CHAPTER 5. TECHNICAL ASSESSMENT OF CATEGORIES

5.0. SUMMARY OF CATEGORIES

In this chapter, we provide a discussion of the architectural coatings categories included in the proposed SCM. This chapter contains descriptions of the coatings that are covered under each category, and the rationale for establishing a new VOC limit or retaining the existing VOC limit.

In most cases, the VOC limits in the proposed SCM are consistent with the South Coast AQMD's Rule 1113 VOC limits that will be in effect by 2008.
To allow time for district rule adoption and manufacturer reformulation, ARB is proposing an effective date of January 1, 2010 for most categories and January 1, 2012 for Rust Preventative and Specialty Primer, Sealer, and Undercoater.

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. Sources of information for the technology assessments included the following:

- Data from our comprehensive surveys of architectural coatings;
- Information from coating manufacturers and resin suppliers (brochures, product data sheets, product labels, and material safety data sheets);
- Results of durability and performance testing;
- Coating formulation and performance data from Internet websites; books and trade magazines; technical reports;
- Industry standards and specifications;
- Meetings with manufacturers and users of coatings;
- Information provided by trade associations;
- Discussions with other regulatory agencies (local air districts, U.S. EPA, the Ozone Transport Commission, other states, Environment Canada);
- 2000 SCM technical support documents (ARB, 2000, 2000a);
- South Coast AQMD staff reports from Rule 1113 amendments (South Coast AQMD, 1996, 1999, 2001, 2002a, 2003, 2004, 2006); and
- U.S. EPA's National Rule preamble and Background Information Document (U.S. EPA, 1998, 1998a).

Table 5-1 contains a summary of the proposed categories and VOC limits. Table 5-2 summarizes the categories that are proposed for elimination from the SCM VOC Limits table. See Chapter 2 for a table summarizing emission reductions.

**Table 5-1:
Draft Proposed SCM VOC Limits**

Coating Category	Current VOC Limit (g/l, less water)	Proposed VOC Limit (g/l, less water) Effective Date 1/1/2010	Effective Date 1/1/2012
Aluminum Roof Coatings [1]	500	400	
Antenna Coatings (Deleted effective 1/1/2010)	530	N/A	
Antifouling Coatings (Deleted effective 1/1/2010)	400	N/A	
Basement Specialty Coatings [2]	400	400	
Bituminous Roof Coatings	300	50	
Bituminous Roof Primers	350	350	
Bond Breakers	350	350	
Clear Wood Coatings (Deleted effective 1/1/2010) [3] • Clear Brushing Lacquers • Lacquers (including lacquer sanding sealers) • Sanding Sealers (other than lacquer sanding sealers) • Varnishes	680 550 350 350	N/A N/A N/A N/A	
Concrete Curing Compounds	350	350	
Concrete/Masonry Sealer [4]	250-400	100	
Driveway Sealer [5]	100	50	
Dry Fog Coatings	400	150	
Faux Finishing Coatings	350	350	
Fire Resistive Coatings	350	350	
Fire Retardant Coatings: (Deleted effective 1/1/2010) [6] • Clear • Opaque	650 350	N/A N/A	
Flat Coatings	100	50	
Floor Coatings	250	100	
Flow Coatings (Deleted effective 1/1/2010)	420	N/A	
Form-Release Compounds	250	250	
Graphic Arts Coatings (Sign Paints)	500	500	
High Temperature Coatings	420	420	
Industrial Maintenance Coatings	250	250	
Low Solids Coatings	120 [7]	120 [7]	
Magnesite Cement Coatings	450	450	
Mastic Texture Coatings	300	100	
Metallic Pigmented Coatings	500	500	
Multi-Color Coatings	250	250	
Nonflat Coatings	150	100	
Nonflat - High Gloss Coatings	250	150	
Pre-Treatment Wash Primer	420	420	
Primers, Sealers, and Undercoaters	200	100	
Quick Dry Enamels (Deleted effective 1/1/2010)	250	N/A	
Quick Dry Primers, Sealers, and Undercoaters (Deleted effective 1/1/2010)	200	N/A	
Reactive Penetrating Sealer[8]	250-400	350	
Recycled	250	250	
Roof	250	50	

Table 5-1:
Draft Proposed SCM VOC Limits

Coating Category	Current VOC Limit (g/l, less water)	Proposed VOC Limit (g/l, less water) Effective Date 1/1/2010	Effective Date 1/1/2012
Rust Preventative	400		250
Shellacs: • Clear • Opaque	 730 550	 730 550	
Specialty Primers, Sealers, and Undercoaters	350		100
Stains	250	250	
Stone Consolidant[9]	100-400	450	
Swimming Pool Coatings	340	340	
Swimming Pool Repair and Maintenance Coatings (Deleted effective 1/1/2010)	340	N/A	
Temperature Indicator Safety Coatings (Deleted effective 1/1/2010)	550	N/A	
Traffic Marking	150	100	
Tub and Tile Refinish [10]	100-250	420	
Waterproofing Membranes [11]	250-400	250	
Waterproofing Sealers (Deleted effective 1/1/2010)	250	N/A	
Waterproofing Concrete/Masonry Sealers (Deleted effective 1/1/2010)	400	N/A	
Wood Coatings [12]	250-680	275	
Wood Preservatives	350	350	
Zinc-Rich Primer [13]	500	340	

1. Aluminum Roof is a proposed new category that was formerly covered by Metallic Pigmented.
2. Basement Specialty Coatings is a proposed new category that was formerly covered by Waterproofing Sealer and Waterproofing Concrete/Masonry Sealer.
3. It is proposed that all Clear Wood Coatings be combined under the new "Wood Coatings" category, upon the effective date of this rule.
4. Concrete/Masonry Sealer is a proposed new category that was formerly covered by Waterproofing Sealer, Waterproofing Concrete/Masonry Sealer, and other categories. The "Existing VOC Limit" for this category represents the range of VOC limits for the coatings that were combined into this new category.
5. Driveway Sealer is a proposed new category that was formerly covered by the default VOC limits.
6. Upon the effective date of this rule, the Fire Retardant coating categories are eliminated and coatings with fire retardant properties will be subject to the VOC limit of their primary category (e.g., Flat, Nonflat, etc.)
7. The VOC Limit for Low Solids Coatings is expressed as "VOC, including water and exempt compounds" (i.e., Material VOC or VOC Actual).
8. Reactive Penetrating Sealer is a proposed new category that was formerly covered by Waterproofing Sealer and Waterproofing Concrete/Masonry Sealer.
9. Stone Consolidant is a proposed new category that was formerly covered by Waterproofing Concrete/Masonry Sealer and Other.
10. Tub and Tile Refinish is a proposed new category that was formerly coverd by the default VOC limits and Nonflat – High Gloss.
11. Waterproofing Membrane is a proposed new category that was formerly covered by Waterproofing Sealer and Waterproofing Concrete/Masonry Sealer.
12. Wood Coatings is a proposed new category that was formerly covered by Clear Brushing Lacquers, Lacquers, Sanding Sealers, Waterproofing Sealers, Varnishes, and other categories.
13. Zinc-Rich Primer is a proposed new category that was formerly covered by Metallic Pigmented.
14. N/A: Not applicable because category is being eliminated in the proposed SCM.

Provided below is a summary of the categories that are proposed for elimination from the SCM VOC Limits table.

Table 5-2:
SCM Categories That Have Been Removed from the VOC Limits Table

Category	Reason For Removal
Antenna	No products were reported in 2005 survey. Coatings used for antennas can be covered under other categories (e.g., Industrial Maintenance, Rust Preventative).
Antifouling	No products were reported in 2001 survey or 2005 survey. Antifouling coatings are primarily covered by marine coating rules.
Fire-Retardant – Clear Fire-Retardant - Opaque	The Fire Retardant categories are no longer needed. Products with Fire Retardant properties can comply with VOC limits in the Flat, Nonflat, and other applicable categories. Therefore, there is no need for separate categories to accommodate higher-VOC Fire Retardant coatings.
Flow	No products were reported in 2005 survey. Flow coatings can be covered under other categories (e.g., Industrial Maintenance).
Quick Dry Enamel	Category is no longer needed as these products fall under the Nonflat High Gloss category. During development of the 2000 SCM, ARB staff indicated that this category would be eliminated.
Quick Dry Primer, Sealer, Undercoater	Category is no longer needed as these products fall under the PSU and Specialty PSU categories. During development of the 2000 SCM, ARB staff indicated that this category would be eliminated.
Swimming Pool Repair and Maintenance Coatings	Will be covered under revised definition of Swimming Pool Coatings. During development of the 2000 SCM, ARB staff indicated that this category would be eliminated.
Temperature Indicator Safety	No products were reported in 2001 survey or 2005 survey. Coatings used for temperature indicator safety can be covered under other categories (e.g., Industrial Maintenance, High Temperature).
Waterproofing Concrete/Masonry Sealers	Most of the products that were formerly classified as Waterproofing Concrete/Masonry Sealers will be covered by the new Concrete/Masonry Sealer category. In addition, some products will be reclassified as Basement Specialty Coatings; Industrial Maintenance; Reactive Penetrating Sealer; Stone Consolidant; Wood Coatings; and Waterproofing Membranes.
Waterproofing Sealers	Most of the products that were formerly classified as Waterproofing Sealers will be covered by the new Concrete/Masonry Sealer category. In addition, some products will be reclassified as Basement Specialty Coatings; Industrial Maintenance; Reactive Penetrating Sealer; Wood Coatings; and Waterproofing Membranes.

The remainder of this chapter contains a writeup for each coating category that includes: a comparison of VOC limits from different architectural coating rules; the proposed category definition; major changes between the 2000 SCM and the proposed SCM; a description of product uses and formulations; survey data; the rationale for the proposed VOC limit; and a discussion of the issues associated with the proposed VOC limit. For each category, survey data is provided for solventborne products only, waterborne products only, and all products. Sales-weighted averages are based on the reported sales volumes for solventborne products, waterborne products, and all products, including small containers.

Lists of compliant products for many coating categories are provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm). Some lists also include noncompliant products for comparison purposes. These lists are intended to provide examples of coatings that would comply with the proposed VOC limits. The lists are not intended to serve as approved product lists and mention of any product or manufacturer does not indicate endorsement by ARB.

5.1. ALUMINUM ROOF

VOC Limit Table (g/l)

USEPA: 500 (under Metallic Pigmented)	Canada: 500 (under Metallic Pigmented)	OTC: 500 (under Metallic Pigmented)	SCAQMD: 100	SCM Proposed: 400

5.1.1. Category Definition

A coating labeled and formulated exclusively for application to roofs and containing at least 84 grams of elemental aluminum pigment per liter of coating (0.7 pounds per gallon). Pigment content shall be determined in accordance with SCAQMD Method 318-95.

5.1.2. Major Proposed Changes

- Aluminum Roof is a new category for coatings that were formerly covered by Metallic Pigmented.
- The proposed VOC Limit for Aluminum Roof coatings would decrease from 500 g/l to 400 g/l.

5.1.3. Coating Description

Aluminum Roof Coating is a new category that was formerly included in the Metallic Pigmented category. These coatings are primarily used as a topcoat for asphalt roof systems or metal roofs that need a reflective coating. They contain aluminum flakes for the reflection of solar radiation to reduce the surface temperature of the roof and the internal temperature of the structure. These aluminum pigments float to the surface of the coating during settling (a process known as "leafing") and they can reflect up to 60% of ultraviolet (UV) rays. They also aid in the inhibition of rust formation and alleviate corrosion of metal surfaces. Aluminum Roof coatings are also aesthetically pleasing. These coatings are not intended to prevent water penetration or stop leaks, repair seams, or repair blisters, but they can prevent moisture accumulation due to the inherent nature of bituminous resin water resistance (RCMA, 1997). In addition, most Aluminum Roof coatings are Underwriter's Laboratory (UL) Class A Fire Rated, which improves fire resistance and enhances building safety.

The Cool Roof Rating Council (CRRC) is an independent organization that established a rating system that accurately displays the radiative property data for the outmost layer of a roofing system (CRRC, 2007). As part of their testing, they determine the emissivity and reflectance of a roof coating which are used to determine if a roof coating can be termed a "cool roof". The emittance or emissivity of a coating is a measure of the amount of thermal radiation (long-wave) given off by the coating divided by the amount of thermal radiation given off by a black body at the same temperature. A black body will emit the maximum amount of thermal radiation at a particular temperature. Reflectance is the amount of solar (short-wave) radiation that is not absorbed by the material. The CRRC will test and register Aluminum Roof coatings, but none are considered "Cool Roof" in the State of California, because they do not meet the Title 24 solar reflectance minimum of 70% or the thermal emmittance minimum of 75% (CEC, 2006). However, like Bituminous Roof coatings, they can contribute to the "overall envelope" of a cool building, set by Title 24 standards (CEC, 2005).

