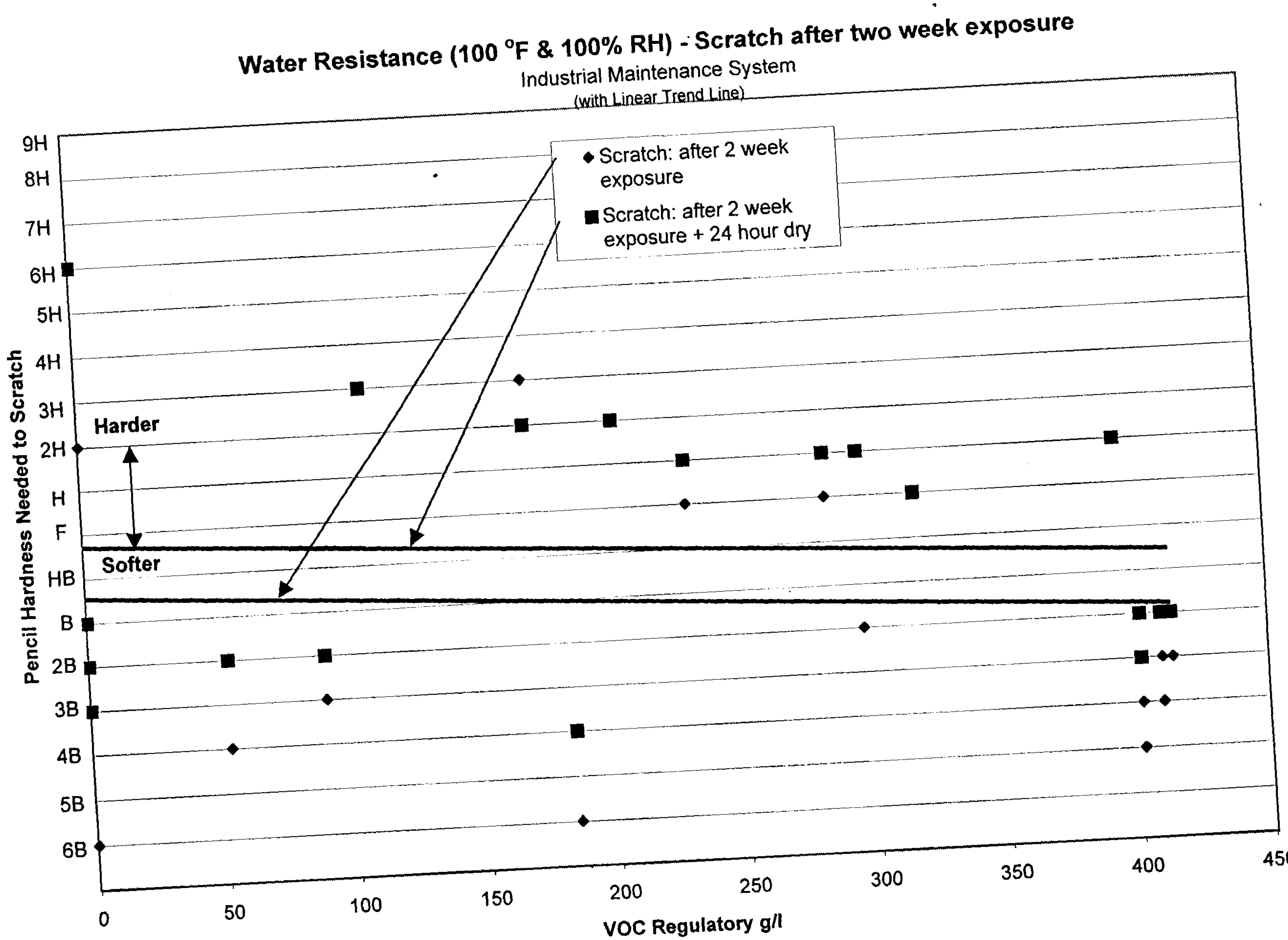

Corrosion Resistance - Blistering
Industrial Maintenance System
(with Linear Trend Line)
Rating
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l
Scribeline Rating (1-10, 10 Ideal)
Central Region Rating (1-10, 10 Ideal)
Scribeline Frequency (0-4, 0 Ideal)
Central Region Frequency (0-4, 0 Ideal)



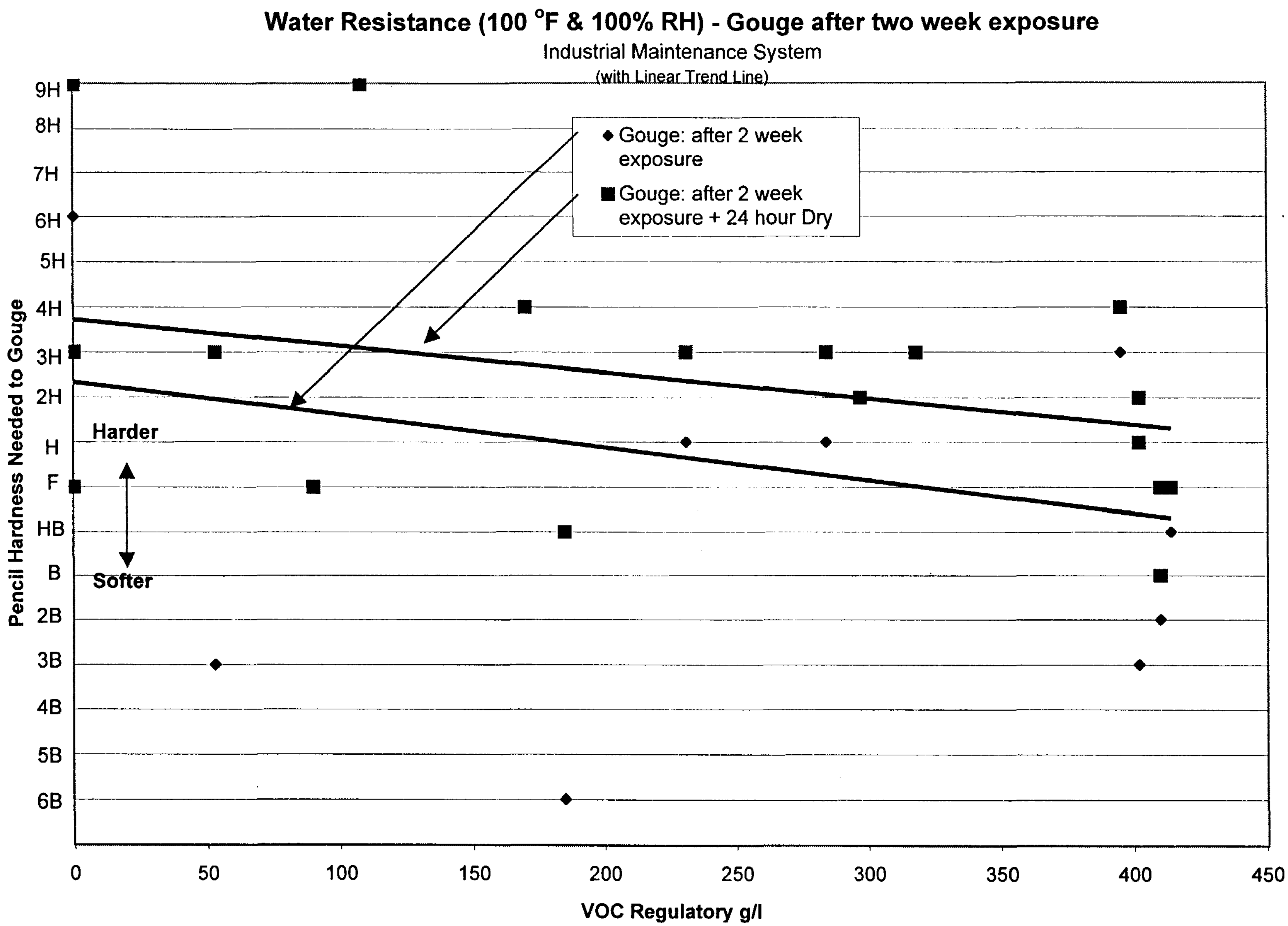
Corrosion Resistance - Filiform Corrosion
Industrial Maintenance System
(with Linear Trend Line)
4.0
3.0
2.0
1.0
0.0
Rating
At Scribeline Frequency (0-4, 0 Ideal)
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l


Corrosion Resistance - Rust
Industrial Maintenance System
(with Linear Trend Line)
Rating
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l
Rating (0-10, 10 Ideal)
% of Area (1 = 100%)

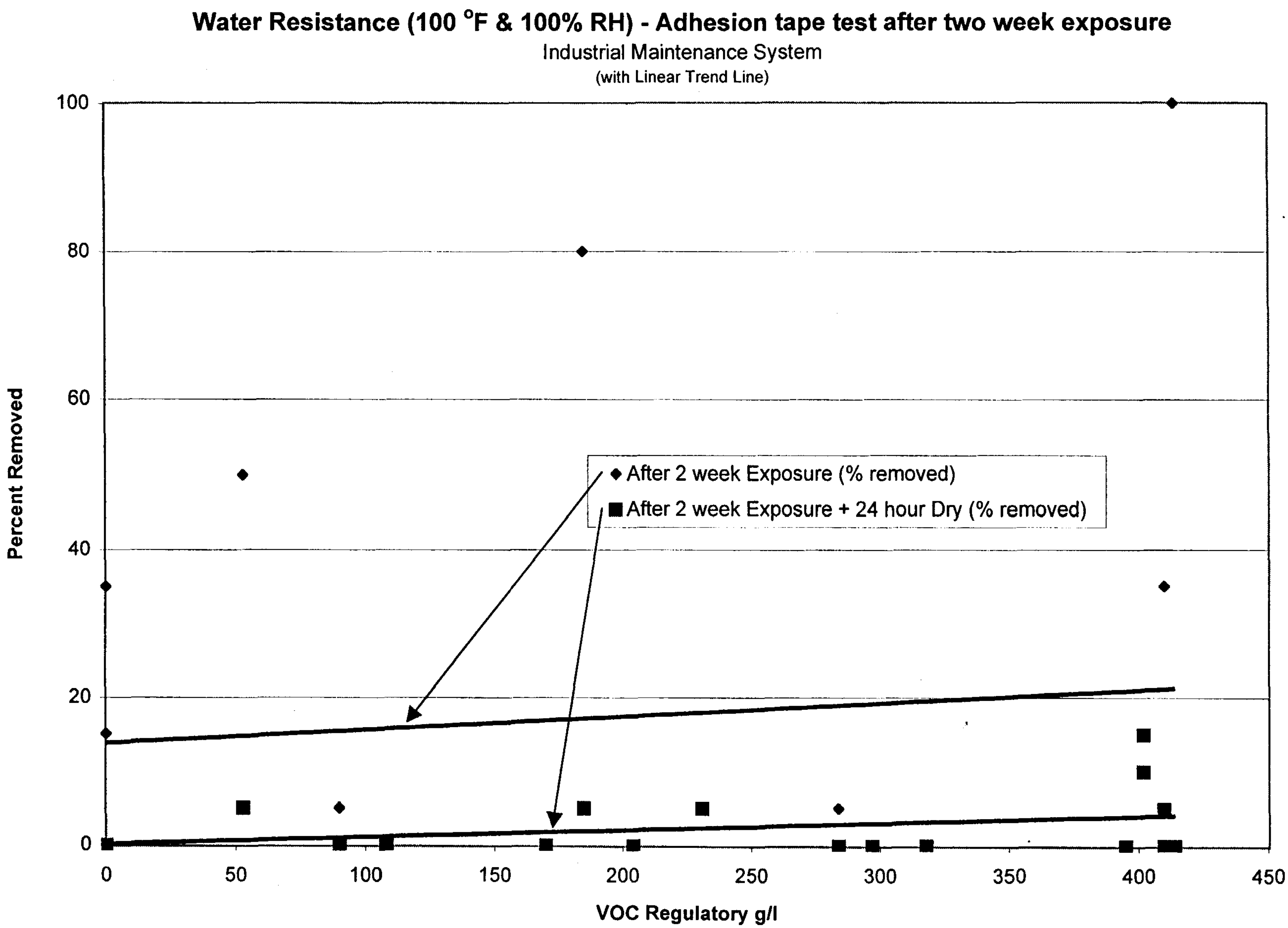

Dry Film Thickness
Industrial Maintenance System
(with Linear Trend Line)
Dry Film Thickness, Metal
Dry Film Thickness (mils)
35
30
25
20
15
10
5
0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l



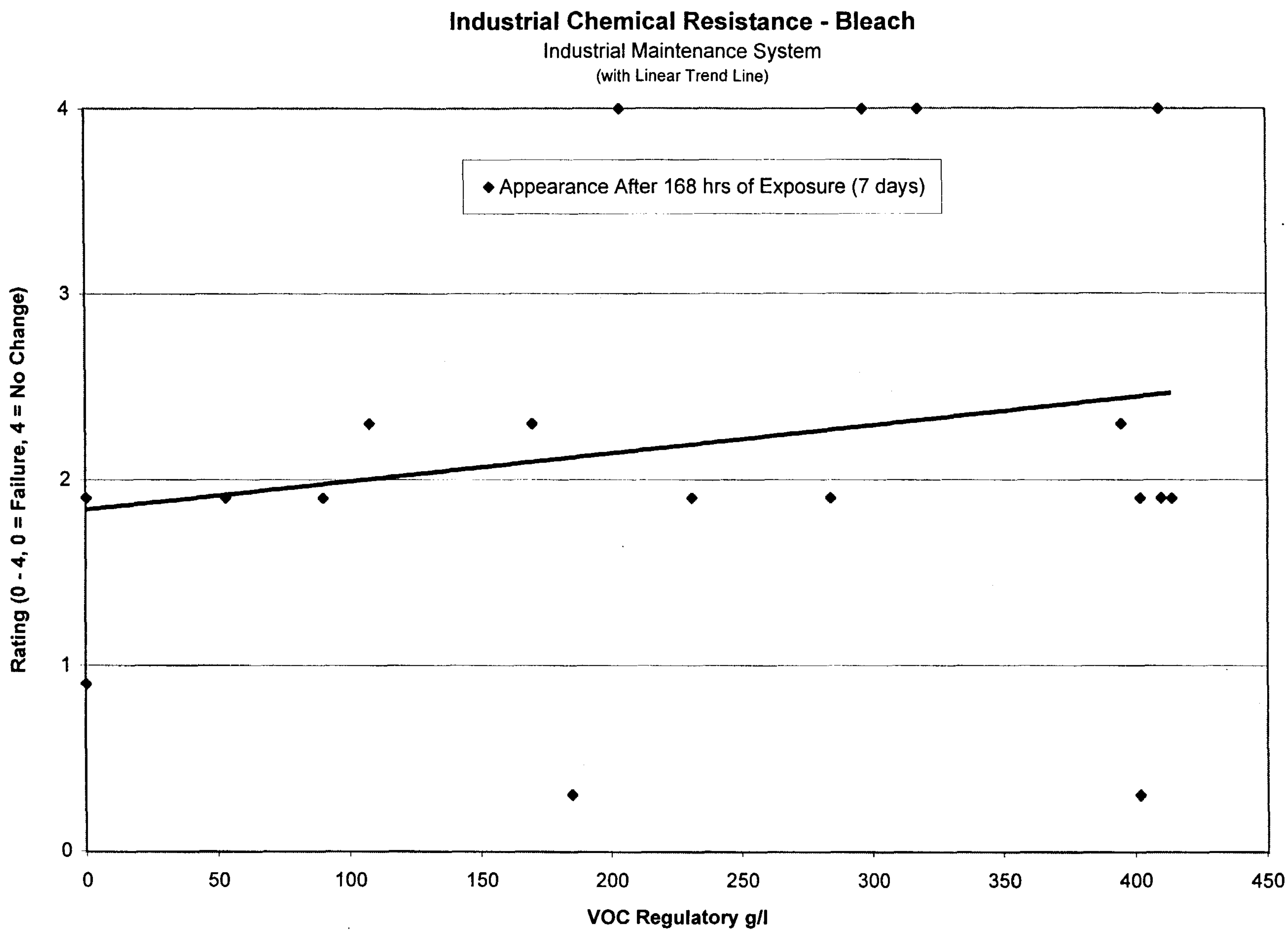
Water Resistance (100 °F & 100% RH) - Scratch after two week exposure
Industrial Maintenance System
(with Linear Trend Line)
Scratch: after 2 week exposure
Scratch: after 2 week exposure + 24 hour dry
Harder
Softer
9H
8H
7H
6H
5H
4H
3H
2H
H
F
HB
B
2B
3B
4B
5B
6B
Pencil Hardness Needed to Scratch
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

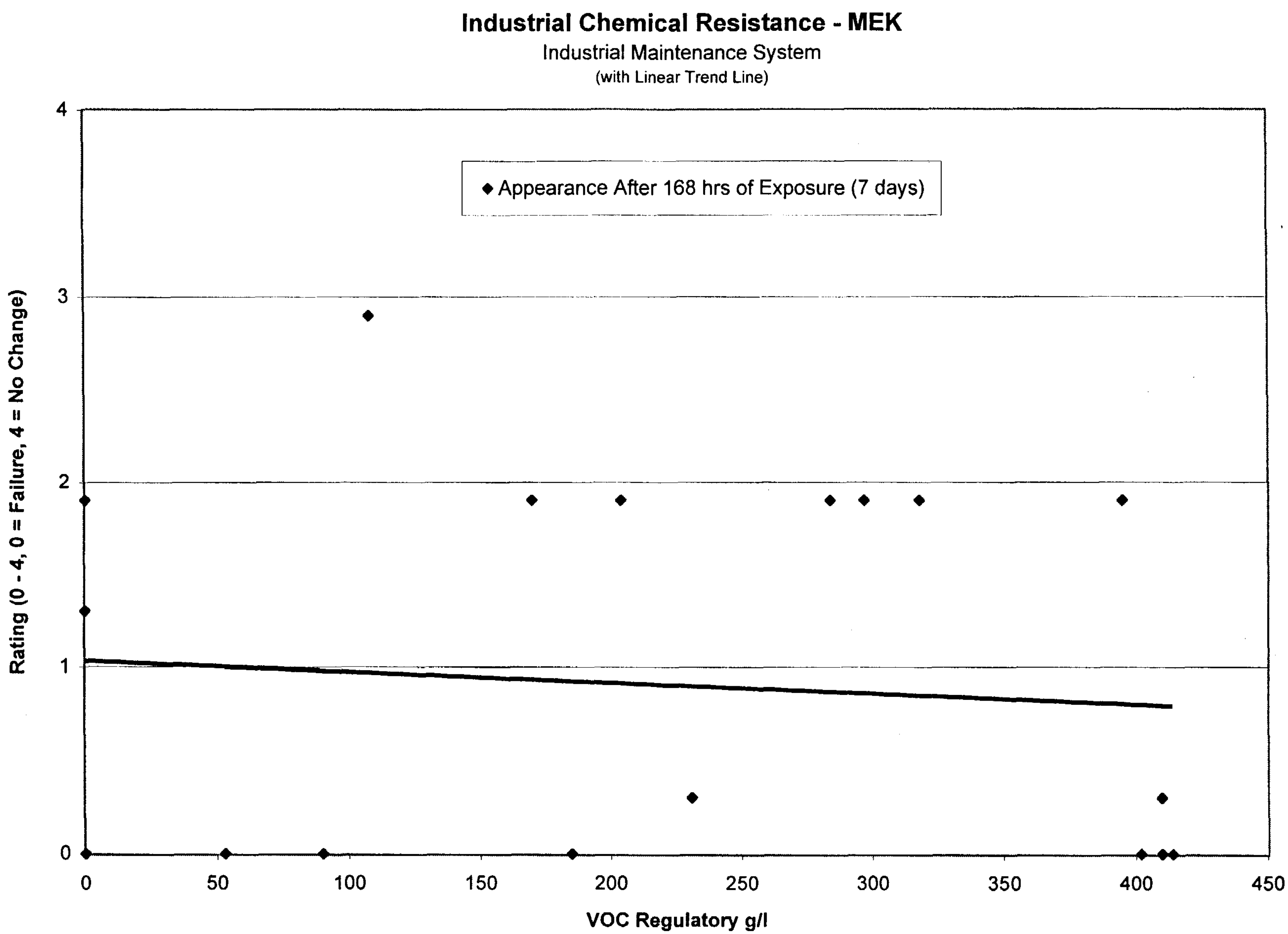


Water Resistance (100 °F & 100% RH) - Gouge after two week exposure
Industrial Maintenance System
(with Linear Trend Line)
Gouge: after 2 week exposure
Gouge: after 2 week exposure + 24 hour Dry
Pencil Hardness Needed to Gouge
9H
8H
7H
6H
5H
4H
3H
2H
H
F
HB
B
2B
3B
4B
5B
6B
Harder
Softer
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

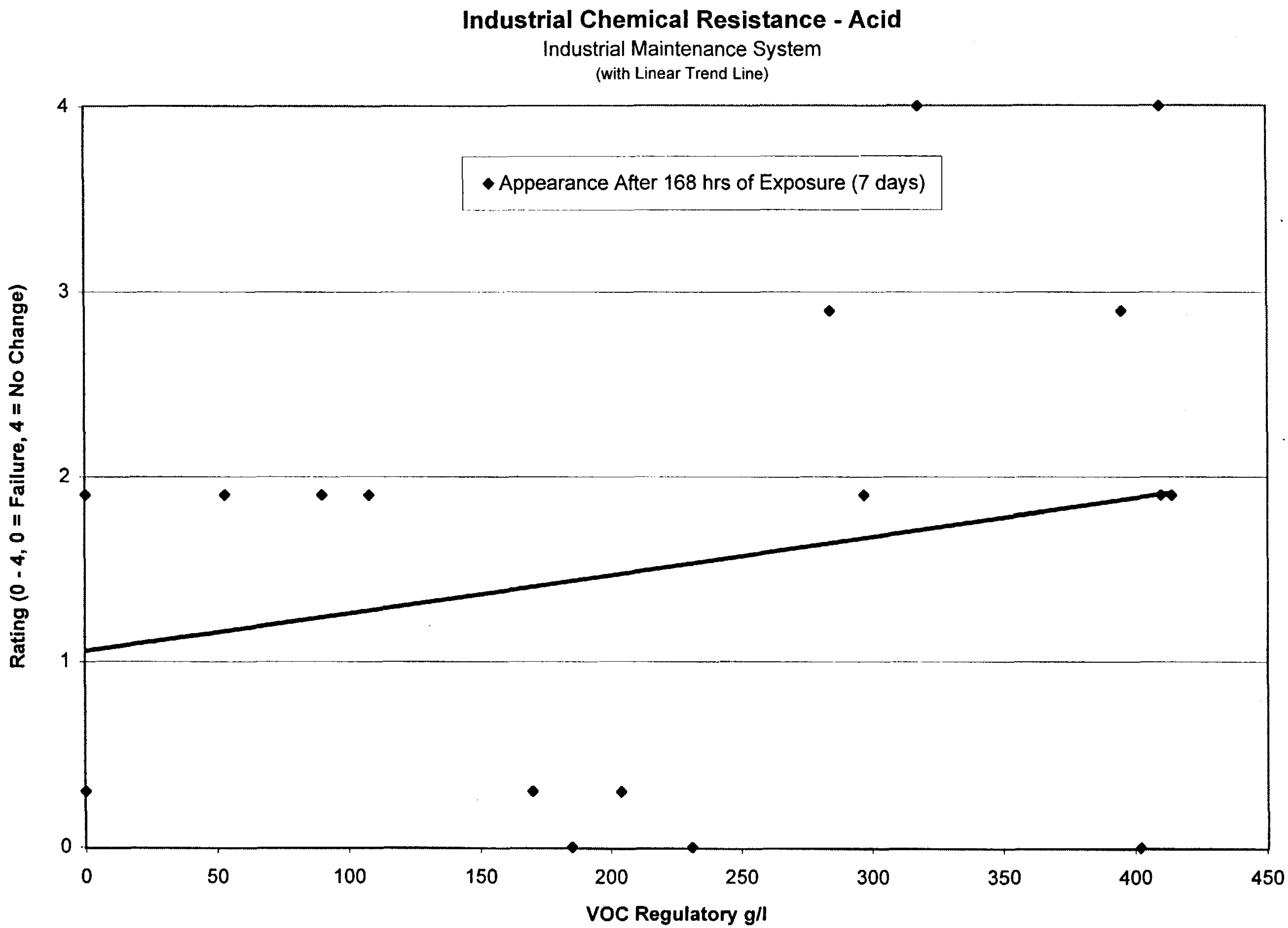


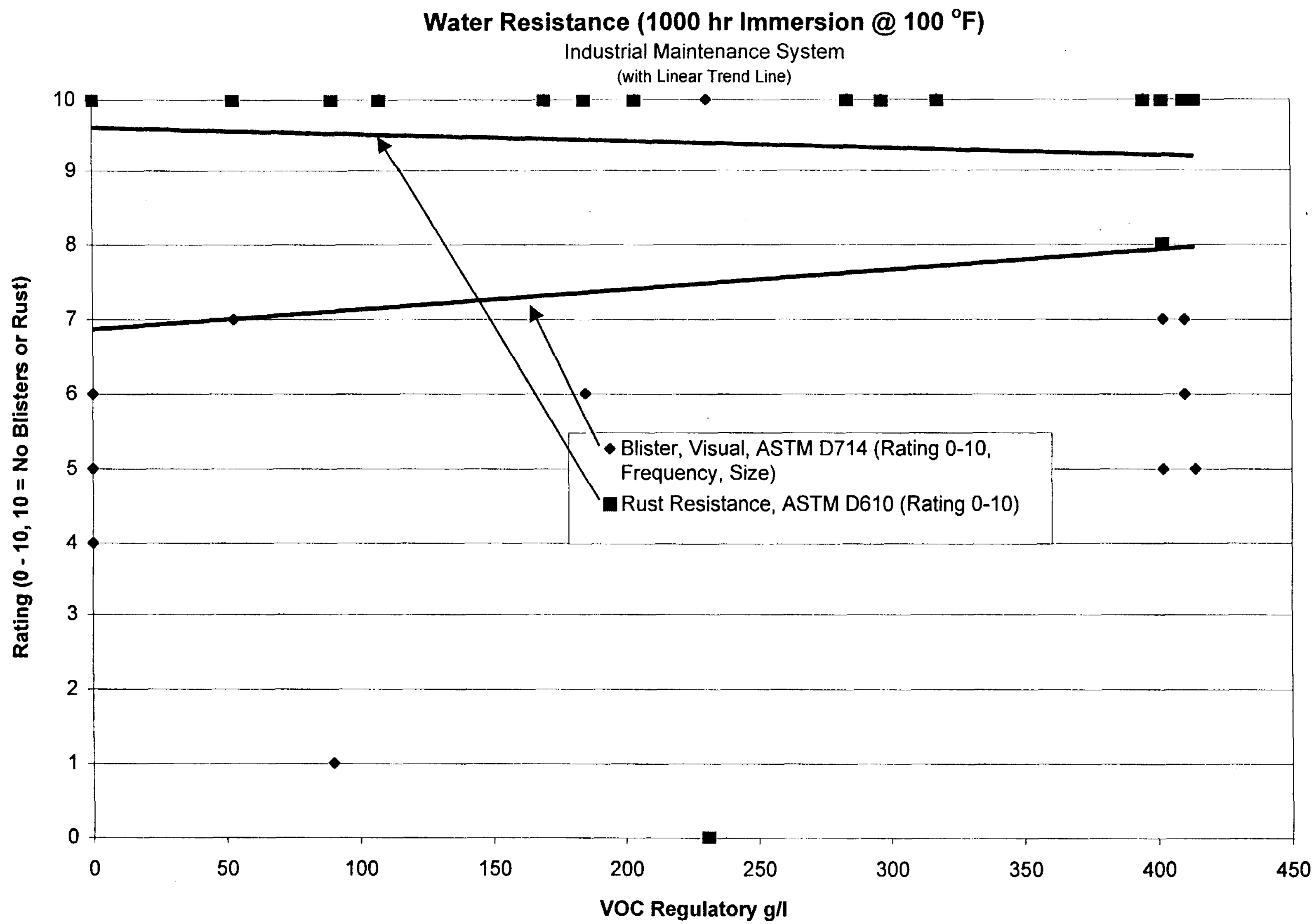
Water Resistance (100 °F & 100% RH) - Adhesion tape test after two week exposure
Industrial Maintenance System
(with Linear Trend Line)
Percent Removed
100
80
60
40
20
0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l
After 2 week Exposure (% removed)
After 2 week Exposure + 24 hour Dry (% removed)


Industrial Chemical Resistance - Bleach
Industrial Maintenance System
(with Linear Trend Line)
Appearance After 168 hrs of Exposure (7 days)
Rating (0 - 4, 0 = Failure, 4 = No Change)
4
3
2
1
0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

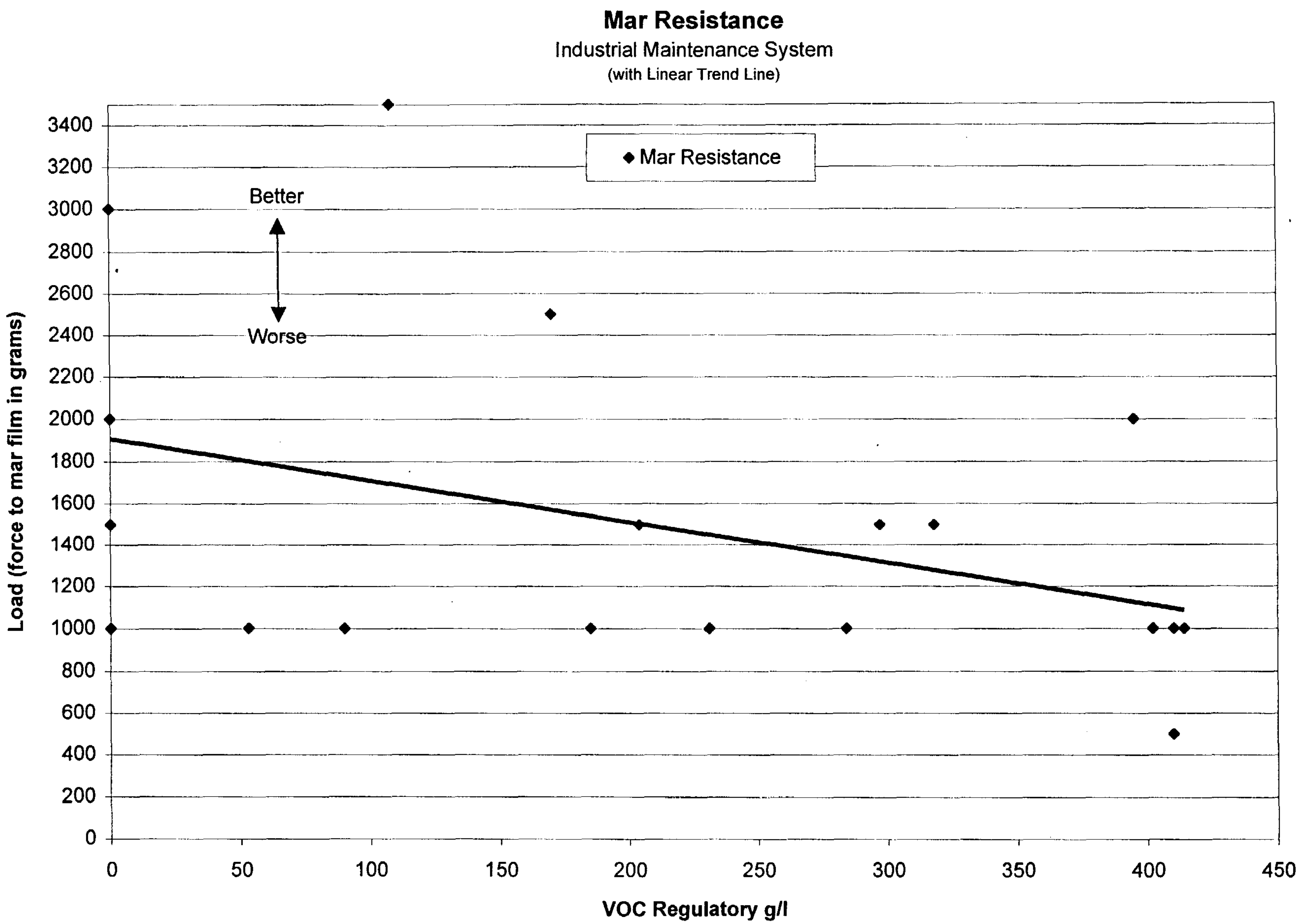


Industrial Chemical Resistance - MEK
Industrial Maintenance System
(with Linear Trend Line)
Appearance After 168 hrs of Exposure (7 days)
Rating (0 - 4, 0 = Failure, 4 = No Change)
VOC Regulatory g/l
0
1
2
3
4
0
50
100
150
200
250
300
350
400
450


Industrial Chemical Resistance - Acid
Industrial Maintenance System
(with Linear Trend Line)
Appearance After 168 hrs of Exposure (7 days)
Rating (0 - 4, 0 = Failure, 4 = No Change)
VOC Regulatory g/l
0
1
2
3
4
0
50
100
150
200
250
300
350
400
450



Water Resistance (1000 hr Immersion @ 100 °F)
Industrial Maintenance System
(with Linear Trend Line)
Rating (0 - 10, 10 = No Blisters or Rust)
10
9
8
7
6
5
4
3
2
1
0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l
Blister, Visual, ASTM D714 (Rating 0-10, Frequency, Size)
Rust Resistance, ASTM D610 (Rating 0-10)


Mar Resistance
Industrial Maintenance System
(with Linear Trend Line)
Mar Resistance
Better
Worse
Load (force to mar film in grams)
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

Industrial Maintenance Coating System (IMCS) Data Table

Protocol Test Number					3.1b	3.2	3.5					
System Reference Designator	System Reference Numbers	Polymer Class	VOC Content	Reference VOC or average	Adhesion to Substrate, PATTI	Appearance and Finish, Coted Panels	Corrosion Resistance: Prohesion (2000 hr. exposure)					
							Blistering (evaluated IAW ASTM D714) Averaged Values				Filiform Corrosion - IAW ASTM D2803 Averaged Values	
Units			g/l		psi		Scribeline Rating (1-10, 10 Ideal)	Scribeline Frequency (0-4, 0 Ideal)	Central Region Rating (1-10, 10 Ideal)	Central Region Frequency (0-4, 0 Ideal)	At Scribeline Length	At Scribeline Frequency (0-4, 0 Ideal)
IMCS-06	910-911	Epoxy/Urethane	0/0	0	1564	rough, semigloss	2.7	3.7	10.0	0.0	12.0	3.0
IMCS-07	912-913-913	Novolac/Novolac/Novolac	0/0/0	0	1535	uniform, satin	8.7	0.2	10.0	0.0	0.0	0.0
IMCS-08	914-915-915	Butadiene-epoxy/Urethane	0/0/0	0	1628	particles, satin	4.0	2.7	10.0	0.0	0.0	0.0
IMCS-09	914-916-916	Butadiene-epoxy/Epoxy	0/0/0	0	1482	uniform, satin	5.3	3.0	6.7	2.3	0.0	0.0
IMCS-03	904-905-905	Epoxy-Polyamide, Zinc-rich/Water-based polyester-urethane	49/55/55	53	1099	glossy, particles	10.0	0.0	10.0	0.0	0.0	0.0
IMCS-05	908-909	Acrylic/Acrylic	60/120	90	1197	non-uniform, semigloss	8.0	1.0	9.3	0.7	0.0	0.0
IMCS-01	901-901	Siloxirane/Siloxirane	108/108	108	1600	glossy off-white	10.0	0.0	10.0	0.0	0.0	0.0
IMCS-11	919-919	Epoxy/Epoxy	170/170	170	1514	uniform, satin-flat	8.0	2.0	10.0	0.0	0.0	0.0
IMCS-04	906-907-907	Water-based polyester-urethane	138/208/208	185	1092	uniform, satin	3.7	2.5	10.0	0.0	22.0	3.7
IMCS-12	920-921	Epoxy/Siloxane	288/120	204	968	uniform, high-gloss	10.0	0.0	10.0	0.0	0.0	0.0
IMCS-13	922-922	Acrylic/Acrylic	231/231	231	986	eggshell, rust spots	3.3	3.3	8.7	0.3	0.0	0.0
IMCS-18	932-932	Epoxy/Epoxy	284/284	284	2105	uniform, satin	8.7	0.3	10.0	0.0	7.0	2.0
IMCS-16	927-928-929	Epoxy/Epoxy/Urethane	320/275/295	297	2136	uniform, satin-gloss	10.0	0.0	10.0	0.0	0.0	0.0
IMCS-19	933-932-934	Inorganic Zinc Silicate/Epoxy/Urethane	282/284/388	318	1129	uniform, high gloss	8.7	0.7	10.0	0.0	0.0	0.0
IMCS-15	925-925	Epoxy/Epoxy	395/395	395	1861	uniform, satin-flat	6.0	1.3	10.0	0.0	5.7	1.0
IMCS-14	923-924	Alkyd/Alkyd	383/422	402	985	ridged, satin-gloss	8.0	1.7	9.3	0.3	0.5	0.2
IMCS-17	930-931	Alkyd/Alkyd	419/385	402	735	uniform, satin-flat	3.3	3.3	10.0	0.0	4.0	0.1
IMCS-20	902-10	Epoxy Ester/Urethane	400/420	410	603	uniform, high gloss	6.7	1.7	10.0	0.0	8.6	1.8
IMCS-02	902-903	Epoxy Ester/Silicone Alkyd	400/420	410	1131	uniform, semigloss	7.3	1.7	10.0	0.0	7.7	2.0
IMCS-10	917-918	Alkyd/Urethane Alkyd	417/411	414	895	uniform, glossy	10.0	0.0	10.0	0.0	11.8	1.7

Industrial Maintenance Coating System (IMCS) Data Table

Protocol Test Number					3.6	3.10	3.8					
System Reference Designator	System Reference Numbers			Undercutting, ASTM D1654	Dirt Resistance: Dry	Dry Film Thickness, Metal	Environmental Resistance					
		Rust Resistance - IAW ASTM D610 - Averaged Values					Delta Gloss, Pretest-2 weeks (+ = Decrease, - = Increase)			Delta Gloss, Pretest-2 weeks + 24 hours (+ = Decrease, - = Increase)		
Units		Rating (0-10, 10 Ideal)	% of Area (1 = 100%)	Rating 0 - 10		mils	20 degrees	60 degrees	85 degrees	20 degrees	60 degrees	85 degrees
IMCS-06	910-911	9.0	0.03	4.00		10.5	-0.4	-6.2	-12.9	1	-1.2	0.7
IMCS-07	912-913-913	9.0	0.03	10.00		29.1	13.7	50.9	43.1	13.2	50.3	40.9
IMCS-08	914-915-915	9.0	0.03	5.70		5.3	28.7	48.2	43.3	29.1	49.8	46.5
IMCS-09	914-916-916	7.0	0.30	3.80		6.6	1.5	-0.4	2.8	0.5	0.7	-0.2
IMCS-03	904-905-905	9.0	0.03	9.00		6.3	18.9	2	5.7	23.5	3.5	5.8
IMCS-05	908-909	10.0	0.00	8.10		4	4.5	6.8	-3.5	-8.3	14.7	8.7
IMCS-01	901-901	10.0	0	9.5		17.1	20	2.3	5.9	6.1	6.1	-0.6
IMCS-11	919-919	10.0	0.00	5.30		7.5	-0.2	-1.7	-3.7	-0.3	-2.6	-3.8
IMCS-04	906-907-907	9.0	0.03	4.30		8.6	8.8	10	-9.6	11	15.7	-1.1
IMCS-12	920-921	10.0	0.00	9.50		7.1	9.2	-2.8	-0.3	4.3	-1.3	-0.7
IMCS-13	922-922	1.0	>0.5	1.30		3.5	0.8	0.9	0.8	-0.1	0.2	1
IMCS-18	932-932	10.0	0.00	6.70		7	7.1	12.2	4.6	7.6	13.3	5.6
IMCS-16	927-928-929	10.0	0.00	7.00		9.2	-2.3	-0.5	-6.3	-0.5	0.6	-5.6
IMCS-19	933-932-934	10.0	0.00	7.20		8.5	-4.8	-1.4	-4.4	-4.7	-1.3	-1.7
IMCS-15	925-925	9.0	0.03	3.80		6	1	1.8	1	1.4	2.9	2.3
IMCS-14	923-924	9.0	0.03	5.80		3.7	18.5	8.8	7.2	23.6	15.1	10.6
IMCS-17	930-931	8.7	0.03	3.90		4.4	3.3	5.1	-6.8	5.9	12.2	1.5
IMCS-20	902-10	10.0	0.00	4.80		4.5	10.1	-0.2	-4.4	2.7	0.1	-9.2
IMCS-02	902-903	9.0	0.10	8.10		3.9	3.1	2.5	-4.3	5.9	5.9	-0.4
IMCS-10	917-918	8.7	0.03	5.50		3.4	37.4	11.4	15.6	24.2	7.4	12