Aluminum Roof coatings are usually single component products that can be sprayed on, brushed, or roller applied. Typically, these coatings have a smooth texture with some degree of a glossy, metal luster. They are generally applied by contractors on flat, low-slope commercial buildings, but they can also be applied by homeowners or business owners. Even when these coatings are applied properly, aluminum particles naturally degrade and erode over time due to UV exposure and ponding water. This depreciates the coating reflectivity and may lead to the need for recoating every two to four years for maintenance purposes (Zielnik, 2006; Zielnik, 2006b). Aluminum Roof coatings also tend to be less elastic, and the surfaces can "alligator" due to thermal-mechanical stresses (Zielnik, 2006; Zielnik, 2006b). Therefore, Aluminum Roof coatings may not be recommended for roofs that require a low-maintenance coating with good weatherability, because they may require frequent recoating due to UV degradation and thermal-mechanical stresses.

Most of the reported Aluminum Roof coatings are composed of bituminous resins, but a few have alkyd, oleoresin or urethane/polyurethane resins. Some Aluminum Roof coatings contain fibers (asbestos or non-asbestos) that allow for cross-linking and interlocking to increase durability, longevity, and/or viscosity for application purposes. The use of asbestos fibers is declining due to the associated health risks. Aluminum Roof coatings are formulated to maximize the aluminum surface area that is exposed to solar radiation and optimize reflectivity. The use of aggressive thinning solvents in an Aluminum Roof coating may induce asphalt to bleed through the aluminum and/or inhibit proper aluminum leafing activity (RCMA, 1997). During curing and drying, a natural process occurs that is known as "tobacco juicing," which results when a residue seeps out of the asphalt/coal contained in Aluminum Roof coatings. The residue is water soluble and washes away with the first rain of the season. However, if not properly washed away, it can cause peeling of Aluminum Roof coatings (ARMA, 1994).

Most of the reported Aluminum Roof coatings are solventborne products with relatively high VOC levels, but some waterborne formulations were also reported in ARB's survey. When comparing solventborne to waterborne products, the lowest VOC solventborne product generates almost four times the VOC emissions of the highest VOC waterborne product. Waterborne emulsions may be as effective as solventborne Aluminum Roof coatings if they are applied during favorable atmospheric conditions that allow for proper curing, such as temperatures above 40 degrees F and minimal moisture. Proceedings from the Fourth International Symposium on Roofing Technology in 1997 state that waterborne Aluminum Roof coatings applied to roofing membranes perform well, exhibiting good adhesion and reflectivity (FISRT, 1997).

However, waterborne Aluminum Roof coatings can have shelf life stability problems, because hydrogen gas can be formed when water and aluminum chemically react, particularly in hotter temperatures. When enclosed in a container, this reaction can produce a buildup of hydrogen gas that could explode upon opening. The shelf life for waterborne Aluminum Roof emulsions is typically shorter than the shelf life for solventborne coatings, due to this undesired chemical reaction which also presents a safety concern. On product data sheets, some companies state that these coatings should not be stored for more than six months at room temperature.

According to the California Department of Transportation (Caltrans), the most effective Aluminum Roof Coatings used by Caltrans have VOC contents from 200 g/l to 250 g/l. They use products with multi-component formulations applied by trained personnel, which helps minimize the potential for the formation of hydrogen gas during storage. These coatings require technical expertise to mix and apply properly and may not be suitable for use by the average contractor, business owner, or homeowner. Caltrans has not identified any acceptable products that could meet a 100 g/l VOC limit (Caltrans, 2007).

5.1.4. Substrates/Exposures

All Aluminum Roof coatings are applied to external roofing surfaces to provide solar reflective properties. These coatings can be applied to new roof systems that have cured for at least 30-90 days or they can be applied for maintenance of weathered systems. They are usually applied to asphalt and metal substrates, but can be applied to other bituminous surfaces (Built-Up Roofs and Modified Bituminous Systems), concrete, stone, masonry, and some properly prepared wood and shingled surfaces. Aluminum Roof coatings should not be installed on roofs that are damaged or cracked and susceptible to ponding water as it leads to adhesion failure and degradation of the aluminum. Application on improper surfaces can drastically shorten the lifetime and impair the reflective properties, resulting in more frequent re-application and higher energy costs.

Conditions pertaining to wetness and moisture can also lead to improper curing and adhesion failure. In addition, extreme cold weather inhibits aluminum leafing and hot temperatures above 110 degrees F may induce streaking and highlights (RCMA, 1997). For most applications, the temperature must be at least 5 degrees F above the dew point for best adhesion and cure. An advantage of solventborne Aluminum Roof coatings is that they can be applied in colder and wetter conditions, due to lower freezing temperatures and quicker cure times. However, temperatures that are too low can inhibit leafing. In some cases improper leafing can be resolved during aging over the summer months. The use of solventborne Aluminum Roof coatings is advantageous for areas such as Northern California, the Sierra Nevada area, and similar climates with colder and wetter conditions. Waterborne coatings are subject to freezing at temperatures below 40 degrees F and can improperly cure, due to excess moisture.

5.1.5. Survey Results

Table 5.1-1 summarizes our estimate of sales and VOC emissions from the Aluminum Roof Coating category, based on results from the ARB survey. In 2004, the sales volume for Aluminum Roof in California was almost 503,000 gallons which represents less than 0.5 percent of the total California sales volume for architectural coatings.

In 2004, VOC emissions from Aluminum Roof coatings were about 2 tpd, which represents 2 percent of the total emissions from architectural coatings. Solventborne coatings produce about 98 percent of the VOC emissions from this category, but they only account for 77 percent of the sales volume. According to the ARB Survey, roughly 3 tpd of VOCs are released from all coatings related to roofing, including emissions from Aluminum Roof, Bituminous Roof, Bituminous Roof Primer, and Roof coatings. Aluminum Roof coatings emit almost two-thirds of reported VOC emissions from all roofing-related products, but they only make up 15 percent of the total sales volume of these products.

Table 5.1-1: Survey Data
Aluminum Roof

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	55	387,675	77%	0%	100%	0%	0%	437	1.93
WB	6	115,318	23%	0%	100%	0%	0%	65	0.03
Total	**61**	**502,993**	**100%**	**0%**	**100%**	**0%**	**0%**	**352**	**1.96**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.1-2 contains complying marketshare data for the Aluminum Roof category, based on results from the ARB survey. This table shows that

31 percent of the sales volume for Aluminum Roof coatings complies with the proposed VOC limit of 400 g/l. The expected VOC emission reductions for this proposed limit are 0.18 tpd. If this SCM were to propose a VOC limit of 100 g/l for this category, approximately 15% of the reported sales volume would be compliant, but there would only be two compliant products.

Table 5.1-2: Complying Marketshare & Emission Reductions
Aluminum Roof

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
400	13	31%	0.18

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

A listing of Aluminum Roof manufacturers and products that comply with the proposed VOC limit is provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm). Of the 12 companies that reported sales in this category, four offered Aluminum Roof coatings that comply with the proposed limit. One of these four companies is considered a small business because they employ less than 250 employees.

5.1.6. Manufacturer and Industry Issues

Some manufacturers and industry representatives have expressed concerns about certain aspects of the proposed SCM regarding VOC limits, definitions, and other technical issues. Below are key issues that have been brought to our attention during our interactions with industry representatives.

5.1.6.1. Issue: The Roof Coatings Manufacturers Association (RCMA) and the National Paint and Coatings Association (NPCA) have expressed concerns about the proposed VOC limit. They believe that lowering the VOC limit from 500 g/l to 400 g/l or 100 g/l could lead to a ban of unique and irreplaceable coatings that are low cost, have long term performance, have lower application rates, and decreased resistance to overnight moisture exposure.

Response: ARB is not proposing a 100 g/l VOC limit, which has been in effect in the South Coast AQMD since 2005. The South Coast AQMD has determined that it is technically feasible to implement a 100 g/l limit for Aluminum Roof coatings, because they have local climatic conditions that are not representative of other areas in the State. It appears that there are some products that meet this limit and may be used in Southern California. For the remainder of California, ARB staff has determined that the technology exists to formulate Aluminum Roof coatings that comply with a 400 g/l limit and are just as effective as the 500 g/l products.

5.1.6.2. Issue: Industry representatives, including NPCA and RCMA, recommend the use of a reactivity-based approach for regulating Aluminum Roof coatings. The RCMA suggested that the ARB use the units of grams of ozone generated per gallon of coating to establish a reactivity-based standard. NPCA and some manufacturers have also suggested that low-reactive products with higher VOC contents should be exempt from future SCM limits, because they have lower ozone formation potential. Industry representatives have suggested that lower reactivity products could be formulated by replacing some hydrocarbon solvents with other hydrocarbon solvents that have a lower maximum incremental reactivity (MIR) value.

Response: ARB staff analyzed industry's proposed approach for developing Aluminum Roof coatings with a reduced ozone formation potential. Staff compared ozone reductions from a mass-based limit to ozone reductions that could be achieved with a reactivity-based limit. With a mass-based limit, manufacturers would need to reduce the overall VOC content. With a reactivity-based limit, manufacturers could maintain their current overall VOC contents, but they would need to reformulate with less reactive hydrocarbon solvents.

The reactivity (i.e., maximum ozone formation potential) can be determined based on the MIR value for each of the chemicals contained in a coating. Since hydrocarbon solvents are mixtures of several chemicals, ARB developed a bin system to assign MIR values to hydrocarbon solvents, based on boiling point and chemical characteristics (ARB, 2007). For hydrocarbon solvents, the assigned MIR values range from 0.81 grams ozone per gram product (g O_3/g product) for Bin 12 up to 8.01 g O_3/g product for Bin 23. The most common hydrocarbon solvents reported for Aluminum Roof Coatings are Bin 15 (MIR = 1.82 g O_3/g product) and Bin 22 (MIR = 7.51 g O_3/g product).

Using data from the ARB Survey, ARB staff determined that the maximum ozone formation potential (OFP) for all Aluminum Roof coatings was 3.06 tpd ozone in 2004, outside of the South Coast AQMD (ARB, 2007). Implementing a 400 g/l VOC limit is expected to achieve an emission reduction of 0.18 tpd and a corresponding ozone reduction of 0.52 tpd, outside of the South Coast AQMD. Shown below are the estimated emission reductions and ozone reductions that would be achieved for various VOC limits:

VOC Limit (g/l)	Emission Reductions (excluding South Coast AQMD) (tons/day)	Estimated Ozone Reductions (excluding South Coast AQMD) (tons/day)
400	0.18	0.52
350	0.36	1.02
300	0.52	1.44
200	0.76	2.11
100	0.95	2.66

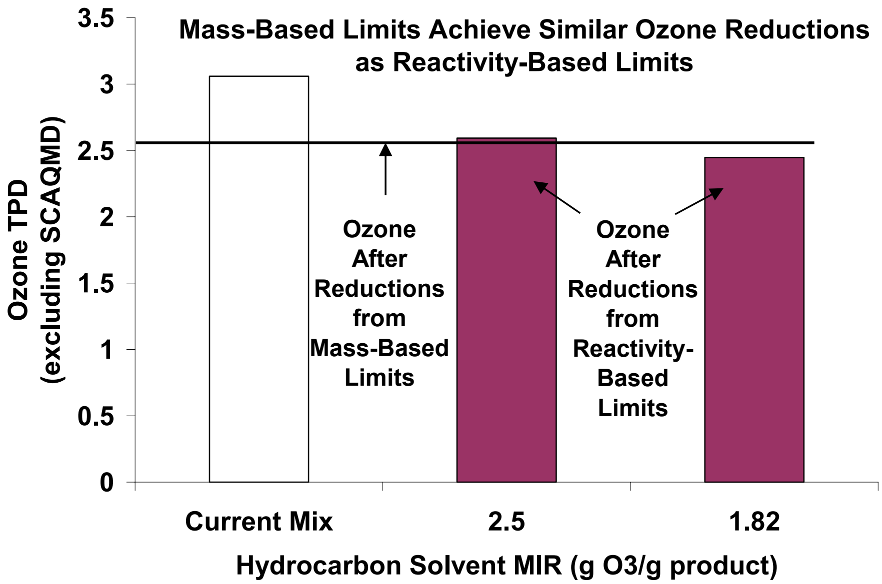
As shown above, the proposed mass-based limit of 400 g/l is expected to achieve 0.52 tpd of ozone reductions.

ARB staff then determined the expected ozone reductions from a reactivity-based limit. Staff identified all of the Aluminum Roof coatings that contained hydrocarbon solvents with MIR values greater than 1.82 g O_3/g product. Based on industry recommendations, staff evaluated two possible substitutions: (1) Replace all of the higher-MIR solvents with Bin 15 hydrocarbon solvents that had an MIR value of 1.82 g O_3/g product. This substitution would result in a maximum ozone formation potential of 2.0 tpd, outside of the South Coast AQMD; or (2) Replace all of the higher-MIR solvents with a blend of hydrocarbon solvents that had an MIR value of 2.50 g O_3/g product. This substitution would result in a maximum ozone formation potential of 2.2 tpd, outside of the South Coast AQMD. These analyses assume that the solvent substitution would be on an equivalent mass basis. However, industry representatives acknowledge that they might need to use larger amounts (e.g., 20% more) of the low-MIR hydrocarbon solvents to achieve a solvency that is comparable to the higher-MIR solvents. Therefore, it is expected that the maximum ozone formation potential could be up to 2.6 tpd for reformulated products. When this amount is compared to the 2004 baseline of 3.06 tpd, the amount of ozone reduction from a reactivity-based limit would likely be about 0.5 tpd. This amount is comparable to the reduction that would be expected from establishing a mass-based VOC limit of 400 g/l.

Based on this analysis, it does not appear that a reactivity-based limit would achieve emission reductions beyond what could be achieved by implementing the proposed mass-based limit of 400 g/l. Since a reactivity-based limit would require additional district resources without providing a significant increase in ozone reductions, ARB staff determined that the proposed mass-based limit was preferable. Figure 5.1-1 illustrates the analysis stated above.

ARB staff also evaluated what type of solvent substitution would be required to achieve an ozone reduction that is comparable to the 100 g/l VOC limit that is in effect in the South Coast AQMD. As shown above, a 100 g/l limit would achieve an estimated 2.66 tpd of ozone reductions outside of the South Coast AQMD. To achieve a similar type of reduction, using solvent substitution, ARB staff estimate that it would be necessary to replace all hydrocarbon solvents with a solvent blend that has an MIR value of 0.21 g O_3/g product. ARB staff does not believe that existing hydrocarbon solvent blends are available with this type of MIR value and the necessary physical properties. This analysis assumes that the hydrocarbon substitution would be on an equivalent mass basis.

Figure 5.1-1
Aluminum Roof Coatings: Ozone Reductions From Using Less Reactive Solvents



5.1.6.3. Issue: The RCMA and NPCA believe that the use of high-reflective, low-emissive coatings such as Aluminum Roof coatings may have a niche within cool climate areas throughout the State of California.

Response: As mentioned previously, research results indicate that the application of these products can be advantageous in colder climates (e.g., such as Northern California) and they can provide energy savings. This may be associated with the low-emissive nature of the Aluminum Roof coatings that allow it to maintain heat in colder temperatures while remediating some solar radiation during warmer temperatures. ARB staff believes that high-reflective, low-emissive coatings are available in formulations that are compliant with the proposed 400 g/l VOC limit.

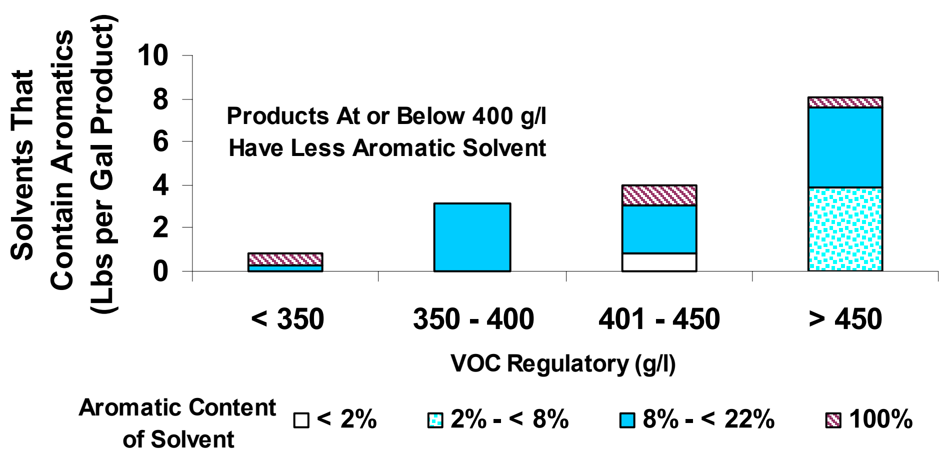
5.1.6.4. Issue: RCMA states that the Aluminum Roof category should retain the definition of 0.4 lbs aluminum per gallon that it had under the Metallic Pigmented category rather than use the definition of at least 0.7 lbs aluminum per gallon.

Response: Based on the results of the ARB Survey, the majority of aluminum roof products reported were bituminous-based coatings that complied with the proposed 400 g/l VOC limit and met the proposed threshold of 0.7 lbs/gal. In a meeting with the Henry Company and RCMA, they stated that the optimal range for bituminous-based Aluminum Roof coatings is around 0.7 to 1.0 lbs/gal. Above 1.0 lb/gal, the benefits are minimal, and reflectivity and emissivity can decrease in value. From 0.4 to 0.7 lbs/gal there is a rapid increase in reflectivity potential for these bituminous-based coatings. An aluminum content requirement of 0.7 lbs/gal is also consistent with the South Coast AQMD Rule 1113 definition. Therefore, ARB staff believes that the 0.7 lbs/gal is appropriate at this time.

5.1.6.5. Issue: RCMA believes that lowering the VOC limit from 500 g/l to 400 g/l would decrease the use of aliphatic, low MIR, solvents and increase the use of aromatic, high MIR, solvents.

Response: ARB staff investigated the hydrocarbon solvent use in Aluminum Roof coatings based on ARB survey data. Hydrocarbon solvents are mixtures of several chemicals that contain varying amounts of aromatic hydrocarbons (ARB, 2007). Figure 5.1-2 illustrates the usage of aromatic hydrocarbon solvents at varying VOC contents. This shows the use of hydrocarbon blends containing high aromatics contents decreases with decreasing VOC content. Thus, the use of aromatic hydrocarbons does not increase when the VOC limit is lowered to 400 g/l.

Figure 5.1-2
Aromatic Hydrocarbon Solvent Usage vs. VOC Content



5.1.7. Conclusion

We recommend a 400 g/l VOC limit for Aluminum Roof coatings, effective January 1, 2010. The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on our review of ARB survey data, complying marketshares, the number of companies making compliant products, and product information from manufacturers. The United States Environmental Protection Agency (U.S. EPA), Ozone Transport Commission (OTC), and Canada do not have a separate category for Aluminum Roof coatings. These products are regulated under the Metallic Pigmented category with a VOC limit of 500 g/l. The South Coast AQMD adopted a 100 g/l limit for Aluminum Roof coatings that became effective January 1, 2005. Our recommended limit is higher than the limit adopted by the South Coast AQMD, but lower than the limits set by the U.S. EPA, OTC, and Canada.

The South Coast area has a temperate climate that is not subject to the weather extremes that occur in other parts of California. ARB staff found that solventborne products are needed for colder, wetter climates until the technology advances for waterborne products. In addition, ARB staff is concerned about potential safety issues associated with the generation of hydrogen gas in waterborne aluminum coatings. Based on discussions with manufacturers, those products that do meet the South Coast limit have been repackaged with plastic containers and vents, have a shelf life of six months from production to application, and are usually made to order for specific jobs.

5.2. BASEMENT SPECIALTY COATINGS

VOC Limit Table (g/l)

USEPA: 600 (WST)	Canada: 400 (WCMS or WPS)	OTC: 400 (WCMS or WPS)	SCAQMD: 100 (WCMS or WPS)	SCM Proposed: 400

5.2.1. Category Definition

A clear or opaque coating that is labeled and formulated for application to concrete and masonry surfaces to provide a hydrostatic seal for basements and other below-grade surfaces. Basement Specialty Coatings must meet the following criteria:

- Coating must be capable of withstanding at least 10 psi of hydrostatic pressure, as determined in accordance with ASTM Standard D7088-04; and
- Coating must be resistant to mold and mildew growth and must achieve a microbial growth rating of 8 or more, as determined in accordance with ASTM Standard D3273-00 (Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber) and D3274-95 (Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation).

“Basement Specialty Coating” is a proposed new category that includes products which were formerly covered by the following two categories in the 2000 SCM:

> Waterproofing Concrete/Masonry Sealer (WCMS): A clear or pigmented film-forming coating that is labeled and formulated for sealing concrete and masonry to provide resistance against water, alkali, acids, ultraviolet light and staining.
>
> Waterproofing Sealer (WPS): A coating labeled and formulated for application to a porous substrate for the primary purpose of preventing the penetration of water.

These two categories have been eliminated from the proposed SCM and the types of products that were previously in these categories would be covered by the following: Basement Specialty Coating; Concrete/Masonry Sealer; Wood Coatings; Industrial Maintenance; Primer, Sealer, Undercoater; and Waterproofing Membrane.

Under the U.S. EPA Architectural Coating regulation, Basement Specialty Coatings would be covered by the “Waterproofing Sealers and Treatments (WST)” category.

5.2.2. Major Proposed Changes

- Basement Specialty Coating is a new category that includes coatings formerly classified under Waterproofing Concrete/Masonry Sealer and Waterproofing Sealer.

5.2.3. Coating Description

Basement Specialty Coatings prevent the intrusion of water into basement areas and help to prevent mold, mildew, and efflorescence. They are designed to withstand hydrostatic pressures and are sometimes certified in accordance with Federal Specification TT-P-1411 (Paint, Copolymer-Resin, Cementitious for Waterproofing Concrete and Masonry Walls). Specification TT-P-1411 was officially cancelled on December 1, 1994 without replacement. However, there is an active standard which applies to this group, ASTM Standard D-7088-04 (Standard Practice for Resistance to Hydrostatic Pressure for Coatings Used in Below Grade Applications Applied to Masonry). Some waterborne latex products can reportedly withstand hydrostatic pressures of at least 10 psi, while some cementitious solventborne coatings can reportedly withstand hydrostatic pressures greater than 30 psi. Some of the solventborne products that were reported in the survey can be applied to wet basement walls. None of the waterborne coatings claimed to be suitable for application on wet basement walls. In addition to these products, there are also many zero-VOC cementitious powders that are mixed with water and are specifically intended for application on wet basement walls. For decorative purposes, these cementitious coatings may be tinted or topcoated with a waterborne acrylic coating. There are some safety concerns associated with the use of cementitious powder products, because they contain silica dust which can become airborne during handling. Crystalline Silica is included on California's Proposition 65 List of "Chemicals Known to the State to Cause Cancer or Reproductive Toxicity".

Basement Specialty Coatings can either be applied by professional contractors or homeowners. Application methods for liquid coatings include brush, roller, and sprayer. Solventborne Basement Specialty Coatings are generally single component formulations with acrylic or vinyl toluene resins. Waterborne formulations contain acrylic, styrene-butadiene, and vinyl acrylic resins. Products that can withstand 10 psi hydrostatic pressure are available in waterborne formulations that have VOC contents less than 150 g/l. Waterborne coatings with VOC contents less than 150 g/l represent 23 percent of the sales volume for the Basement Specialty Coating group, excluding small containers. Solventborne products with VOC contents less than 400 g/l represent the remaining 77 percent of sales volume.

Some industry representatives requested a 400 g/l VOC limit for Basement Specialty Coatings to accommodate cementitious solventborne products that could be applied to wet surfaces and would be resistant to mold and mildew. ARB staff considered the following options:

Option 1: Establish a 400 g/l limit that would only be allowed for cementitious products which were capable of being resistant to a hydrostatic pressure of at least 30 psi and could be applied to wet surfaces. Basement coatings that could not meet these requirements would be covered by the Concrete/Masonry Sealer category and would be subject to a 100 g/l limit. This option was not chosen because some industry representatives were concerned that establishing a 30 psi threshold was unnecessary because basements aren't generally exposed to such high pressures (30 psi is equivalent to 69 feet of water at 60 degrees F). In addition, they expressed safety concerns associated with testing concrete blocks under such high pressures, because ASTM D-7088 was not designed for pressures greater than 10-15 psi. ARB staff agreed with these concerns.

Option 2: Establish a 150 g/l limit that would effectively restrict basement coatings to waterborne technology. Wet basement walls could be coated with zero-VOC cementitious powder products. This option was not chosen because industry representatives expressed safety concerns about the use of cementitious powders that contain silica dust which could be inhaled and create a health risk. In addition, the emission reductions that would be achieved with this option are relatively negligible.

Option 3: Establish a 400 g/l limit that would apply to basement coatings that were capable of being resistant to a hydrostatic pressure of at least 10 psi and could achieve a rating of at least 8 for mold and mildew resistance (ASTM, 2002; ASTM, 2005). ARB staff determined that this option was technologically feasible and included appropriate criteria that would help prevent abuse of the category.