Industrial Maintenance Coating System (IMCS) Data Table

Protocol Test Number		3.8									
System Reference Designator	System Reference Numbers	Reflectance Delta CIE (+ = Decrease, - = Increase)		Delta E313 Yellow (+ = Decrease, - = Increase)		Hardness				Adhesion, Tape	
Units		pretest-2 week	pretest-2 week+ 24 hour dry	pretest-2 week	pretest-2 week+ 24 hour dry	Scratch: after 2 week exposure	Scratch: after 2 week exposure + 24 hour dry	Gouge: after 2 week exposure	Gouge: after 2 week exposure + 24 hour Dry	After 2 week Exposure (% removed)	After 2 week Exposure + 24 hour Dry (% removed)
IMCS-06	910-911	4.81	5.89	-1.30	-1.35	B	B	F	F	2B, 35%	5B, 0%
IMCS-07	912-913-913	1.97	2.17	-0.91	-0.96	2H	6H	3H	9H	5B, 0%	5B, 0%
IMCS-08	914-915-915	2.14	3.63	-0.65	-0.86	6B	3B	<6H	3H	3B, 5-15%	5B, 0%
IMCS-09	914-916-916	4.20	5.09	-0.63	-3.43	B	2B	F	F	5B, 0%	5B, 0%
IMCS-03	904-905-905	-0.04	0.49	-0.04	0.07	4B	2B	3B	3H	1B, 50% of topcoat	4B, <5%
IMCS-05	908-909	-1.30	0.58	-0.08	0.10	3B	2B	F	F	4B, <5%	5B, 0%
IMCS-01	901-901	3.17	3.47	-1.03	-0.96	3H	3H	9H	9H	5B, 0%	5B, 0%
IMCS-11	919-919	-1.85	-1.14	0.97	0.92	3H	2H	4H	4H	5B, 0%	5B, 0%
IMCS-04	906-907-907	-1.81	-0.51	0.52	-0.43	6B	4B	6B	HB	0B, 80% of topcoat	4B, <5%
IMCS-12	920-921	5.27	2.91	-1.54	-0.94	2H	2H	6H	6H	5B, 0%	5B, 0%
IMCS-13	922-922	-10.62	-9.60	-28.37	-28.49	F	H	H	3H	4B, <5%	4B, <5%
IMCS-18	932-932	3.52	4.22	-1.03	-0.96	F	H	H	3H	4B, <5%	5B, 0%
IMCS-16	927-928-929	-0.25	-0.26	0.04	0.17	2B	H	2H	2H	5B, 0%	5B, 0%
IMCS-19	933-932-934	-0.10	-0.11	-0.04	0.02	F	F	3H	3H	5B, 0%	5B, 0%
IMCS-15	925-925	3.40	3.95	-1.31	-1.43	H	H	3H	4H	5B, 0%	5B, 0%
IMCS-14	923-924	10.19	7.96	-2.97	-2.00	5B	3B	3B	H	3B, 10%	3B, 10%
IMCS-17	930-931	2.22	1.32	-0.67	-0.12	4B	2B	3B	2H	3B, 15%	3B, 15%
IMCS-20	902-10	2.23	1.77	-0.35	-0.23	3B	2B	F	F	5B, 0%	5B, 0%
IMCS-02	902-903	-1.21	-3.04	0.24	1.16	4B	2B	2B	B	2B, 35%	4B, <5%
IMCS-10	917-918	19.34	15.68	-5.49	-4.29	3B	2B	HB	F	0B, 100%	5B, 0%

Above values converted to numeric value only (6B=1, ...9H=17)

Industrial Maintenance Coating System (IMCS) Data Table

Protocol Test Number		3.4						
		Industrial Chemical Resistance						
System Reference Designator	System Reference Numbers	Bleach	Bleach	Methyl Ethyl Ketone (MEK)		Acid		Visual
Units		Appearance After 168 hrs of Exposure (7 days)	Rating per Tnemc Method 59	Appearance After 168 hrs of Exposure (7 days)	Rating per Tnemc Method 59	Appearance After 168 hrs of Exposure (7 days)	Rating per Tnemc Method 59	
IMCS-06	910-911	slightly softened and slightly dulled	2S,3VS	softened and slightly dulled	2X,3VS	Softened, swollen, delaminated (adhesive delam of primer)	2S,3VS	as follows
IMCS-07	912-913-913	softened and slightly dulled	3X,2S	Softened, swollen, delaminated (adhesive delam of primer)	2VS,3S,2S	softened and dulled	3X,2S	no visual change
IMCS-08	914-915-915	ened, swollen, delaminated (adhesive delam of pri	2S,3VS,1S	softened and dulled	1X,0X	softened, slightly whitened, blistered, medium-dense #6	3VS,2S,1X	darkened
IMCS-09	914-916-916	softened and dulled	2S,3VS	softened, slightly whitened, blistered, medium-dense #6	1X,0X	Softened, swollen, delaminated (cohesive delam of topcoat)	2S,3VS,1X	whitened
IMCS-03	904-905-905	Dull, slightly raised	2S,3VS	Slightly softened	2S,0S	raised; blistered, dense #4	2S,3VS	as follows
IMCS-05	908-909	raised; blistered, dense #4	2S,3S	slightly softened and slightly dulled	2X,0X	softened and slightly dulled	2S	as follows
IMCS-01	901-901	Severally Yellowed	3X	slightly dulled	3VS	Dull, slightly raised	3S,2S	no visual change
IMCS-11	919-919	ned, swollen, delaminated (cohesive delam of top	3X	dulled, softened and slightly raised	2S,3X	softened, slightly whitened	2S,1X	no visual change
IMCS-04	906-907-907	Slightly softened	2S,3S,1X	raised; blistered, dense #4	2S,0X	slightly softened and slightly dulled	3VS,2S,0VS	as follows
IMCS-12	920-921	dulled, softened and slightly raised	4	softened, slightly whitened	2S,3X	raised, severely softened, "crinkled" appearance and cohesive delam of topcoat only	2S,1X	no visual change
IMCS-13	922-922	softened, slightly whitened	3S,2S	raised, severely softened, "crinkled" appearance and cohesive delam of topcoat only	2X,1X	slightly softened	0X	covered with rust
IMCS-18	932-932	slightly raised and slightly dulled	3S,2S	severely yellowed and slightly softened	3S,2S	slightly raised, increased dulled appearance and softened	3VS	no visual change
IMCS-16	927-928-929	slightly raised and dulled	4	severely raised, softened , dulled	3VS,2X	slightly raised and slightly dulled	2S,3VS	no visual change
IMCS-19	933-932-934	severely yellowed and slightly softened	4	slightly raised, increased dulled appearance and softened	2S	discolored medium pink/blue, moderately raised	4	no visual change
IMCS-15	925-925	slightly softened	3X	slightly raised and dulled	2S	severely raised, softened , dulled	3VS	no visual change
IMCS-14	923-924	raised, severely softened, "crinkled" appearance and cohesive delam of topcoat only	2S,3VS,1X	slightly softened	2X,1X,0X	slightly raised and dulled	2S,0X	slightly darkened
IMCS-17	930-931	severely raised, softened , dulled	2S,3VS	slightly raised and slightly dulled	2S,1X,0X	severely yellowed and slightly softened	2S,1X,0X	yellowed, with some rust spots around blisters
IMCS-20	902-10	htly raised, increased dulled appearance and softe	4	discolored medium pink/blue, moderately raised	2S,0X	softened, dulled and blistered, medium #4	4	as follows
IMCS-02	902-903	slightly dulled	2S	Dull, slightly raised	2S,1X	Slightly softened	2S,3VS	yellowed
IMCS-10	917-918	ftened, slightly whitened, blistered, medium-dense	2S	Softened, swollen, delaminated (cohesive delam of topcoat)	1X,0X	dulled, softened and slightly raised	2S	yellowed

Industrial Maintenance Coating System (IMCS) Data Table

Protocol Test Number		3.23		3.24b	3.25b	3.25c
System Reference Designator	System Reference Numbers	Water Resistance		Mar Resistance	Weathering Resistance, Outdoor, Steel	Weathering Resistance, Accelerated, Outdoor
Units		Blister, Visual, ASTM D714 (Rating 0-10, Frequency, Size)	Rust Resistance, ASTM D610 (Rating 0-10)	Load in grams		
IMCS-06	910-911	5, medium-dense, #4	10-no rusting or less than 0.01% of surface rusted	2000		
IMCS-07	912-913-913	10, None	10-no rusting or less than 0.01% of surface rusted	3000		
IMCS-08	914-915-915	4, medium-dense, #2	10-no rusting or less than 0.01% of surface rusted	1500		
IMCS-09	914-916-916	6, medium-dense, #6	10-no rusting or less than 0.01% of surface rusted	1000		
IMCS-03	904-905-905	7, few, #4	10-no rusting or less than 0.01% of surface rusted	1000		
IMCS-05	908-909	1, dense, #2	10-no rusting or less than 0.01% of surface rusted	1000		
IMCS-01	901-901	10, None	10-no rusting or less than 0.01% of surface rusted	3500		
IMCS-11	919-919	10, None	10-no rusting or less than 0.01% of surface rusted	2500		
IMCS-04	906-907-907	6, medium, #4	10-no rusting or less than 0.01% of surface rusted	1000		
IMCS-12	920-921	10, none	10-no rusting or less than 0.01% of surface rusted	1500		
IMCS-13	922-922	10, None	0-approximately 100% of surface rusted	1000		
IMCS-18	932-932	10, None	10-no rusting or less than 0.01% of surface rusted	1000		
IMCS-16	927-928-929	10, None	10-no rusting or less than 0.01% of surface rusted	1500		
IMCS-19	933-932-934	10, None	10-no rusting or less than 0.01% of surface rusted	1500		
IMCS-15	925-925	10, None	10-no rusting or less than 0.01% of surface rusted	2000		
IMCS-14	923-924	5, medium-dense, #4 or #6	10-no rusting or less than 0.01% of surface rusted	1000		
IMCS-17	930-931	7, few, #4 or #2	8-less than 0.1% of surface rusted	1000		
IMCS-20	902-10	7, dense, #8	10-no rusting or less than 0.01% of surface rusted	1000		
IMCS-02	902-903	6, medium, #4	10-no rusting or less than 0.01% of surface rusted	500		
IMCS-10	917-918	5, medium-dense, #4	10-no rusting or less than 0.01% of surface rusted	1000		

Section 4: Nonflat Primer, Quick Dry Primer, and Primer Sealer Undercoater - Interior

Total # manufactuers or brands	12
Single component coatings	10
Multi-component coatings	1
Total # coatings	17

Note: Six coatings part status (single or multi-component) not available.

Test Summary

Brushing Properties Wet:
- Low VOC coatings exhibited slightly lower performance compared to high VOC coatings. One high VOC coating exhibited excellent performance.

Brushing Properties Dry:
- Low VOC coatings exhibited slightly lower performance compared to high VOC coatings. One high VOC coating exhibited excellent performance.

Dry Time - Dry To Touch:
- Low VOC coatings exhibited similar dry times at 50 °F and 90% RH, but exhibited slightly lower dry times at 90 °F and 30% RH compared to high VOC coatings.

Dry Time - Dry Hard:
- Low VOC coatings exhibited similar performance compared to high VOC coatings

Contrast Ratio (Hiding Power):
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Spreading Rate:
- Low VOC coatings exhibited lower performance compared to high VOC coatings.

Leveling:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Sag Resistance:
- Low VOC coatings exhibited slightly higher performance compared to high VOC coatings.

Hiding Wet to Dry Changes:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Dry Film Thickness:
- Low VOC coatings exhibited slightly lower dry film thicknesses compared to high VOC coatings.

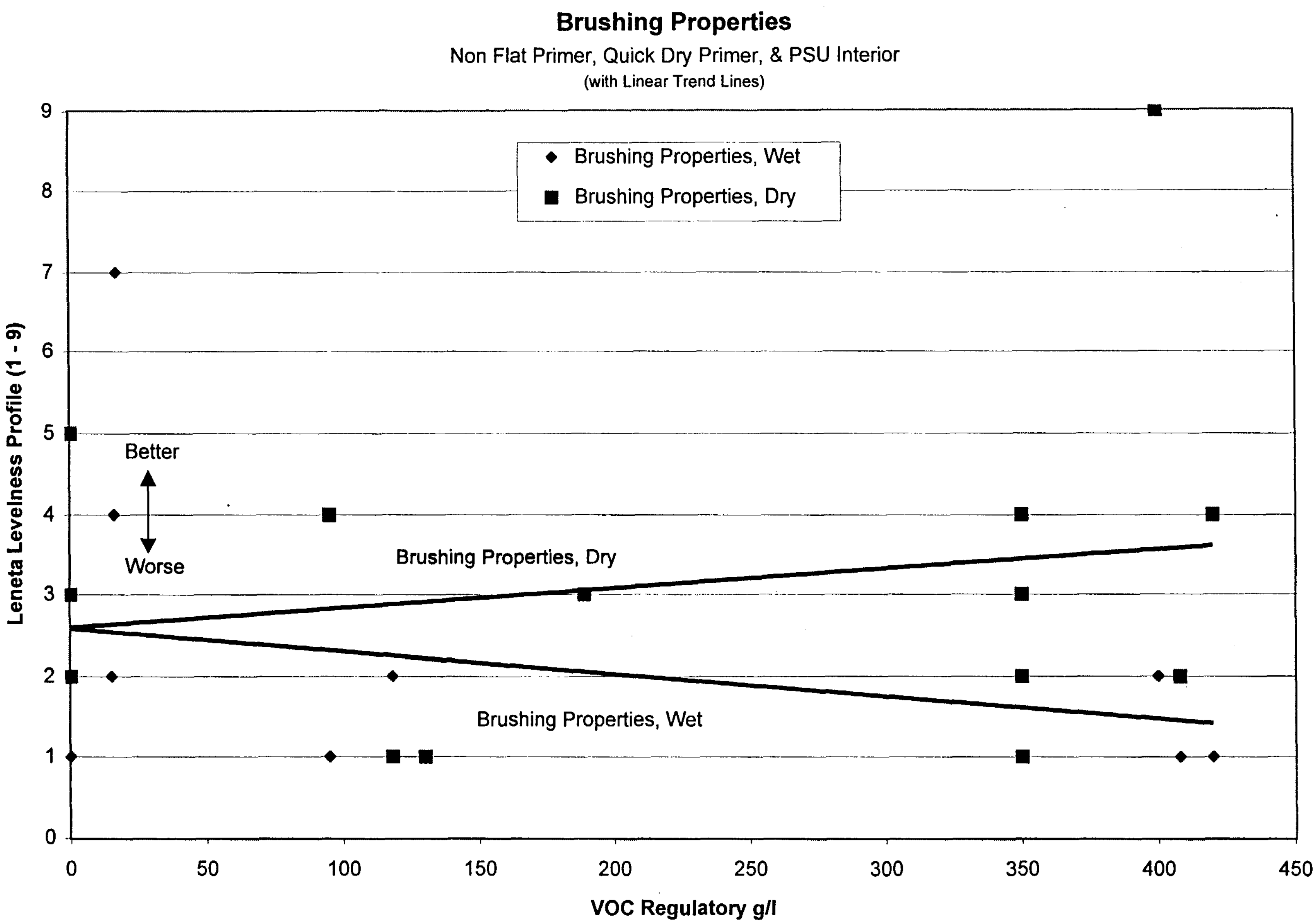
Comments:

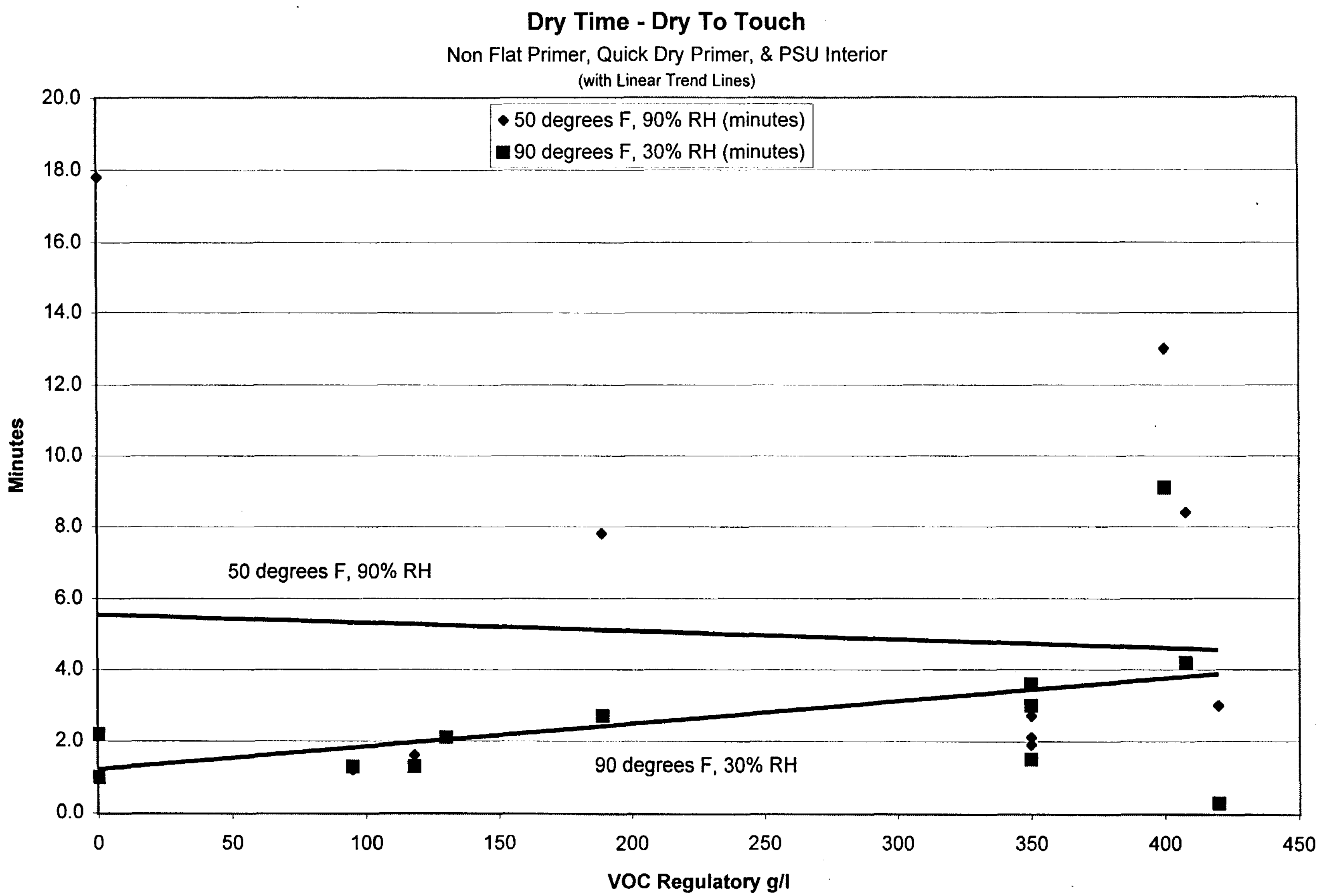
Overall, low VOC coatings exhibited similar performance to high VOC coatings.

Nonflat Primer, Quickdry Primer, and Primer Sealer Undercoater - Interior

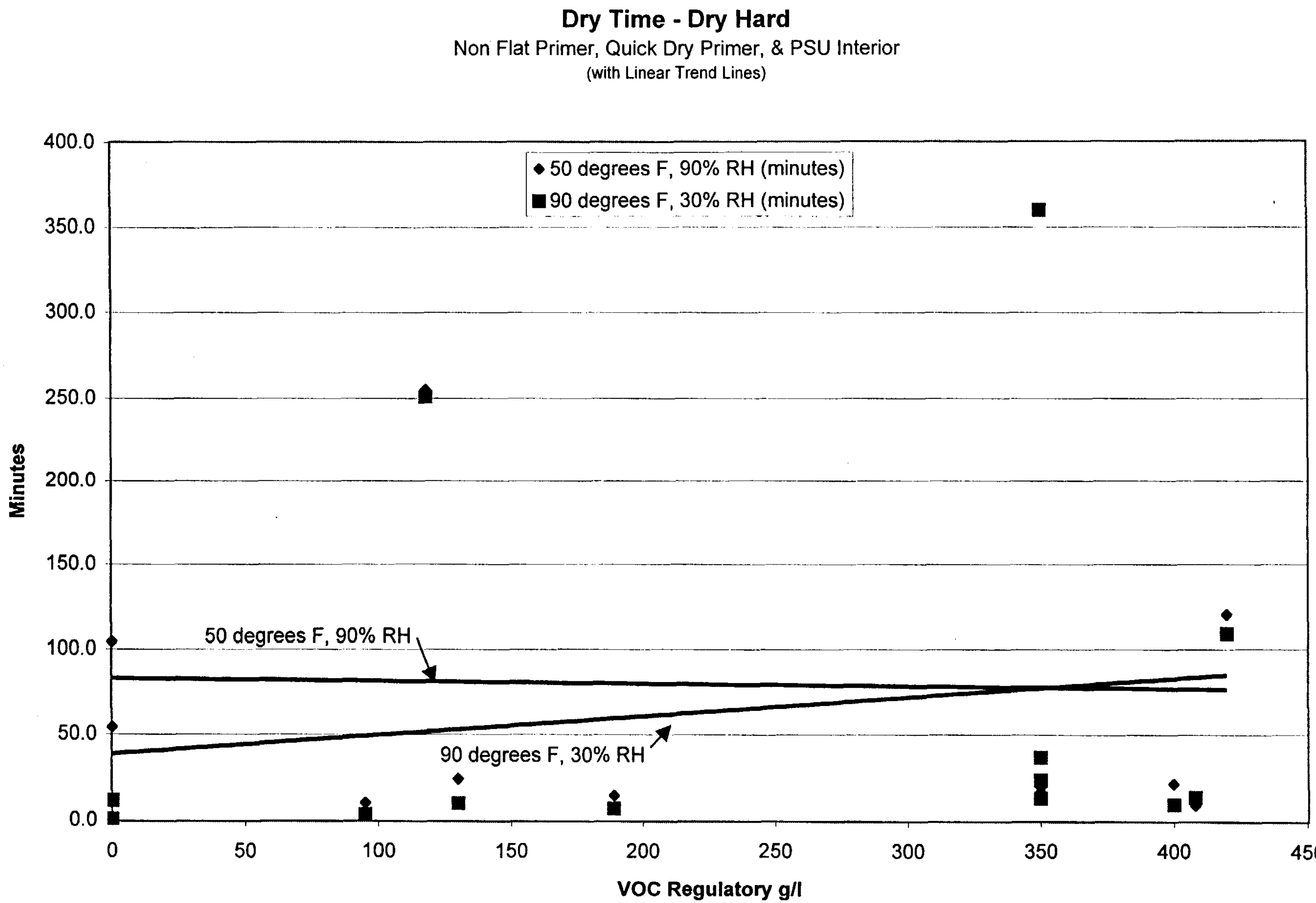
Coating Reference Designator	VOC, g/l	Part	Polymer Class	Intended Application	Total
333	189	(blank)	(blank)	P	1
327	0	1	Acrylic latex	P	1
103	408	1	Alkyd	P	1
320	350	1	Alkyd	P	1
10	420	2	Urethane	T	1
321	130	1	Acrylic latex	P	1
329	0	(blank)	(blank)	P	1
330	350	(blank)	(blank)	P	1
334	0	(blank)	Acrylic latex	P	1
326	0	(blank)	(blank)	P	1
313	118	1	Acrylic emulsion	S	1
111	400	1	Alkyd	P	1
315	0	1	Acrylic emulsion	P	1
303	0	1	(blank)	S	1
324	350	1	Alkyd	P	1
323	35	(blank)	(blank)	U	1
308	95	1	(blank)	S	1
Grand Total					17

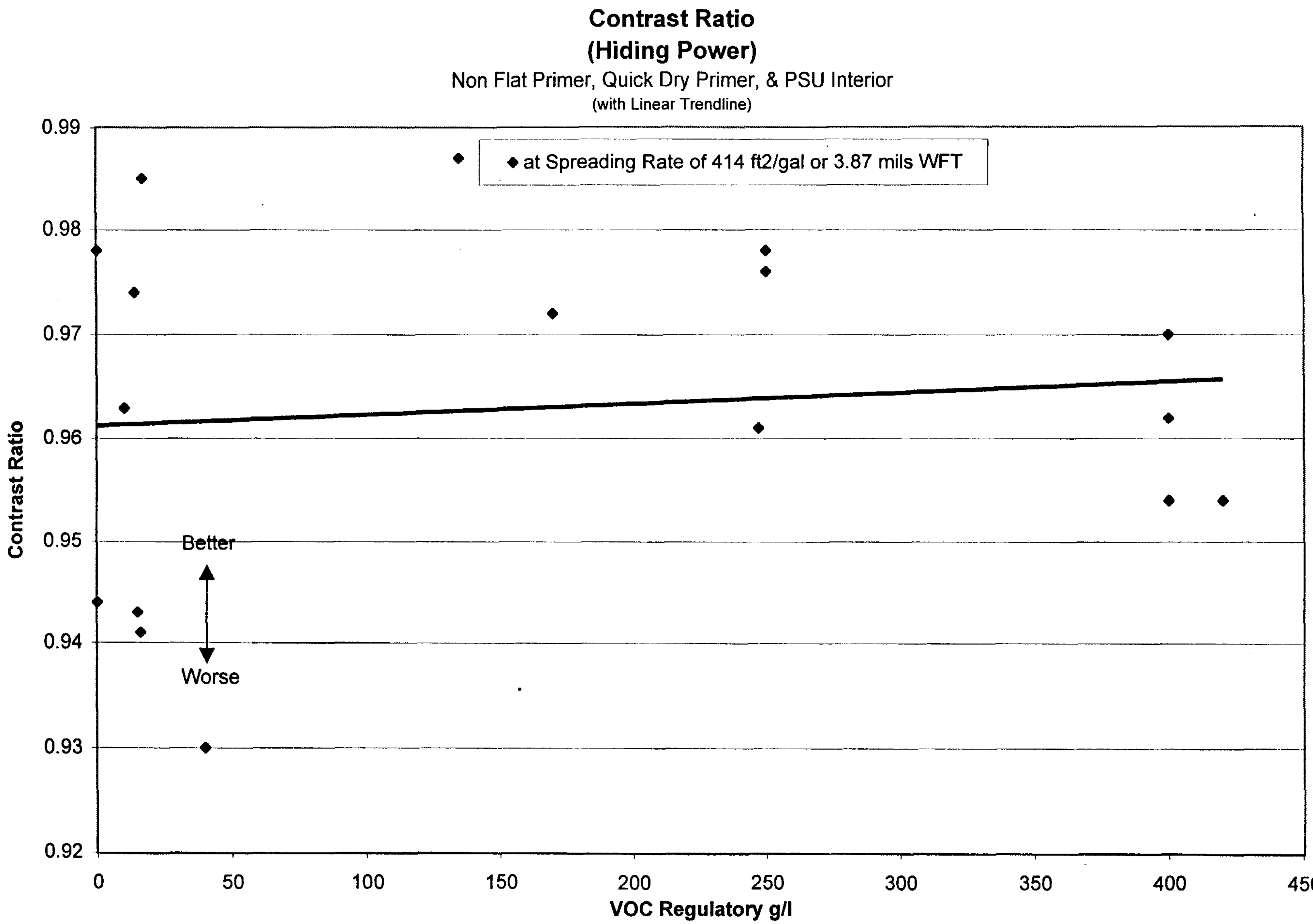
Single component coatings = 10 Multi-component coatings = 1

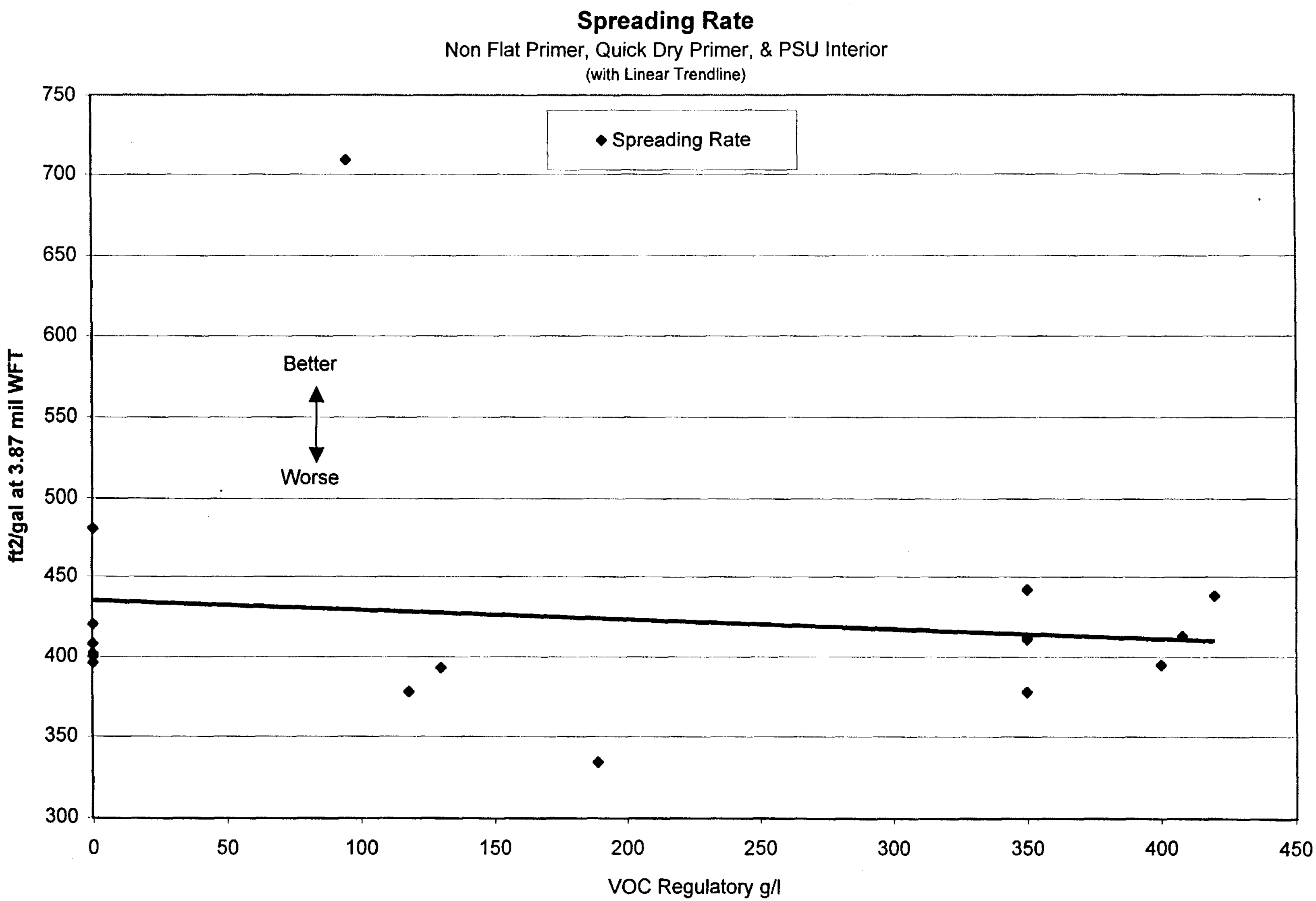

Brushing Properties
Non Flat Primer, Quick Dry Primer, & PSU Interior
(with Linear Trend Lines)
Brushing Properties, Wet
Brushing Properties, Dry
Better
Worse
Brushing Properties, Dry
Brushing Properties, Wet
Leneta Levelness Profile (1 - 9)
VOC Regulatory g/l
0
1
2
3
4
5
6
7
8
9
0
50
100
150
200
250
300
350
400
450



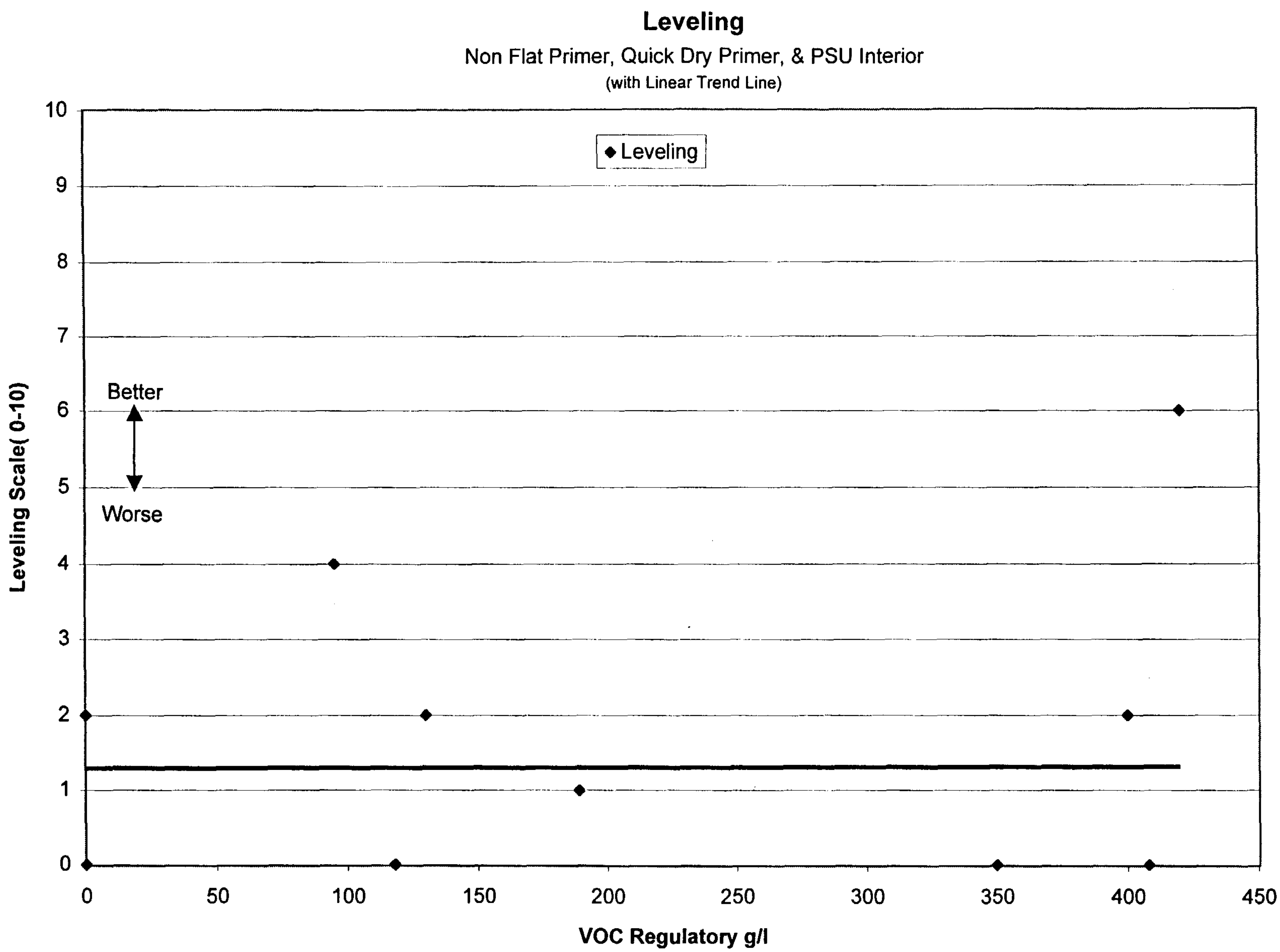
Dry Time - Dry To Touch
Non Flat Primer, Quick Dry Primer, & PSU Interior
(with Linear Trend Lines)
50 degrees F, 90% RH (minutes)
90 degrees F, 30% RH (minutes)
50 degrees F, 90% RH
90 degrees F, 30% RH
Minutes
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l


Dry Time - Dry Hard
Non Flat Primer, Quick Dry Primer, & PSU Interior
(with Linear Trend Lines)
50 degrees F, 90% RH (minutes)
90 degrees F, 30% RH (minutes)
Minutes
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
50 degrees F, 90% RH
90 degrees F, 30% RH
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

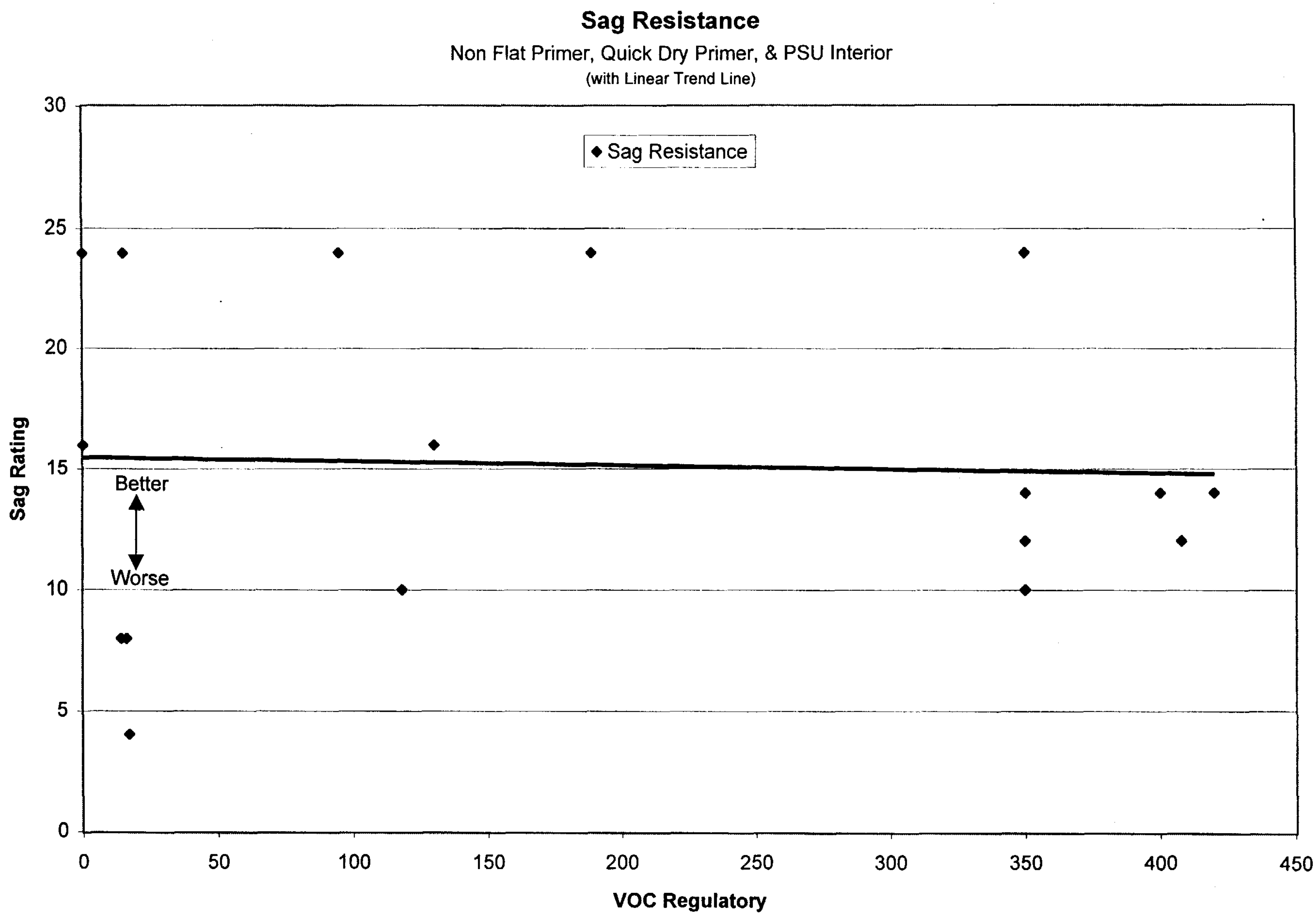

Contrast Ratio
(Hiding Power)
Non Flat Primer, Quick Dry Primer, & PSU Interior
(with Linear Trendline)
at Spreading Rate of 414 ft2/gal or 3.87 mils WFT
Better
Worse
Contrast Ratio
0.99
0.98
0.97
0.96
0.95
0.94
0.93
0.92
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

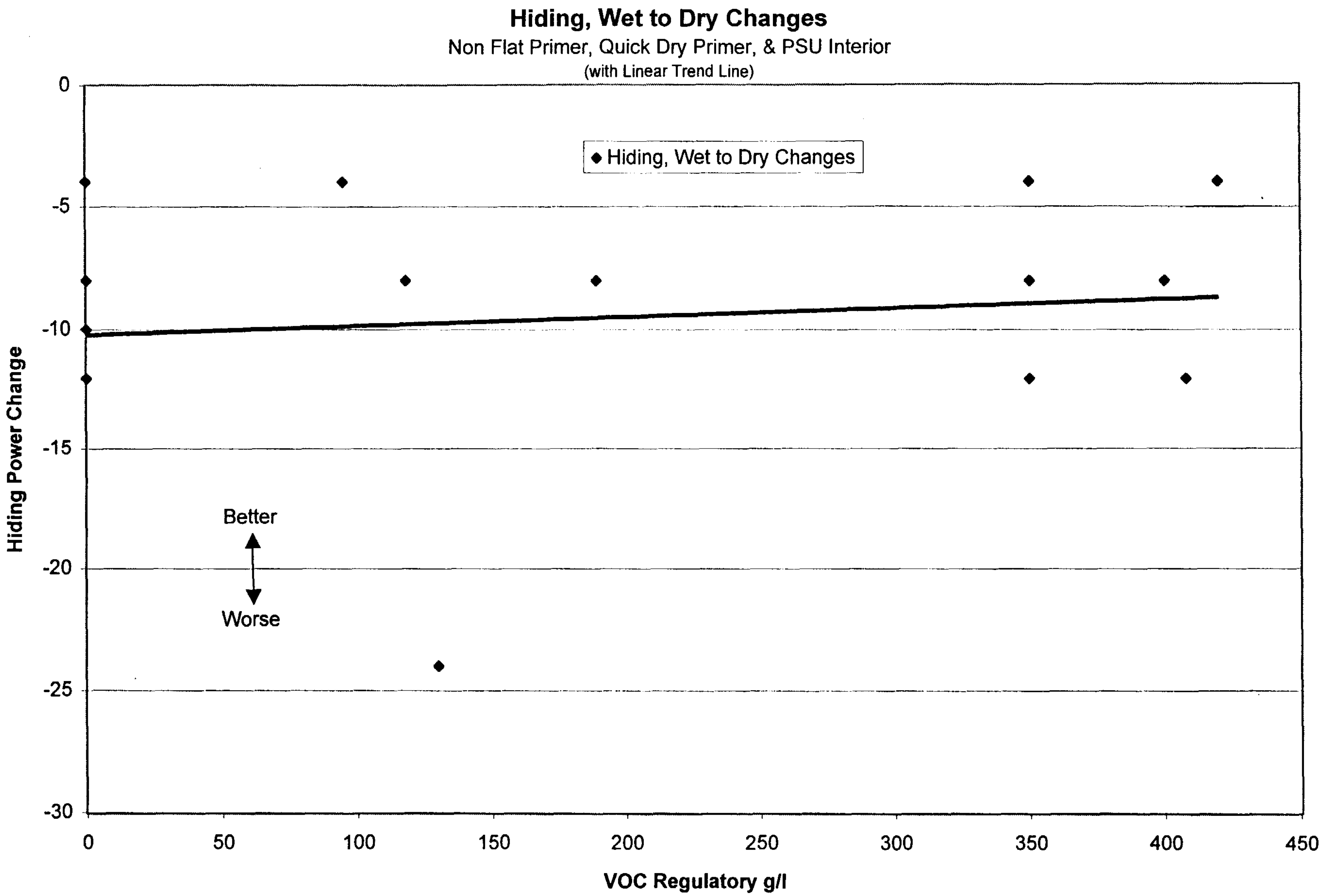


Spreading Rate
Non Flat Primer, Quick Dry Primer, & PSU Interior
(with Linear Trendline)
Spreading Rate
Better
Worse
ft2/gal at 3.87 mil WFT
750
700
650
600
550
500
450
400
350
300
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

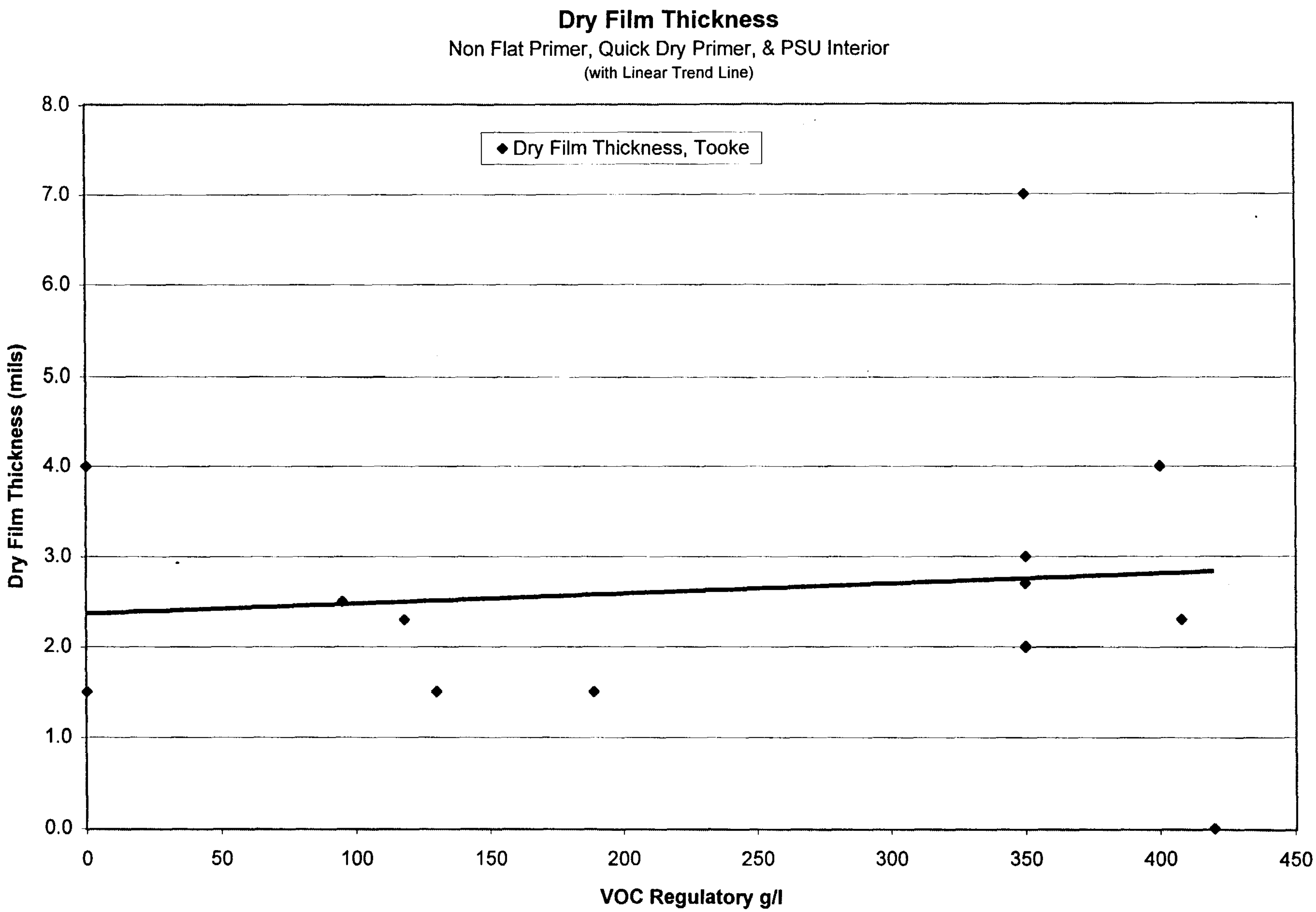


Leveling
Non Flat Primer, Quick Dry Primer, & PSU Interior
(with Linear Trend Line)
Leveling
Better
Worse
Leveling Scale(0-10)
10
9
8
7
6
5
4
3
2
1
0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l


Sag Resistance
Non Flat Primer, Quick Dry Primer, & PSU Interior
(with Linear Trend Line)
Sag Resistance
Sag Rating
Better
Worse
VOC Regulatory
30
25
20
15
10
5
0
0
50
100
150
200
250
300
350
400
450



Hiding, Wet to Dry Changes
Non Flat Primer, Quick Dry Primer, & PSU Interior
(with Linear Trend Line)
Hiding, Wet to Dry Changes
Hiding Power Change
Better
Worse
VOC Regulatory g/l
0
-5
-10
-15
-20
-25
-30
0
50
100
150
200
250
300
350
400
450


Dry Film Thickness
Non Flat Primer, Quick Dry Primer, & PSU Interior
(with Linear Trend Line)
Dry Film Thickness, Tooke
Dry Film Thickness (mils)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

Nonflat Primer (NFP), Quick Dry Primer (QDP), and Primer Sealer Undercoater (PSU) INTERIOR Data Table

Protocol Test Number							2.1	2.1	2.2		2.2		3.14	3.14
Coating Reference Number	Coating Reference Designator	VOC Content	Polymer Class	Nonvolatile by Weight	Coarse Particles	Density	Brushing Properties, Wet	Brushing Properties, Dry	Dry time, Dry to Touch - One Part Coatings		Dry time, Dry Hard - One Part Coatings		Contrast Ratio (Cw) Hiding Power	Spreading Rate
Units		g/l		%	Size in Microns	lbs/gal	Leneta Leveliness Profile, 1 - 9	Leneta Leveliness Profile, 1 - 9	50 degrees F, 90% RH (minutes)	90 degrees F, 30% RH (minutes)	50 degrees F, 90% RH (minutes)	90 degrees F, 30% RH (minutes)	at Spreading Rate of 414 ft2/gal or 3.87 mils WFT	ft2/gal at 3.87 mil WFT
326	NFP10	0	Acrylic Latex	48.1	40	10.79	1	2	9.9	1.9	16.5	3.4	0.944	402
327	NFP11	0	Acrylic Latex	39.1	48	10.01	2	3	2.7	2.4	7.5	7.8	0.978	400
329	NFP13	0	Acrylic Latex	56.8	60	11.32	1	3	1.3	1.0	17.8	11.8	0.963	408
334	NFP18	0	Acrylic Latex	57.6	100	11.67	1	2	1.6	0.3	5.8	3.9	0.93	396
303	PSU1	0	Vinyl Polymer Latex	43.5	36	10.7	2	4	17.8	1.0	54.1	1.0	0.987	420
315	NFP3	0	Acrylic	56.1	100	11.18	<1	3	1.0	2.2	104.2	11.8	0.972	481
308	PSU2	95	Acrylic Latex	50.7	40	10.95	3	5	1.2	1.3	10.2	3.7	0.961	709
313	PSU3	118	Acrylic Emulsion	52.8	20	11.3	1	1	1.6	1.3	255.1	250.9	0.978	378
321	NFP5	130	Acrylic Latex	59.8	36	12.08	2	3	2.1	2.1	24.0	10.2	0.976	393
333	NFP17	189	Acrylic Latex	39.6	28	10.55	2	4	7.8	2.7	14.6	7.2	0.954	334
320	NFP4	350	Alkyd	74.9	44	12.11	2	3	2.1	1.5	17.1	23.7	0.97	412
323	NFP7	350	Alkyd	76.5	40	11.67	2	3	2.1	3.0	19.8	13.2	0.962	442
324	NFP8	350	Alkyd	71.2	100	11.58	<1	<1	1.9	3.6	359.2	360.0	0.954	378
330	NFP14	350	Alkyd	75.2	33	12.5	1	2	2.7	3.6	20.7	36.9	0.974	411
111	QDP4	400	Alkyd	64.5	40	10.34	2	3	13.0	9.1	21.7	9.7	0.943	395
103	QDP2	408	Alkyd	66.1	28	11.2	4	6	8.4	4.2	9.0	13.8	0.941	413
10	REF	420	Urethane	73.6	none	11.1	7	9	3.0	0.3	120.3	109.2	0.985	438

Nonflat Primer (NFP), Quick Dry Primer (QDP), and Primer Sealer Undercoater (PSU) INTERIOR Data Table

Protocol Test Number		2.4	2.7	2.10							3.2	3.2	3.10
Coating Reference Number	Coating Reference Designator	Leveling	Sag Resistance	Hiding, Wet to Dry Changes	Wet Film Thickness			Wet Film/Dry Film/WW & Bar Applicator Gap Relationships			Appearance and Finish, Drawdown Charts	Appearance and Finish, Coated Wood Panels	Dry Film Thickness, Tooke
					WW Rod #30	WW Rod #48	WW Rod #80	WW Rod #30	WW Rod #48	WW Rod #80			
Units		Scale, 0-10	Notch Clearance in mils	Wet-Dry Hiding Change (WDHC) Factor	mils	mils	mils	mils	mils	mils			mils
326	NFP10	2	16	-12	5.5	6.5	10.5	1.4	2.3	3.3	uniform, flat	uniform, flat	2.0
327	NFP11	1	>24	-8	4.5	5.5	9.0	1.3	1.5	2.1	smooth, flat	uniform, flat	2.0
329	NFP13	0	>24	-12	4.5	5.5	7.5	1.6	2.1	2.6	smooth, flat	uniform, flat	2.5
334	NFP18	1	10	-12	4.5	5.0	8.5	2.0	2.4	2.8	smooth, flat	uniform, eggshell	5.0
303	PSU1	2	16	-4	4.5	4.5	7.5	1.4	2.1	2.1	smooth, flat	uniform, flat	1.5
315	NFP3	0	>24	-10	4.5	7.5	7.5	1.7	2.4	3.1	semi-rough, flat matte	uniform, flat	4.0
308	PSU2	4	12	-4	5.5	5.5	7.5	1.6	1.9	2.5	slightly crinkled, flat	uniform, flat	2.5
313	PSU3	0	>24	-8	5.5	7.5	9.5	1.5	2.7	2.5	even, satin-flat	smooth, satin-flat	2.3
321	NFP5	2	14	-24	4.5	5.5	7.5	2.0	2.2	2.3	smooth, flat	uniform, eggshell	1.5
333	NFP17	1	10	-8	5.5	6.5	7.5	1.6	1.9	2.4	smooth, flat	even, flat/thin	1.5
320	NFP4	0	14	-12	3.5	5.5	8.5	1.2	2.3	3.8	smooth, matte	uniform, flat-matte	3.0
323	NFP7	0	12	-8	4.5	5.5	8.5	2.4	3.3	3.4	smooth, flat	uniform, flat	7.0
324	NFP8	0	14	-4	3.5	7.5	10.5	2.0	2.4	4.2	smooth, eggshell	smooth satin-flat	2.0
330	NFP14	0	8	-12	5.5	6.5	7.5	1.9	2.1	3.4	smooth, matte	uniform, flat	2.7
111	QDP4	2	>24	<-8	5.5	6.5	8.5	2.4	2.3	3.0	smooth, matte	eggshell	4.0
103	QDP2	0	8	<-12	4.5	5.5	8.5	2.6	2.2	2.3	smooth, eggshell	uniform, eggshell	2.3
10	REF	6	<4	-4	4.5	6.5	8.5	1.2	2.5	3.4	smooth, high gloss	N/A	N/A

Section 5: Nonflat Primer, Quick Dry Primer, and Primer Sealer Undercoater - Exterior

Total # manufactuers or brands	11
Single component coatings	9
Multi-component coatings	1
Total # coatings	14

Note: Four coatings part status (single or multi-component) not available.

Test Summary

Brushing Properties Wet:

- Low VOC coatings exhibited slightly lower performance compared to high VOC coatings. One high VOC coatings exhibited excellent performance.

Brushing Properties Dry:

- Low VOC coatings exhibited slightly lower performance compared to high VOC coatings. One high VOC coatings exhibited excellent performance.

Dry Time - Dry To Touch:

- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Dry Time - Dry Hard:

- Low VOC coatings exhibited faster dry times at 50 °F and 90% RH, and at 90 °F and 30% RH compared to high VOC coatings.

Contrast Ratio (Hiding Power):

- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Spreading Rate:

- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Leveling:

- Low VOC coatings exhibited slightly lower performance compared to high VOC coatings.

Sag Resistance:

- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Hiding Wet to Dry Changes:

- Low VOC coatings exhibited slightly better performance compared to high VOC coatings.

Dry Film Thickness:

- Low VOC coatings exhibited similar dry film thicknesses compared to high VOC coatings.

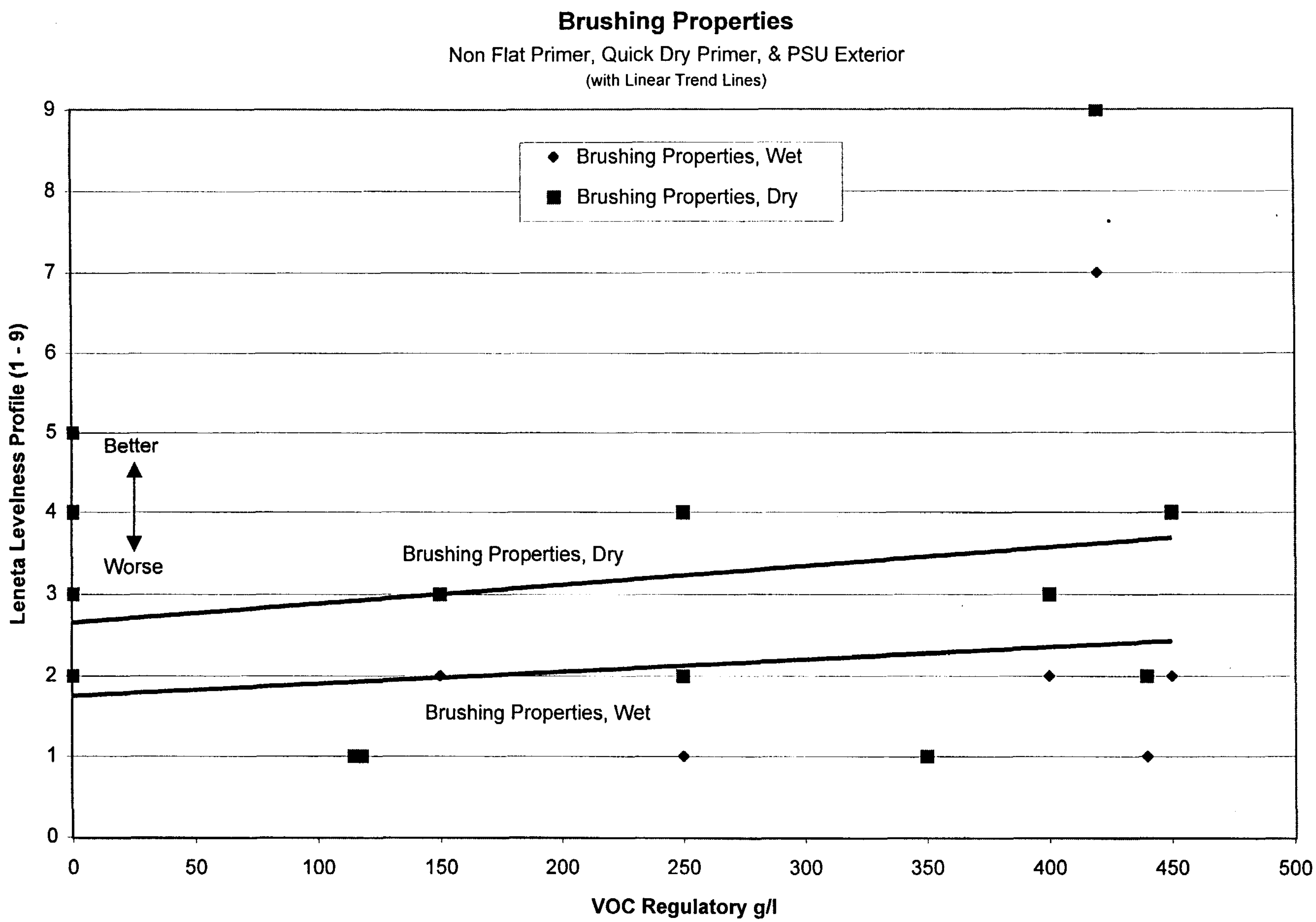
Comments:

Overall, low VOC coatings exhibited similar performance to high VOC coatings.

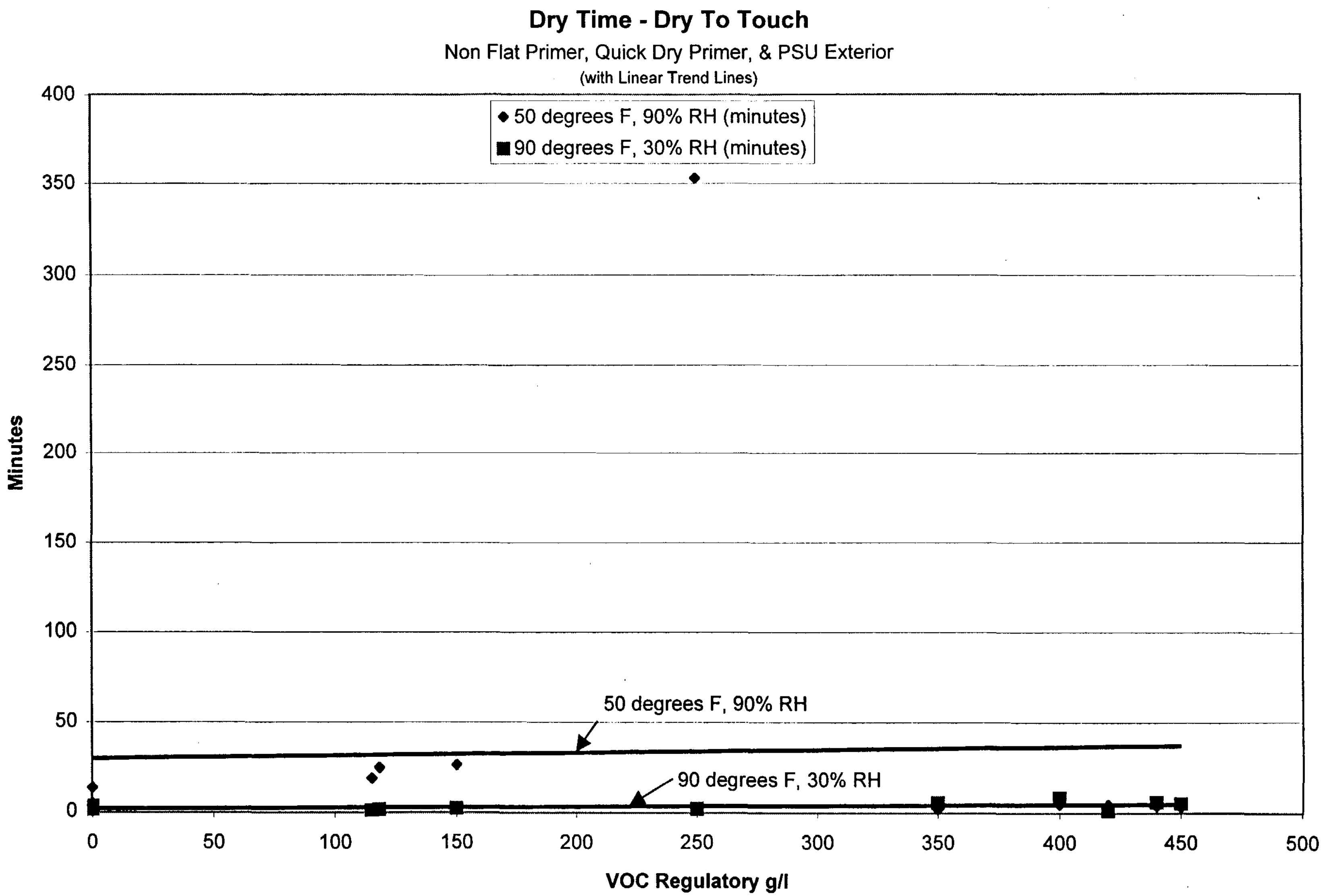
Nonflat Primer, Quickdry Primer, and Primer Sealer Undercoater - Exterior

Coating Reference Designator	VOC, g/l	Part	Polymer Class	Intended Application	Total
328	350	1	Alkyd	P	1
322	115	1	Acrylic latex	P	1
101	440	1	Alkyd	P	1
10	420	2	Urethane	T	1
331	250	(blank)	(blank)	P	1
301	1	1	Copolymer Latex	P	1
325	0	(blank)	(blank)	P	1
313	118	1	Acrylic emulsion	S	1
111	400	1	Alkyd	P	1
332	250	(blank)	(blank)	P	1
319	150	(blank)	(blank)	P	1
308	95	1	(blank)	S	1
109	450	1	Oil base	P	1
310	0	1	Acrylic latex	P	1
Grand Total					14

Single component coatings = 9 Multi-component coatings = 1



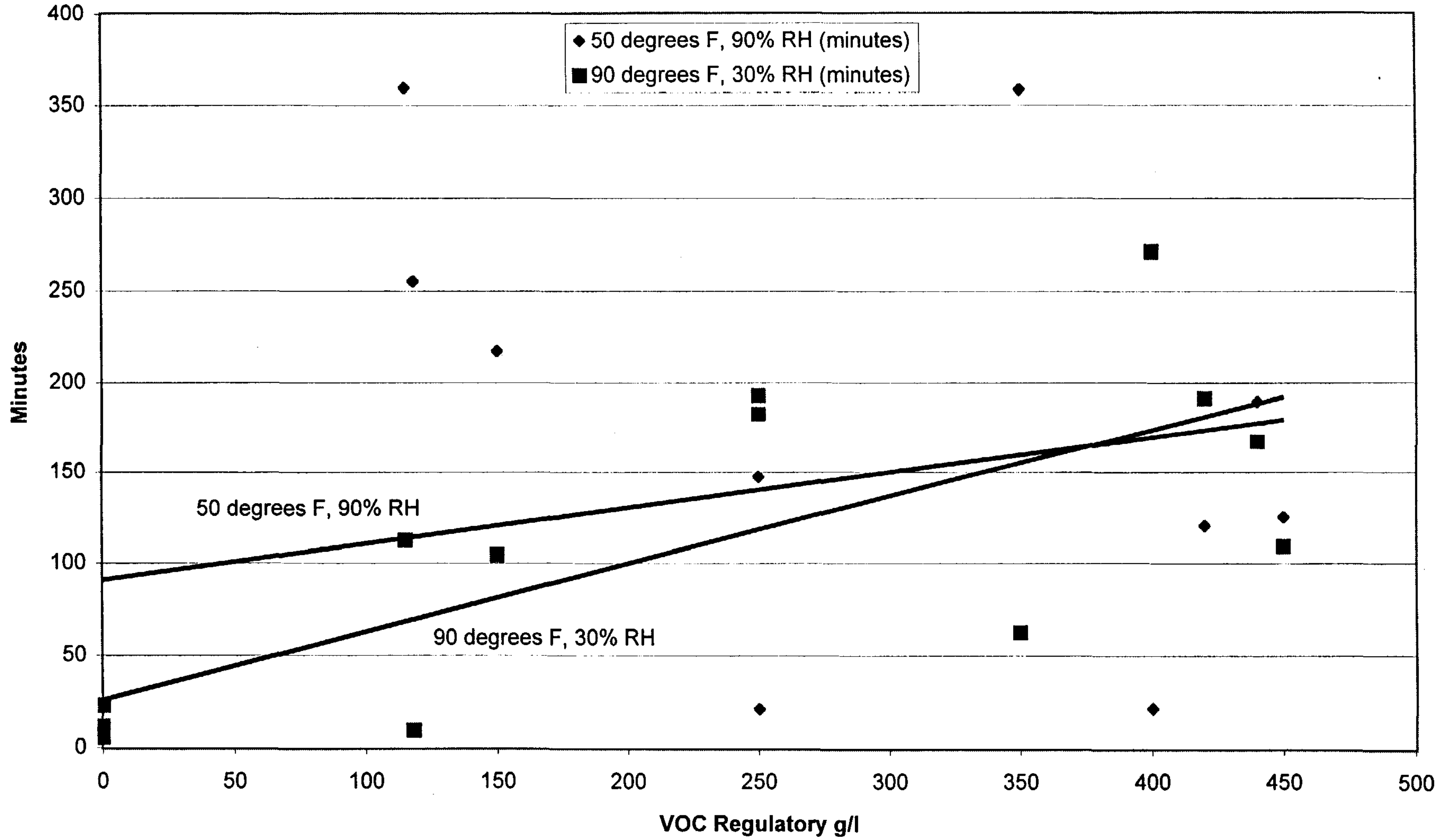
Brushing Properties
Non Flat Primer, Quick Dry Primer, & PSU Exterior
(with Linear Trend Lines)
Brushing Properties, Wet
Brushing Properties, Dry
Better
Worse
Brushing Properties, Dry
Brushing Properties, Wet
Leneta Levelness Profile (1 - 9)
VOC Regulatory g/l
0
1
2
3
4
5
6
7
8
9
0
50
100
150
200
250
300
350
400
450
500

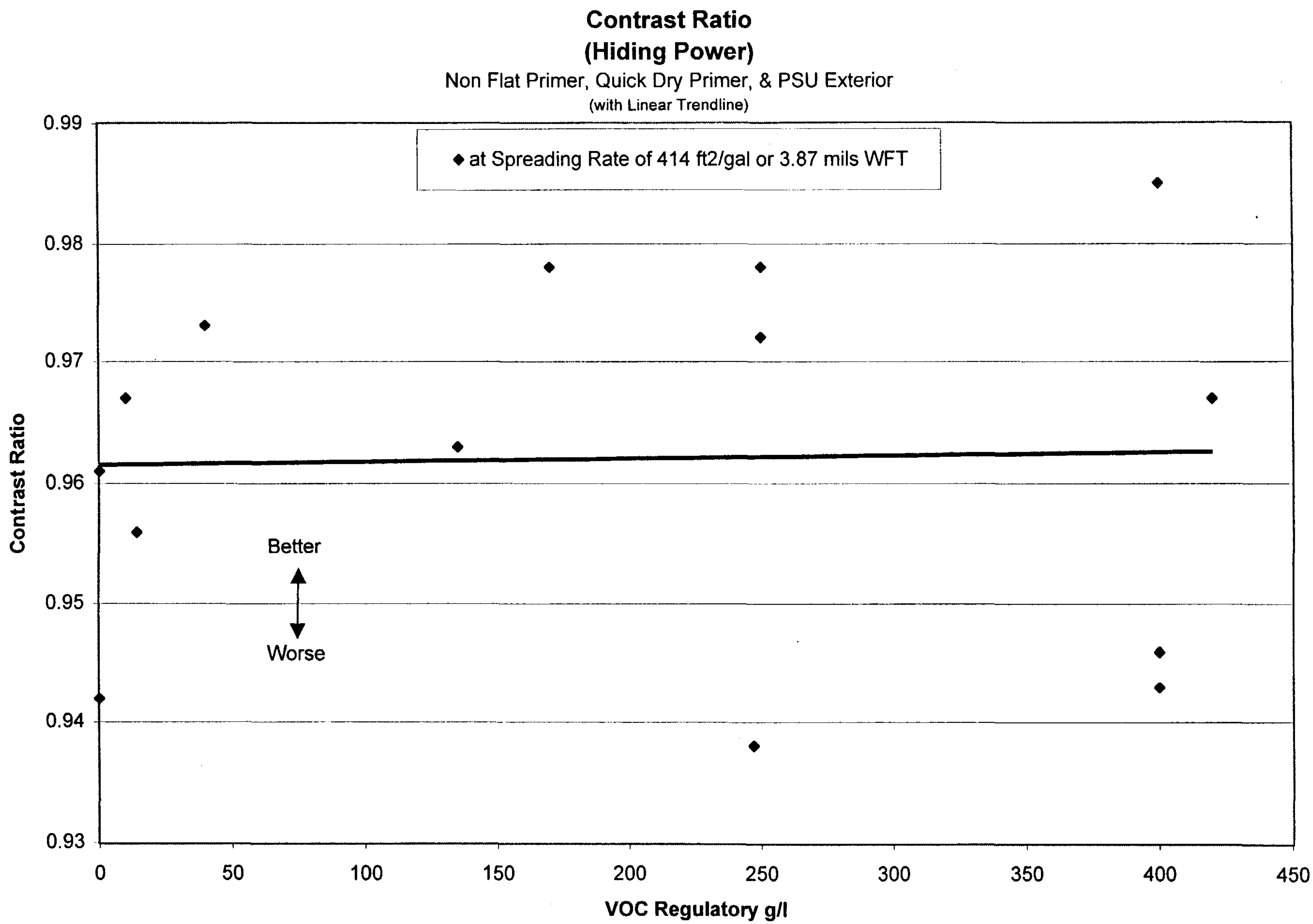

Dry Time - Dry To Touch
Non Flat Primer, Quick Dry Primer, & PSU Exterior
(with Linear Trend Lines)
50 degrees F, 90% RH (minutes)
90 degrees F, 30% RH (minutes)
50 degrees F, 90% RH
90 degrees F, 30% RH
Minutes
VOC Regulatory g/l
0
50
100
150
200
250
300
350
400
450
500

Dry Time - Dry Hard

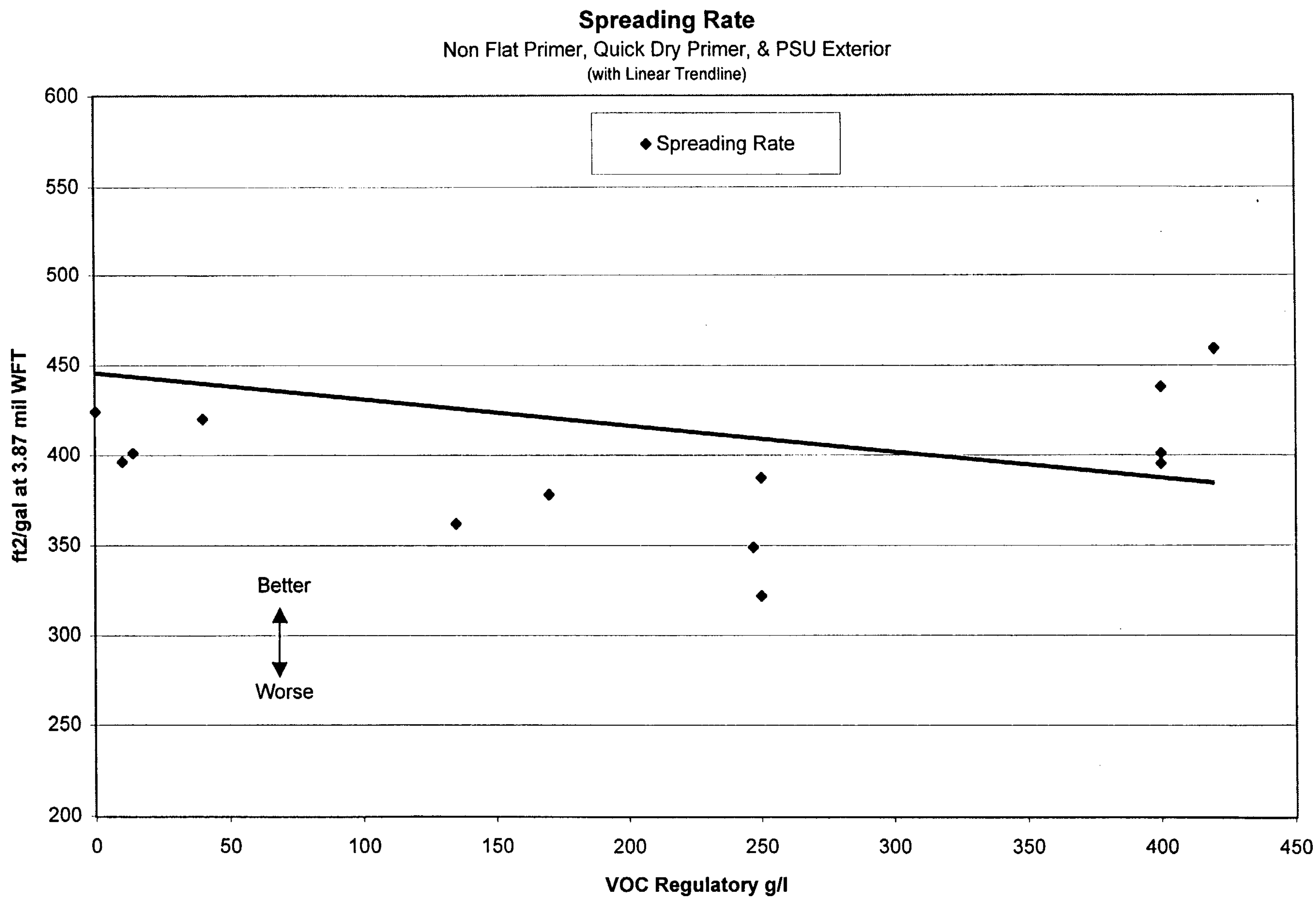
Non Flat Primer, Quick Dry Primer, & PSU Exterior

(with Linear Trend Lines)