Although, the 400 g/l limit is higher than the 100 g/l limit for Concrete/Masonry Sealers, the emission reduction losses are relatively negligible because this category has a small sales volume in California. This may not be the case in other areas (e.g., the Northeast, Midwest, etc.) where sales of basement coatings are much greater and there is an increased potential for achieving emission reductions.

5.2.4. Substrates/Exposures

Basement Specialty Coatings are intended for application to concrete and masonry substrates in basements and other below-grade surfaces. Products in this category provide a waterproofing seal to prevent water intrusion and some products can be applied to wet surfaces.

5.2.5. Survey Results

Basement Specialty Coating is a new category; therefore, it was not reported separately in ARB's 2005 Architectural Coating Survey. Please refer to the Concrete/Masonry Sealer section for survey data that were reported for Waterproofing Concrete/Masonry Sealer and Waterproofing Sealer.

Table 5.2-1 contains complying marketshare data for the proposed new Basement Specialty Coating category. This table reflects combined data for Basement Specialty Coating products that were reported under two previous categories: Waterproofing Concrete/Masonry Sealer and Waterproofing Sealer.

The table shows that 100 percent of the sales volume complies with the proposed VOC limit of 400 g/l. This complying marketshare is based on the assumption that available products will be able to meet the requirement for mold and mildew resistance that is established in the new category definition. However, it is possible that some products will not meet the new criteria, which would result in a lower complying marketshare. It is ARB staff's intention that the Basement Specialty Coating category be restricted to products that have resistance to hydrostatic pressure and mold/mildew, because we do not believe that a 400 g/l limit is necessary for products that only have 10 psi hydrostatic pressure resistance. Products that do not have mold/mildew resistance and do not meet the criteria for the Basement Specialty Coating definition would be covered by other categories (e.g., Concrete/Masonry Sealer). ARB staff identified four products that are intended for basement applications and could comply with the proposed 100 g/l VOC limit for Concrete/Masonry Sealer. Therefore, staff believes that compliant products are available for basement coatings that do not have the mold/mildew resistance to meet the performance criteria for Basement Specialty Coating. A listing of coatings intended for basement application is provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm).

Table 5.2-1: Complying Marketshare & Emission Reductions
Basement Specialty Coating

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
400	9	100%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.2.6. Conclusion

For the new Basement Specialty Coating category, we are recommending a VOC limit of 400 g/l, effective January 1, 2010. The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on the complying marketshare and information provided by manufacturers. The proposed VOC limit is higher than the 100 g/l limit contained in SCAQMD Rule 1113. However, manufacturers that provide coatings in the SCAQMD area can still sell products which exceed the 100 g/l limit, if they participate in SCAQMD's averaging program. The proposed SCM does not contain an averaging provision, so all manufacturers will be subject to the same limit. In addition, the emission reduction losses for this category are negligible for a 400 g/l limit as compared to a 100 g/l limit, due to the small sales volume. The proposed SCM VOC limit is lower than the national limit of 600 g/l promulgated by the United States Environmental Protection Agency (U.S. EPA). The proposed limit is the same as the limit for Waterproofing Concrete/Masonry Sealers (400 g/l) and higher than the limit for Waterproofing Sealers (250 g/l), as approved for the Ozone Transport Commission and proposed by Canada.

5.3. BITUMINOUS ROOF COATING

VOC Limit Table (g/l)

USEPA: 500 (Bituminous Coatings and Mastics)	Canada: 300	OTC: 300	SCAQMD: 50	SCM Proposed: 50

5.3.1. Category Definition

A coating which incorporates bitumens that is labeled and formulated exclusively for roofing.

5.3.2. Major Proposed Changes

- The proposed VOC limit for Bituminous Roof Coatings would decrease from 300 g/l to 50 g/l.

5.3.3. Coating Description

Bituminous Roof coatings have historically been an inexpensive and effective way to protect a roof from water penetration and corrosion from many elements. Today, the use of bituminous products remains prevalent in the roofing industry with a few minor formulation changes for environmental precautions and protection. As with all bitumen products, roofing bitumens may either be a product of petroleum refining (asphalts) or a product of the coal cooking process (coal tar pitch) (ARMA, 2007). Usually, Bituminous Roof coatings are used between layers for a flat or low-slope Built Up Roof (BUR) system or as a base coat for modern reflective coatings. Recently, bituminous products have been reinforced or modified with polymers to improve tensile strength and durability to improve physical properties for most environments. These are roof coatings that complement Modified Bitumen Systems (MBS). Both BUR and MBS are similar in that they may require layers of asphalt, adhesives, and plies or fabric sheets to ensure protective properties. Bituminous Roof coatings are used in several applications, including: adhesive/waterproofing agents for BUR and MBS systems; base layers for reflective coatings; and as weathering barriers for metal roofs.

Bituminous Roof coatings can be applied with a brush, trowel, mop, or sprayer. In the past, asphalt products were hot-applied with mops or were torch-applied, but these coatings have been replaced by safer, cold-applied products that cure at ambient temperatures. As a result, energy use in the field has decreased because it is not necessary to heat up and maintain hot asphalt. The finished characteristics of these coatings are typically brown or black in color with a flat, coarse texture. Bituminous products are not naturally reflective and they retain solar radiation due to absorptive properties of dark colors. Solar reflectance (a.k.a. albedo), the amount of solar radiation not absorbed, for BURs and MBSs ranges from 5% up to 25% and infrared emittance, the amount of thermal radiation given off, for bituminous products is around 90% (Kriner, 2006; Bretz et al., 1998). Therefore, these products do not meet Title 24 Cool Roof requirements for stand-alone roofing options, which need to achieve a minimum solar reflectance of 70 percent and infrared emittance of 75 percent (CEC, 2006). However, it's possible to meet Title 24 standards by using a bituminous basecoat and a white elastomeric topcoat. This type of system was applied to the Convention Center in Anaheim, California, and it qualified as a Title 24 Cool Roof (JAC, 2007).

Bituminous Roof coatings are generally applied by professional roofing crews, but they are also applied by homeowners and business owners. These products are single component formulations that contain asphalts, coal tars, and/or gilsonite (a naturally occurring asphalt). They may also contain additives such as clay, fibers, pigments, polymers, and/or surface active agents (RCMA, 2006). Some products contain polymers that improve UV resistance, flexibility, and resistance to aging and weathering. Some polymers contribute to a UL Class A

Fire Rating to improve the safety of the building. The two most popular modifiers are styrene-butadiene-styrene (SBS) and atactic polypropylene (APP) polymers. During curing, a natural process occurs known as “tobacco juicing,” which is when a residue seeps out of asphalt/coal during the drying process. It is water soluble and washes away with the first rain of the season. However, if not properly washed away, it can cause peeling of acrylic and aluminum topcoats (ARMA, 1994).

With bituminous coatings being petroleum based, the historical tendency was towards solventborne products that contained mineral spirits or other hydrocarbon solvents. In recent years, the trend in California has shifted to waterborne asphalt emulsions that satisfy local VOC requirements. Some industry experts consider asphalt emulsions to be inferior to solventborne asphalts due to slightly restrictive ambient temperature applications, elasticity, adhesion, and longevity. With advancements in waterborne formulations, pigment, and polymer additives, waterborne emulsions “can flow and be easily applied” while solvent-based additives are added “to provide additional properties to the coating, such as freeze resistance and improved film formation” (Sosinski, 2006). Polymer additives are also beneficial for roof performance by allowing the coating to stretch and retract during thermal expansions and contractions. After the curing process, predominately in warmer conditions, waterborne roof coatings can “provide excellent performance with respect to water resistance, dirt pick-up, and adhesion to the substrate” (Sosinski, 2006). These lower VOC waterborne products, through reformulations, are gradually providing performance comparable to solventborne coatings, particularly during warmer temperatures. However, both waterborne and solventborne coatings require periodic re-coating to retain their much needed protective properties.

In California, most Bituminous Roof coatings are waterborne asphalt emulsions and they function well in the moderately temperate conditions throughout the State. Outside of the South Coast Air Basin, which has a very temperate climate, the vast majority of California’s population still resides in areas that are temperate enough to apply asphalt emulsions throughout most of the year. However, residents of the Sierra Nevada, Northern California, and other parts of the country (e.g. Northeast and Midwest) are subject to colder or less temperate climates that may not permit the use of waterborne emulsions. Emulsion Bituminous Roof coatings can be adversely impacted by unexpected rain, heavy dew, thick fog, and extremely cold temperatures due to slower cure times compared to solventborne coatings. Traditional solventborne bituminous products may be beneficial in less temperate climates because they have the potential to adhere better and withstand sudden shifts in climate.

5.3.4. Substrates/Exposures

Bituminous Roof coatings can be used for new roofing, re-roofing, and re-covering projects on a wide variety of substrates. Certain substrates, like concrete and wood, must be properly prepared to accept bituminous coatings. In some cases, it may be necessary to apply felt, fiberglass, polyester or composite sheets, prior to the application of bituminous coatings. Most roofs that are wet, damp, or subject to ponding water are generally not suitable for these coatings. All roofs should have positive drainage to maximize roof coating properties, including longevity. However, some products have the ability to deter the degradation effects associated with ponding water.

Solventborne and waterborne bituminous products are usually sensitive to ambient temperatures outside the range of 50 – 120 degrees F, and should never be subjected to freezing temperatures. Some specialty products can be applied outside of this temperature range. For most applications, the temperature must be at least 5 degrees F above the dew point for the best adhesion and cure. Solventborne products have a slight advantage in colder applications. They can be applied as low as 40 degrees F with some manufacturers stating applications as low as 32 degrees F.

In some cases, roofers use solventborne adhesives, cements, or sealants to patch roofs during inclement weather. They can then apply waterborne coatings when conditions are more favorable. It is important to note that roof patching adhesives, cements, and sealants are not covered by architectural coatings regulations. They are subject to VOC limits in districts' Adhesive and Sealant Rules. If applied correctly, Bituminous Roof coatings resist water penetration and have the ability to endure extreme environments. They can be formulated with polymer modifiers to resist mild alkali or acidic conditions and can be highly resistive to UV light.

5.3.5. Survey Results

Table 5.3-1 summarizes our estimate of sales and VOC emissions from the Bituminous Roof Coatings category, based on results from the ARB survey. In 2004, the sales volume for Bituminous Roof coatings in California was approximately 1.5 million gallons which represents 1.3 percent of the total California sales volume for architectural coatings. In 2000, the sales volume for Bituminous Roof coatings was more than 3 million gallons, because some manufacturers reported cements, adhesives, and sealers under the Bituminous Roof category. The drop in sales volume from 2000 to 2004 is primarily due to the elimination of cements, sealers, and adhesives from the survey data.

In 2004, VOC emissions from Bituminous Roof Coatings were about 0.4 tpd, which represents approximately 0.4 percent of the total emissions from architectural coatings. Solventborne coatings produce about 93 percent of the VOC emissions from this category, but only account for 9 percent of the sales volume.

Table 5.3-1: Survey Data
Bituminous Roof

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	41	133,728	9%	0%	100%	0%	2%	252	0.38
WB	38	1,330,598	91%	0%	100%	0%	0%	3	0.03
Total	**79**	**1,464,326**		**0%**	**100%**	**0%**	**0%**	**26**	**0.41**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.3-2 contains complying marketshare data for the Bituminous Roof Coatings category, based on results from the ARB survey. This table shows that 90 percent of the sales volume for Bituminous Roof coatings complies with the proposed VOC limit of 50 g/l. The expected VOC emission reductions for this proposed limit are 0.17 tpd.

Waterborne Bituminous Roof Coatings have a sales-weighted average (SWA) VOC Regulatory level of 3 g/l, which is below the proposed VOC limit for this category. From 2000 to 2004, the overall SWA VOC Regulatory level for this category has decreased from 120 g/l to 26 g/l, a 78 percent drop.

Table 5.3-2: Complying Marketshare & Emission Reductions
Bituminous Roof

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
50	35	90%	0.17

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

A listing of Bituminous Roof coating manufacturers and products that comply with the proposed VOC limit is provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm). Of the 16 companies that reported sales in this category, eleven offered Bituminous Roof coatings that comply with the proposed limit (ARB, 2006). Of these eleven companies, three are considered to be small businesses, because they have fewer than 250 employees.

5.3.7. Manufacturer and Industry Issues

Some manufacturers and industry representatives have expressed concerns about certain aspects of the proposed SCM regarding VOC limits, definitions, and other technical issues. Below are key issues that have been brought to our attention during our interactions with the industry representatives.

5.3.7.1. Issue: The Roof Coatings Manufacturers Association (RCMA) and the National Paint and Coatings Association (NPCA) have expressed concerns about premature performance failures of low-VOC roof coating products, because they are not designed for colder, humid, and/or rainy climates. Also, they believe that premature application failures are a result of applying coatings in temperatures or humid conditions not suitable for lower VOC coatings. They believe that these premature failures could reduce life cycle performance and increase waste generation.

Response: Based on manufacturer product data sheets, total sales volume, and complying marketshare it appears that some waterborne products require a minimum application temperature of 50 degrees F versus 40 degrees F. However, the 90 percent complying marketshare suggests that these lower VOC waterborne products are just as effective as higher VOC solventborne coatings while providing adequate protection from cold, humid, and/or rainy climates.

5.3.7.2. Issue: The NPCA and RCMA recommend the use of a reactivity-based approach for regulating Roof Coatings. Some industry representatives have suggested that the ARB use the units of grams of ozone generated per gallon of coating to establish a reactivity-based standard. Industry and manufacturer representatives have also suggested that low-reactive products with higher VOC contents should be exempt from future SCM limits, because they have lower ozone formation potential. Industry representatives have suggested that lower-reactivity products could be formulated by replacing some hydrocarbon solvents with other hydrocarbon solvents that have a lower maximum incremental reactivity (MIR) value.

Response: ARB staff analyzed industry’s proposed approach for developing Bituminous Roof coatings with a reduced ozone formation potential. Staff compared ozone reductions from a mass-based limit to ozone reductions that could be achieved with a reactivity-based limit. With a mass-based limit, manufacturers would need to reduce their overall VOC content. With a reactivity-based limit, manufacturers could maintain their current overall VOC contents, but they would need to reformulate with less reactive hydrocarbon solvents.

The reactivity (i.e., maximum ozone formation potential) can be determined based on the MIR value for each of the chemicals contained in a coating. Since hydrocarbon solvents are mixtures of several chemicals, ARB developed a bin system to assign MIR values to hydrocarbon solvents, based on boiling point and chemical characteristics (ARB, 2007). For hydrocarbon solvents, the assigned MIR values range from 0.81 grams ozone per gram product (g O_3/g product) for Bin 12 up to 8.01 g O_3/g product for Bin 23. The most common hydrocarbon solvents reported for Bituminous Roof Coatings are Bin 15 (MIR = 1.82 g O_3/g product).

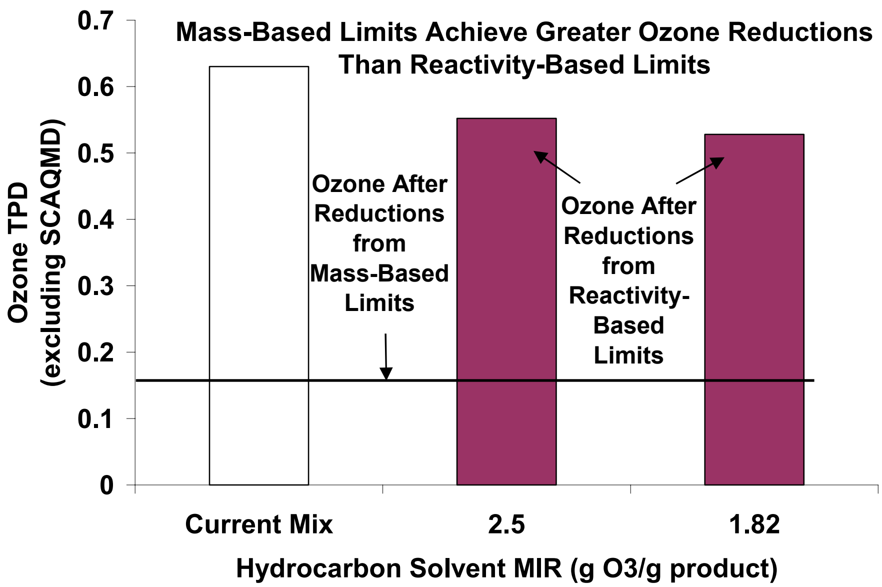
Using data from the ARB Survey, ARB staff determined that the maximum ozone formation potential (OFP) for all Bituminous Roof coatings was 0.63 tpd Ozone in 2004, outside of the South Coast AQMD (ARB, 2007). Implementing a mass-based 50 g/l VOC limit is expected to achieve an emission reduction of 0.17 tpd and a corresponding ozone reduction of 0.47 tpd, outside of the South Coast AQMD.

ARB staff then determined the expected ozone reductions from a reactivity-based limit. Staff identified all of the Bituminous Roof coatings that contained hydrocarbon solvents with MIR values greater than 1.82 g O_3/g product. Based on industry recommendations, staff evaluated two possible substitutions: (1) Replace all of the higher-MIR solvents with Bin 15 hydrocarbon solvents that had an MIR value of 1.82 g O_3/g product. This substitution would result in a maximum ozone formation potential of 0.44 tpd, outside of the South Coast AQMD; or (2) Replace all of the higher-MIR solvents with a blend of hydrocarbon solvents that had an MIR value of 2.50 g O_3/g product. This substitution would result in a maximum ozone formation potential of 0.46 tpd, outside of the South Coast AQMD. This analysis assumes that the hydrocarbon substitution would be on an equivalent mass basis. However, industry representatives acknowledge that they might need to use larger amounts (e.g., 20% more) of the low-MIR hydrocarbon solvents to achieve a solvency that is comparable to the higher-MIR solvents. Therefore, it is expected that the maximum ozone formation potential could be up to 0.55 tpd for reformulated products. When this amount is compared to the 2004 baseline of 0.63 tpd, the amount of ozone reduction from a reactivity-based limit would likely be about 0.1 tpd. This amount is less than the reduction that would be expected from establishing a mass-based VOC limit of 50 g/l.

Based on this analysis, it does not appear that a reactivity-based limit would achieve emission reductions beyond what could be achieved by implementing the proposed mass-based limit of 50 g/l. Since a reactivity-based limit would require additional district resources without providing an increase in reductions, ARB staff determined that the proposed mass-based limit was preferable. Figure 5.3-1 illustrates the analysis stated above.

ARB staff also evaluated what type of solvent substitution would be required to achieve an ozone reduction that is comparable to the 50 g/l VOC limit that is proposed in the SCM. A 50 g/l limit would achieve an estimated 0.47 tpd of ozone reductions outside of the South Coast AQMD. To achieve a similar type of reduction, using solvent substitution, ARB staff estimates that it would be necessary to replace all hydrocarbon solvents with a solvent blend that has an MIR value of 0.5 g O_3/g product. ARB staff does not believe that existing hydrocarbon solvent blends are available with this type of MIR value and the necessary physical properties. This analysis assumes that the hydrocarbon substitution would be on an equivalent mass basis.

Figure 5.3-1
Bituminous Roof Coatings: Ozone Reductions From Using Less Reactive Solvents



5.3.7.3. Issue: RCMA stated that, in California, waterborne emulsions are applied as a part of regular roof maintenance during the summer while solventborne coatings are used during storms to repair leaking roofs.

Response: The ARB has recognized the need for emergency repair and has omitted adhesives, sealants, and cements from this SCM category. These products are subject to district rules, and generally have higher VOC limits to ensure proper application, curing, and the ability to handle repairs during inclement weather.

5.3.7.4. Issue: RCMA believes that lowering the VOC content may result in greater quantities of coating used per square foot, because compliant coatings have a higher viscosity and using them could increase solvent release, ozone formation, and consumer costs. They believe this could also lead to higher ozone formation by forcing manufacturers to use only highly reactive solvents.

Response: ARB staff does not expect this VOC limit to result in lower VOC solventborne products with highly reactive solvents. Products that comply with the proposed 50 g/l limit can be formulated with waterborne emulsions.

5.3.9. Conclusion

We recommend a 50 g/l VOC limit for Bituminous Roof coatings, effective January 1, 2010. The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on our review of ARB survey data, complying marketshares, number of companies making compliant products, and product information from manufacturers. The United States Environmental Protection Agency (U.S. EPA) has a 500 g/l limit for all bituminous coatings. The Ozone Transport Commission (OTC) and Canada have set a 300 g/l limit. The South Coast AQMD adopted a 50 g/l limit for all Roof coatings that became effective January 1, 2005. Our recommended limit is consistent with the limit adopted by the South Coast AQMD, but lower than the limits set by the U.S. EPA, OTC, and Canada.

With the proposed ARB VOC limit of 50 g/l, the complying marketshare for this category is 90 percent. This is substantial and indicates that technology is available to achieve a 50 g/l VOC limit.

5.4. BITUMINOUS ROOF PRIMER

VOC Limit Table (g/l)

USEPA: 500 (Bituminous Coatings and Mastics)	Canada: 350	OTC: 350	SCAQMD: 350	SCM Proposed: 350

5.4.1. Category Definition

A primer which incorporates bitumens that is labeled and formulated exclusively for roofing and intended for the purpose of preparing a weathered or aged surface or improving the adhesion of subsequent surfacing components.

5.4.2. Major Proposed Changes

- Definition has been altered to specify the role of bituminous roof primers.

5.4.3. Coating Description

Bituminous Roof Primers are used to prepare a surface for the application of a bituminous/asphalt based roofing system or a reflective topcoat. They are designed to improve adhesion to substrates that are not prepared to receive topcoats or roofing systems. They also provide protection from water intrusion and improved weatherability. Some substrates do not require the use of primers to enhance adhesion. In some cases, Bituminous Roof Coatings can be used as basecoats and they are sufficient to prepare the surface for a reflective topcoat. However, excessively weathered, dirty, and aged substrates typically require a Bituminous Roof Primer prior to application of a reflective topcoat.

Typically, Bituminous Roof Primers are single component coatings. Most of the reported products have solventborne formulations with mineral spirits or other hydrocarbon solvents, but waterborne products are also available with asphalt emulsions. One of the reported waterborne products incorporates a styrene-butadiene resin to improve curing time.

Bituminous Roof Primers are cold-applied in a thin layer, using a brush or sprayer. Manufacturers do not recommend applying a thick layer of primer because there may be an increase in curing time due to slower evaporation of solvent. This can cause adhesion failures (e.g. peeling and bubbling) and potential problems with topcoat application. These coatings are generally applied by roofing contractors, but they can also be applied by homeowners.

5.4.4. Substrates/Exposures

Bituminous Roof Primers are for exterior use only and are primarily used to prepare existing bituminous roofs. They can also be applied to a wide range of substrates, including asphalt, concrete, stone, masonry, metal, plywood, hardboard, and other composition materials.

Drying times and re-coat times vary widely for bituminous roof primers. Some must be topcoated within 24 hours or repriming is necessary. Others require 1 - 4 months of curing before applying a topcoat, to ensure that “tobacco juices” do not bleed into the top-coat and cause staining. During application, it is advisable to apply roof primer to flat, low-slope roofs with positive drainage, and no ponding water. Cold weather below 50˚F can also increase curing time, so extra time is required before applying any other roof coatings. Hot weather above 120˚F can cause Bituminous Roof Primers to become less viscous and induce sagging, running, and bubbling. Since Bituminous Roof Primers are designed primarily for primer purposes, direct exposure to the elements is not recommended.

5.4.5. Survey Results

Table 5.4-1 summarizes our estimate of sales and VOC emissions from the Bituminous Roof Primers category based on results from the ARB survey. In 2004, the sales volume for Bituminous Roof Primers in California was approximately 68,000 gallons which represents less than 0.1 percent of the total California sales volume for architectural coatings. From 2000 to 2004, the sales volume for Bituminous Roof Primers decreased 60 percent and the overall sales-weighted average VOC Regulatory level increased from 211 g/l to 324 g/l, a 54 percent increase.

In 2004, VOC emissions from Bituminous Roof Primers were about 0.24 tpd, which represents less than one percent of the total emissions from architectural coatings. Solventborne coatings produce about 96 percent of the VOC emissions, but they only account for 88 percent of the sales volume.

Table 5.4-1: Survey Data
Bituminous Roof Primer

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day) [4]
SB	26	59,968	88%	0%	100%	0%	0%	346	0.23
WB	5	8,124	12%	0%	100%	0%	0%	167	0.01
Total	**31**	**68,092**		**0%**	**100%**	**0%**	**0%**	**324**	**0.24**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.4-2 contains complying marketshare data for the Bituminous Roof Primers category, based on results from the 2005 ARB survey. This table shows that 79 percent of the sales volume for Bituminous Roof Primers complies with the current VOC limit of 350 g/l. In 2000, 73 percent of the sales volume complied with the 350 g/l limit.

Table 5.4-2: Complying Marketshare & Emission Reductions
Bituminous Roof Primer

Existing VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
350	15	79%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

A listing of Bituminous Roof Primer manufacturers and products that comply with the proposed VOC limit is provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm). Of the nine companies that reported sales in this category, four offered Bituminous Roof Primers that comply with the existing limit (ARB, 2006). Of these four companies, one company is considered to be a small business, because they have less than 250 employees.