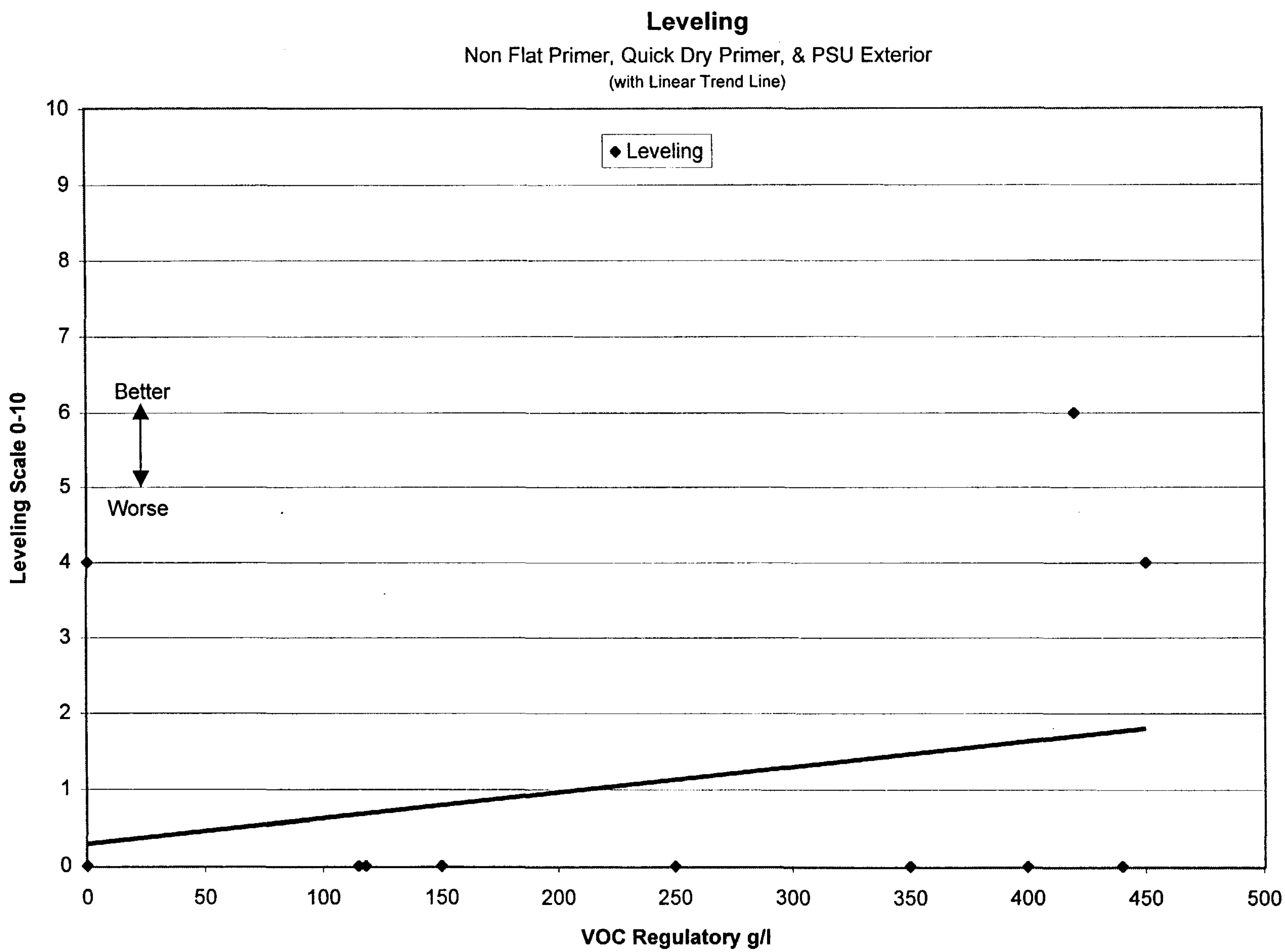




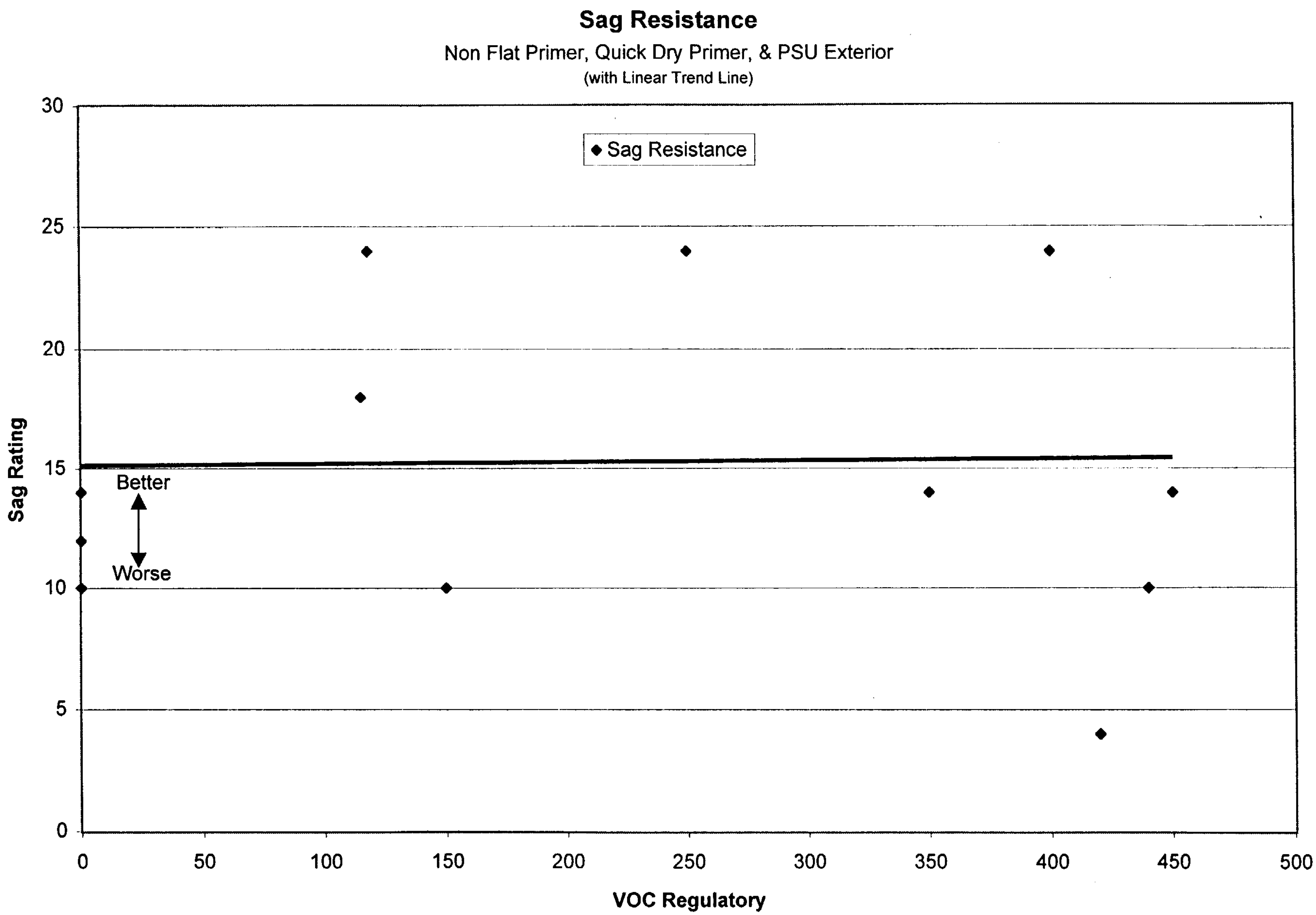
Contrast Ratio
(Hiding Power)
Non Flat Primer, Quick Dry Primer, & PSU Exterior
(with Linear Trendline)
at Spreading Rate of 414 ft2/gal or 3.87 mils WFT
Contrast Ratio
0.99
0.98
0.97
0.96
0.95
0.94
0.93
Better
Worse
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l



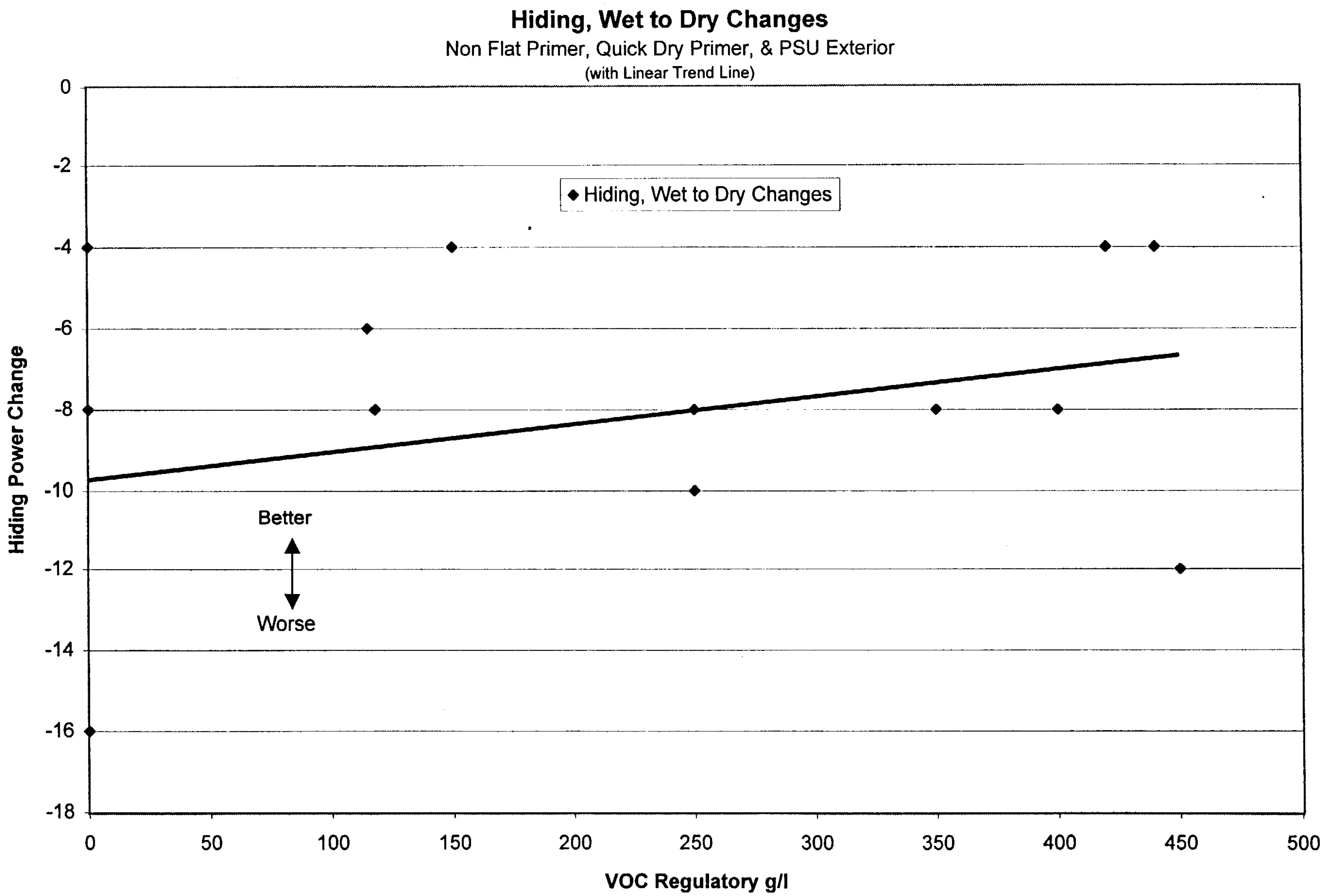
Spreading Rate
Non Flat Primer, Quick Dry Primer, & PSU Exterior
(with Linear Trendline)
Spreading Rate
ft2/gal at 3.87 mil WFT
600
550
500
450
400
350
300
250
200
Better
Worse
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

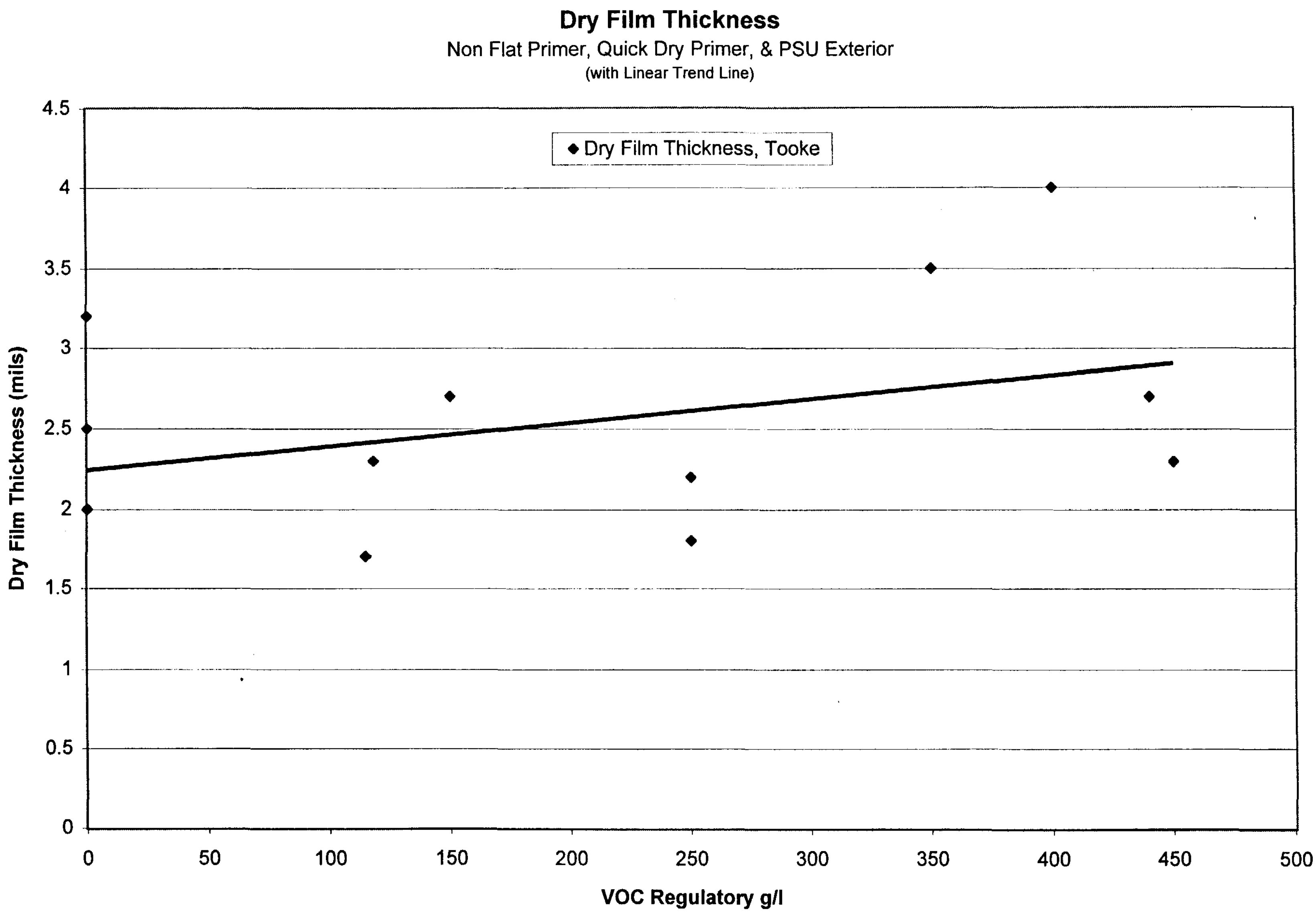


Leveling
Non Flat Primer, Quick Dry Primer, & PSU Exterior
(with Linear Trend Line)
Leveling
Better
Worse
Leveling Scale 0-10
VOC Regulatory g/l
0
1
2
3
4
5
6
7
8
9
10
0
50
100
150
200
250
300
350
400
450
500



Sag Resistance
Non Flat Primer, Quick Dry Primer, & PSU Exterior
(with Linear Trend Line)
Sag Resistance
Better
Worse
Sag Rating
VOC Regulatory
0
5
10
15
20
25
30
0
50
100
150
200
250
300
350
400
450
500


Hiding, Wet to Dry Changes
Non Flat Primer, Quick Dry Primer, & PSU Exterior
(with Linear Trend Line)
Hiding, Wet to Dry Changes
Hiding Power Change
Better
Worse
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
50
100
150
200
250
300
350
400
450
500
VOC Regulatory g/l


Dry Film Thickness
Non Flat Primer, Quick Dry Primer, & PSU Exterior
(with Linear Trend Line)
Dry Film Thickness, Tooke
Dry Film Thickness (mils)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
50
100
150
200
250
300
350
400
450
500
VOC Regulatory g/l

Nonflat Prmer (NFP), Quick Dry Primer (QDP) and Primer Sealer Undercoater (PSU) - EXTERIOR Data Table

Protocol Test Number							2.1	2.1	2.2		2.2		3.14
Coating Reference Number	Coating Reference Designator	VOC Content	Polymer Class	Nonvolatile by Weight	Coarse Particles	Density	Brushing Properties, Wet	Brushing Properties, Dry	Dry time, Dry to Touch - One Part Coatings		Dry time, Dry Hard - One Part Coatings		Contrast Ratio (Cw) Hiding Power
Units		g/l		%	Size in Microns	lbs/gal	Leneta Levelness Profile, 1 - 9	Leneta Levelness Profile, 1 - 9	50 degrees F, 90% RH (minutes)	90 degrees F, 30% RH (minutes)	50 degrees F, 90% RH (minutes)	90 degrees F, 30% RH (minutes)	at Spreading Rate of 414 ft2/gal or 3.87 mils WFT
301	NFP1	0	Vinyl Polymer Latex	55.7	92	11.21	2	3	3.3	2.7	7.5	3.6	0.942
308	PSU2	0	Acrylic Latex	50.7	40	10.95	3	5	1.2	1.3	10.2	3.7	0.961
325	NFP9	0	Acrylic Latex	59.0	80	11.20	2	2	2.7	3.3	10.5	4.2	0.967
310	NFP2	0	Acrylic Emulsion	51.2	24	10.73	2	4	5.7	2.1	9.6	2.1	0.973
322	NFP6	115	Acrylic Latex	48.7	80	10.08	>1	>1	11.1	1.0	359.1	39.7	0.963
313	PSU3	118	Acrylic Emulsion	52.8	20	11.30	1	1	1.6	1.3	255.1	250.9	0.978
319	PSU4	150	Acrylic	51.3	60	10.42	2	3	2.1	2.1	217.2	3.7	0.938
331	NFP15	250	Acrylic Latex	59.2	76	10.65	1	2	17.8	1.6	21.4	5.2	0.978
332	NFP16	250	Acrylic Latex	47.9	52	10.41	2	4	3.3	2.1	147.4	17.7	0.972
328	NFP12	350	Alkyd	78.6	40	12.10	1	1	22.5	5.5	358.2	355.0	0.946
111	QDP4	400	Alkyd	64.5	40	10.34	2	3	3.7	8.2	21.7	9.7	0.943
10	REF	420	Urethane	73.6	none	11.10	7	9	3.0	0.3	120.3	109.2	0.985
101	QDP1	440	Alkyd	66.5	48	10.82	1	2	9.0	5.8	189.6	40.0	0.967
109	QDP3	450	Oil Base	64.0	60	10.85	2	4	4.5	5.1	125.1	6.9	0.956

Nonflat Prmer (NFP), Quick Dry Primer (QDP) and Primer Sealer Undercoater (PSU) - EXTERIOR Data Table

Protocol Test Number		3.14	2.4	2.7	2.10						
						Wet Film Thickness			Wet Film/Dry Film/WW & Bar Applicator Gap Relationships		
Coating Reference Number	Coating Reference Designator	Spreading Rate	Leveling	Sag Resistance	Hiding, Wet to Dry Changes	WW Rod #30	WW Rod #48	WW Rod #80	WW Rod #30	WW Rod #48	WW Rod #80
Units		ft2/gal at 3.87 mil WFT	Scale, 0-10	Notch Clearance in mils		mils	mils	mils	mils	mils	mils
301	NFP1	424	0	10	-8	4.5	4.5	7.5	1.4	2.1	2.6
308	PSU2	709	4	12	-4	5.5	5.5	7.5	1.6	1.9	2.5
325	NFP9	396	0	14	-16	3.5	5.5	7.5	1.8	2.6	3.5
310	NFP2	420	0	12	-16	3.5	5.5	7.5	1.5	2.1	2.8
322	NFP6	362	0	18	-6	4.5	5.5	7.5	2.1	2.2	2.8
313	PSU3	378	0	>24	-8	5.5	7.5	9.5	1.5	2.7	2.5
319	PSU4	349	0	10	-4	4.5	6.5	7.5	2.3	2.8	3.5
331	NFP15	322	0	>24	-8	3.5	5.5	8.5	1.7	2.4	3.6
332	NFP16	387	0	>24	-10	5.5	5.5	7.5	1.8	1.9	2.6
328	NFP12	401	0	14	-8	3.5	4.5	10.5	2.3	3.5	5.9
111	QDP4	395	0	>24	<-8	5.5	6.5	8.5	2.4	2.3	3.0
10	REF	438	6	<4	-4	4.5	6.5	8.5	1.2	2.5	3.4
101	QDP1	459	0	10	-4	4.5	7.5	8.5	1.5	1.5	3.6
109	QDP3	401	4	14	<-12	6.5	7.5	9.5	2.3	2.3	2.7

Nonflat Prmer (NFP), Quick Dry Primer (QDP) and Primer Sealer Undercoater (PSU) - EXTERIOR Data Table

Protocol Test Number		3.2	3.2	3.10
Coating Reference Number	Coating Reference Designator	Appearance and Finish, Drawdown Charts	Appearance and Finish, Coted Panels	Dry Film Thickness, Tooke
Units				mils
301	NFP1	smooth, flat	smooth, flat	2.0
308	PSU2	slightly crinkled	uniform, flat	2.5
325	NFP9	flat, uniform	uniform, flat-satin	3.2
310	NFP2	smooth, matte	smooth, satin	2.0
322	NFP6	flat, matte	flat, matte	1.7
313	PSU3	even, satin-flat	smooth, satin-flat	2.3
319	PSU4	smooth, eggshell	smooth, flat	2.7
331	NFP15	smooth, flat	smooth, satin-flat	2.2
332	NFP16	smooth, satin	smooth, satin-flat	1.8
328	NFP12	smooth, eggshell	smooth, eggshell	3.5
111	QDP4	smooth, matte	eggshell	4.0
10	REF	smooth, high gloss	N/A	N/A
101	QDP1	smooth, matte	smooth, matte	2.7
109	QDP3	smooth, matte	uniform, flat	2.3

Section 6: Nonflat Topcoat and Quickdry Topcoat - Interior

Total # manufactuers or brands	10
Single component coatings	13
Multi-component coatings	1
Total # coatings	14

Test Summary

Brushing Properties Wet:
- Low VOC coatings exhibited lower performance compared to high VOC coatings. One high VOC coatings exhibited excellent performance.

Brushing Properties Dry:
- Low VOC coatings exhibited lower performance compared to high VOC coatings. One high VOC coatings exhibited excellent performance.

Dry Time - Dry To Touch:
- Low VOC coatings exhibited similar dry times at 50 °F and 90% RH and at 90 °F and 30% RH compared to high VOC coatings. Two coatings at 150 g/l and 250 g/l exhibited significantly longer dry times.

Dry Time - Dry Hard:
- Low VOC coatings exhibited faster dry times at 50 °F and 90% RH and at 90 °F and 30% RH compared to high VOC coatings.

Contrast Ratio (Hiding Power):
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Spreading Rate:
- Low VOC coatings exhibited lower performance compared to high VOC coatings.

Leveling:
- Low VOC coatings exhibited slightly lower performance compared to high VOC coatings.

Sag Resistance:
- Low VOC coatings exhibited slightly higher performance compared to high VOC coatings.

Hiding Wet to Dry Changes:
- Low VOC coatings exhibited slightly lower performance compared to high VOC coatings.

Blocking Resistance:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Dry Film Thickness:
- Low VOC coatings exhibited similar dry film thickness compared to high VOC coatings.

Dirt Removal Ability:

- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Scrub Abrasion Resistance:

- Low VOC coatings exhibited lower performance compared to high VOC coatings.

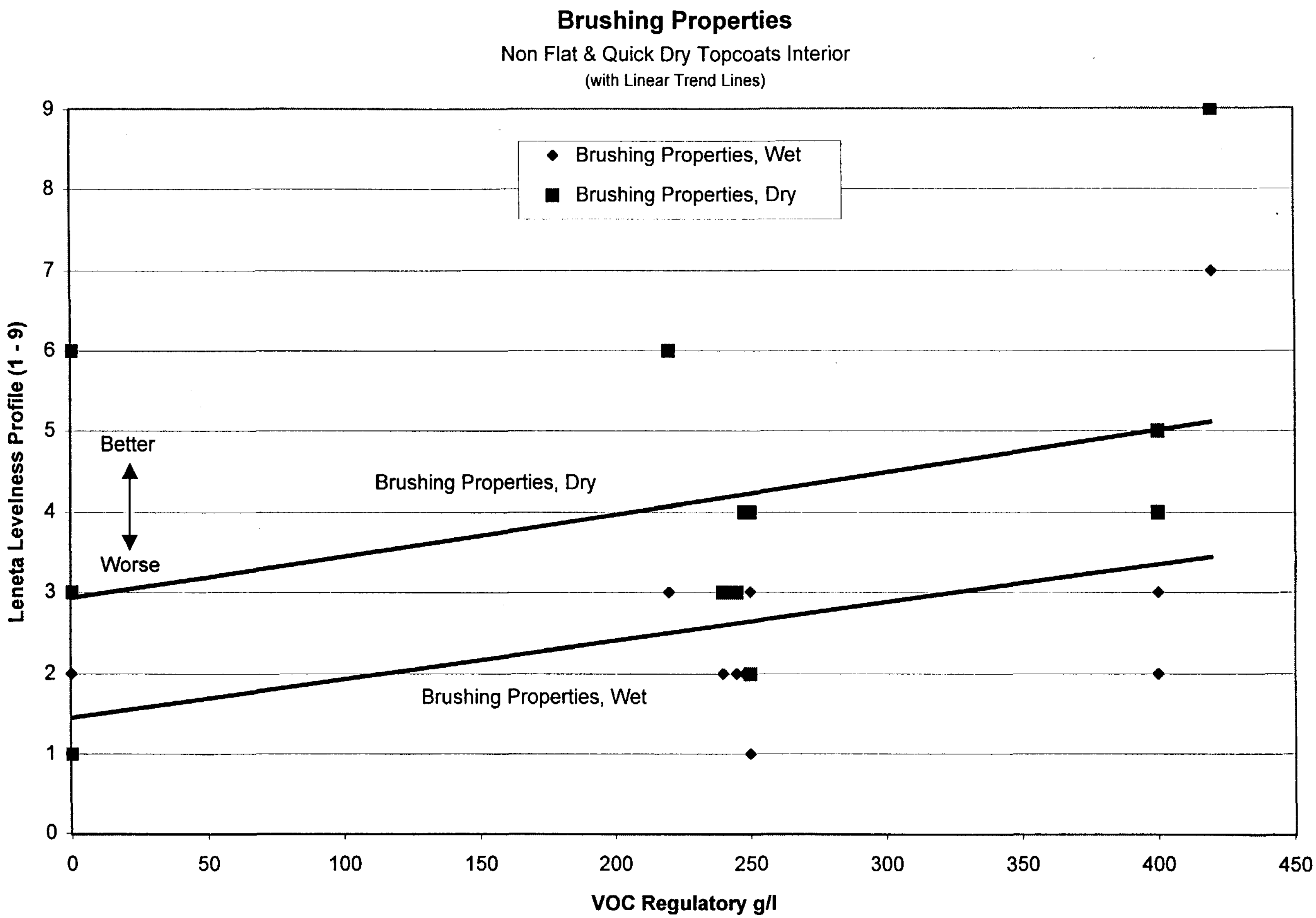
Comments:

Overall, low VOC coatings exhibited similar performance to high VOC coatings. Low VOC coatings did exhibit faster dry hard times while high VOC coatings exhibited higher scrub abrasion resistance.

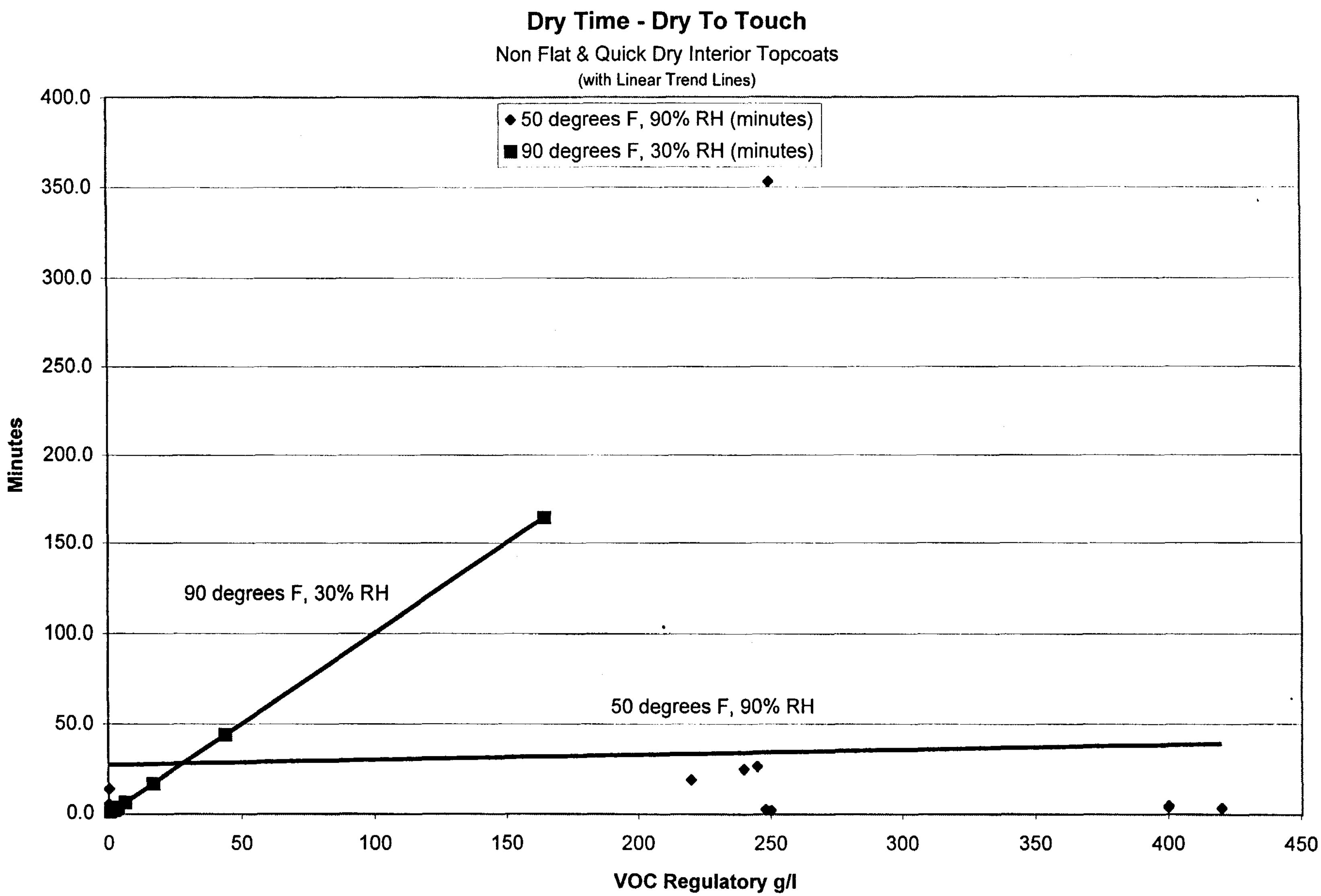
Nonflat Topcoat and Quickdry Topcoat - Interior

Coating Reference Designator	VOC, g/l	Part	Polymer Class	Intended Application	Total
219	245	1	Acrylic Latex	T	1
212	240	1	PWP Latex	T	1
104	400	1	Alkyd	T	1
205	220	1	Acrylic Latex	T	1
204	250	1	Acrylic Latex	T	1
10	420	2	Urethane	T	1
235	0	1	(blank)	T	1
214	250	1	Alkyd	T	1
238	0	1	(blank)	T	1
211	0	1	Acrylic Emulsion	T	1
112	<400	1	Alkyd	T	1
203	0	1	Acrylic Emulsion	T	1
208	250	1	Vinyl Acrylic Latex	T	1
207	400	1	(blank)	T	1
Grand Total					14

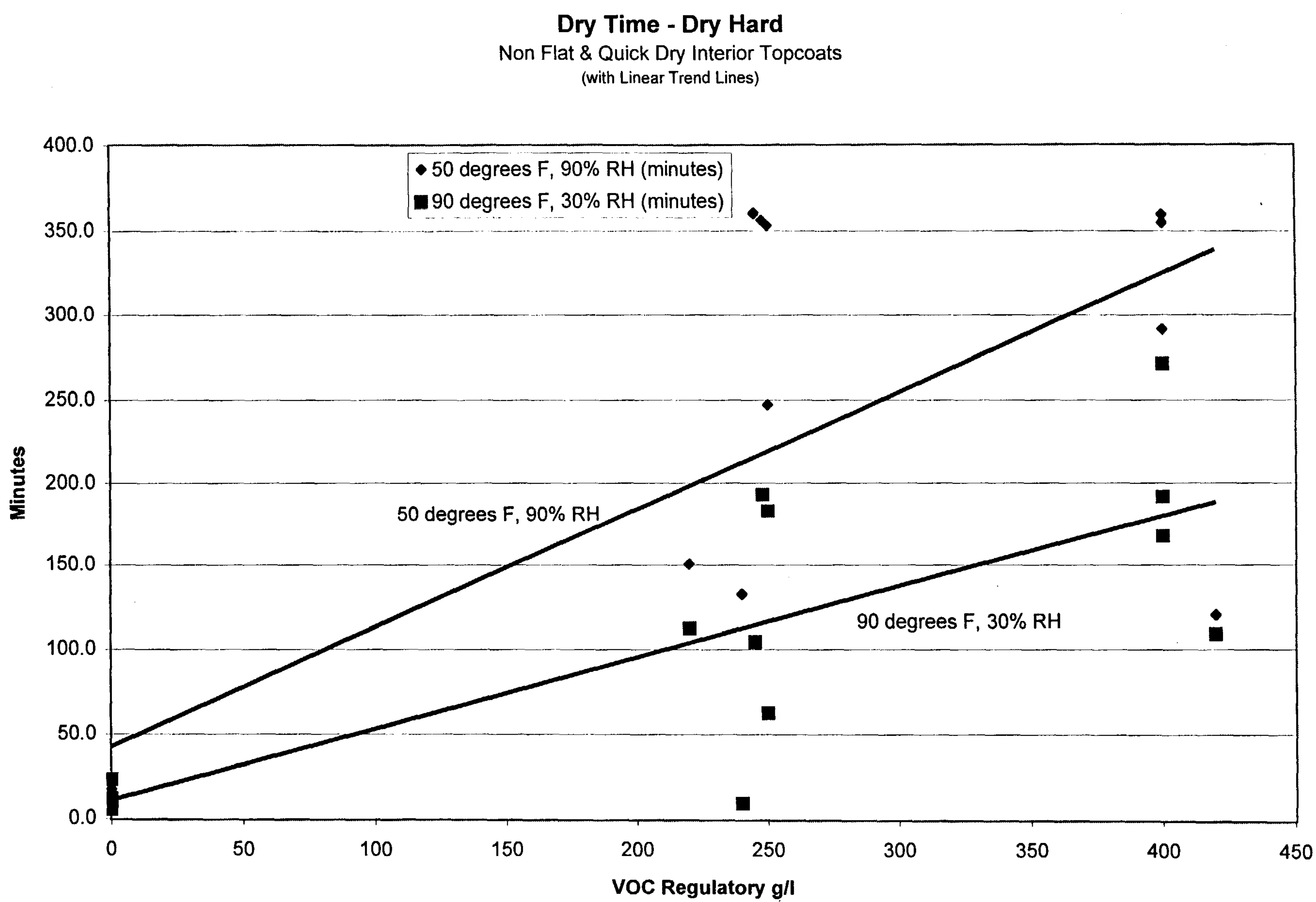
Single component coatings = 13 Multi-component coatings = 1

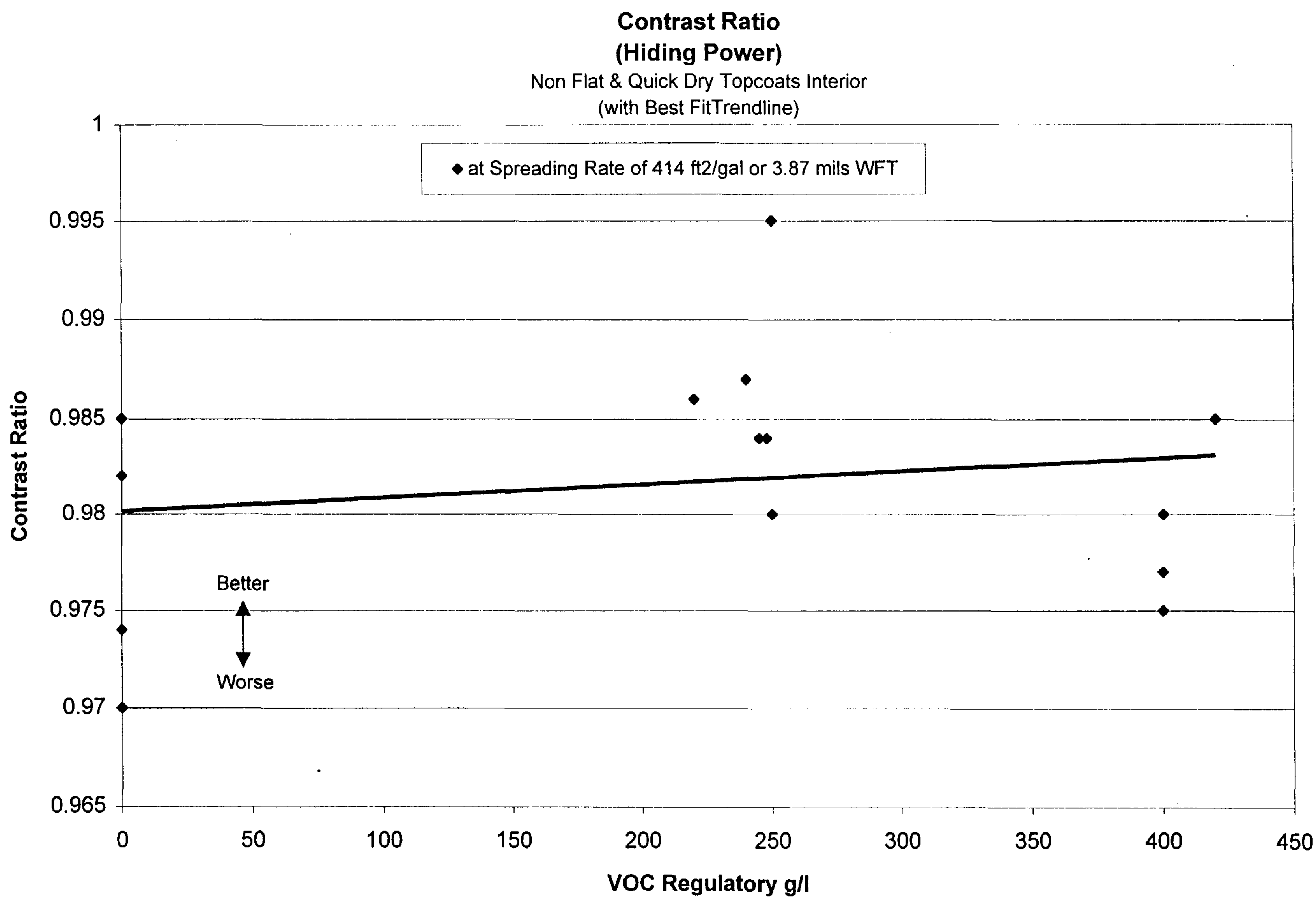


Brushing Properties
Non Flat & Quick Dry Topcoats Interior
(with Linear Trend Lines)
Brushing Properties, Wet
Brushing Properties, Dry
Better
Worse
Brushing Properties, Dry
Brushing Properties, Wet
Leneta Levelness Profile (1 - 9)
VOC Regulatory g/l
0
1
2
3
4
5
6
7
8
9
0
50
100
150
200
250
300
350
400
450