5.4.6. Conclusion

We recommend maintaining the existing 350 g/l VOC limit for Bituminous Roof Primers. The proposed VOC limit is technologically and commercially feasible, based on our review of ARB survey data, the complying marketshare, the number of companies making compliant products, and product information from manufacturers. The United States Environmental Protection Agency (U.S. EPA) has a higher 500 g/l limit for all bituminous coatings. Our recommended limit is consistent with the limit adopted by the South Coast AQMD and the Ozone Transport Commission, and the limit proposed by Canada.

5.5. BOND BREAKERS

VOC Limit Table (g/l)

USEPA: 600	Canada: 350	OTC: 350	SCAQMD: 350	SCM Proposed: 350

5.5.1 Category Definition

A coating labeled 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.

5.5.2. Major Proposed Changes

- None.

5.5.3. Coating Description

Bond Breakers are coatings used to prevent bonding of concrete slabs to each other during tilt-up and precast construction. After the first concrete slab is poured and the final trowelling is complete, Bond Breaker is applied. Manufacturers generally recommend applying at least two coats. After the Bond Breaker dries, the second concrete slab can be poured on top of the Bond Breaker. After the second concrete slab dries, it is lifted to make a wall. Bond Breakers can also be applied on top of aged concrete surfaces, prior to pouring a new slab. Some products contain a temporary dye that allows one to conduct a quick visual inspection and ensure good coverage. The dye is no longer visible within hours after application. Many Bond Breakers are multi-functional and they can also be used for concrete curing and sealing. Some of the products that function as concrete curing compounds are designed to meet the requirements of ASTM standard C-309-06 (Liquid Membrane-Forming Compounds for Curing

Concrete). Products are usually applied by professional contractors using sprayers.

All of the Bond Breakers reported in the ARB survey are single component products sold in large containers and they fall into two main groups:

- Chemically Reactive: These products react with the alkali or lime in the concrete and seal the concrete pores.
- Non-Reactive: These products form a membrane, but they do not react with the concrete.

Chemically Reactive: These Bond Breakers react with the alkali or lime in the concrete and seal the concrete pores. This prevents fresh concrete and water from penetrating into the set concrete and sticking to the first slab. These chemically reactive products are not designed to dissipate, so Bond Breaker manufacturers generally recommend that concrete surfaces be cleaned with power washing, prior to the application of subsequent coatings or sealers. Most of the reported products in the chemically reactive group are waterborne formulations containing hydrocarbon resin, oleoresin, or polybutene resin. There are also solventborne formulations with hydrocarbon resin. Some waterborne formulations are available with VOC contents less than 200 g/l. For the Chemically Reactive group, products with VOC contents less than 200 g/l represent 3% of the reported sales volume, while 97% of the products in this group have VOC contents between 300 - 360 g/l.

Non-Reactive: These Bond Breakers form a membrane, but they do not react with the concrete. These products are designed to dissipate or break down in 4 - 6 weeks. After dissipation, residual material can be removed by pressure washing, prior to the application of subsequent coatings or sealers. Most of the reported products in the non-reactive group are waterborne formulations containing hydrocarbon resin, but there are also solventborne formulations with hydrocarbon resin. For the Non-reactive group, products with VOC contents less than 200 g/l represent 0% of the reported sales volume and almost 100% of the products have VOC contents between 250 -300 g/l.

5.5.4. Substrates/Exposures

Bond Breakers are applied to concrete slabs. Some products are designed to be resistant to rainfall, ultraviolet light exposure, and abrasion from foot traffic during the construction process.

5.5.5. Survey Results

Table 5.5-1 summarizes our estimate of sales and VOC emissions from the Bond Breaker category, as reported for the ARB 2005 survey.

Table 5.5-1: Survey Data
Bond Breaker Coatings

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	2	PD	PD	0%	100%	0%	0%	717	0.01
WB	11	PD	PD	0%	100%	0%	0%	300	0.16
Total	**13**	**187,785**		**0%**	**100%**	**0%**	**0%**	**302**	**0.17**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

The sales volume for Bond Breakers represents about 0.2 percent of the total California sales volume of architectural coatings in 2004. VOC emissions from Bond Breakers represent approximately 0.2 percent of the total emissions from architectural coatings. When compared to the data reported for calendar year 2000, Bond Breakers sales volume increased 100 percent in 2004, VOC emissions increased 148 percent, and the sales-weighted average VOC content increased 24 percent.

Table 5.5-2 contains complying marketshare data for Bond Breaker coatings, based on results from the 2005 ARB survey. This table shows that 73 percent of the sales volume for Bond Breakers complies with the current VOC limit of 350 g/l. When considering the number of products reported, approximately 69 percent comply with the current limit. Of the 5 companies that reported in this category, all 5 offered Bond Breaker coatings that comply with the current limit.

Table 5.5-2: Complying Marketshare & Emission Reductions
Bond Breaker Coatings

Current VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
350	9	73%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.5.6. Conclusion

It appears to be technologically feasible to formulate Bond Breakers with VOC contents less than 300 g/l. However, the resulting emission reductions would be negligible. Therefore, we recommend that the VOC limit for Bond Breaker coatings remain at 350 g/l, at this time. The current VOC limit is technologically and commercially feasible, based on complying marketshare, the number of companies making complying products, and product information from manufacturers. The current VOC limit is lower than the national limit promulgated by the United States Environmental Protection Agency (U.S. EPA) for this category. The current limit of 350 g/l VOC is consistent with the limits in effect in the South Coast Air Quality Management District, the Ozone Transport Commission, and the proposed limit for Canada.

5.6. CONCRETE CURING COMPOUNDS

VOC Limit Table (g/l)

USEPA: 350	Canada: 350	OTC: 350	SCAQMD: 100 (general) 350 (roadways & bridges)	SCM Proposed: 350

5.6.1. Category Definition

A coating labeled and formulated for application to freshly poured concrete to perform one or more of the following functions:

- Retard the evaporation of water; or
- Harden or dustproof the surface of freshly poured concrete.

5.6.2. Major Proposed Changes

- The category definition was modified to include products that are used on freshly poured concrete for hardening and dustproofing. It does not include products that are only suitable for application on cured concrete.

5.6.3. Coating Description

After concrete is poured, it undergoes a period of curing during which chemical and physical changes occur as the cement reacts with water. According to the American Concrete Institute, "The curing period is defined as the time period beginning at placing, through consolidation and finishing, and extending until the desired concrete properties have developed. The objectives of curing are to prevent the loss of moisture from concrete and, when needed, supply additional moisture and maintain a favorable concrete temperature for a sufficient period of time." (ACI, 2001).

Concrete Curing Compounds help control the evaporation of water, which allows the concrete to properly hydrate during the curing period. These products are used on a variety of concrete surfaces, including walls, roadways, bridges, floors, sidewalks, and ramps. Many products are designed to comply with the requirements of ASTM C-309-06 (Liquid Membrane-Forming Compounds for Curing Concrete). The ASTM C-309 specification includes Type I materials, which are clear products, and Type II materials, which are white pigmented products that may be specified for use in hot weather. Other applicable standards are the American Association of State Highway and Transportation Officials (AASHTO) M-148 and the California Department of Transportation (CalTrans) Standard Specification 90-7.01B, which designates the acceptable types of Concrete Curing Compounds, based on ASTM C-309. CalTrans has worked on revising this specification to allow for the use of low-VOC ($\leq$100 g/l) products wherever possible, but they have had difficulty identifying low-VOC products that provide acceptable performance for roadways and bridges. Due to these difficulties, the South Coast AQMD established a special category for Concrete Curing Compounds that are applied on roadways and bridges with a VOC limit of 350 g/l.

All of the products that were reported in the survey are single component products sold in large containers and they are usually applied by professional contractors, using sprayers. They can also be applied with rollers or brushes. Concrete Curing Compounds fall into two general groups:

- New Concrete Only - Products that are applied to freshly poured concrete during the initial curing process; and
- New & Aged Concrete - Products that can either be applied to freshly poured concrete or to aged concrete.

There are several types of products that are only intended for application on freshly poured concrete. In general, these products form a membrane or film that seals in moisture for several days and ensures that the concrete is properly hydrated during the curing process. They also help resist cracking and dusting. Provided below are descriptions of Concrete Curing Compounds that are only for freshly poured concrete.

New Concrete Only - Cure & Wear Away: Some Concrete Curing Compounds form membranes that wear away or dissipate within a few months if they are exposed to sunlight, weathering, and abrasion. After the membrane wears away or is removed manually, the concrete can be sealed or topcoated. Some of these products contain a temporary dye that allows one to conduct a quick visual inspection and ensure good coverage. The dye begins to fade within hours after application with exposure to sunlight. The products in this group generally comply with ASTM C-309, Type I. Most of the products in this group are waterborne formulations. Most of them contain hydrocarbon resin, but there are also waterborne products with alkyd, acrylic, polyvinyl acetate, and oleoresin binders. A small portion of the sales volume includes solventborne formulations with phenolic resin. In this group, 11% of the sales volume had VOC contents less than 100 g/l and 35% had VOC contents less than 250 g/l.

New Concrete Only - Cure & Remain on Surface: For concrete surfaces that will not be topcoated, there are Concrete Curing Compounds that form a membrane and remain on the surface, rather than wearing away. The products in this group generally comply with ASTM C-309, Type II. This group is the only one where most products are designed to meet the Type II specification, which is a requirement for some CalTrans specifications. Most of the sales volume for these products includes solventborne formulations with styrene-butadiene resin or waterborne formulations with hydrocarbon resins. There are also some waterborne products with wax emulsions and solventborne products with vinyl toluene resin. In this group, 4% of the sales volume had VOC contents less than 100 g/l and 35% had VOC contents less than 250 g/l.

New Concrete Only – Cure, Harden, Dustproof: Some Concrete Curing Compounds form a membrane and they help produce a hard, dustproof surface. These products reportedly enhance the strength and durability of the concrete. Some of the products in this group comply with ASTM C-309, Type I, while others comply with Type II. All of the reported products were waterborne formulations, most of which had wax emulsions. Other resin types include alkyd and hydrocarbon resins. In this group, 81% of the sales volume had VOC contents less than 100 g/l and 100% had VOC contents less than 250 g/l.

New Concrete Only – Evaporation Retarder: In the 2000 SCM, the definition for Concrete Curing Compounds only has one criteria - retarding the evaporation of water. However, there are products in this category that retard evaporation, but are not considered to be curing compounds. These products are called "evaporation reducers", "vapor retarders", or "evaporation retarders" and they can be used during the initial curing stages when water is evaporating too rapidly (e.g., during hot, dry, or windy conditions). Some products form a monomolecular film that slows evaporation, but still allows the concrete finishing work to be completed. After the finishing work is complete, Concrete Curing Compounds can be applied to control the evaporation of water during the remainder of the curing process. Since evaporation retarders are not curing compounds, they are not designed to comply with ASTM C-309. Since they are relatively new products, no industry-wide specifications have been developed for them, at this time (FHWA, 2006). Evaporation retarders only account for 1% of the total sales volume for Concrete Curing Compounds. All of the reported products were waterborne formulations, most of which contain fatty alcohol binders. In this group, 63% of the sales volume had VOC contents less than 100 g/l and 100% had VOC contents less than 250 g/l.

New & Aged Concrete: Some products in the Concrete Curing Compound category can be used for both new concrete and aged concrete. These products are designed for multiple functions, including curing, sealing, hardening, and dustproofing. On freshly poured concrete, they provide a film to slow the evaporation of water and they help create a hard, dustproof surface. Subsequent applications can provide a seal that improves resistance to abrasion, staining, and chemicals. On aged concrete, these products are designed to renew the surface, by providing a dustproof seal that protects against abrasion, staining, and chemicals. The products in this group generally comply with ASTM C-309, Type I. A large portion of the sales volume for this group (45%) consists of zero-VOC, waterborne, sodium silicate formulations that penetrate and react with the concrete. These penetrating, reactive products are designed so they don't impair the adhesion of topcoats or sealers. Another large portion of the sales volume for this group (38%) consists of waterborne, acrylic formulations with VOC contents between 140 g/l and 250 g/l. The remaining products are either waterborne formulations with hydrocarbon resin or styrene acrylate or solventborne formulations with acrylic or hydrocarbon resins. In this group, 45% of the sales volume had VOC contents less than 100 g/l and 84% had VOC contents less than 250 g/l.

Most of the products for new and aged concrete were reported in the Concrete Curing Compound category, but they were also reported under Waterproofing Sealer and Waterproofing Concrete/Masonry Sealer. ARB staff believes that these products should all be grouped together under the Concrete Curing Compound category. Therefore, the definition for Concrete Curing Compounds has been modified to include products that are used for hardening and dustproofing and can be applied to freshly poured concrete. The revised definition does not include products that are only suitable for application on cured or aged concrete. For this SCM revision, products that were formerly reported under Waterproofing Sealer or Waterproofing Concrete/Masonry Sealer (e.g., curing/sealers, hardener/dustproofers) should be classified as Concrete Curing Compounds, in accordance with the revised definition.

5.6.4. Substrates/Exposures

Concrete Curing Compounds are applied to freshly poured concrete and masonry surfaces, with interior and exterior exposures. Some products are also suitable for application to aged concrete. Some Concrete Curing Compounds are designed to wear away upon exposure to the elements, while others contain UV stabilizers and other ingredients that provide protection against weathering, staining, oils, salts, chemicals, and abrasion.

5.6.5. Survey Results

Table 5.6-1 summarizes our estimate of sales and VOC emissions, as reported for the ARB survey.

Table 5.6-1: Survey Data
Concrete Curing Compounds

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	12	43,771	6%	0%	93%	7%	0%	344	0.11
WB	102	749,795	94%	0%	32%	68%	0%	155	0.32
Total	**114**	**793,566**		**0%**	**35%**	**65%**	**0%**	**166**	**0.43**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

The sales volume for Concrete Curing Compounds represents about 0.7 percent of the total California sales volume of architectural coatings in 2004. VOC emissions from Concrete Curing Compounds represent approximately 0.45 percent of the total emissions from architectural coatings. When compared to the data reported for calendar year 2000, Concrete Curing Compounds sales volume increased 14 percent in 2004, VOC emissions increased 16 percent, and the sales-weighted average VOC content increased 14 percent.

Table 5.6-2 contains complying marketshare data for Concrete Curing Compounds, based on results from the ARB survey. When determining the complying marketshare, we included those curing/sealer and hardener/dustproofer products that were formerly reported under Waterproofing Sealer and Waterproofing Concrete/Masonry Sealer, but would be covered by the revised Concrete Curing Compound category. This table shows that 99 percent of the sales volume for Concrete Curing Compounds complies with the current VOC limit of 350 g/l. When considering the number of products reported, approximately 91 percent comply with the current limit. Of the 26 companies that reported in this category, 25 offered Concrete Curing Compounds that comply with the current limit.

Table 5.6-2: Complying Marketshare & Emission Reductions
Concrete Curing Compounds

Current VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
350	121	99%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.6.6. Conclusion

For some applications, it appears to be technologically feasible to formulate Concrete Curing Compounds that can meet VOC limits below 350 g/l. However, there are concerns about the feasibility of formulating products below 350 g/l that can be used on roadways and bridges and will meet the requirements of ASTM C-309, Type II, as contained in CalTrans Standard Specifications. Therefore, we recommend maintaining a 350 g/l VOC limit for Concrete Curing Compound coatings. ARB staff considered the possibility of creating a special category for Type II products, similar to the approach used in the South Coast AQMD, but staff determined that the associated emission reductions would not be substantial enough to warrant this action. The current VOC limit is the same as the limit in effect for the United States Environmental Protection Agency (U.S. EPA), the Ozone Transport Commission, and the proposed limit for Canada. The current VOC limit is higher than the limit contained in SCAQMD Rule 1113 for regular Concrete Curing Compounds (100 g/l), but the same for Concrete Curing Compounds used on roadways and bridges.

5.7. CONCRETE/MASONRY SEALERS

VOC Limit Table (g/l)

USEPA: 600 (WST)	Canada: 250 (WPS); 400 (WCMS)	OTC: 250 (WPS); 400 (WCMS)	SCAQMD: 100	SCM Proposed: 100

5.7.1. Category Definition

A clear or opaque coating that is labeled and formulated primarily for application to concrete and masonry surfaces to perform one or more of the following functions:

- Prevent penetration of water; or
- Provide resistance against abrasion, alkalis, acids, mildew, staining, or ultraviolet light; or
- Harden or dustproof the surface of aged or cured concrete.

Please note that "Concrete/Masonry Sealer" is a new category that is a consolidation of the following two categories that were contained in the 2000 SCM:

> 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, alkali, acids, ultraviolet light and staining.
>
> Waterproofing Sealer: A coating labeled and formulated for application to a porous substrate for the primary purpose of preventing the penetration of water.

These two categories have been eliminated from the proposed SCM and the types of products that were previously in these categories would be covered by the following: Concrete/Masonry Sealer; Wood Coatings; Industrial Maintenance; or Primer, Sealer, Undercoater.

5.7.2. Major Proposed Changes

- Concrete/Masonry Sealer is a new category to replace Waterproofing Concrete/Masonry Sealer and Waterproofing Sealer.
- Some products that were previously covered by Waterproofing Concrete/Masonry Sealer and Waterproofing Sealer were reclassified under the new Basement Specialty Coating category or Waterproofing Membrane category.

- The term “Waterproofing” has been removed from the category name, because most products claim to provide water resistance, rather than waterproofing.
- The category definition has been revised to remove references to “film-forming” or “penetrating” properties.
- For products that were formerly covered by Waterproofing Concrete/Masonry Sealer, the proposed VOC limit decreases from 400 g/l to 100 g/l.
- For products that were formerly covered by Waterproofing Sealer, the proposed VOC limit decreases from 250 g/l to 100 g/l.

5.7.3. Coating Description

Concrete/Masonry Sealers cover a wide range of applications and functions. Provided below are descriptions for some of the primary applications based on the products reported in ARB’s Architectural Coating Survey. ARB staff evaluated the various functions associated with Concrete/Masonry Sealers to determine the potential impact of the proposed SCM VOC limit. For the purpose of this analysis, ARB staff developed groups that were based on products with similar purposes or functions. In some cases, a product could belong to multiple groups. These multi-functional products were only evaluated in a single group to simplify the analysis.

Basement Coatings: Based on the definitions contained in the 2000 SCM, basement coatings could be classified as either Waterproofing Concrete/Masonry Sealers or Waterproofing Sealers. However, for this proposed revision of the SCM, ARB staff believes that basement coatings should be classified under the new “Basement Specialty Coating” category (see Section 5.2.)

Crack Filling and Repair: Some concrete surfaces become deteriorated due to chemical attack, freeze/thaw expansion and contraction damage, and chloride ion intrusion. In addition, concrete can be damaged by spalling when rebar corrodes and causes chips of concrete to break away. Crack Filling and Repair products can seal existing areas that are cracked and deteriorated, as well as penetrating into sound concrete to provide a protective layer. Products are spread over horizontal concrete surfaces in both interior and exterior areas. These coatings are generally applied by professional contractors who pour the material onto the surface and spread it with a roller, broom, or squeegee. Materials can also be applied with low-pressure spray equipment. A small number of Crack Filling and Repair products were reported with a sales volume that only amounts to approximately 0% of the reported sales volume and 0% of the VOC emissions for Waterproofing Concrete/Masonry Sealers. All of the reported Crack Filling and Repair products are available in solventborne, multi-component, high-solids, epoxy or acrylic epoxy formulations that have VOC contents less than 100 g/l.

Curing Compound and Sealer: Based on the definitions contained in the 2000 SCM, concrete curing compounds and sealers could be classified as either Waterproofing Concrete/Masonry Sealers or Waterproofing Sealers. However, for this proposed revision of the SCM, ARB staff believes that curing compounds and sealers should be classified under Concrete Curing Compounds (see Section 5.6.).

Dampproofing: These products are applied on concrete and masonry surfaces to help prevent the transmission or absorption of water or water vapor. They are generally used for exterior applications and can be applied either above-grade or in below-grade applications, such as building foundations or walls. Products are generally bituminous waterborne or solventborne formulations and they can be applied on damp surfaces and uncured concrete, usually by professional contractors. Dampproofing materials are generally applied in relatively thick coats (e.g., 60 - 120 mil wet film thickness) and they can be applied with heavy-duty spray equipment, bristle brush, roller, or trowel.

Dampproofing products accounted for 2% of the reported sales volume and 4% of the VOC emissions for Waterproofing Sealers. Products are available in single component, waterborne bituminous emulsions with VOC contents less than 100 g/l. These low-VOC products represent approximately 43 percent of the sales volume for the Dampproofing group, excluding small containers.

Deck Coating: These products are applied to concrete and masonry decks in a variety of locations (e.g., parking garages, roofs, stadiums, balconies, pool areas, tennis courts, bridges, etc.) The coatings are designed to make the concrete waterproof or water resistant, while withstanding abrasion and wear from vehicle traffic and pedestrian traffic. These products are suitable for interior and exterior areas on horizontal and vertical surfaces. Materials are generally applied by professional contractors, using either roller, squeegee, or spray. After the initial application, aggregate or sand can be spread over the wet coating to provide a non-skid surface.

Deck coatings accounted for 15% of the reported sales volume for Waterproofing Concrete/Masonry Sealers and 3% of the sales for Waterproofing Sealers. They also accounted for 15% of the VOC emissions for Waterproofing Concrete/Masonry Sealers and 4% of the VOC emissions for Waterproofing Sealers. Products are often elastomeric and resin types include: acrylic, amine/amide, epoxy, polyurethane, and silicone/silane. Solventborne and 100% solids deck coatings with VOC contents less than 100 g/l are available in multi-component formulations (e.g., epoxy, polyurethane). Higher-VOC solventborne formulations include single component, moisture-cure urethanes and multi-component polyurethanes. Waterborne deck coatings with VOC contents less than 100 g/l are available in single component formulations with acrylic or silane/siloxane resins. Higher-VOC waterborne formulations are also available with silane/siloxane resins. Low-VOC products (<100 g/l) represent approximately 27 percent of the sales volume for the Deck Coating group, excluding small containers.

Decorative/Protective Sealer: These products are applied to concrete and masonry areas to provide a decorative appearance, while providing resistance to water and stains (e.g., oil and grease). In addition, they can also help reduce efflorescence which can result when moisture leaches salts out of a concrete/masonry surface, causing a powder or stain to appear. These products are often designed to provide a clear, glossy finish to improve the appearance of concrete, tile, brick, slate, and other substrates. In some cases, they may serve as the final seal coat after concrete has been dyed or painted. Coatings can either be applied by professional contractors (e.g., in commercial or institutional areas) or by homeowners (e.g., for patios, walkways, or garage floors). Application methods include: brush, roller, wax applicator, and spray equipment. Most products are suitable for exterior exposures, but some are only intended for indoor use. Decorative/Protective Sealers can be film-forming or penetrating.

Decorative/Protective Sealers accounted for 25% of the reported sales volume for Waterproofing Concrete/Masonry Sealers and 16% of the sales for Waterproofing Sealers. They also accounted for 25% of the VOC emissions for Waterproofing Concrete/Masonry Sealers and 17% of the VOC emissions for Waterproofing Sealers. Waterborne coatings with VOC contents less than 100 g/l are available in single component formulations with acrylic or silicone/silane resins. These low-VOC products include silicone/silane products that are designed to prevent or resist efflorescence. Higher-VOC waterborne products are available in single component formulations (acrylic, silicone/silane, urethane, vinyl acrylic) and multi-component formulations (epoxy, acrylic, polyurethane). Solventborne coatings with VOC contents less than 100 g/l are available in multi-component formulations with epoxy resins. Higher-VOC solventborne products are available in single component formulations (acrylic, oil, silicone/silane) or multi-component formulations (acrylic, urethane). Low-VOC (<100 g/l) products represent approximately 16 percent of the sales volume for the Decorative/Protective Sealers group, excluding small containers. For products with VOC contents greater than 100 g/l, it is expected that some could be re-classified as Low Solids coatings, because they contain one pound or less of solids per gallon coating.

It is important to note that the previous Waterproofing Sealer category included Decorative/Protective Sealers that were intended for use on wood substrates only. These products are now classified under the proposed new Wood Coating category (see Section 5.38).

Dustproofing/Hardening: Based on the definitions contained in the 2000 SCM, Dustproofing/Hardening products could be classified as either Waterproofing Concrete/Masonry Sealers or Waterproofing Sealers. However, for this proposed revision of the SCM, ARB staff believes that Dustproofing/Hardening products should be classified under Concrete Curing Compounds, if they are suitable for application on freshly poured concrete (see Section 5.6).

Penetrating and Reactive Products: These coatings are covered by the new Reactive Penetrating Sealer category (see Section 5.27) and the new Stone Consolidant category (see Section 5.34). Reactive Penetrating Sealers penetrate and chemically react with concrete and masonry substrates to provide a breathable protective seal that is resistant to water, chemicals, and deicing salts. Stone Consolidants are used for historical preservation efforts to consolidate deteriorated concrete and masonry substrates and restore structural integrity.