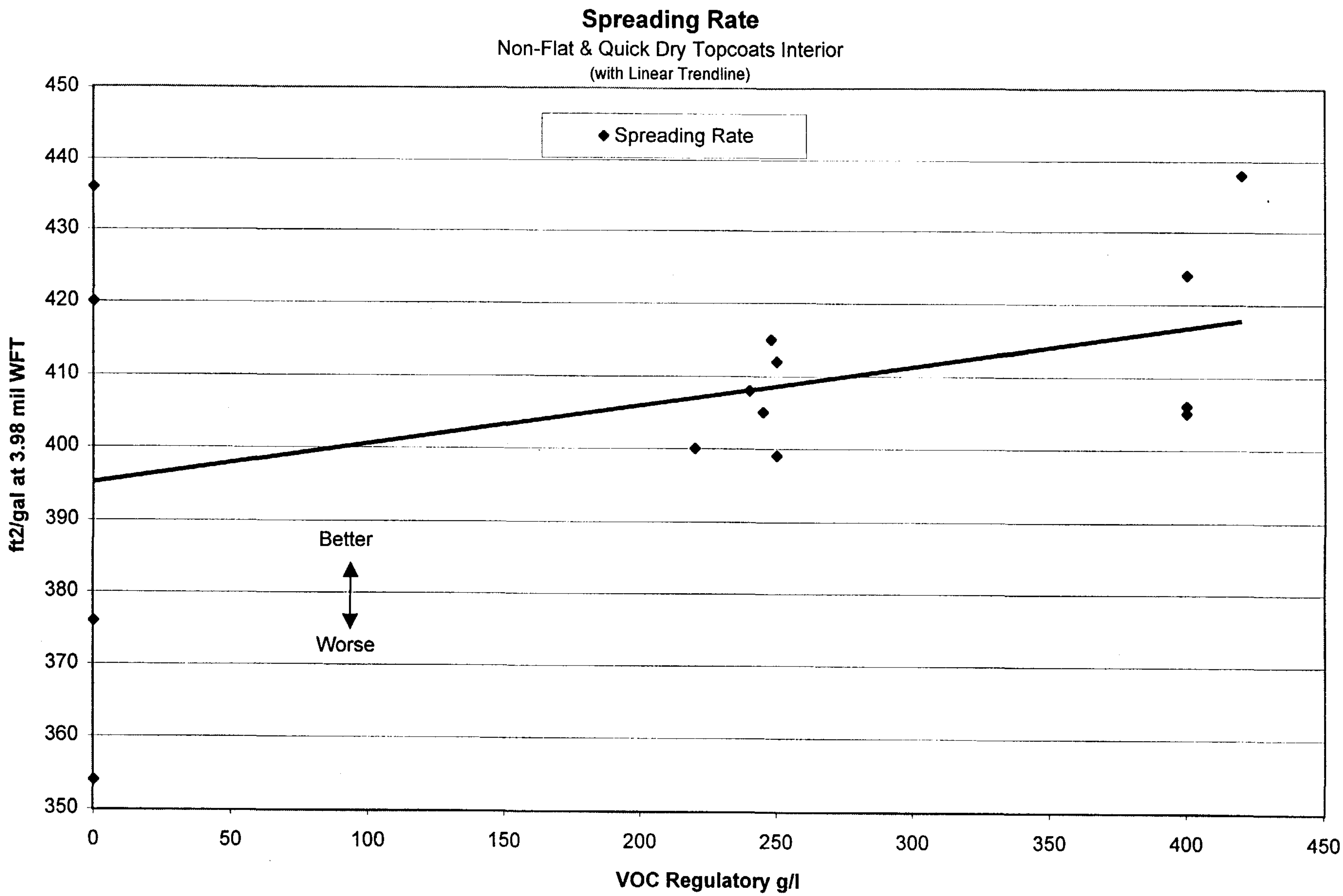


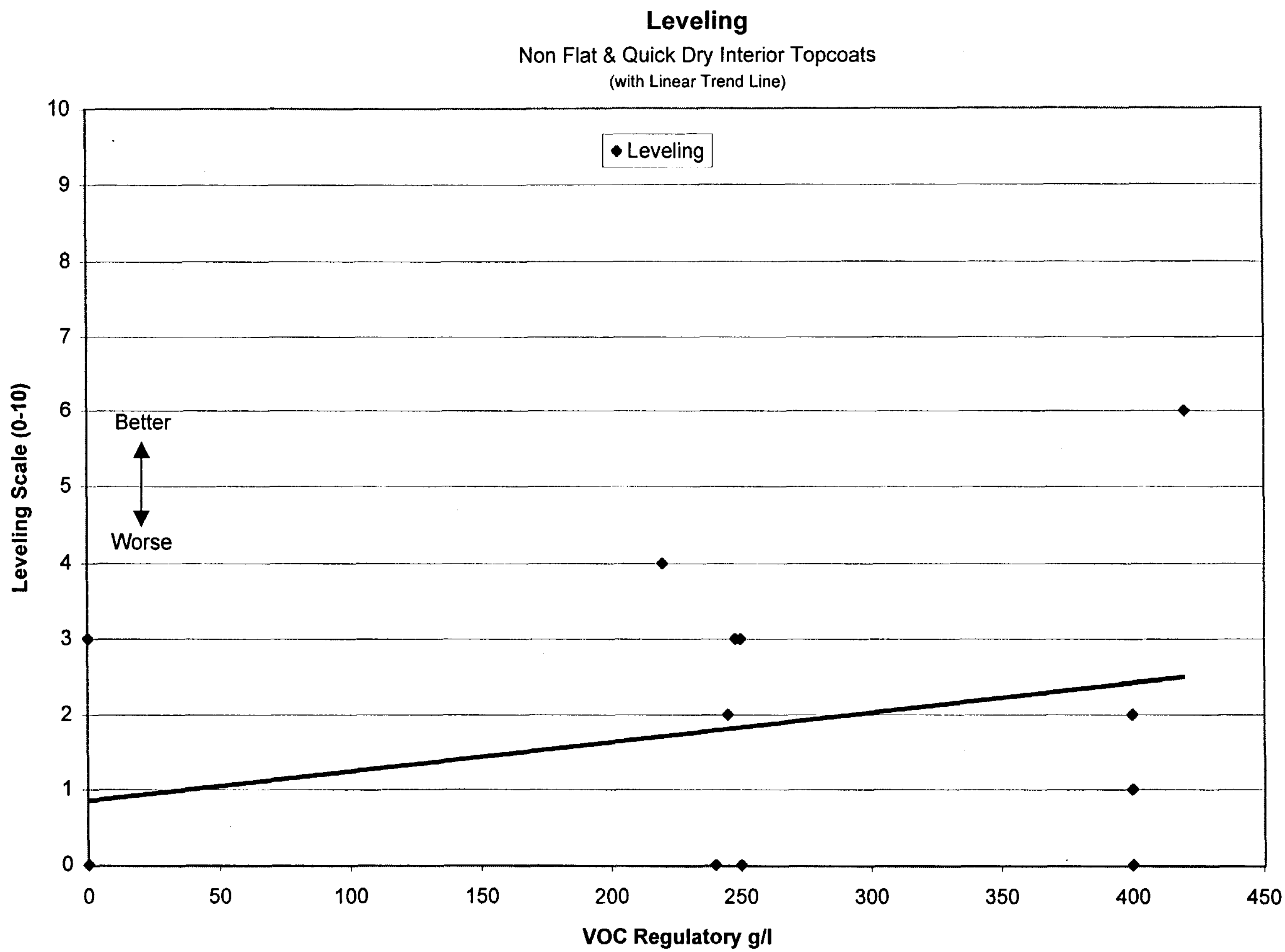
Dry Time - Dry To Touch
Non Flat & Quick Dry Interior Topcoats
(with Linear Trend Lines)
50 degrees F, 90% RH (minutes)
90 degrees F, 30% RH (minutes)
90 degrees F, 30% RH
50 degrees F, 90% RH
Minutes
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l


Dry Time - Dry Hard
Non Flat & Quick Dry Interior Topcoats
(with Linear Trend Lines)
50 degrees F, 90% RH (minutes)
90 degrees F, 30% RH (minutes)
50 degrees F, 90% RH
90 degrees F, 30% RH
Minutes
VOC Regulatory g/l
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0
50
100
150
200
250
300
350
400
450

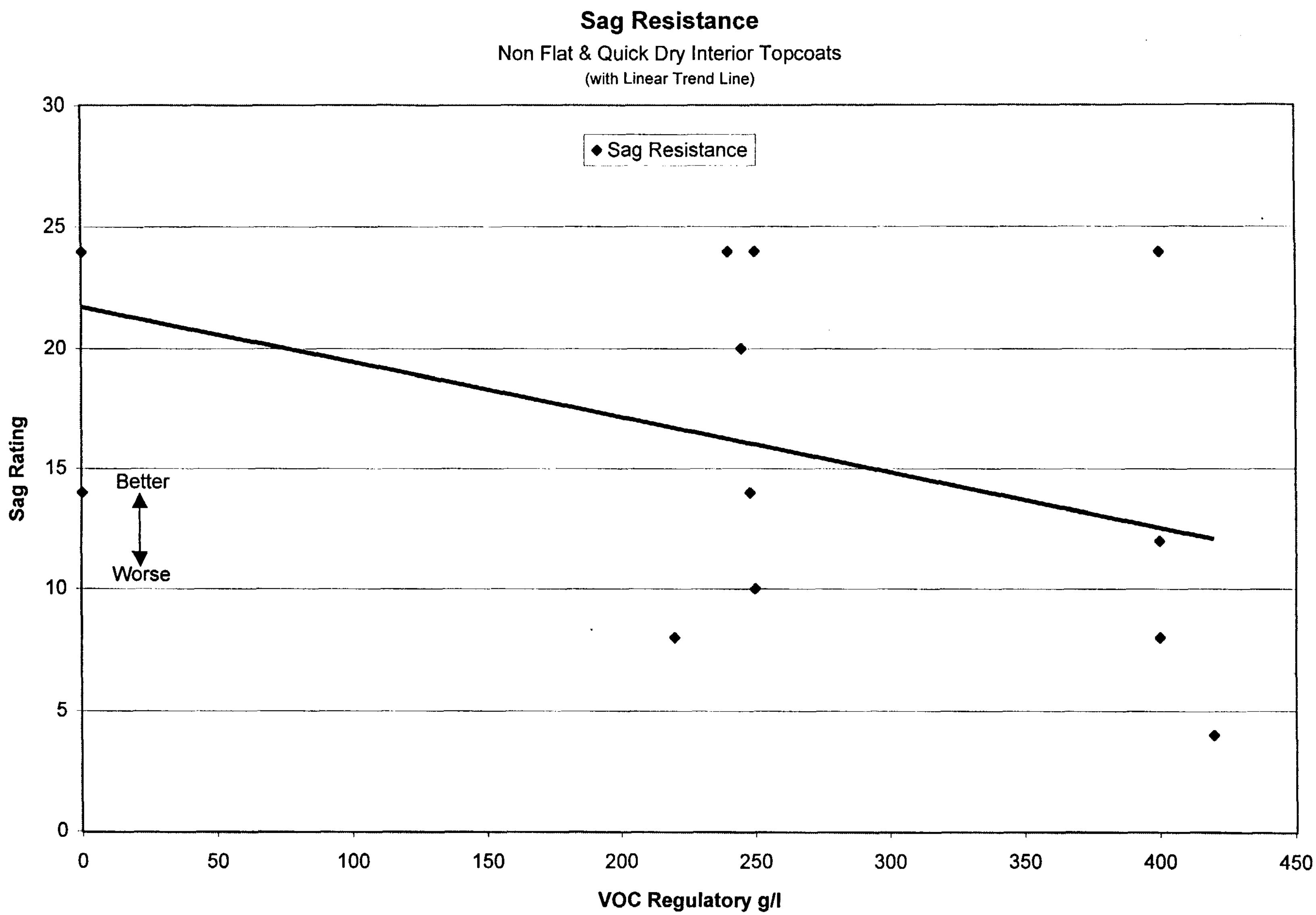


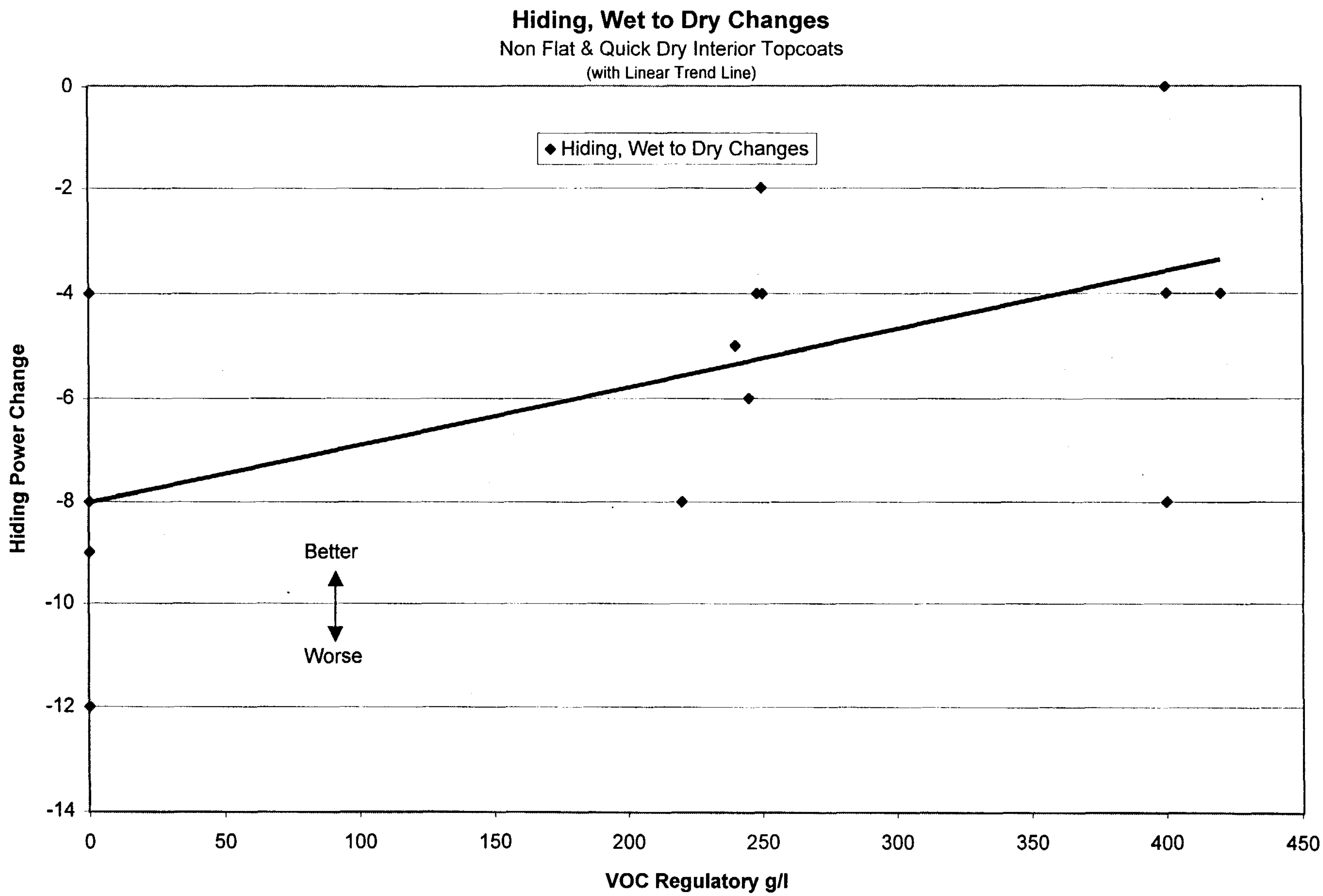
Contrast Ratio
(Hiding Power)
Non Flat & Quick Dry Topcoats Interior
(with Best FitTrendline)
◆ at Spreading Rate of 414 ft2/gal or 3.87 mils WFT
Contrast Ratio
1
0.995
0.99
0.985
0.98
0.975
0.97
0.965
Better
Worse
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l


Spreading Rate
Non-Flat & Quick Dry Topcoats Interior
(with Linear Trendline)
Spreading Rate
Better
Worse
ft2/gal at 3.98 mil WFT
VOC Regulatory g/l
450
440
430
420
410
400
390
380
370
360
350
0
50
100
150
200
250
300
350
400
450

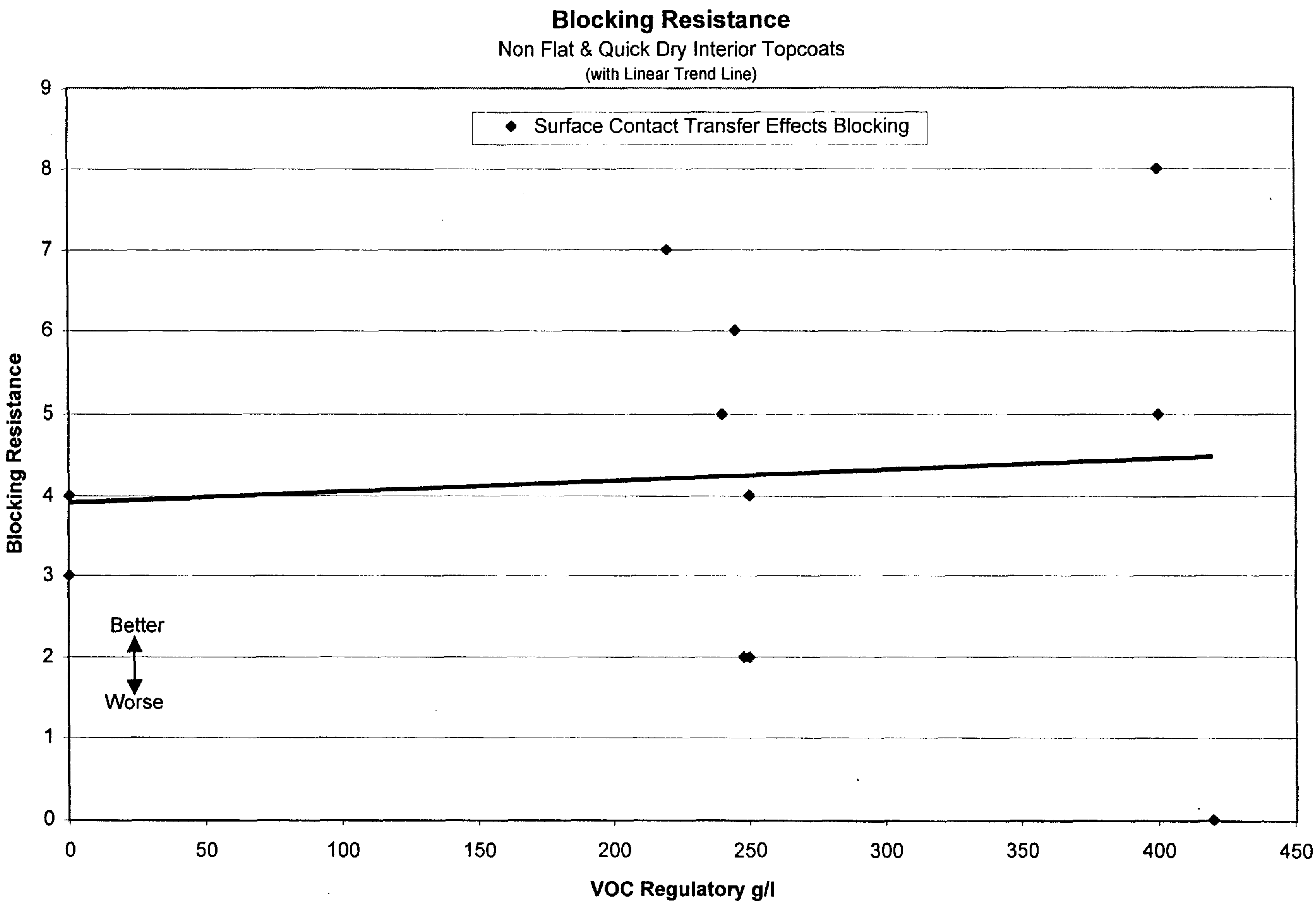


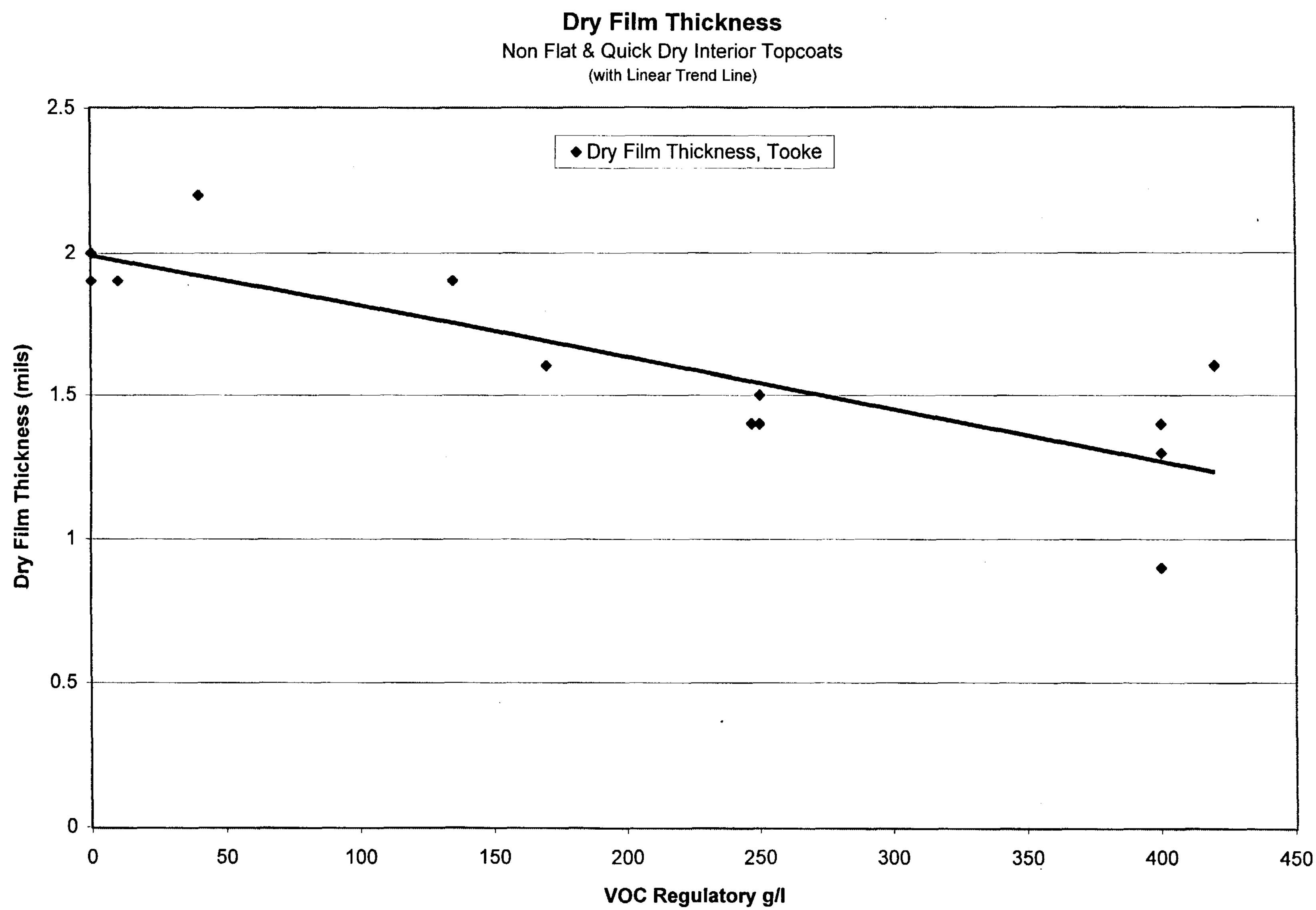
Leveling
Non Flat & Quick Dry Interior Topcoats
(with Linear Trend Line)
Leveling
Better
Worse
Leveling Scale (0-10)
10
9
8
7
6
5
4
3
2
1
0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l


Sag Resistance
Non Flat & Quick Dry Interior Topcoats
(with Linear Trend Line)
Sag Resistance
Sag Rating
Better
Worse
VOC Regulatory g/l
0
5
10
15
20
25
30
0
50
100
150
200
250
300
350
400
450

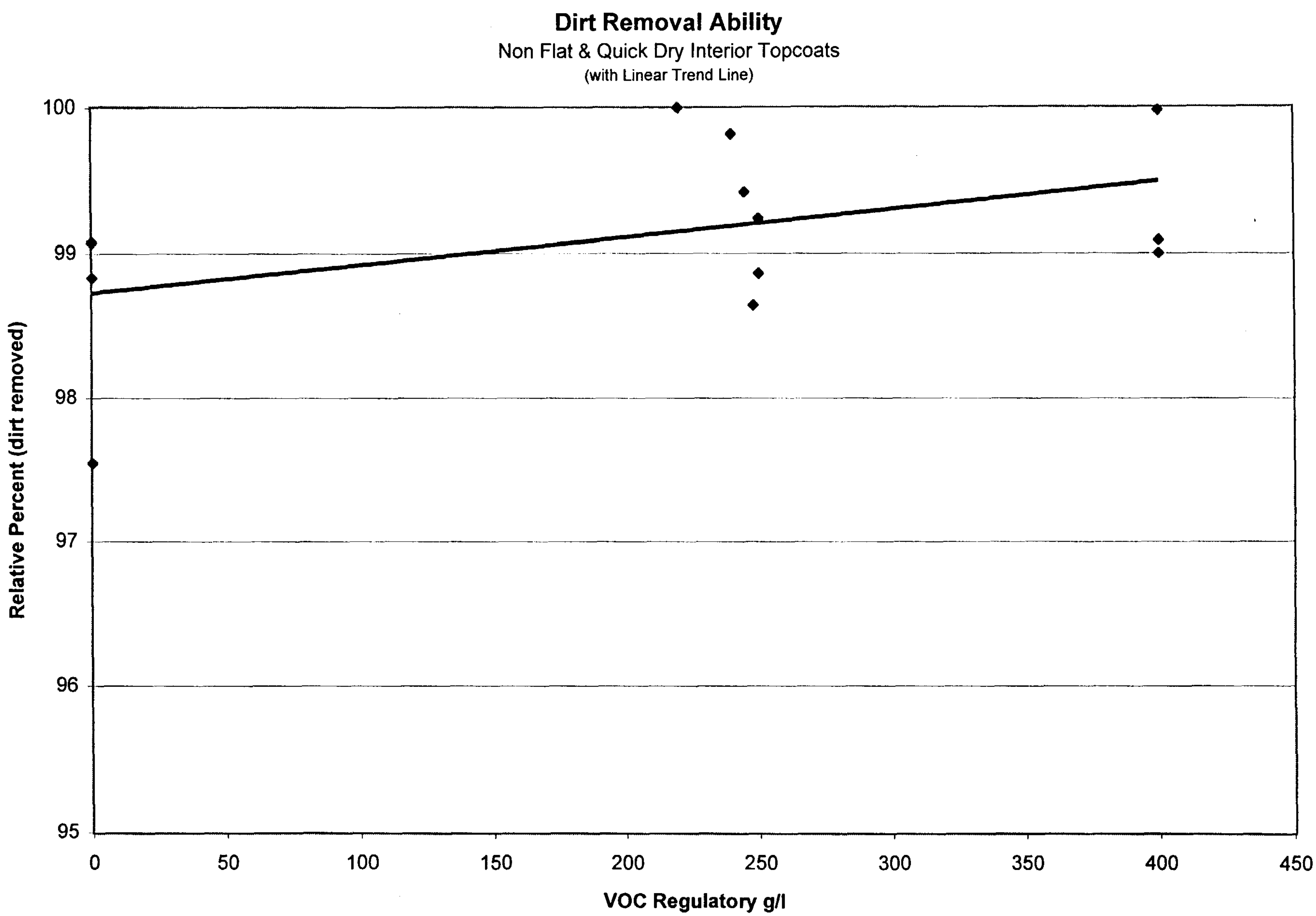


Hiding, Wet to Dry Changes
Non Flat & Quick Dry Interior Topcoats
(with Linear Trend Line)
Hiding, Wet to Dry Changes
Hiding Power Change
Better
Worse
0
-2
-4
-6
-8
-10
-12
-14
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

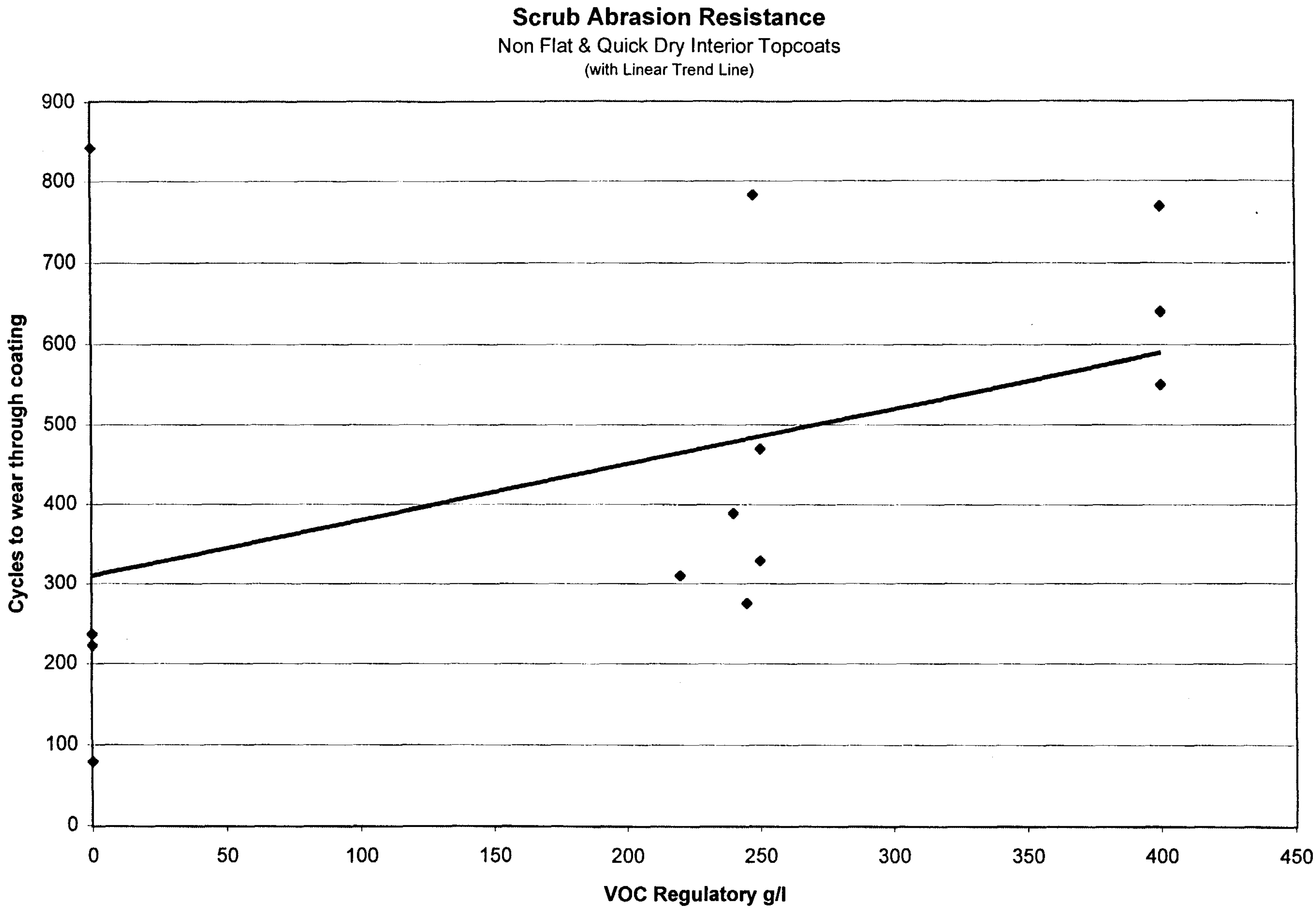

Blocking Resistance
Non Flat & Quick Dry Interior Topcoats
(with Linear Trend Line)
Surface Contact Transfer Effects Blocking
Blocking Resistance
9
8
7
6
5
4
3
2
1
0
Better
Worse
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l



Dry Film Thickness
Non Flat & Quick Dry Interior Topcoats
(with Linear Trend Line)
Dry Film Thickness, Tooke
Dry Film Thickness (mils)
2.5
2
1.5
1
0.5
0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l



Dirt Removal Ability
Non Flat & Quick Dry Interior Topcoats
(with Linear Trend Line)
Relative Percent (dirt removed)
100
99
98
97
96
95
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l


Scrub Abrasion Resistance
Non Flat & Quick Dry Interior Topcoats
(with Linear Trend Line)
Cycles to wear through coating
900
800
700
600
500
400
300
200
100
0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

Nonflat Topcoat (NFT) and Quick Dry Topcoat (QDT) - INTERIOR Data Table

Protocol Test Number							2.1	2.1	2.2		2.2		3.14
Coating Reference Number	Coating Reference Designator	VOC Content	Polymer Class	Nonvolatile by Weight	Coarse Particles	Density	Brushing Properties, Wet	Brushing Properties, Dry	Dry time, Dry to Touch - One Part Coatings		Dry time, Dry Hard - One Part Coatings		Contrast Ratio (Cw) Hiding Power
Units		g/l		%	Size in Microns	lbs/gal	Leneta Leveliness Profile, 1 - 9	Leneta Leveliness Profile, 1 - 9	50 degrees F, 90% RH (minutes)	90 degrees F, 30% RH (minutes)	50 degrees F, 90% RH (minutes)	90 degrees F, 30% RH (minutes)	at Spreading Rate of 414 ft2/gal or 3.87 mils WFT
203	NFT2	0	Acrylic Emulsion	54.7	100	10.96	2	3	3.0	2.2	8.1	12.1	0.974
211	NFT9	0	Acrylic Emulsion	50.4	30	10.51	2	6	5.1	2.5	10.2	5.5	0.985
235	NFT18	0	Acrylic Latex	48.2	56	10.63	2	3	2.8	6.1	8.8	7.0	0.97
238	NFT20	0	Copolymer Latex	53.5	100	10.34	1	1	13.5	2.2	17.4	23.2	0.982
205	NFT4	220	Acrylic Latex	48.5	20	10.60	3	6	18.7	16.7	150.5	112.4	0.986
212	NFT10	240	Acrylic	43.5	32	10.12	2	3	24.6	2.4	132.6	9.6	0.987
219	NFT17	245	Acrylic Latex	47.7	6	10.47	2	3	26.1	43.9	360.0	104.5	0.984
214	NFT12	248	Alkyd	80.6	28	11.75	2	4	2.1	2.1	356.1	192.9	0.984
204	NFT3	250	Acrylic Latex	82.6	24	12.57	3	4	353.1	164.6	353.1	182.8	0.995
208	NFT7	250	Vinyl Acrylic Latex	50.1	56	10.55	1	2	1.6	1.6	247.0	62.5	0.98
104	QDT2	400	Alkyd	65.6	20	9.96	3	4	4.2	2.7	354.6	271.2	0.977
112	QDT4	400	Alkyd	64.5	20	10.23	3	5	4.2	3.3	291.3	191.4	0.975
207	NFT6	400	Alkyd	66.3	16	9.98	2	4	3.6	1.6	359.1	167.5	0.98
10	REF	420	Urethane	73.6	none	11.10	7	9	3.0	0.3	120.3	109.2	0.985

Nonflat Topcoat (NFT) and Quick Dry Topcoat (QDT) - INTERIOR Data Table

Protocol Test Number		3.14	2.4	2.7	2.10	3.21						
Coating Reference Number	Coating Reference Designator	Spreading Rate	Leveling	Sag Resistance	Hiding, Wet to Dry Changes	Surface Contact Transfer Effects Blocking	Wet Film Thickness			Wet Film/Dry Film/WW & Bar Applicator Gap Relationships		
							WW Rod #30	WW Rod #48	WW Rod #80	WW Rod #30	WW Rod #48	WW Rod #80
Units		ft2/gal at 3.87 mil WFT	Scale, 0-10	Notch Clearance in mils	Hiding Indes Change between the Wet and Dry State		mils	mils	mils	mils	mils	mils
203	NFT2	354	0	>24	-12	3	4.5	5.5	7.5	1.8	2.1	2.8
211	NFT9	420	3	>24	-9	4	5.5	6.5	9.5	1.5	1.6	2.5
235	NFT18	436	0	14	-4	4	4.5	5.5	7.5	1.5	1.7	2.2
238	NFT20	376	0	>24	-8	4	4.5	4.5	7.5	1.8	2.0	3.2
205	NFT4	400	4	8	-8	7	5.5	6.5	8.5	1.6	2.1	2.6
212	NFT10	408	0	24	-5	5	4.5	5.0	8.0	1.2	1.4	1.9
219	NFT17	405	2	20	-6	6	3.5	6.5	8.5	1.2	1.5	2.6
214	NFT12	415	3	14	-4	2	4.5	5.0	8.5	2.2	2.6	2.9
204	NFT3	412	3	10	-4	4	5.5	6.5	9.5	2.1	2.8	5.2
208	NFT7	399	0	>24	-2	2	4.5	5.5	7.5	1.8	2.0	2.4
104	QDT2	424	2	8	0	8	4.5	6.5	10.5	1.2	2.0	2.9
112	QDT4	405	1	12	-4	5	5.5	6.5	8.5	1.7	2.2	3.7
207	NFT6	406	0	>24	-8	5	5.5	5.8	8.5	1.9	2.2	2.9
10	REF	438	6	<4	-4	N/A	4.5	6.5	8.5	1.2	2.5	3.4

Nonflat Topcoat (NFT) and Quick Dry Topcoat (QDT) - INTERIOR Data Table

Protocol Test Number		3.2	3.2	3.7	3.10	3.9	3.24a
Coating Reference Number	Coating Reference Designator	Appearance and Finish, Drawdown Charts	Appearance and Finish, Coted Panels	Dirt Removal Ability	Dry Film Thickness, Chart; 4 mil drawdown	Film Flexibility	Scrub Abrasion Resistance
Units				Relative Percent	mils		cycles to wear thruogh coating w/shim
203	NFT2	smooth, flat	smooth, flat	97.54	1.6	pass	842
211	NFT9	uniform, satin-flat	smooth, satin	99.07	1.6	pass	222
235	NFT18	smooth, flat	smooth, flat	99.08	2.1	pass	236
238	NFT20	rough, shiny	rough, satin	98.83	1.1	pass	79
205	NFT4	smooth, glossy	smooth, semi-gloss	100	1.8	pass	310
212	NFT10	smooth, glossy	smooth, satin	99.82	1.4	pass	389
219	NFT17	smooth, glossy	smooth, semi-gloss	99.42	1.7	pass	275
214	NFT12	smooth, glossy	smooth semi-gloss	98.64	1.9	pass	782
204	NFT3	smooth, semi-gloss	smooth, satin	98.86	1.8	pass	469
208	NFT7	smooth, flat	smooth, eggshell	99.24	2.1	pass	329
104	QDT2	uniform, semi-gloss	smooth, semi-gloss	99.09	1.1	pass	768
112	QDT4	smooth, semi-gloss	smooth, semi-gloss	99.98	1.4	pass	640
207	NFT6	smooth, semi-gloss	smooth, satin	99	1.2	pass	551
10	REF	smooth, high-gloss	smooth, gloss	N/A	N/A	pass	N/A

Section 7: Nonflat Topcoat and Quickdry Topcoat - Exterior

Total # manufactuers or brands	10
Single component coatings	11
Multi-component coatings	2
Total # coatings	13

Test Summary

Brushing Properties Wet:
- Low VOC coatings exhibited lower performance compared to high VOC coatings. One high VOC coatings exhibited excellent performance.

Brushing Properties Dry:
- Low VOC coatings exhibited lower performance compared to high VOC coatings. One high VOC coatings exhibited excellent performance.

Dry Time - Dry To Touch:
- Low VOC coatings exhibited similar dry times at 50 °F and 90% RH and at 90 °F and 30% RH compared to high VOC coatings. Two coatings in the 125 to 175 g/l range exhibited significantly longer dry times.

Dry Time - Dry Hard:
- Low VOC coatings exhibited faster dry times at 50 °F and 90% RH and at 90 °F and 30% RH compared to high VOC coatings. Several mid to low VOC coatings exhibited dry times similar to the high VOC coatings.

Contrast Ratio (Hiding Power):
- Low VOC coatings exhibited slightly lower performance compared to high VOC coatings.

Spreading Rate:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Leveling:
- Low VOC coatings exhibited lower performance compared to high VOC coatings.

Sag Resistance:
- Low VOC coatings exhibited higher performance compared to high VOC coatings.

Hiding Wet to Dry Changes:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Blocking Resistance:
- Low VOC coatings exhibited slightly higher performance compared to high VOC coatings.

Dry Film Thickness:

- Low VOC coatings exhibited slightly higher dry film thickness compared to high VOC coatings.

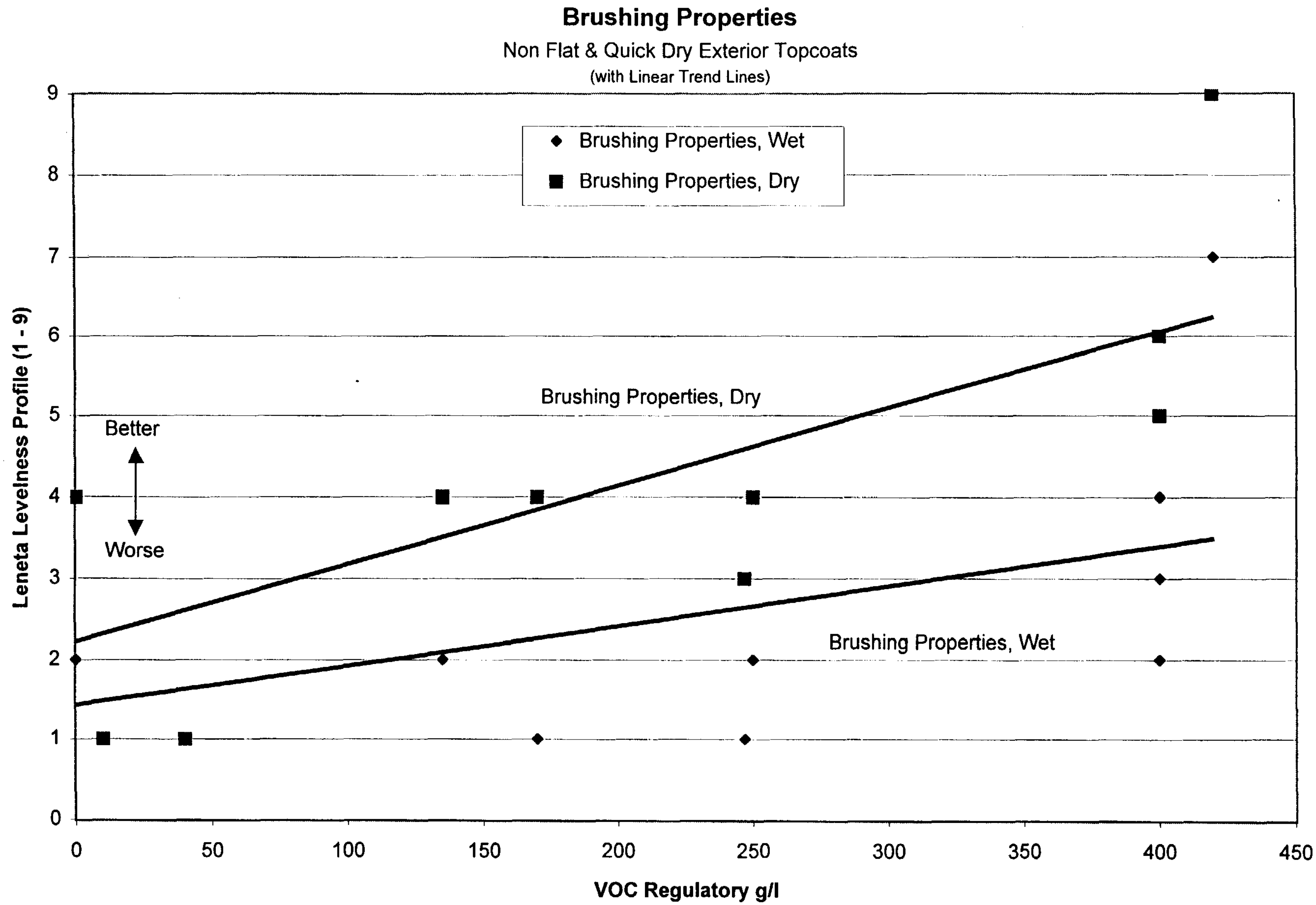
Comments:

Overall, low VOC coatings exhibited similar performance to high VOC coatings. Low VOC coatings did exhibit significantly lower performance for leveling compared to high VOC coatings.

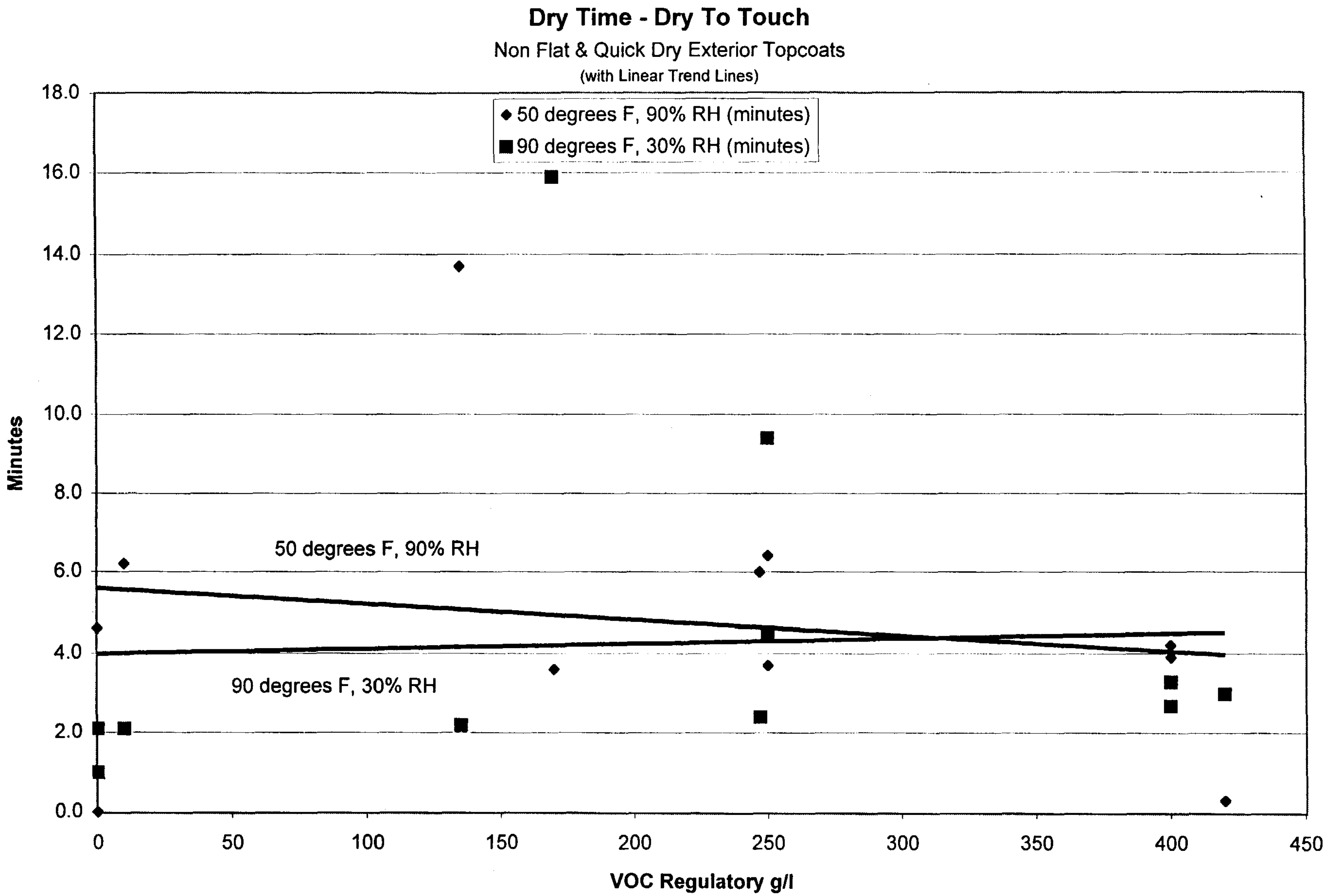
Nonflat Topcoat and Quickdry Topcoat - Exterior

Coating Reference Designator	VOC, g/l	Part	Polymer Class	Intended Application	Total
215	30	2	Urethane	T	1
213	247	1	Acrylic Latex	T	1
206	135	1	Acrylic	T	1
102	400	1	Alkyd	T	1
10	420	2	Urethane	T	1
218	100	1	(blank)	T	1
237	250	1	(blank)	T	1
201	0	1	Acrylic Latex	T	1
210	0	1	Acrylic emulsion	T	1
217	<250	1	Acrylic emulsion	T	1
112	<400	1	Alkyd	T	1
216	<10	1	?Copolymer latex	T	1
110	400	1	Alkyd	T	1
Grand Total					13

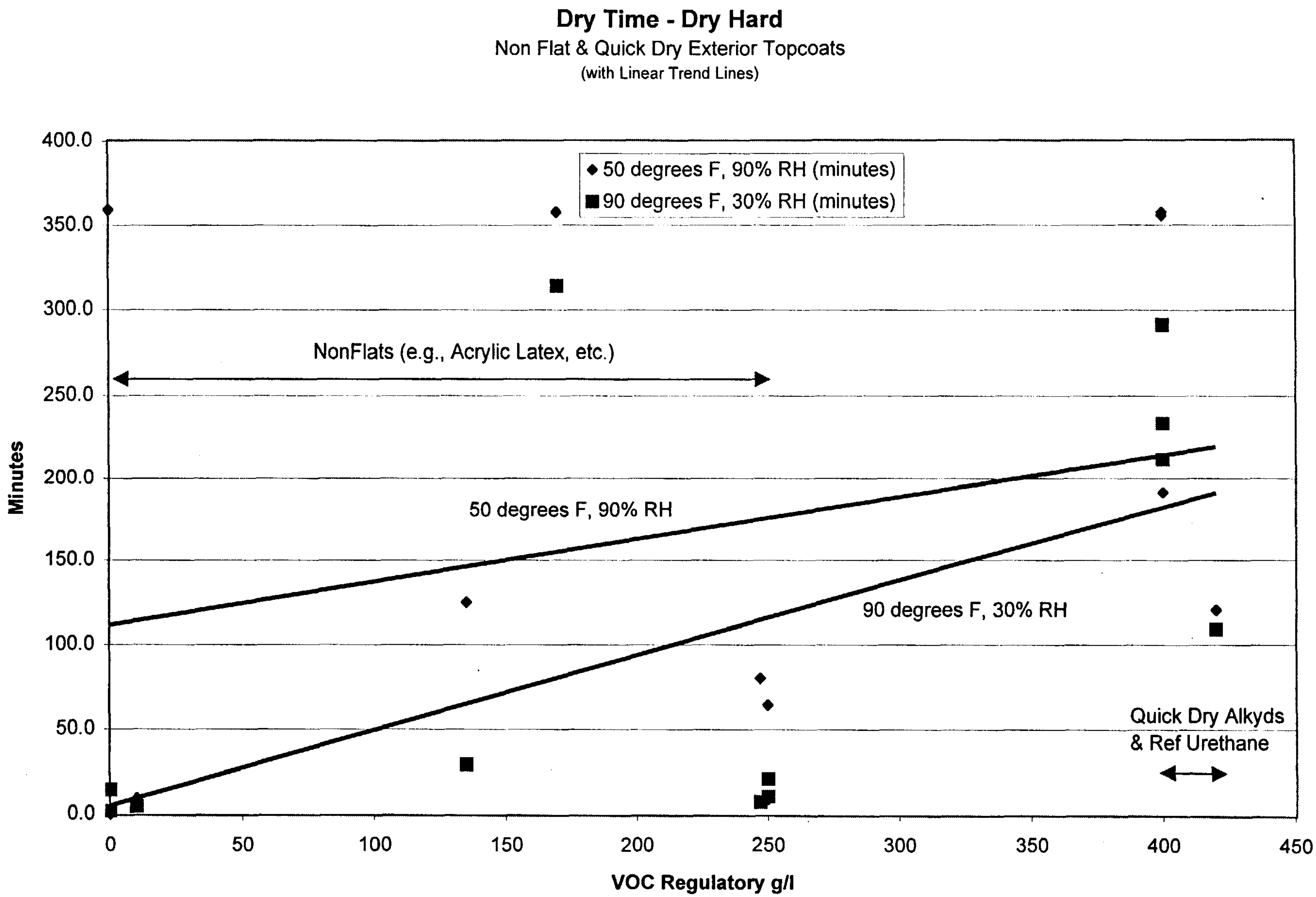
Single component coatings = 11 Multi-component coatings = 2

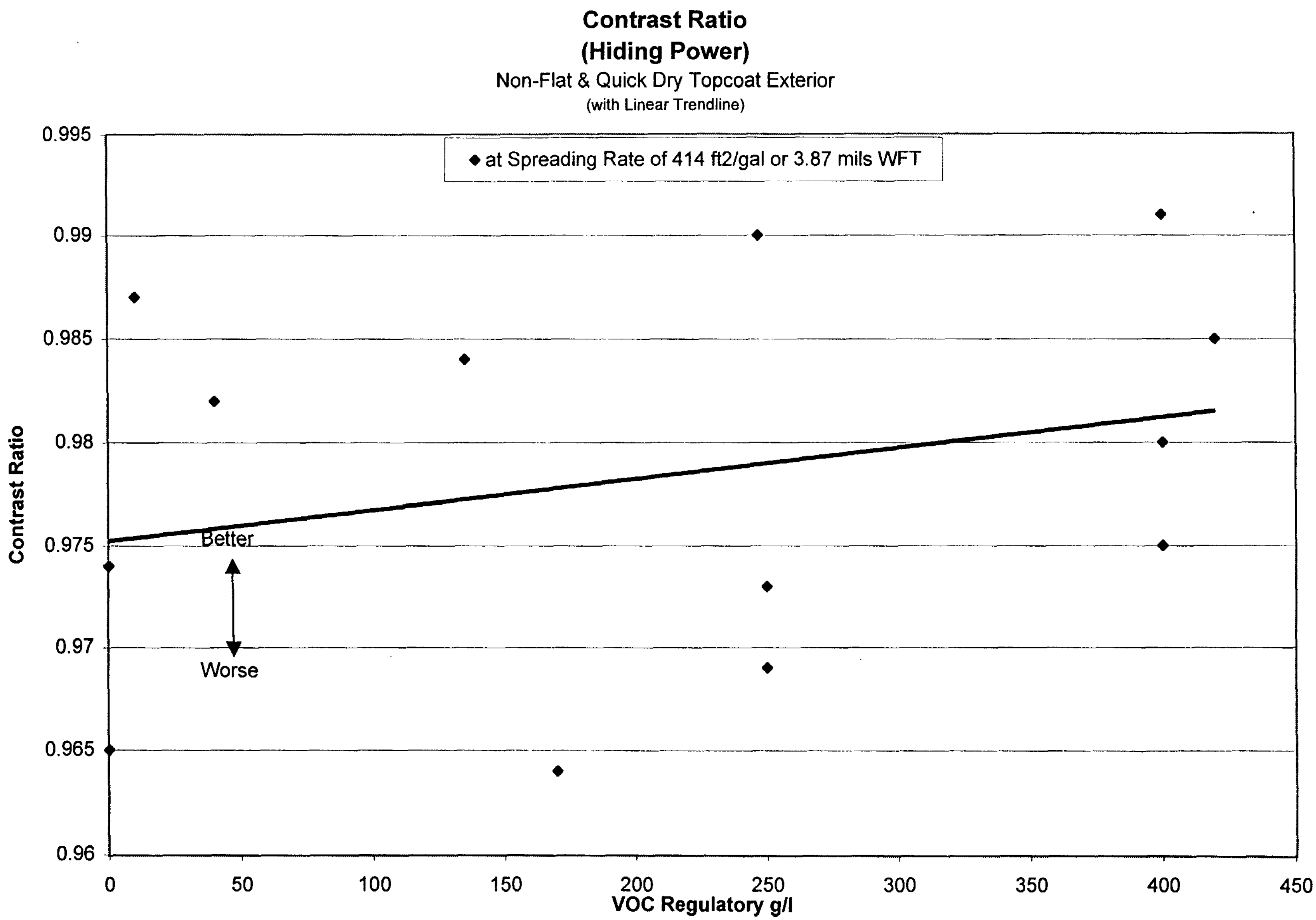


Brushing Properties
Non Flat & Quick Dry Exterior Topcoats
(with Linear Trend Lines)
Brushing Properties, Wet
Brushing Properties, Dry
Brushing Properties, Dry
Better
Worse
Brushing Properties, Wet
Leneta Levelness Profile (1 - 9)
VOC Regulatory g/l
0
1
2
3
4
5
6
7
8
9
0
50
100
150
200
250
300
350
400
450

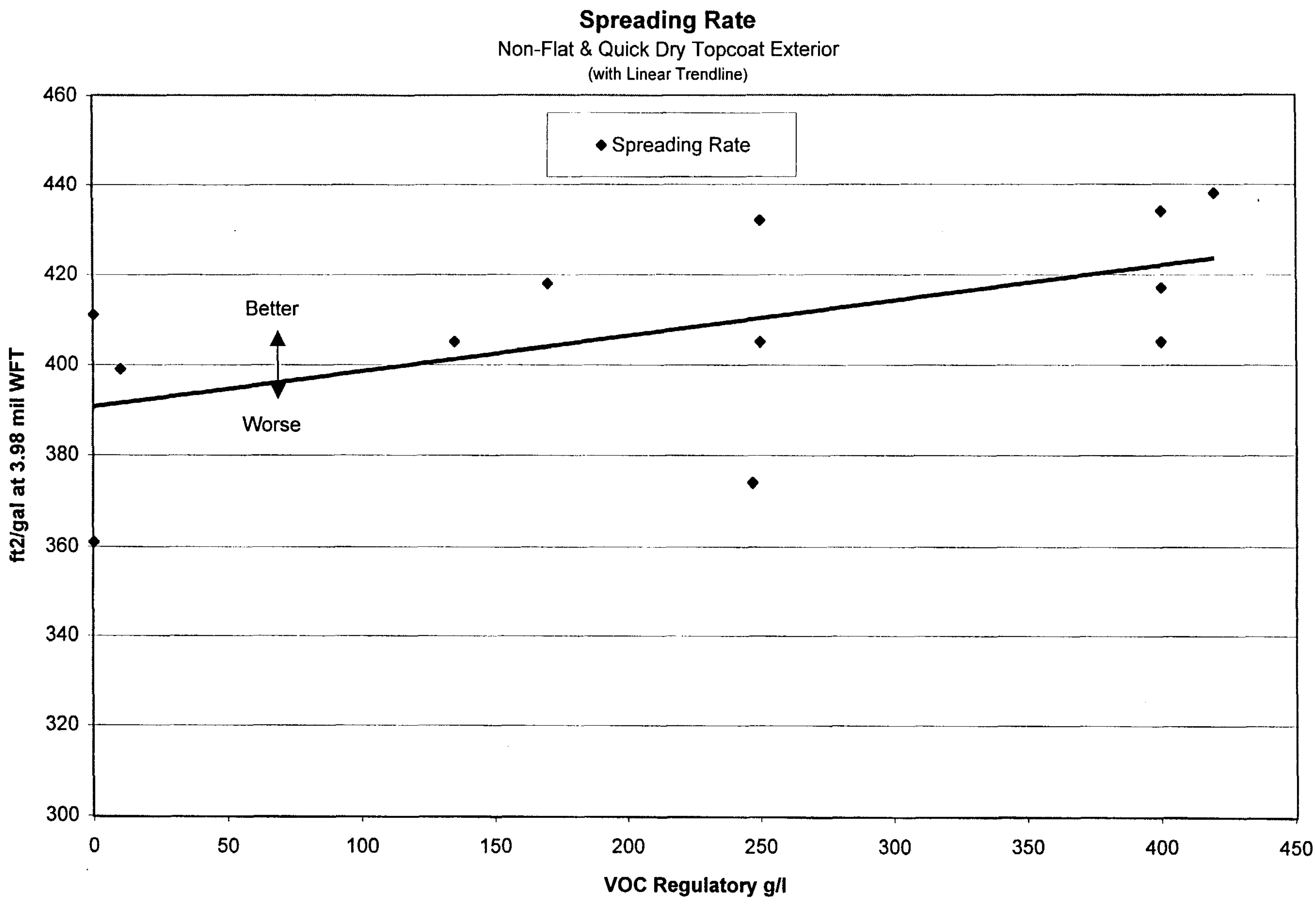


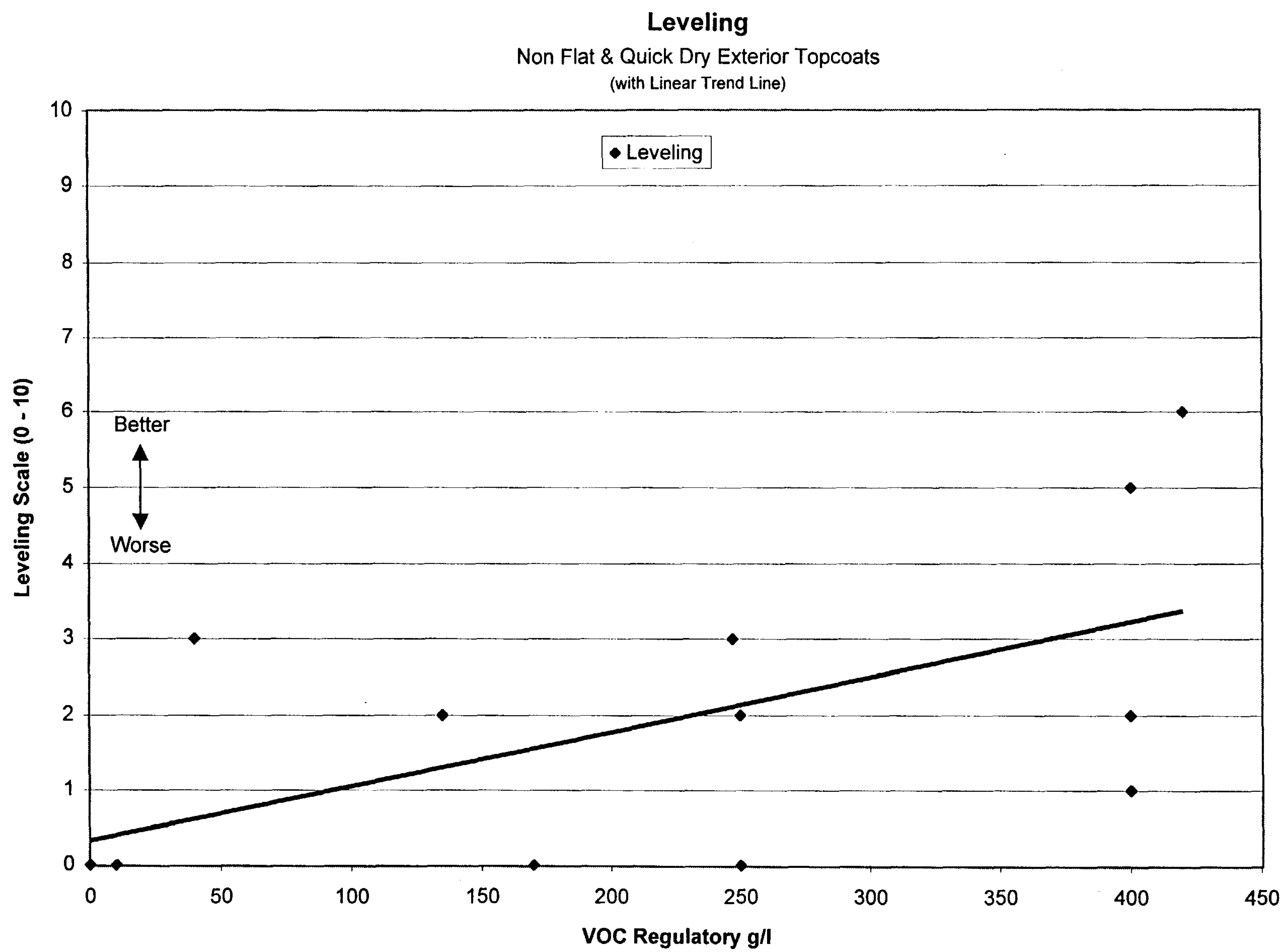
Dry Time - Dry To Touch
Non Flat & Quick Dry Exterior Topcoats
(with Linear Trend Lines)
50 degrees F, 90% RH (minutes)
90 degrees F, 30% RH (minutes)
50 degrees F, 90% RH
90 degrees F, 30% RH
Minutes
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

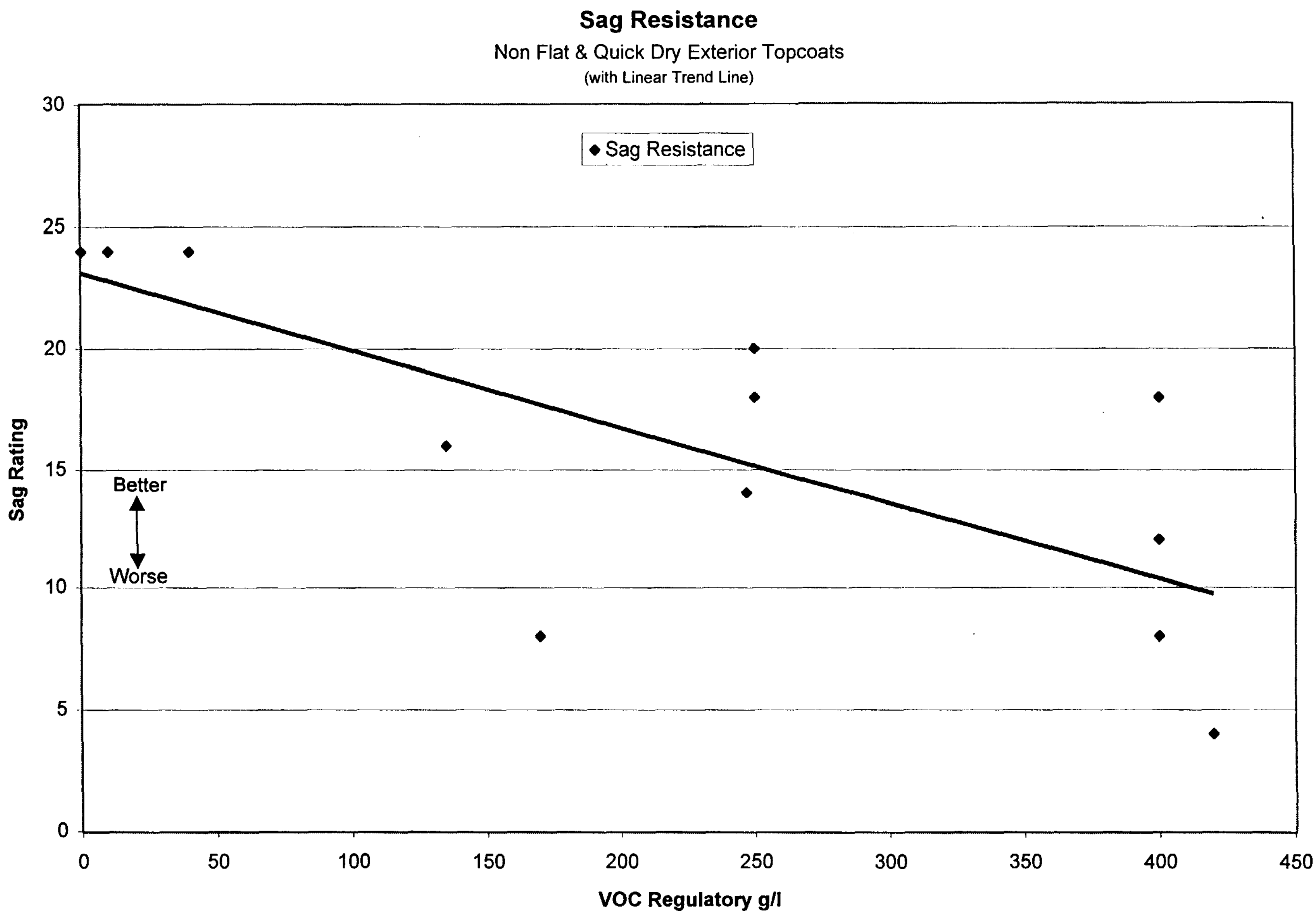

Dry Time - Dry Hard
Non Flat & Quick Dry Exterior Topcoats
(with Linear Trend Lines)
50 degrees F, 90% RH (minutes)
90 degrees F, 30% RH (minutes)
NonFlats (e.g., Acrylic Latex, etc.)
50 degrees F, 90% RH
90 degrees F, 30% RH
Quick Dry Alkyds
& Ref Urethane
Minutes
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

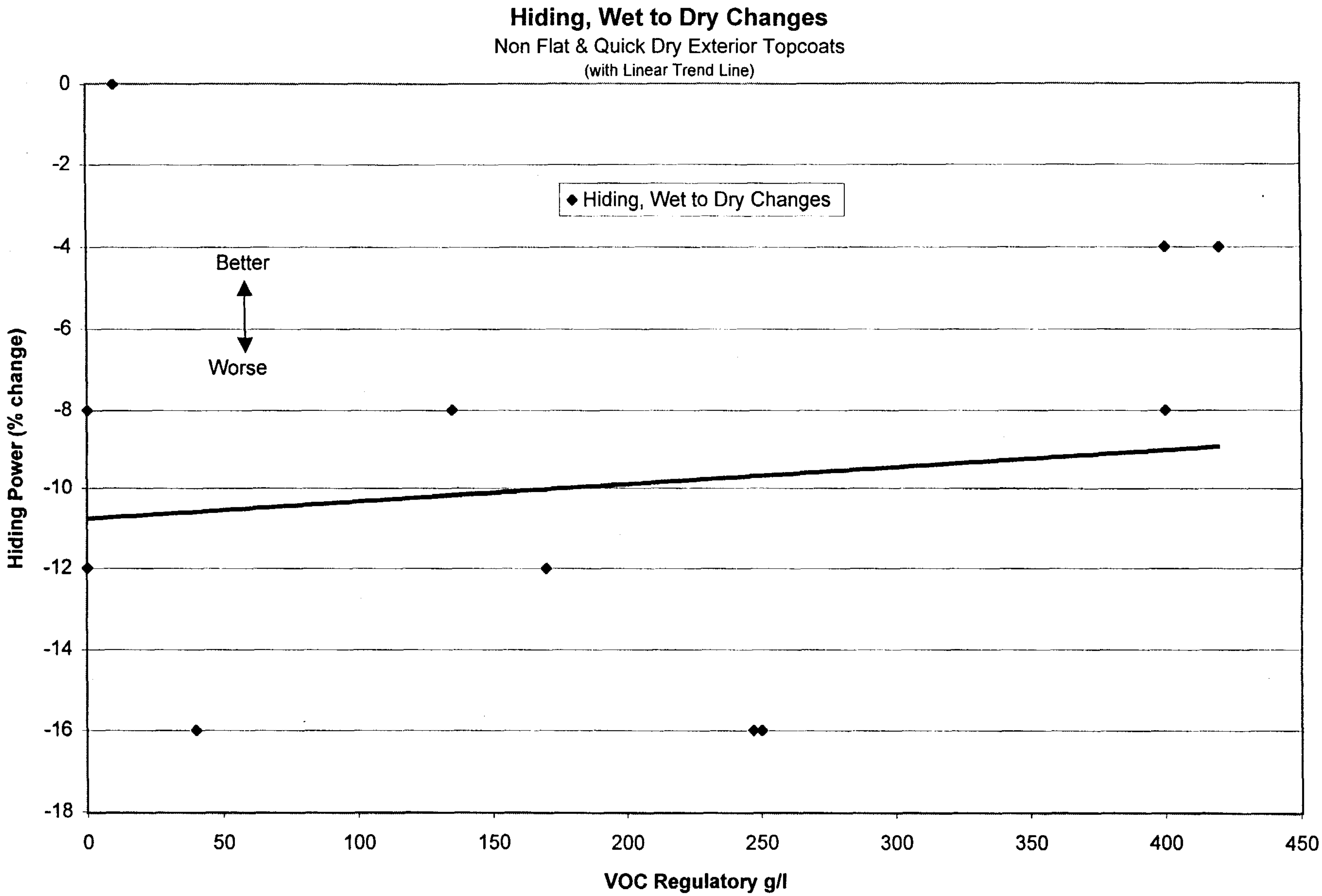


Contrast Ratio
(Hiding Power)
Non-Flat & Quick Dry Topcoat Exterior
(with Linear Trendline)
at Spreading Rate of 414 ft2/gal or 3.87 mils WFT
Contrast Ratio
0.995
0.99
0.985
0.98
0.975
0.97
0.965
0.96
Better
Worse
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

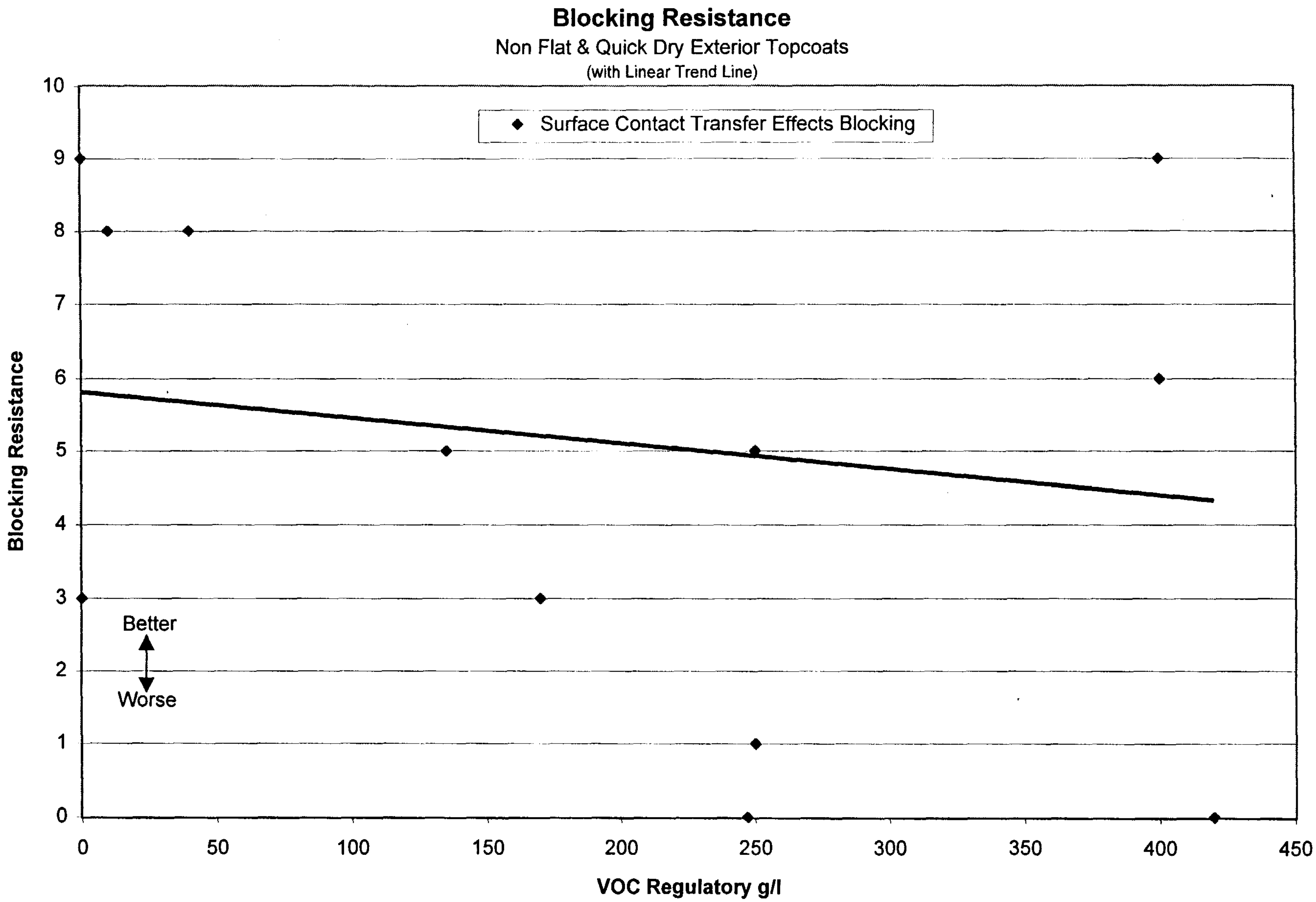

Spreading Rate
Non-Flat & Quick Dry Topcoat Exterior
(with Linear Trendline)
Spreading Rate
Better
Worse
ft2/gal at 3.98 mil WFT
VOC Regulatory g/l
460
440
420
400
380
360
340
320
300
0
50
100
150
200
250
300
350
400
450


Leveling
Non Flat & Quick Dry Exterior Topcoats
(with Linear Trend Line)
Leveling
Better
Worse
Leveling Scale (0 - 10)
VOC Regulatory g/l
0
1
2
3
4
5
6
7
8
9
10
0
50
100
150
200
250
300
350
400
450

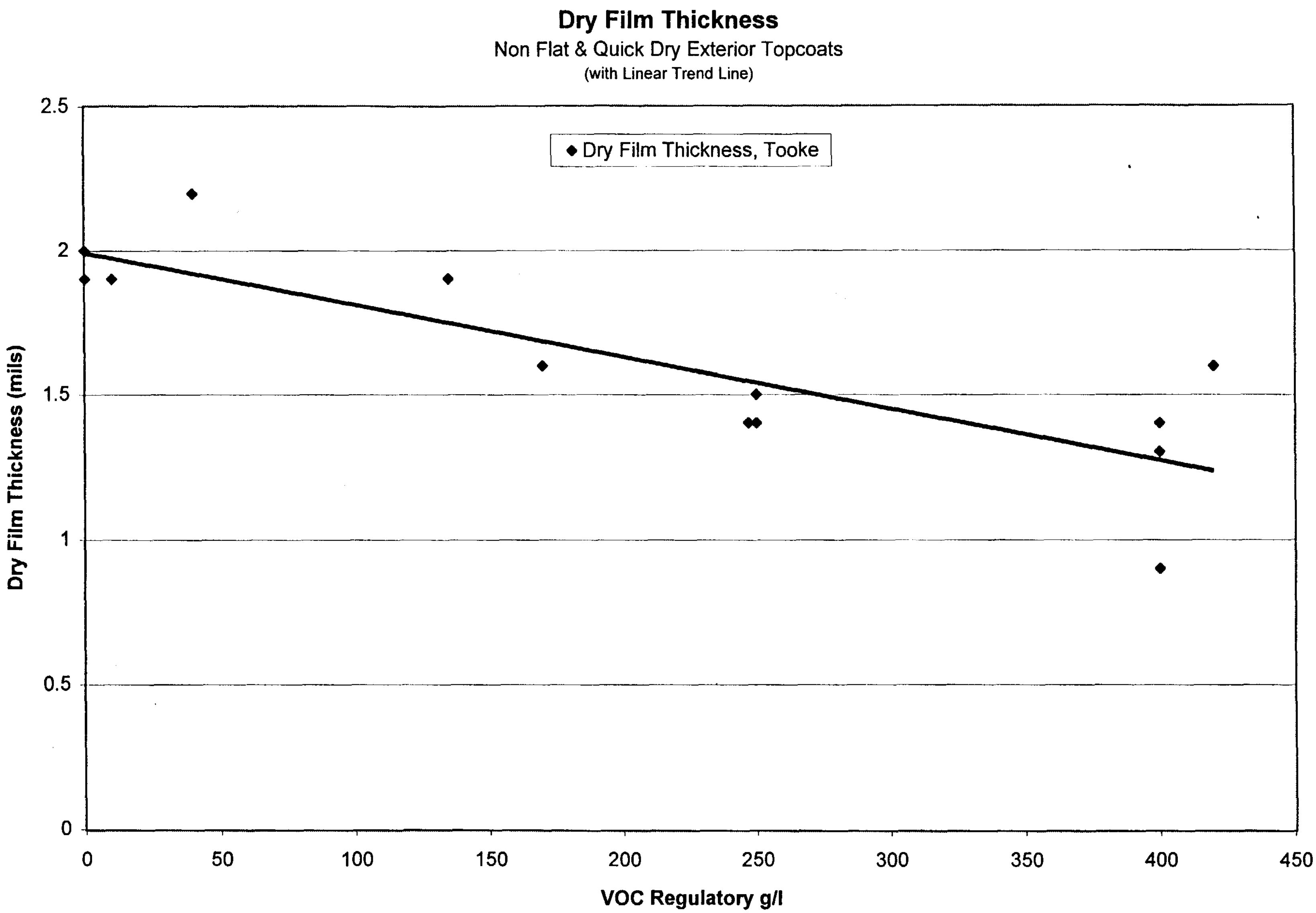

Sag Resistance
Non Flat & Quick Dry Exterior Topcoats
(with Linear Trend Line)
Sag Resistance
Better
Worse
Sag Rating
VOC Regulatory g/l
30
25
20
15
10
5
0
0
50
100
150
200
250
300
350
400
450



Hiding, Wet to Dry Changes
Non Flat & Quick Dry Exterior Topcoats
(with Linear Trend Line)
◆ Hiding, Wet to Dry Changes
Better
Worse
Hiding Power (% change)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l



Blocking Resistance
Non Flat & Quick Dry Exterior Topcoats
(with Linear Trend Line)
Surface Contact Transfer Effects Blocking
Blocking Resistance
10
9
8
7
6
5
4
3
2
1
0
Better
Worse
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l


Dry Film Thickness
Non Flat & Quick Dry Exterior Topcoats
(with Linear Trend Line)
Dry Film Thickness, Tooke
Dry Film Thickness (mils)
2.5
2
1.5
1
0.5
0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

Nonflat Topcoat (NFT) and Quick Dry Topcoat (QDT) - EXTERIOR Data table

Protocol Test Number							3.1c	2.1	2.1	2.2		2.2		3.14
Coating Reference Number	Coating Reference Designator	VOC Content	Polymer Class	Nonvolatile by Weight	Coarse Particles	Density	Wet Penetration test (Gordon)	Brushing Properties, Wet	Brushing Properties, Dry	Dry time, Dry to Touch - One Part Coatings		Dry time, Dry Hard - One Part Coatings		Contrast Ratio (Cw) Hiding Power
Units		g/l		%	Size in Microns	lbs/gal	Halo Ring, 2r mm	Leneta Levelness Profile, 1 - 9	Leneta Levelness Profile, 1 - 9	50 degrees F, 90% RH (minutes)	90 degrees F, 30% RH (minutes)	50 degrees F, 90% RH (minutes)	90 degrees F, 30% RH (minutes)	at Spreading Rate of 414 ft2/gal or 3.87 mils WFT
201	NFT1	0	Acrylic Latex	53.1	88	10.31	no halo	4	4	0.0	2.1	0.0	2.1	0.974
210	NFT8	0	Acrylic Emulsion	46.4	40	10.74	no halo	2	4	4.6	1.0	358.9	14.7	0.965
216	NFT14	10	Copolymer Latex	55.1	100	10.83	2	1	1	6.2	2.1	9.5	4.8	0.987
215	NFT13	40	Two-Part Urethane	59.2	80	10.93	no halo	1	1	[1]	[1]	[1]	[1]	0.982
206	NFT5	135	Acrylic Latex/Emulsion	54.0	30	11.12	3	2	4	13.7	2.2	124.7	29.5	0.984
218	NFT16	170	Alkyd, Epoxied Drying Oils	85.7	36	9.74	no halo	1	4	3.6	15.9	357.6	314.1	0.964
213	NFT11	247	Acrylic Latex	43.9	50	10.14	no halo	1	3	6.0	2.4	80.1	7.8	0.99
217	NFT15	250	Acrylic Emulsion	41.8	12	9.82	2	2	4	3.7	4.5	64.3	21.3	0.973
237	NFT19	250	Acrylic Latex	43.5	60	10.24	0.5	2	4	6.4	9.4	9.1	10.9	0.969
102	QDT1	400	Alkyd	64.4	16	9.63	no halo	2	6	4.2	2.7	355.5	212.1	0.991
110	QDT3	400	Alkyd	64.6	36	9.78	no halo	4	6	3.9	2.7	357.6	233.7	0.98
112	QDT4	400	Alkyd	64.5	20	10.23	no halo	3	5	4.2	3.3	291.3	191.4	0.975
10	REF	420	Urethane	73.6	none	11.10	N/A	7	9	3.0	0.3	120.3	109.2	0.985

[1] Insufficient amount of coating to test

Nonflat Topcoat (NFT) and Quick Dry Topcoat (QDT) - EXTERIOR Data table

Protocol Test Number		3.14	2.4	2.7	2.10	3.21						
Coating Reference Number	Coating Reference Designator	Spreading Rate	Leveling	Sag Resistance	Hiding, Wet to Dry Changes	Surface Contact Transfer Effects Blocking	Wet Film Thickness			Wet Film/Dry Film/WW & Bar Applicator Gap Relationships		
							WW Rod #30	WW Rod #48	WW Rod #80	WW Rod #30	WW Rod #48	WW Rod #80
Units		ft2/gal at 3.87 mil WFT	Scale, 0-10	Notch Clearance in mils	Hiding Indes Change between the Wet and Dry State		mils	mils	mils	mils	mils	mils
201	NFT1	411	0	>24	-12	3	4.5	5.5	7.5	1.6	2.2	2.9
210	NFT8	361	0	>24	-8	9	3.5	5.5	7.5	1.5	2.0	2.4
216	NFT14	399	0	>24	0	8	4.5	6.5	7.5	2.0	3.1	3.3
215	NFT13	[1]	3	>24	-16	8	5.5	6.5	7.5	1.6	2.2	3.3
206	NFT5	405	2	16	-8	5	4.5	6.5	7.5	2.0	2.3	3.2
218	NFT16	418	0	8	-12	3	4.5	5.5	7.5	2.4	3.6	4.4
213	NFT11	374	3	14	-16	0	4.5	4.5	8.5	1.5	1.5	2.6
217	NFT15	405	0	18	-16	5	4.5	6.5	8.5	1.7	1.7	2.1
237	NFT19	432	2	20	-16	1	4.5	5.5	7.5	1.0	1.1	1.7
102	QDT1	434	5	8	-8	6	5.5	5.5	8.5	1.5	1.5	3.6
110	QDT3	417	2	18	-8	9	4.5	5.5	11.5	1.8	2.1	4.3
112	QDT4	405	1	12	-4	9	5.5	6.5	8.5	1.7	2.2	3.7
10	REF	438	6	<4	-4	N/A	4.5	6.5	8.5	1.2	2.5	3.4

[1] Insufficient amount of coating to test

Nonflat Topcoat (NFT) and Quick Dry Topcoat (QDT) - EXTERIOR Data table

Protocol Test Number		3.2	3.2	3.10	3.9
Coating Reference Number	Coating Reference Designator	Appearance and Finish, Drawdown Charts	Appearance and Finish, Coated Panels	Dry Film Thickness, Tooke	Film Flexibility
Units				mils	
201	NFT1	smooth, gloss	smooth, semi-gloss	1.9	pass
210	NFT8	smooth, flat	smooth, flat	2	pass
216	NFT14	rough, flat	rough, satin-flat	1.9	pass
215	NFT13	uneven, semi-gloss	no paint	2.2	no paint
206	NFT5	smooth, flat	smooth, satin-flat	1.9	pass
218	NFT16	smooth, semi-gloss	wrinkled, semi-gloss	1.6	pass
213	NFT11	smooth, gloss	smooth, semi-gloss	1.4	pass
217	NFT15	smooth, gloss	smooth, satin	1.5	pass
237	NFT19	smooth, gloss	smooth, satin	1.4	pass
102	QDT1	smooth, gloss	smooth, gloss	0.9	pass
110	QDT3	smooth, gloss	smooth, semi-gloss	1.3	pass
112	QDT4	smooth, semi-gloss	smooth, semi-gloss	1.4	pass
10	REF	smooth, gloss	smooth, gloss	1.6	pass

Section 8: Nonflat System and Quick Dry System - Interior

	1st Coat	2nd Coat	3rd Coat
Total # manufactuers or brands	10	10	2
Single component coatings	7	14	2
Multi-component coatings	?	0	0
Total # coatings	14	14	2

Test Summary

Dry Film Thickness:

- Low VOC coatings exhibited lower dry film thicknesses compared to high VOC coatings.

Adhesion of Topcoats (Tape applied over X-cut):

- Low VOC coatings (<250 g/l) exhibited a higher failure rate compared to high VOC coatings.

Household Chemical Resistance (Exposure to 409 for 30 minutes at 75 °F & 50% RH):

- Softening - Low VOC coatings (<250 g/l) exhibited moderate softening compared to high VOC coatings with only slight softening.
- Swelling - Low VOC coatings exhibited similar performance.
- Adhesion - Low VOC coatings (<250 g/l) exhibited a higher failure rate compared to high VOC coatings.

Comments:

Low VOC coatings exhibited higher failure rates compared to higher VOC coatings for adhesion and softening tests performed. Low VOC coatings did exhibit similar performance in resistance to swelling.

Nonflat System and Quickdry System - Interior - 1st Coat / Primer

Coating Reference Designator	VOC, g/l	Part	Polymer Class	Intended Application	Total
333	189	(blank)	(blank)	P	1
327	0	1	Acrylic Latex	P	1
103	408	1	Alkyd	P	1
320	350	1	Alkyd	P	1
321	130	1	Acrylic Latex	P	1
329	0	(blank)	(blank)	P	1
330	350	(blank)	(blank)	P	1
334	0	(blank)	Acrylic Latex	P	1
326	0	(blank)	(blank)	P	1
111	400	1	Alkyd	P	1
315	0	1	Acrylic emulsion	P	2
324	350	1	Alkyd	P	1
323	350	(blank)	(blank)	U	1
Grand Total					14

Single component coatings = 7 Multi-component coatings = ?

Nonflat System and Quickdry System - Interior - 2nd Coat / Midcoat or Topcoat

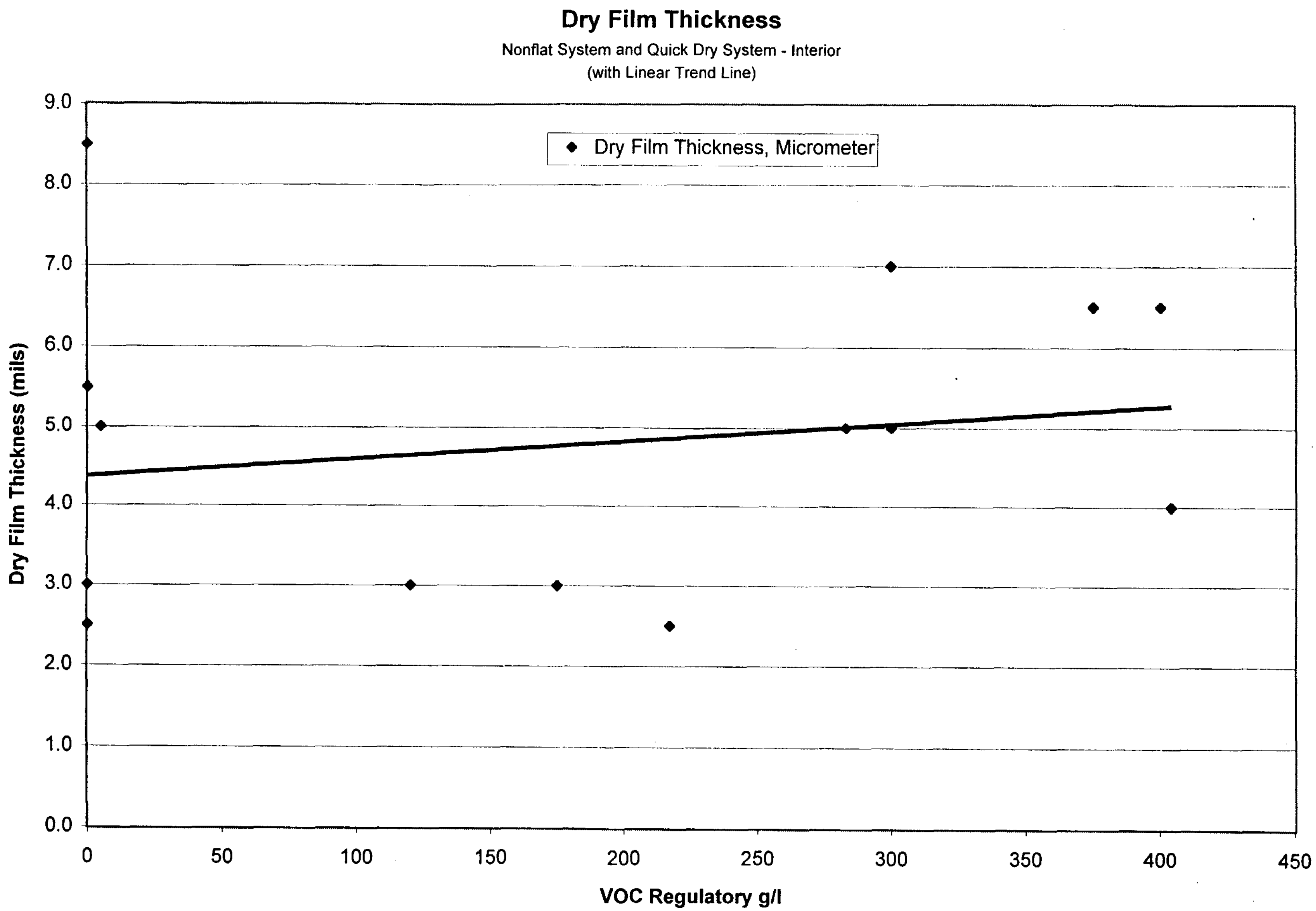
Coating Reference Designator	VOC, g/l	Part	Polymer Class	Intended Application	Total
219	245	1	Acrylic Latex	T	1
212	240	1	PWP Latex	T	1
104	400	1	Alkyd	T	1
205	220	1	Acrylic Latex	T	1
204	250	1	Acrylic Latex	T	1
235	0	1	(blank)	T	1
214	250	1	Alkyd	T	1
238	0	1	(blank)	T	1
211	0	1	Acrylic Emulsion	T	1
111	400	1	Alkyd	P	1
216	<10	1	?Copolymer latex	T	1
203	0	1	Acrylic Emulsion	T	1
208	250	1	Vinyl Acrylic Latex	T	1
207	400	1	(blank)	T	1
Grand Total					14

Single component coatings = 14 Multi-component coatings = 0

Nonflat System and Quickdry System - Interior - 3rd Coat / Topcoat

Coating Reference Designator	VOC, g/l	Part	Polymer Class	Intended Application	Total
112	<400	1	Alkyd	T	1
208	250	1	Vinyl Acrylic Latex	T	1
Grand Total					2

Single component coatings = 2 Multi-component coatings = 0



Dry Film Thickness
Nonflat System and Quick Dry System - Interior
(with Linear Trend Line)
Dry Film Thickness, Micrometer
Dry Film Thickness (mils)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l

Nonflat System (NFS) and Quickdry System (QDS) - INTERIOR Data Table

Protocol Test Number					3.2	3.10	3.1a
System Reference Designator	Coating Reference Designators	Polymer Class	VOC Content	Reference VOC or average	Appearance and Finish, Coted Panels	Dry Film Thickness, Micrometer	Adhesion of Topcoats over New Suraces (Tape)
		Units	g/l	g/l		mils	pass/fail
NFS-02	334-238	Acrylic Latex/Copolymer Latex	0/0	0	ridged, semi-gloss	8.5	pass
NFS-03	315-203	Acrylic Latex/Acrylic Emulsion	0/0	0	uniform, flat	5.5	pass
NFS-10	326-211	Acrylic Latex/Acrylic Emulsion	0/0	0	unifrom, satin	2.5	failed to substrate
NFS-13	329-235	Acrylic Latex/Acrylic Latex	0/0	0	uniform, eggshell	3.0	test not possible
NFS-17	315-216	Acrylic/Copolymer Latex	0/10	5	ridged, satin-flat	5.0	pass
NFS-11	327-212	Acrylic Latex/PWP Latex	0/240	120	unifrom, satin-flat	3.0	failed to topcaot
NFS-06	321-205	Acrylic Latex/Acrylic Latex	130/220	175	uniform, semi-gloss	3.0	failed to substrate
NFS-19	333-219	Acrylic Latex/Acrylic Latex	189/245	217	uniform, satin	2.5	pass
NFS-08	324-208-208	Alkyd/Vinyl Acrylic Latex/Vinyl Acrylic Latex	350/250/250	283	unifrom, falt	5.0	test not possible
NFS-04	320-204	Alkyd/Acrylic Latex	350/250	300	unifrom, satin	5.0	pass
NFS-14	330-214	Alkyd/Alkyd	350/250	300	uniform, semi-gloss	7.0	pass
NFS-07	323-207	Alkyd/Alkyd	350/400	375	uniform, semi-gloss	6.5	pass
QDS-04	111-111-112	Alkyd/Alkyd/Alkyd	400/400/400	400	uniform, semi-gloss	6.5	pass
QDS-02	103-104	Alkyd/Alkyd	408/400	404	uniform, semi-gloss	4.0	pass

[1] Insufficient amount of coating to test

Nonflat System (NFS) and Quickdry System (QDS) - INTERIOR Data Table

Protocol Test Number		3.3								3.15
System Reference Designator	Coating Reference Designators	Household Chemical Resistance								Mildew and Fungus Resistance
		Delta CIE	Delta E313 Yellow	softening	swelling	Adhesion, Tape	Delta Gloss 20 degrees	Delta Gloss 60 degrees	Delta Gloss 85 degrees	
NFS-02	334-238	-0.98	0.28	moderate	slight	pass	-0.50	-1.00	1.60	10
NFS-03	315-203	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	10
NFS-10	326-211	-0.56	0.06	moderate	none	failure of topcaot	0.20	-1.60	-1.20	10
NFS-13	329-235	-1.32	-0.41	slight	none	pass	0.10	0.70	-1.00	10
NFS-17	315-216	-4.08	1.66	moderate	none	pass	0.20	1.80	6.70	10
NFS-11	327-212	-3.53	0.53	moderate	very slight	test not possible	3.30	14.10	11.50	10
NFS-06	321-205	4.72	2.79	slight	slight	failed to substrate	-3.10	-13.70	-14.80	10
NFS-19	333-219	-0.21	0.01	moderate	slight	pass	-3.70	-6.60	17.30	10
NFS-08	324-208-208	-9.57	1.86	moderate	none	test not possible	0.20	1.90	5.40	10
NFS-04	320-204	16.26	4.95	none	none	failed to substrate	6.20	10.60	6.60	10
NFS-14	330-214	21.61	-6.40	slight	slight	pass	-0.60	-1.50	0.70	10
NFS-07	323-207	15.05	4.46	slight	none	pass	0.60	0.00	1.00	10
QDS-04	111-111-112	17.11	5.08	slight	none	pass	2.20	4.40	3.60	10
QDS-02	103-104	22.67	6.65	none	none	pass	-0.50	-1.00	1.60	10

[1] Insufficient amount of coating to test

Section 9: Nonflat System and Quick Dry System - Exterior

	1st Coat	2nd Coat	3rd Coat
Total # manufactuers or brands	8	11	2
Single component coatings	10	11	1
Multi-component coatings	?	1	1
Total # coatings	12	12	2

Test Summary

Dry Film Thickness:

- Low VOC coatings exhibited lower dry film thickness compared to high VOC coatings.

Water Resistance (100 °F & 100% RH) - Scratch after two week exposure:

- Low VOC coatings exhibited similar performance to high VOC coatings.

Water Resistance (100 °F & 100% RH) - Gouge after two week exposure:

- Low VOC coatings exhibited similar performance to high VOC coatings.

Water Resistance (100 °F & 100% RH) - Adhesion tape test after two week exposure:

- Low and high VOC coatings exhibited poor performance after exposure. If the coatings were allowed a 24 hour dry time after exposure the low VOC coatings exhibited similar performance compared to high VOC coatings.

Comments:

Low VOC coatings exhibited similar performance to high VOC coatings.

Nonflat System and Quickdry System - Exterior - 1st Coat / Primer

Coating Reference Designator	VOC, g/l	Part	Polymer Class	Intended Application	Total
328	350	1	Alkyd	P	1
322	115	1	Acrylic Latex	P	2
101	440	1	Alkyd	P	1
331	250	(blank)	(blank)	P	1
301	1	1	Copolymer Latex	P	1
325	0	(blank)	(blank)	P	1
111	400	1	Alkyd	P	2
315	0	1	Acrylic emulsion	P	1
109	450	1	Oil base	P	1
310	0	1	Acrylic Latex	P	1
Grand Total					12

Single component coatings = 10 Multi-component coatings = ?

Nonflat System and Quickdry System - Exterior - 2nd Coat - Midcoat / Topcoat

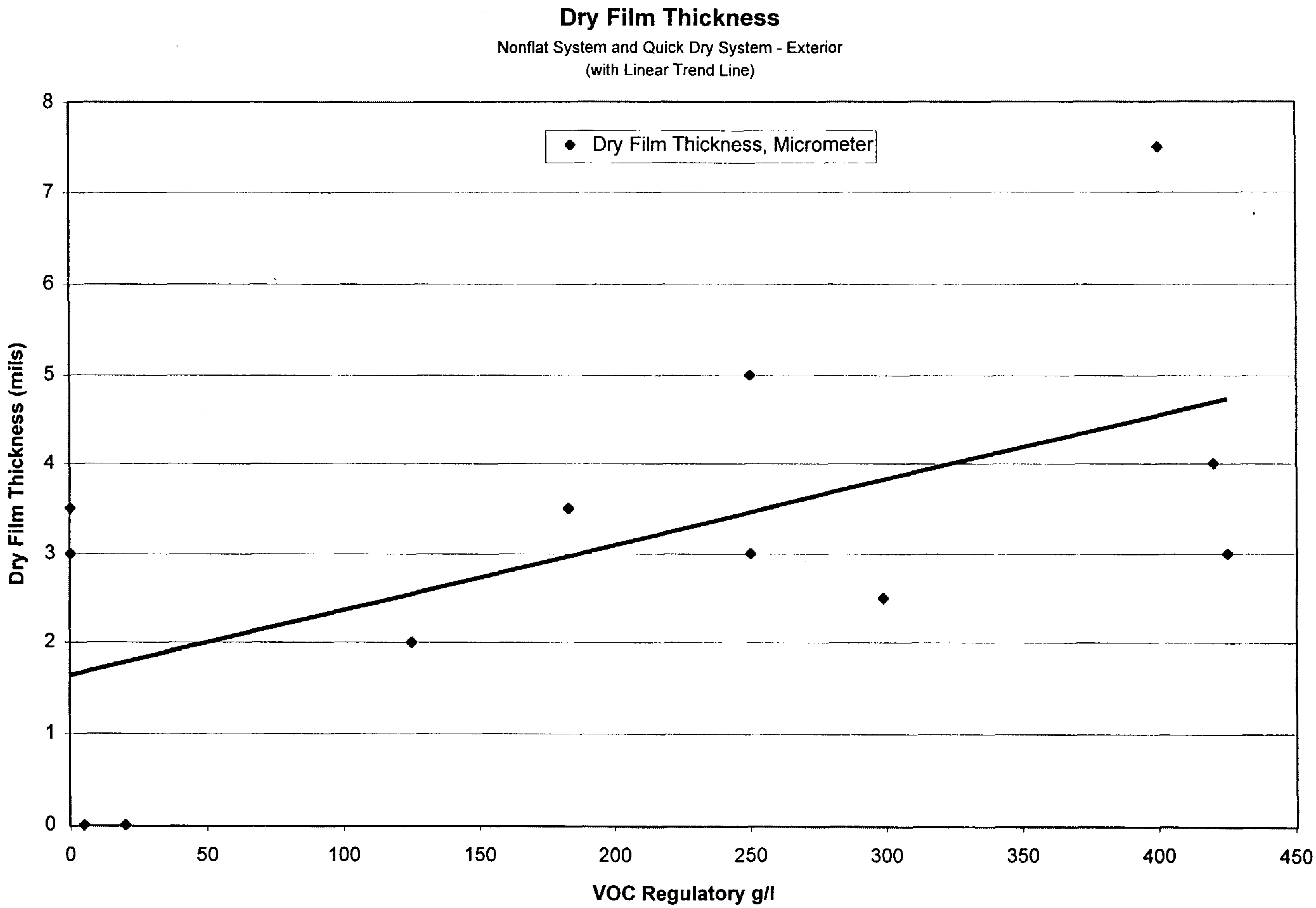
Coating Reference Designator	VOC, g/l	Part	Polymer Class	Intended Application	Total
215	30	2	Urethane	T	1
213	247	1	Acrylic Latex	T	1
206	135	1	Acrylic	T	1
102	400	1	Alkyd	T	1
218	100	1	(blank)	T	1
237	250	1	(blank)	T	1
201	0	1	Acrylic Latex	T	1
210	0	1	Acrylic emulsion	T	1
111	400	1	Alkyd	P	1
217	<250	1	Acrylic emulsion	T	1
216	<10	1	?Copolymer latex	T	1
110	400	1	Alkyd	T	1
Grand Total					12

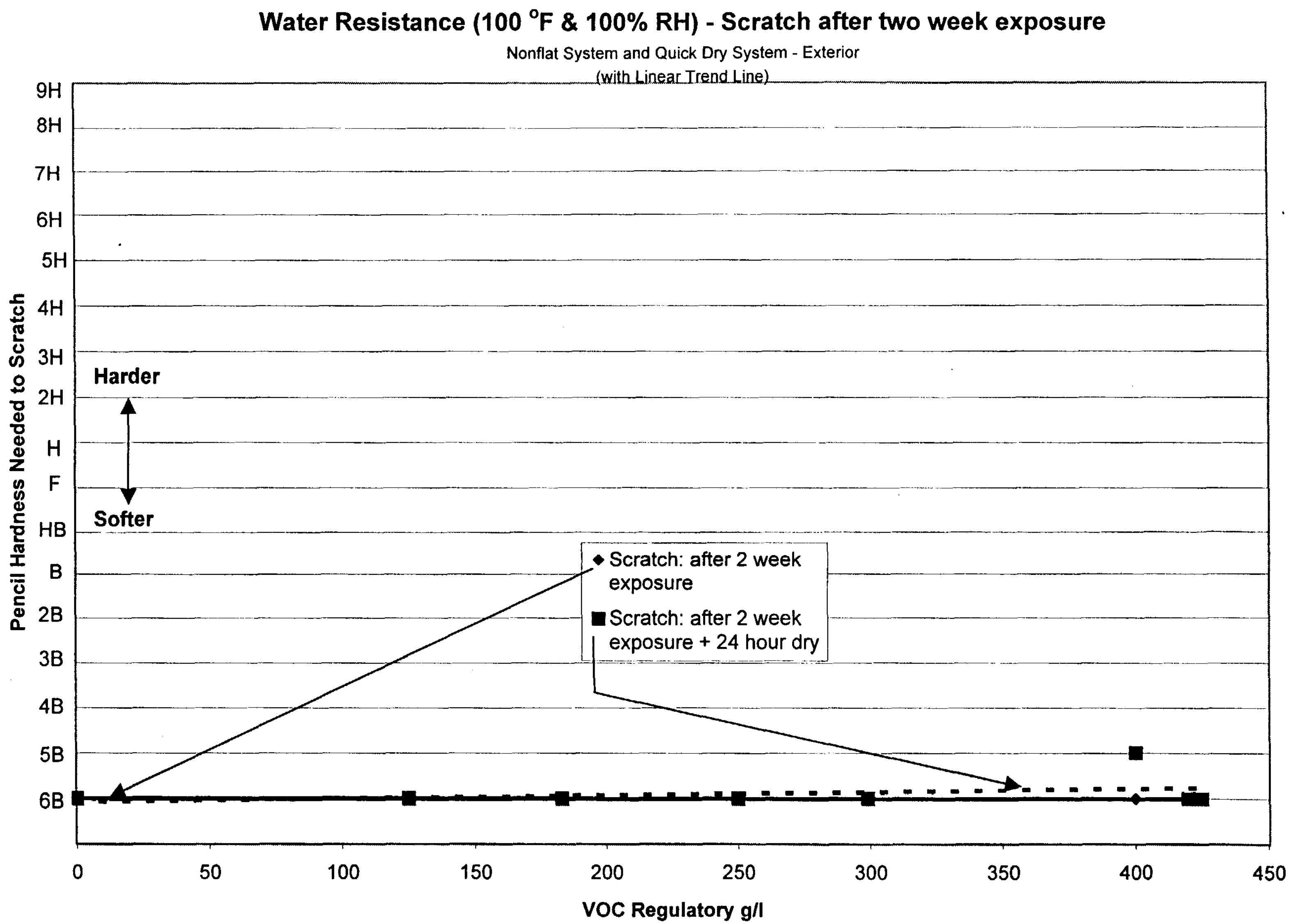
Single component coatings = 11 Multi-component coatings = 1

Nonflat System and Quickdry System - Exterior - 3rd Coat - Topcoat

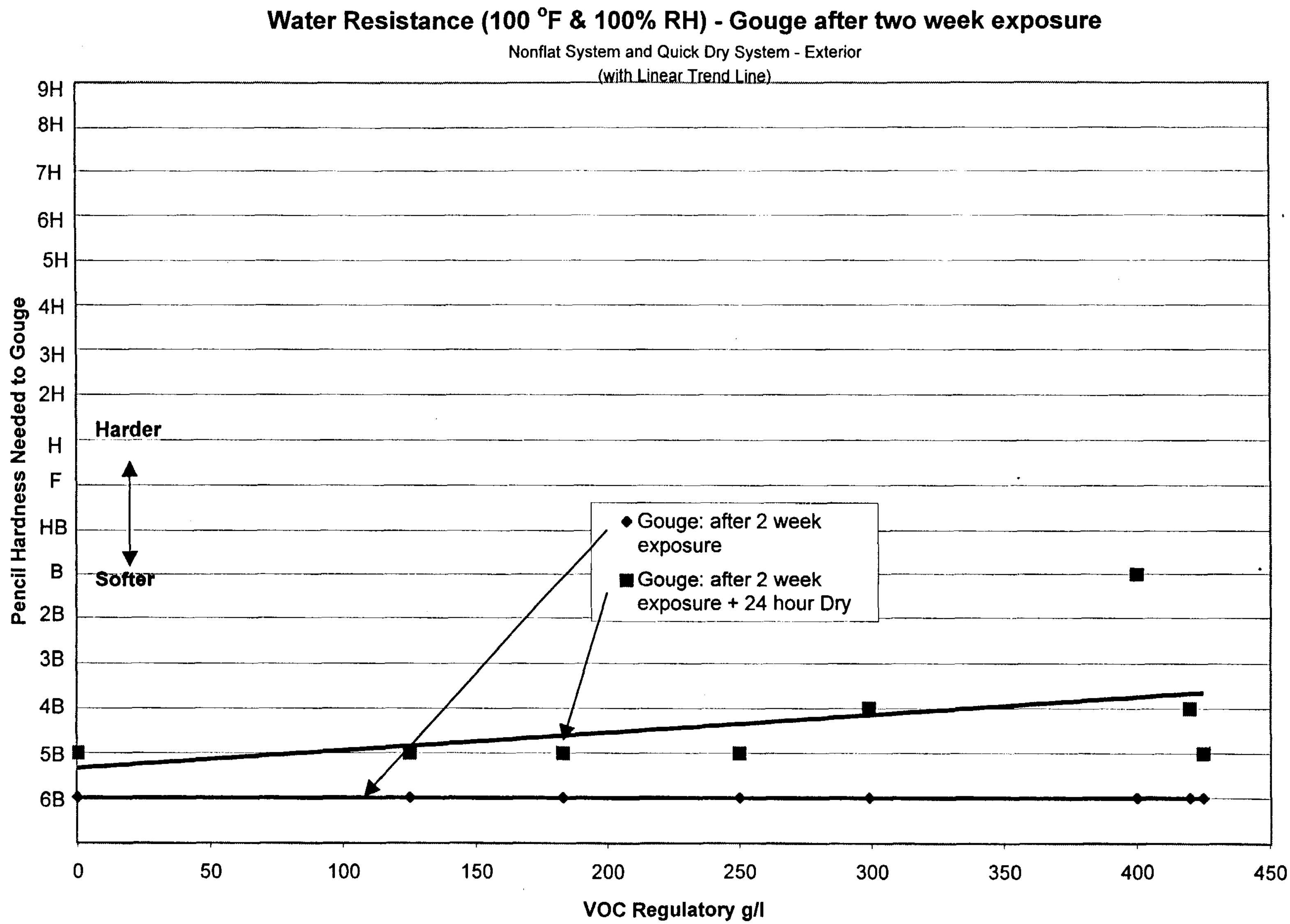
Coating Reference Designator	VOC, g/l	Part	Polymer Class	Intended Application	Total
215	30	2	Urethane	T	1
112	<400	1	Alkyd	T	1
Grand Total					2

Single component coatings = 1 Multi-component coatings = 1

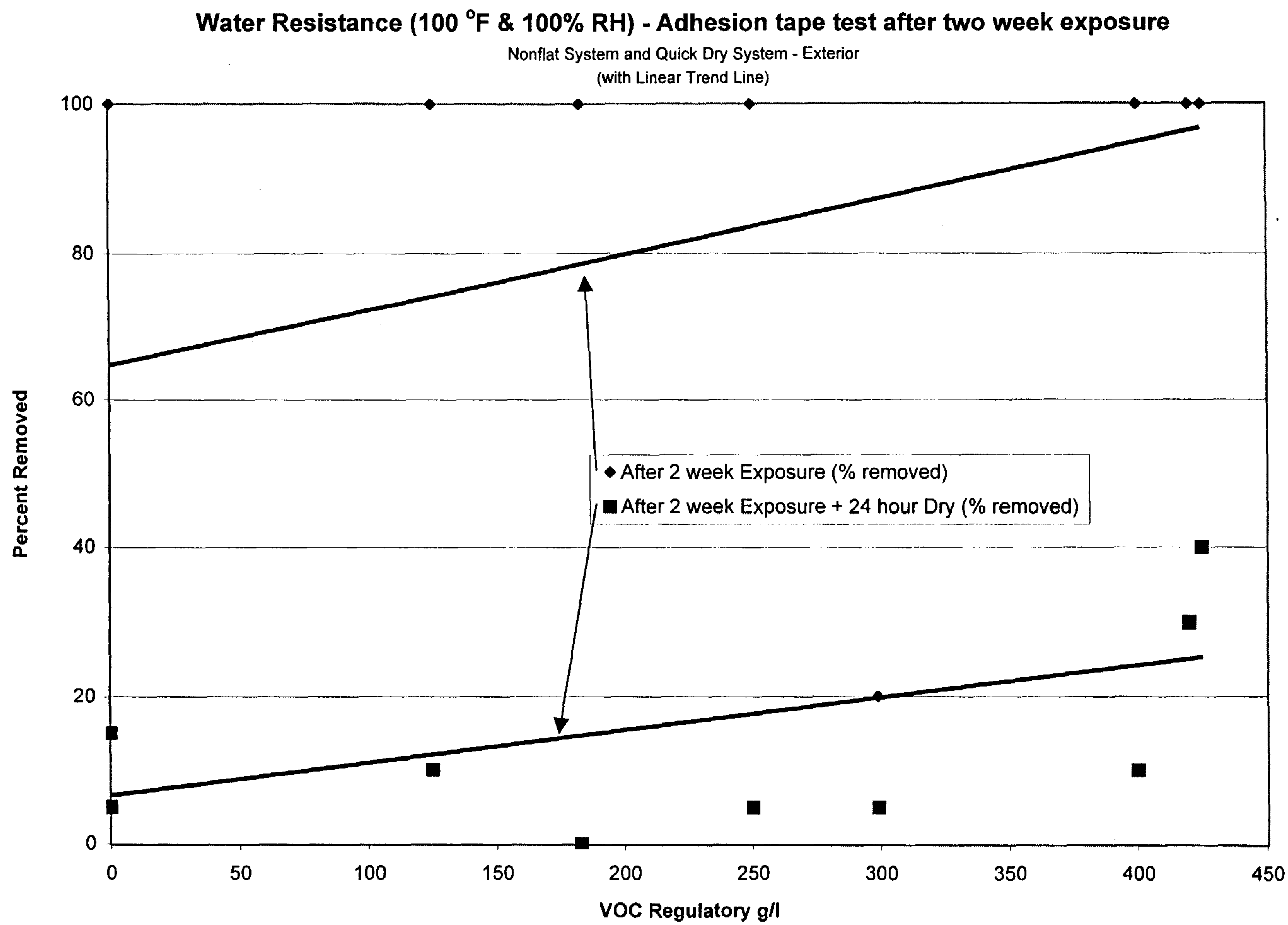

Dry Film Thickness
Nonflat System and Quick Dry System - Exterior
(with Linear Trend Line)
Dry Film Thickness, Micrometer
Dry Film Thickness (mils)
VOC Regulatory g/l
0
1
2
3
4
5
6
7
8
0
50
100
150
200
250
300
350
400
450



Water Resistance (100 °F & 100% RH) - Scratch after two week exposure
Nonflat System and Quick Dry System - Exterior
(with Linear Trend Line)
Pencil Hardness Needed to Scratch
9H
8H
7H
6H
5H
4H
3H
2H
H
F
HB
B
2B
3B
4B
5B
6B
Harder
Softer
Scratch: after 2 week exposure
Scratch: after 2 week exposure + 24 hour dry
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l



Water Resistance (100 °F & 100% RH) - Gouge after two week exposure
Nonflat System and Quick Dry System - Exterior
(with Linear Trend Line)
Pencil Hardness Needed to Gouge
9H
8H
7H
6H
5H
4H
3H
2H
H
F
HB
B
2B
3B
4B
5B
6B
Harder
Softer
Gouge: after 2 week exposure
Gouge: after 2 week exposure + 24 hour Dry
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l


Water Resistance (100 °F & 100% RH) - Adhesion tape test after two week exposure
Nonflat System and Quick Dry System - Exterior
(with Linear Trend Line)
Percent Removed
100
80
60
40
20
0
0
50
100
150
200
250
300
350
400
450
VOC Regulatory g/l
After 2 week Exposure (% removed)
After 2 week Exposure + 24 hour Dry (% removed)

Nonflat System (NFS) and Quick Dry System (QDS) - EXTERIOR Data Table

Protocol Test Number					3.2	3.6	3.10			
System Reference Designator	Coating Reference Designators	Polymer Class	VOC Content	Reference VOC or average	Appearance and Finish, Coted Panels	Dirt Resistance, Dry	Dry Film Thickness, Micrometer	Delta gloss, Pretest-2 week		
		Units	g/l	g/l			mils	20 degrees	60 degrees	85 degrees
NFS-01	301-201	Vinyl Polymer Latex/Acrylic Latex	1/0	0	uniform, satin-flat		3	3.7	8.5	1.6
NFS-09	325-210	Acrylic Latex/Acrylic Emulsion	0/0	0	uniform, flat		3.5	0.1		
NFS-17	315-216	Acrylic/Copolymer Latex	0/10	5	smooth		N/A	[1]		
NFS-16	310-215-215	Acrylic Emulsion/Urethane/Urethane	0/30/30	20	N/A	N/A	N/A	N/A	N/A	N/A
NFS-05	322-206	Acrylic Latex/Acrylic Latex-Emulsion	115/135	125	ridged, flat		2	0	-0.5	-2.1
NFS-18	322-217	Acrylic Latex/Acrylic Emulsion	115/250	183	uniform, semigloss		3.5	10.8	10.3	6.3
NFS-15	331-237	Acrylic Latex/Acrylic Latex	250/250	250	satin-flat		3	1.2	10.4	4
QDNFS-01	111-218	Alkyd/Alkyd, Epoxied Drying Oils	400/100	250	some wrinkling at corners semigloss		5	26	33.8	10.1
NFS-12	328-213	Alkyd/Acrylic Latex	350/247	299	uniform, semi-flat		2.5	0.9	7.6	5.7
QDS-04	111-111-112	Alkyd/Alkyd/Alkyd	400/400/400	400	uniform, satin		7.5	4.7	7.4	1.7
QDS-01	101-102	Alkyd/Alkyd	440/400	420	uniform, high gloss		4	27.6	7.5	11.6
QDS-03	109-110	Oil Base/Alkyd	450/400	425	uniform, medium gloss		3	5.6	12.7	1.3

[1] Insufficient amout of coating to test

Nonflat System (NFS) and Quick Dry System (QDS) - EXTERIOR Data Table

Protocol Test Number		3.8												
System Reference Designator	Coating Reference Designators	Environmental Resistance												
		Delta gloss, Pretest-2 week + 24 hours			Delta CIE		Delta E313 Yellow		Hardness				Adhesion, Tape	
		20 degrees	60 degrees	85 degrees	pretest-2 week	pretest-2 week+ 24 hour dry	pretest-2 week	pretest-2 week+ 24 hour dry	Scratch: after 2 week exposure	Scratch: after 2 week exposure + 24 hour dry	Gouge: after 2 week exposure	Gouge: after 2 week exposure + 24 hour Dry	After 2 week Exposure (% removed).	After 2 week Exposure + 24 hour Dry (% removed)
NFS-01	301-201	4.8	11.4	5.1	1.16	0.88	0.33	0.41	<6B	<6B	<6B	5B	100%	15%
NFS-09	325-210	0.1			1.42	2.25	-0.71	-0.93	<6B	6B	<6B	5B	5%	5%
NFS-17	315-216	[1]			[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]
NFS-16	310-215-215	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NFS-05	322-206	0	-0.6	-3.4	-1.57	-0.57	0.63	0.55	<6B	<6B	6B	5B	100%	10%
NFS-18	322-217	10.9	13.4	8.5	1.1	1.1	-0.16	0.05	<6B	<6B	<6B	5B	100%	0%
NFS-15	331-237	1.2	9.1	0.6	10.75	9.76	-3.15	-2.77	<6B	<6B	6B	5B	100%	5%
QDNFS-01	111-218	26.6	34.7	12.5	13.01	8.11	-4.07	-4.07	<6B	<6B	<6B	5B	100% Topcoat, 5% Primer	50% Topcoat, < 5% Primer
NFS-12	328-213	0.9	7.6	5.7	0.31	1.27	0.18	0.28	<6B	6B	<6B	4B	20%	5%
QDS-04	111-111-112	6.7	12.6	1.8	14.87	14.17	-3.95	-3.39	<6B	5B	<6B	B	100%	10%
QDS-01	101-102	33.4	8.2	8	3.52	1.62	-1.03	-0.26	<6B	<6B	<6B	4B	100% Topcoat, 5% Primer	30% Topcoat, 5% Primer
QDS-03	109-110	6.6	16.5	6.1	8.96	7.12	-2.42	-1.77	<6B	<6B	<6B	5B	100%	40%

[1] Insufficient amout of coating to test

Above values converted to numeric value only (6B=1, ...9H=17)

Nonflat System (NFS) and Quick Dry System (QDS) - EXTERIOR Data Table

Protocol Test Number		3.25c	3.25a
System Reference Designator	Coating Reference Designators	Weathering Resistance, Accelerated, Outdoor	Weathering Resistance, Outdoor, Wood
NFS-01	301-201		
NFS-09	325-210		
NFS-17	315-216		
NFS-16	310-215-215	N/A	N/A
NFS-05	322-206		
NFS-18	322-217		
NFS-15	331-237		
QDNFS-01	111-218		
NFS-12	328-213		
QDS-04	111-111-112		
QDS-01	101-102		
QDS-03	109-110		

[1] Insufficient amout of coating to test

Section 10: Water Proofing Sealer - Concrete

Total # manufactuers or brands	3
Single component coatings	4
Multi-component coatings	0
Total # coatings	4

Test Summary

Freeze / Thaw:
- Two coatings tested, one passed (208 g/l) and one failed (115 g/l).

Water Penetration (average time to leak thru face):
- Similar performance observed. One coating (208 g/l) exhibited significantly better performance compared with the other three coatings.

Water Penetration (% of face leaking after 4 hours):
- Similar performance observed. One coating (208 g/l) exhibited significantly better performance compared with the other three coatings.

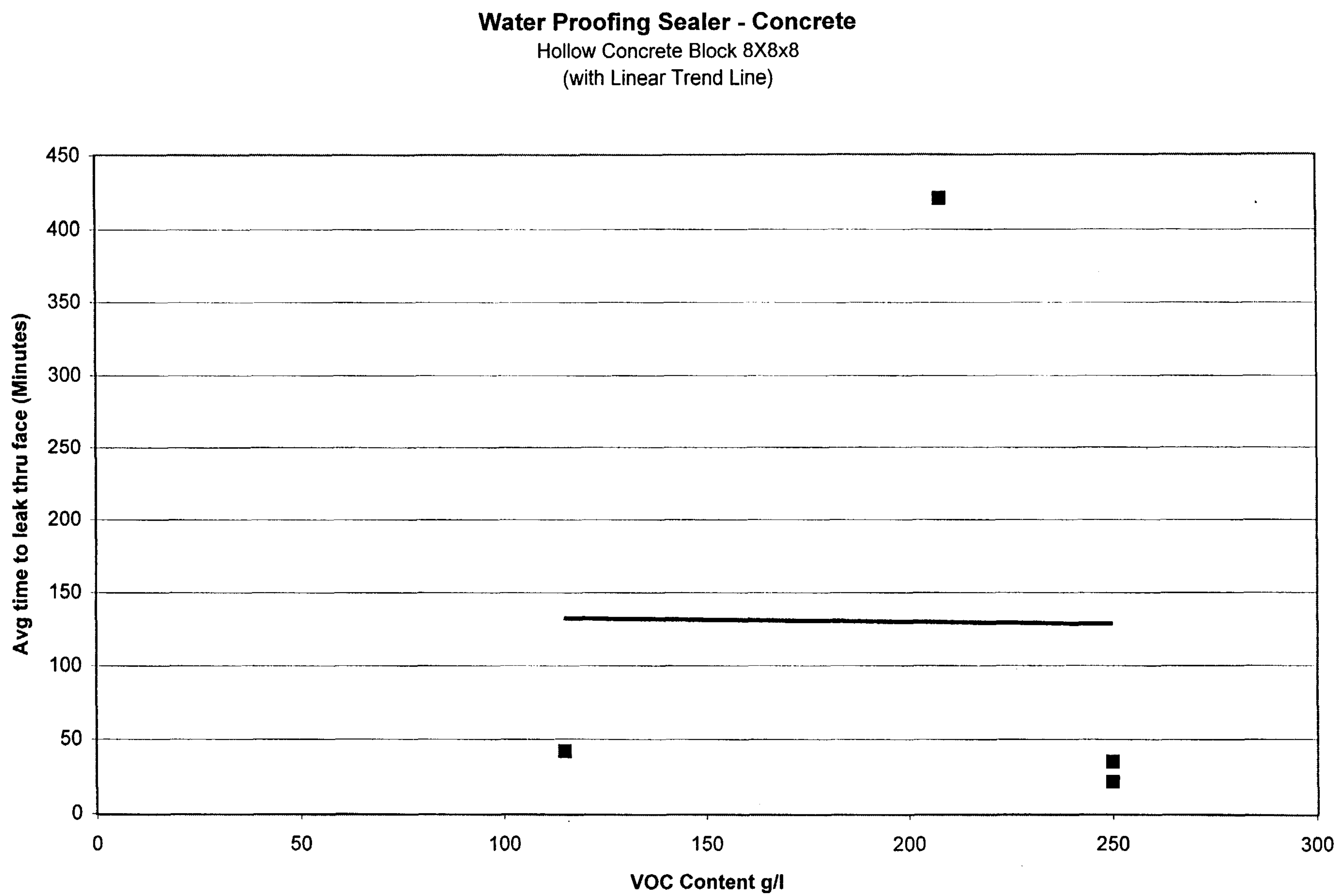
Comments:

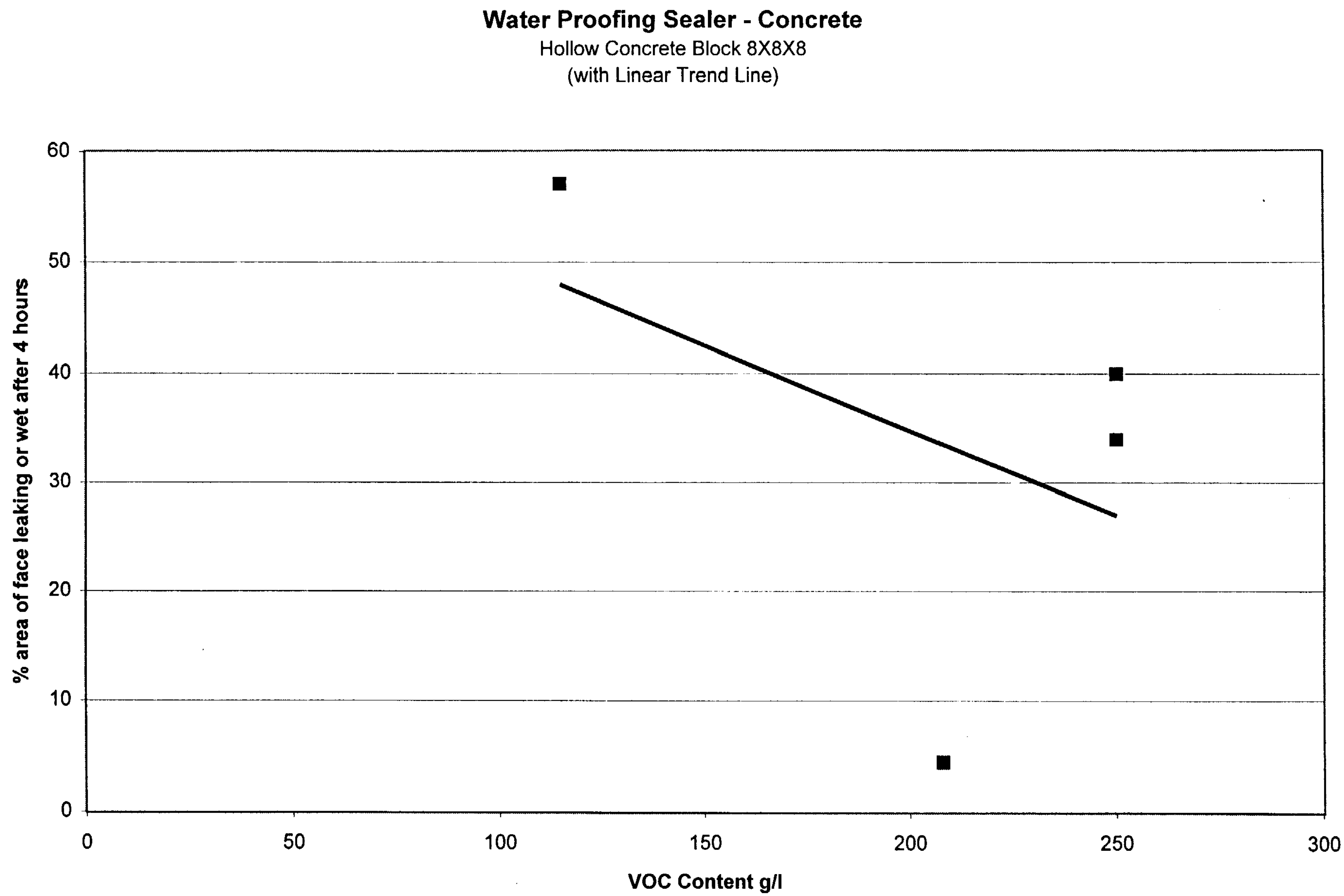
Overall, the coatings tested exhibited similar performance.

Water Proofing Sealer - Concrete

Coating Reference Designator	VOC, g/l	Part	Polymer Class	Intended Application	Total
413	<250	1	Acrylic Polymer	W	1
403	115	1	(blank)	W	1
404	208	1	(blank)	W	1
407	250	1	Acrylic emulsion + siloxane	W	1
Grand Total					4

Single component coatings = 4 Multi-component coatings = 0


Water Proofing Sealer - Concrete
Hollow Concrete Block 8X8x8
(with Linear Trend Line)
Avg time to leak thru face (Minutes)
0
50
100
150
200
250
300
350
400
450
0
50
100
150
200
250
300
VOC Content g/l


Water Proofing Sealer - Concrete
Hollow Concrete Block 8X8X8
(with Linear Trend Line)
% area of face leaking or wet after 4 hours
60
50
40
30
20
10
0
0
50
100
150
200
250
300
VOC Content g/l

Water Proofing Sealer Coating (WPSC) - CONCRETE Data Table

Protocol Test Number				1.3					2.3	3.2	3.16a	
Coating Reference Number	Coating Reference Designator	VOC Content	Polymer Class	Freeze/Thaw		Nonvolatile by Weight	Percent Water by Karl fisher Method	Density	Viscosity, Brookfield, Initial	Appearance and Finish, Coted Panels	Penetration of Water Through Clear Repellant Coatings o Hollow Concrete Blocks	
Units		g/l		Overall Rating	Outcome	%	%	lbs/gal	centipoise		Average Time to Leak Through a Face (minutes)	% Area of Face Leaking or Wet at the End of Four Hours
403	WPSC2	115	Acrylic Polymer	4	fail	9	53.4	8.36	[1]	no change	42	57
404	WPSC3	208	Silicone	10	pass	5.5	92.8	8.57	10.7	no change	421	4.5
407	WPSC5	250	Acrylic Emulsion	N/A	N/A	9.7	91.7	8.37	N/A	no change	35	34
413	WPSC10	250	Acrylic Polymer	N/A	N/A	7.4	91.2	8.31	N/A	no change	22	40

[1] Too viscous to test

Section 11: Water Proofing Sealer - Wood

Total # manufactuers or brands	5
Single component coatings	6
Multi-component coatings	0
Total # coatings	6

Test Summary

Freeze / Thaw:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

Water Repellent Efficiency:
- Low VOC coatings exhibited similar performance compared to high VOC coatings.

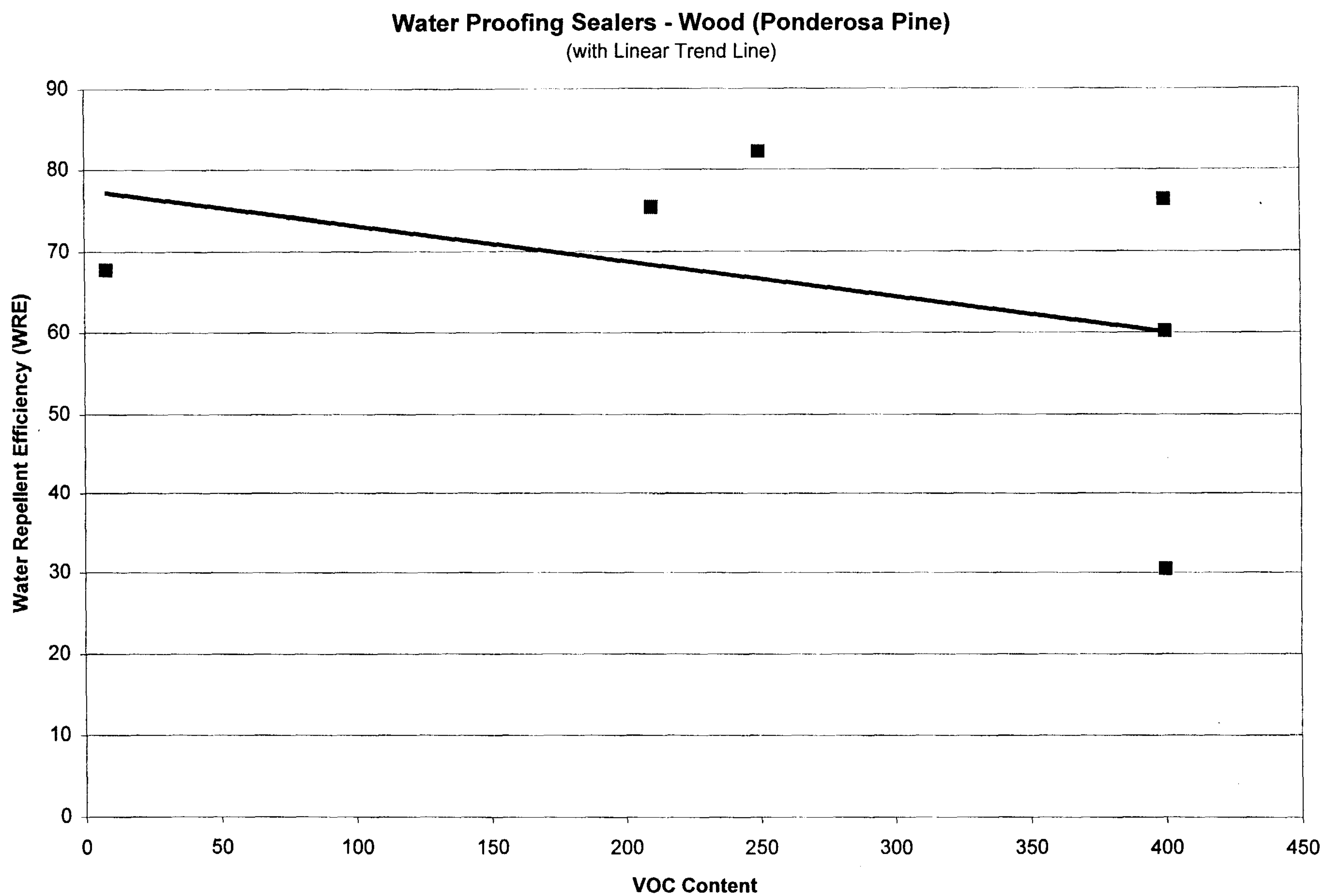
Comments:

Overall, low VOC coatings exhibited similar performance compared to high VOC coatings for the two performance tests conducted.

Water Proofing Sealer - Wood

Coating Reference Designator	VOC, g/l	Part	Polymer Class	Intended Application	Total
402	210	1	Linseed Oil	W	1
405	400	1	(blank)	W	1
408	8	1	Acrylic emulsion	W	1
410	400	1	(blank)	W	1
411	250	1	(blank)	W	1
409	400	1	(blank)	W	1
Grand Total					6

Single component coatings = 6 Multi-component coatings = 0


Water Proofing Sealers - Wood (Ponderosa Pine)
(with Linear Trend Line)
Water Repellent Efficiency (WRE)
VOC Content
0
10
20
30
40
50
60
70
80
90
0
50
100
150
200
250
300
350
400
450

Water Proofing Sealer Coating (WPSC) - WOOD Data Table

Protocol Test Number				1.3					2.3	3.2	3.16b
Coating Reference Number	Coating Reference Designator	VOC Content	Polymer Class	Freeze/Thaw		Nonvolatile by Weight	Percent Water	Density	Viscosity, Brookfield, Initial	Appearance and Finish, Coted Panels	Penetration of Water Through Clear Repellant Coatings on Wood
Units		g/l		Overall Rating	Outcome	%	%	lbs/gal	centipoise		Water Repellent Efficiency (WRE)
408	WPSC6	8	Acrylic Emulsion	10	pass	9.8	88.4	8.36	2	slightly darkened	67.8
402	WPSC1	210	Linseed Oil	10	pass	8.8	86.6	8.40	37.1	slightly darkened	75.4
411	WPSC9	250	Siloxane	N/A	N/A	13.2	N/A	6.83	N/A	slightly darkened	82.2
405	WPSC4	400	Acrylic Emulsion and Siloxane	10	pass	7.7	86.7	8.24	17	slightly darkened	30.5
409	WPSC7	400	High Carbon Resin Emulsion	10	pass	9.3	79.9	8.06	15	slightly darkened	76.3
410	WPSC8	400	Silane	N/A	N/A	6.2	N/A	6.88	N/A	slightly darkened	60.2

Appendix F:

Summary of Cost Calculations.

Formulation:	AIM001	Assumed Compliant Resin		
Category:	Flats	Cost Multiplier (RCM)	1.20	X
Typ. n-comp VOC	8.00%	Average		
Typ. comp VOC	4.00%	Unit Size	160.00	wt oz

Formulation and Cost Comparison

Component (A)	Unit Cost $/lb (B)	RCM (C)	Typical Non-compliant wt% (D)	Typical Non-compliant Cost (B) x (D) / 100	4.00% VOC Typical Compliant wt% (E)	4.00% VOC Typical Compliant Cost (B) x (C) x (E) / 100
Resin 1	0.600		13	0.078		
Resin 2	0.600	1.20			13.0	0.094
TiO2	1.000		15.0	0.150	15.0	0.150
silica/silicates	0.695		15.0	0.104	15.0	0.104
CaCO3	0.132		10.0	0.013	10.0	0.013
Texanol ester alc.	0.600		3.0	0.018	2.0	0.012
Propylene glycol	0.600		5.0	0.030	2.0	0.012
Additives	1.500		2.0	0.030	2.0	0.030
Water	0.002		37.0	0.001	41.0	0.001
	SUM		100.00%		100.00%	

	Typical Non-compliant	Typical Compliant
Total Cost, $/Pound	0.424	0.416
% Cost Diff. Relative to Current Product		-2.0%
Total Cost, $/Unit	4.24	4.16

Assume:

(1) Cost of "All Others" or "Additives" remains at **1.50** per pound
(2) Average unit size = **160.00** ounce
(3) RCM = 1.0 unless otherwise specified

Formulation:	AIM003	**Assumed Compliant Resin**	
Category:	Industrial Maintenance	**Cost Multiplier (RCM)**	1.20 X
Typ. n-comp VOC	30.00%	Average	
Typ. comp VOC	10.00%	Unit Size	160.00 wt oz

Formulation and Cost Comparison

Component (A)	Unit Cost $/lb (B)	RCM (C)	Typical Non-compliant wt% (D)	Typical Non-compliant Cost (B) x (D) / 100	10.00% VOC Typical Compliant wt% (E)	10.00% VOC Typical Compliant Cost (B) x (C) x (E) / 100
Pet. dist. solv.	0.250		30.0	0.075		
DGME	0.870				10.0	0.087
TiO2	1.000		25.0	0.250	18.0	0.180
Alkyd resin	0.500		25.0	0.125		
Acrylic resin	0.600	1.20			25.0	0.180
Water	0.002				45.0	0.001
Al silicates°H20	0.695		8.0	0.056		
CaCO3	0.132		5.0	0.007		
All others	1.500		7.0	0.105	2.0	0.030
	SUM		100.00%		100.00%	

	Typical Non-compliant	Typical Compliant
Total Cost , $/Pound	0.617	0.478
% Cost Diff. Relative to Current Product		-22.6%
Total Cost , $/Unit	6.17	4.78

Assume:

(1) Cost of "All Others" or "Additives" remains at **1.50** per pound
(2) Average unit size = **160.00** ounce
(3) RCM = 1.0 unless otherwise specified

Formulation:	AIM004	**Assumed Compliant Resin Cost Multiplier (RCM)**	1.20 X
Category:	Lacquer		
Typ. n-comp VOC	72.00%	Average Unit Size	160.00 wt oz
Typ. comp VOC	68.00%		

Formulation and Cost Comparison

Component	Unit Cost	RCM	Typical Non-compliant		68.00% VOC Typical Compliant	
	$/lb		wt%	Cost	wt%	Cost
(A)	(B)	(C)	(D)	(B) x (D) / 100	(E)	(B) x (C) x (E) / 100
Nitrocellulose	1.250		28.0	0.350	32.0	0.400
Acetone	0.155				39.0	0.060
Xylene	0.195		3.0	0.006	9.0	0.018
Isopropanol	0.340		8.0	0.027	4.0	0.014
Butyl alcohol	0.520				5.0	0.026
2-butoxy ethanol	0.470		4.0	0.019	4.0	0.019
Butyl acetate	0.630		9.0	0.057	7.0	0.044
Isobutyl alcohol	0.520		7.0	0.036		
Aromatic 100	0.250		4.0	0.010		
VM&P naptha	0.140		19.0	0.027		
MEK	0.460		13.0	0.060		
I-butyl isobutyrate	0.480		5.0	0.024		
	SUM		100.00%		100.00%	

	Typical Non-compliant	Typical Compliant
Total Cost , $/Pound	0.615	0.581
% Cost Diff. Relative to Current Product		-5.7%
Total Cost , $/Unit	6.15	5.81

Assume:

(1) Cost of "All Others" or "Additives" remains at **1.50** per pound
(2) Average unit size = **160.00** ounce
(3) RCM = 1.0 unless otherwise specified.

Formulation: AIM005
Category: Multicolor

Typ. n-comp VOC 39.00%
Typ. comp VOC. 7.00%

Assumed Compliant Resin Cost Multiplier (RCM) 1.20 X

Average Unit Size 160.00 wt oz

Formulation and Cost Comparison

Component (A)	Unit Cost $/lb (B)	RCM (C)	Typical Non-compliant wt% (D)	Typical Non-compliant Cost (B) x (D) / 100		7.00% VOC Typical Compliant wt% (E)	7.00% VOC Typical Compliant Cost (B) x (C) x (E) / 100
Water	0.002					40	0.001
Mineral spirits	0.340		4.0	0.014			
Butyl cellosolve	0.470					7.0	0.033
Aromatic solvent	0.250		35.0	0.088			
WB resin	0.600	1.20				23.0	0.166
SB resin	0.500		42.0	0.210			
Contact adhesive	1.500					20.0	0.300
various pigments	1.000		9.0	0.090		8.0	0.080
Al silicate	0.695		5.0	0.035			
Additives	1.500		5.0	0.075		2.0	0.030
	SUM		100.00%			100.00%	

	Typical Non-compliant	Typical Compliant
Total Cost , $/Pound	0.511	0.609
% Cost Diff. Relative to Current Product		19.3%
Total Cost , $/Unit	5.11	6.09

Assume:
(1) Cost of "All Others" or "Additives" remains at 1.50 per pound
(2) Average unit size = 160.00 ounce
(3) RCM = 1.0 unless otherwise specified

Formulation:	AIM006	**Assumed Compliant Resin**	
Category:	Non-flat (low & medium-gloss)	**Cost Multiplier (RCM)**	1.20 X
Typ. n-comp VOC	9.00%	Average	
Typ. comp VOC	5.00%	Unit Size	160.00 wt oz

Formulation and Cost Comparison

Component (A)	Unit Cost $/lb (B)	RCM (C)	Typical Non-compliant wt% (D)	Typical Non-compliant Cost (B) x (D) / 100	5.00% VOC Typical Compliant wt% (E)	5.00% VOC Typical Compliant Cost (B) x (C) x (E) / 100
Resin 1	0.600		22.0	0.132		
Resin 2	0.600	1.20			22.0	0.158
TiO2	1.000		19.0	0.190	19.0	0.190
Silica/Silicates	0.695		5.0	0.035	5.0	0.035
CaCO3	0.132		2.0	0.003	2.0	0.003
Texanol ester alc.	0.600		3.0	0.018	2.0	0.012
Propylene glycol	0.600		6.0	0.036	3.0	0.018
Additives	1.500		2.0	0.030	2.0	0.030
Water	0.002		41.0	0.001	45.0	0.001
SUM			100.00%		100.00%	

	Typical Non-compliant	Typical Compliant
Total Cost , $/Pound	0.444	0.447
% Cost Diff. Relative to Current Product		0.6%
Total Cost , $/Unit	4.44	4.47

Assume:

(1) Cost of "All Others" or "Additives" remains at **1.50** per pound
(2) Average unit size = **160.00** ounce
(3) RCM = 1.0 unless otherwise specified

Formulation:	AIM007	Assumed Compliant Resin		
Category:	Primers, Sealers, Undercoaters	Cost Multiplier (RCM)	1.20	X
Typ. n-comp VOC	24.50%	Average		
Typ. comp VOC	3.00%	Unit Size	160.00	wt oz

Formulation and Cost Comparison

Component (A)	Unit Cost $/lb (B)	RCM (C)	Typical Non-compliant wt% (D)	Typical Non-compliant Cost (B) x (D) / 100		3.00% VOC Typical Compliant wt% (E)	3.00% VOC Typical Compliant Cost (B) x (C) x (E) / 100
Water	0.002					54	0.001
Acrylic resin	0.600	1.20				15.0	0.108
Alkyd resin	0.500		25.0	0.125			
TiO2	1.000		12.0	0.120		13.0	0.130
Talc	0.840		35.0	0.294		12.0	0.101
Ethylene glycol	0.300					3.0	0.009
Mineral spirits	0.340		24.5	0.083			
Additives	1.500		3.5	0.053		3.0	0.045
	SUM		100.00%			100.00%	

Total Cost , $/Pound	0.675	0.394
% Cost Diff. Relative to Current Product		-41.6%
Total Cost , $/Unit	6.75	3.94

Assume:

(1) Cost of "All Others" or "Additives" remains at **1.50** per pound
(2) Average unit size = **160.00** ounce
(3) RCM = 1.0 unless otherwise specified

Formulation:	AIM008	**Assumed Compliant Resin**	
Category:	Quick Dry Enamel	**Cost Multiplier (RCM)**	1.20 X
Typ. n-comp VOC	36.00%	Average	
Typ. comp VOC	10.00%	Unit Size	160.00 wt oz

Formulation and Cost Comparison

Component (A)	Unit Cost $/lb (B)	RCM (C)	Typical Non-compliant wt% (D)	Typical Non-compliant Cost (B) x (D) / 100	10.00% VOC Typical Compliant wt% (E)	10.00% VOC Typical Compliant Cost (B) x (C) x (E) / 100
Hi-gloss ltx resin	0.600	1.20			26	0.187
Alkyd resin	0.500		32.0	0.160		
TiO2	1.000		25.0	0.250	20.0	0.200
CaCO3	0.132		5.0	0.007		
Texanol ester alc.	0.600				3.0	0.018
Propylene glycol	0.600				7.0	0.042
Additives	1.500		2.0	0.030	2.0	0.030
Water	0.002				42.0	0.001
Mineral spirits	0.340		36.0	0.122		
	SUM		100.00%		100.00%	

	Typical Non-compliant	Typical Compliant
Total Cost , $/Pound	0.569	0.478
% Cost Diff. Relative to Current Product		-16.0%
Total Cost , $/Unit	5.69	4.78

Assume:

(1) Cost of "All Others" or "Additives" remains at **1.50** per pound
(2) Average unit size = **160.00** ounce
(3) RCM = 1.0 unless otherwise specified

Formulation:	AIM009	Assumed Compliant Resin		
Category:	QuickDryPSU	Cost Multiplier (RCM)	1.20	X
Typ. n-comp VOC	36.00%	Average		
Typ. comp VOC	3.00%	Unit Size	160.00	wt oz

Formulation and Cost Comparison

Component (A)	Unit Cost $/lb (B)	RCM (C)	Typical Non-compliant wt% (D)	Typical Non-compliant Cost (B) x (D) / 100	3.00% VOC Typical Compliant wt% (E)	3.00% VOC Typical Compliant Cost (B) x (C) x (E) / 100
Water	0.002				40	0.001
Vinyl acrylic resin	0.500	1.2			30.0	0.180
TiO2	1.000		12.0	0.120	10.0	0.100
CaCO3	0.132				9.0	0.012
Talc	0.110		22.0	0.024	7.0	0.008
Ethylene glycol	0.300				3.0	0.009
VM&P naptha	0.140		29.0	0.041		
Vinyl toluene resin	0.750		21.0	0.158		
Mineral spirits	0.340		7.0	0.024		
Kaolin	0.178		5.0	0.009		
Soya alkyd	0.500		2.0	0.010		
Additives	1.500		2.0	0.030	1.0	0.015
	SUM		100.00%		100.00%	

	Typical Non-compliant	Typical Compliant
Total Cost , $/Pound	0.415	0.324
% Cost Diff. Relative to Current Product		-21.8%
Total Cost , $/Unit	4.15	3.24

Assume:

(1) Cost of "All Others" or "Additives" remains at **1.50** per pound
(2) Average unit size = **160.00** ounce
(3) RCM = 1.0 unless otherwise specified

Formulation:	AIM010	**Assumed Compliant Resin Cost Multiplier (RCM)**	1.20 X
Category:	Stains		
Typ. n-comp VOC	35.00%	Average Unit Size	160.00 wt oz
Typ. comp VOC	0.00%		

Formulation and Cost Comparison

Component (A)	Unit Cost $/lb (B)	RCM (C)	Typical Non-compliant wt% (D)	Typical Non-compliant Cost (B) x (D) / 100	0.00% VOC Typical Compliant wt% (E)	0.00% VOC Typical Compliant Cost (B) x (C) x (E) / 100
Crystalline silica	0.160				12	0.019
Acrylic resin	0.600	1.20			7.0	0.050
Alkyd resin	0.500		8.0	0.040	7.0	0.035
Iron oxide	0.880		7.0	0.062	14.0	0.123
Water	0.002				60.0	0.001
Mineral spirits	0.340		35.0	0.119		
Refnd. linseed oil	0.410		50.0	0.205		
	SUM		100.00%		100.00%	

	Typical Non-compliant	Typical Compliant
Total Cost , $/Pound	0.426	0.229
% Cost Diff. Relative to Current Product		-46.2%
Total Cost , $/Unit	4.26	2.29

Assume:

(1) Cost of "All Others" or "Additives" remains at **1.50** per pound
(2) Average unit size = **160.00** ounce
(3) RCM = 1.0 unless otherwise specified

Formulation: AIM011
Category: Swimming Pool Repair

Typ. n-comp VOC 30.00%
Typ. comp VOC 10.00%

Assumed Compliant Resin
Cost Multiplier (RCM) 1.20 X

Average
Unit Size 160.00 wt oz

Formulation and Cost Comparison

Component (A)	Unit Cost $/lb (B)	RCM (C)	Typical Non-compliant wt% (D)	Typical Non-compliant Cost (B) x (D) / 100		10.00% VOC Typical Compliant wt% (E)	10.00% VOC Typical Compliant Cost (B) x (C) x (E) / 100
Mineral spirits	0.340					20.0	0.068
Xylene	0.195		45.0	0.088			
Epoxy resin	1.140	1.20				30.0	0.410
Chlorinatd rubber	3.200		12.0	0.384			
TiO2	1.000		17.0	0.170		30.0	0.300
Talc	0.840		26.0	0.218			
Polyamide resin	1.100	1.20				20.0	0.264
	SUM		100.00%			100.00%	

	Typical Non-compliant	10.00% VOC Typical Compliant
Total Cost , $/Pound	0.860	1.042
% Cost Diff. Relative to Current Product		21.2%
Total Cost , $/Unit	8.60	10.42

Assume:
(1) Cost of "All Others" or "Additives" remains at 1.50 per pound
(2) Average unit size = 160.00 ounce
(3) RCM = 1.0 unless otherwise specified

Formulation: AIM012

Category: WaterProofing Sealers

Typ. n-comp VOC 40.00%

Typ. comp VOC 4.00%

Assumed Compliant Resin Cost Multiplier (RCM) 1.20 X

Average Unit Size 160.00 wt oz

Formulation and Cost Comparison

Component (A)	Unit Cost $/lb (B)	RCM (C)	Typical Non-compliant wt% (D)	Typical Non-compliant Cost (B) x (D) / 100	4.00% VOC Typical Compliant wt% (E)	4.00% VOC Typical Compliant Cost (B) x (C) x (E) / 100
Water	0.002				80	0.002
Acrylic polymer	0.600	1.20			15.0	0.108
Texanol ester alc.	0.600				2.0	0.012
Ethylene glycol	0.300				2.0	0.006
Crystalline silica	0.160				1.0	0.002
Petrol. distillate	0.250		40.0	0.100		
CaCO3	0.132		30.0	0.040		
Alkyd resin	0.500		30.0	0.150		
	SUM		100.00%		100.00%	

	Typical Non-compliant	Typical Compliant
Total Cost , $/Pound	0.290	0.129
% Cost Diff. Relative to Current Product		-55.4%
Total Cost , $/Unit	2.90	1.29

Assume:

(1) Cost of "All Others" or "Additives" remains at **1.50** per pound

(2) Average unit size = **160.00** ounce

(3) RCM = 1.0 unless otherwise specified