Water Repellent for Weather Resistance: These products are applied to walls and other exterior surfaces, primarily to provide water repellency and protection from wind-driven rain. In addition, these products allow the surface to breathe so water vapor can escape without damaging the protective seal. These coatings are typically applied to exterior walls made of brick, stucco, cinder block, and tilt-up concrete, but they can also be used for interior applications. Many of the products are elastomeric formulations which help smooth over surface imperfections and allow the coating to expand and contract over hairline cracks. These products have a medium build, with thicknesses between a typical nonflat and a high-build mastic coating. Other products in the Water Repellent/Weather Resistance group are non-elastomeric, clear, penetrating materials that also provide weather resistance and breathability. Coatings can either be applied by professional contractors or homeowners and application methods include: sprayer, brush, and roller.

Water Repellent/Weather Resistance coatings accounted for 30% of the reported sales volume for Waterproofing Concrete/Masonry Sealers and 17% of the sales for Waterproofing Sealers. They also accounted for 16% of the VOC emissions for Waterproofing Concrete/Masonry Sealers and 4% of the VOC emissions for Waterproofing Sealers. Products are single component, solventborne and waterborne formulations. Resin types include: acrylic, ethylene vinyl acetate, silicone/silane, and vinyl acrylic. Water Repellents for Weather Resistance are available in single component, waterborne formulations that have VOC contents less than 100 g/l. These low-VOC products include acrylic products that are designed to bind chalky surfaces and silicone/silane products that are designed to prevent or resist efflorescence. Low-VOC
(<100 g/l) products represent approximately 69 percent of the sales volume for the Water Repellents for Weather Resistance group, excluding small containers. For products with VOC contents greater than 100 g/l, it is expected that some could be re-classified as Industrial Maintenance coatings, if they are used in areas that comply with the Industrial Maintenance definition. They may also be re-classified as Low Solids coatings, because they contain one pound or less of solids per gallon coating.

Waterproofing Membranes: These coatings are covered by the new Waterproofing Membrane category (see Section 5.38). The new Waterproofing Membrane category does not include products that are used to coat the surface of parking decks, roof decks, bridges, etc. Those types of deck coatings are covered under the Concrete/Masonry Sealer category, as described above.

Provided below is a table that summarizes the data provided above for the major subcategories included in the Concrete/Masonry Sealer category:

Table 5.7-1
Summary of Concrete/Masonry Sealer Subcategories

Subcategory	Waterproofing Sealer		Waterproofing Concrete/Masonry Sealer		% Compliant with 100 g/l Limit
	% of Volume	% of Emissions	% of Volume	% of Emissions	
Dampproof	2%	4%	-	-	43%
Deck	3%	4%	15%	15%	27%
Decor./Protect	16%	17%	25%	25%	16%
Penet./React.	0%	1%	1%	0%	68%
Water Rep.	17%	4%	30%	16%	69%
Subtotal	38%	30%	71%	56%	-
Wood Coating - Clear	53%	66%	-	-	-
WP Memb.	4%	0%	27%	41%	-
Total	**95%**	**96%**	**98%**	**97%**	**41%**

5.7.4. Substrates/Exposures

Concrete/Masonry Sealers can be applied to concrete and masonry substrates with both interior and exterior exposures. In general, these products provide resistance to water, stains, and some chemicals. Some products are also designed to withstand wear and abrasion from vehicle traffic.

5.7.5. Survey Results

Tables 5.7-2a and 5.7-2b summarize sales and VOC emissions from Waterproofing Concrete/Masonry Sealer and Waterproofing Sealer, as reported for the ARB survey. For the proposed SCM, most of the products that are summarized in these tables would be combined into one new category (Concrete/Masonry Sealers). However, some of the products that were reported as Waterproofing Concrete/Masonry Sealer or Waterproofing Sealer would be classified under Basement Specialty Coating, Wood Coating, or Waterproofing Membrane. For example, clear Wood Coatings accounted for 53% of the reported sales volume and 66% of the VOC emissions for Waterproofing Sealers. Waterproofing Membranes accounted for 25% of the reported sales volume for Waterproofing Concrete/Masonry Sealers and 4% of the sales for Waterproofing Sealers. They also accounted for 41% of the VOC emissions for Waterproofing Concrete/Masonry Sealers and 0% of the VOC emissions for Waterproofing

Sealers. Please refer to Sections 5.2, 5.38, and 5.39 for information on Basement Specialty Coating, Waterproofing Membrane, and Wood Coating.

Table 5.7-2a: Survey Data
Waterproofing Concrete/Masonry Sealers

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	135	955,355	50%	1%	35%	64%	0%	248	2.24
WB	195	953,023	50%	0%	36%	64%	1%	140	0.57
Total	**330**	**1,908,378**		**0%**	**36%**	**64%**	**1%**	**194**	**2.81**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Waterproofing Sealer was one of the categories that could be included in averaging programs during 2004. Under these programs, manufacturers could sell Waterproofing Sealers with VOC levels above 250 g/l, if emissions from these products were offset by emissions from other products that had VOC levels below regulatory limits. For Waterproofing Sealers, seven percent of the total sales volume consisted of high-VOC products with VOC levels above 250 g/l. These high-VOC products accounted for approximately 0.3 tpd of VOC emissions which represents 23 percent of total emissions for Waterproofing Sealers.

Table 5.7-2b: Survey Data
Waterproofing Sealers

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	61	195,212	13%	0%	83%	17%	1%	297	0.60
WB	136	1,316,699	87%	3%	66%	31%	0%	170	0.83
Total	**197**	**1,511,911**		**3%**	**68%**	**30%**	**0%**	**186**	**1.43**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.7-3 contains complying marketshare data for the proposed new Concrete/Masonry Sealer category. This table reflects combined data for products that were reported under two previous categories: Waterproofing Concrete/Masonry Sealer and Waterproofing Sealer. However, the table does not include those products that would be classified under Basement Specialty Coating, Concrete Curing Compounds, Waterproofing Membrane, or Wood Coating. Please refer to Sections 5.2, 5.6, 5.37, and 5.38 for information about these other categories.

Table 5.7-3: Complying Marketshare & Emission Reductions
Concrete/Masonry Sealers

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
100	133	41%	0.54

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

Table 5.7-3 shows that 41 percent of the sales volume for Concrete/Masonry Sealers complies with the proposed VOC limit of 100 g/l. When considering the number of products reported, approximately 35 percent of the reported products comply with the proposed limit. Of the 68 companies that reported in this category, 41 offered Concrete/Masonry Sealers that comply with the proposed limit.

5.7.6. Product Testing Results

5.7.6.1. AVES: SCAQMD awarded a contract to AVES to develop architectural coatings with a zero or near zero content of VOC. This project included the development of a single component Waterproofing Sealer. The new coating was tested side-by-side against three single component commercially available coatings. The report for this project does not include detailed information on the commercially available coatings that were tested. (AVES, 2001)

AVES developed a zero-VOC waterborne Waterproofing Sealer with a hydrophobic acrylic copolymer resin called RESILEX®. The coating was developed for use on wood and concrete surfaces. Analysis by Gas Chromatography/Mass Spectrometry (GC/MS) confirmed that the VOC content was less than 10 g/l. This zero-VOC product was tested side-by-side against commercially available products with the following reported VOC levels: < 8 g/l (waterborne); < 400 g/l (waterborne); and <350 g/l (solventborne). Results of the testing are summarized below:

Table 5.7-4
Summary of AVES Coatings Project - Waterproofing Sealers

Substrate	Comparative Test Performed	Test Method	New Coating Performance As Compared to Commercially Available Products
Wood	Freeze/Thaw	ASTM D2243	Worse
	Moisture Vapor Transmission	ASTM D1653	Equivalent or Better
	Water Repellent Efficiency	ASTM D5401	Better
	Swell	ASTM D4446	Equivalent
	Water Uptake	Non-standard method	Equivalent

Table 5.7-4
Summary of AVES Coatings Project - Waterproofing Sealers

Substrate	Comparative Test Performed	Test Method	New Coating Performance As Compared to Commercially Available Products
Concrete	Freeze/Thaw	ASTM D2243	Worse
	Moisture Vapor Transmission	ASTM D1653	Equivalent or Better
	Beading	Non-standard method	Equivalent or Better
	Coating Penetration	Non-standard method	Better

These test results indicate that low-VOC products have inferior freeze/thaw resistance, but can provide equivalent or better performance for other performance characteristics. However, the test did not include any testing for chemical resistance, abrasion resistance, and other properties that are associated with Concrete/Masonry Sealers. Therefore, we cannot conclude that it is technologically feasible to implement a zero-VOC limit for the Concrete/Masonry Sealer category.

5.7.6.2. UMR: In 2005, the UMR Coatings Institute at the University of Missouri - Rolla conducted a coatings testing project for the South Coast AQMD. The project included tests on products classified as Waterproofing Concrete/Masonry Sealers. UMR tested some general coating properties, including: percent nonvolatile; stability; viscosity; freeze/thaw resistance; dry time; gloss; and hiding – contrast ratio. They also tested performance properties, including: alkali, acid, and stain resistance; prohesion/color change (delta E); chloride/nitrate ion screening; efflorescence; and water vapor transmission. The project was intended to test seven products, three high-VOC products (VOC > 100 g/l) and four low-VOC products (VOC $\leq$ 100 g/l). However, the South Coast AQMD conducted laboratory tests to measure the VOC contents for three of the low-VOC products and the results showed that the three products actually had VOC levels greater than 100 g/l. Therefore, the project actually involved six high-VOC products and one low-VOC product. Listed below are the products that were tested, including their published and measured VOC values.

Table 5.7-5
UMR Project - Waterproofing Concrete/Masonry Sealers That Were Tested

Manufacturer	Product Name	VOC Published Value (Measured Value)
Chem Rex	Thorocoat 200	92 g/l
Monopole	Monochem Aquaseal Silane 40-2040	86 g/l (200 g/l)
Monopole	Monochem Aquaseal Silane 20-2020	65 g/l (220 g/l)
Prosoco	StandOff #55103	270 g/l
Chem Rex	Enviroseal 40	350 g/l
Textured Coatings of America	Tex-Cote XL-70	390 g/l
Behr	#980 (low solids)	12 g/l (630 g/l)

Of the seven coatings tested, five were penetrating coatings, and two were film forming coatings. Of the five penetrating coatings, two appear to be Low Solids coatings that would not meet the proposed VOC regulatory limit of 100 g/l, but would meet the VOC actual limit of 120 g/l for low solids coatings. Of the five higher solids coatings, only one meets the 100 g/l proposed limit, and it is a film-forming coating. Therefore, the testing results for this coating group are not very instructive, since only one non-Low Solids product was tested with a VOC level below 100 g/l. Nevertheless, the one coating below 100 g/l VOC regulatory did perform comparably on most tests with the higher VOC coatings (UMR, 2006).

5.7.7. Other Issues

During the development process for the proposed SCM, ARB staff received comments regarding air barriers, which share some similarities with Concrete/Masonry Sealers. Air barriers control the unintended movement of air into and out of a building (ABAA, 2007). Air barrier systems can significantly reduce energy costs by keeping warm air inside during colder months and cool air inside during warmer months. They can also help prevent mold and mildew by controlling the transfer of water vapor. The National Institute of Standards and Technology conducted a study where they used computer modeling to determine the energy savings that could potentially be achieved by improving the airtightness of buildings. This study predicted potential cost savings from 3 percent to 36 percent for annual heating and cooling costs. The smallest savings corresponded to the warmer, cooling-dominated climates of Phoenix and Miami. The largest savings corresponded to the colder, heating-dominated climates of Bismarck and Minneapolis (NIST, 2005). Since the potential energy savings are highest in colder climates, air barriers have been used primarily in the Northeast and Midwest. However, it is expected that the use of air barriers could increase in warmer climates, such as California, as a means of improving energy efficiency and reducing greenhouse gases.

Air barrier systems can include a variety of different materials that help prevent air leakage. These materials can include sealants, sheet membranes, liquid coatings, etc. Some air barriers are membrane sheets made from bituminous materials, polystyrene, urethane insulation, phenolic insulation board, cement board, foil-backed gypsum board and other materials (JAC, 2005). Air barriers are also available in liquid form as coatings that can be applied by spray, roller, or brush. These liquid coatings can be preferable in cases where spray application is less labor-intensive than installing sheet membranes. Liquid coatings used for air barriers are generally elastomeric formulations with bituminous or acrylic resins. They are applied using sprayer, brush, or roller, to achieve dry film thicknesses from 15 to 60 mils. Spray-applied urethane foams are another type of air barrier liquid coating (MeLampy, 2007). Air barrier materials are subject to requirements for air transfer or air permeance, as determined in accordance with ASTM Standard E2178 (Standard Test Method for Air Permeance of Building Materials).

Massachusetts, Michigan, and Wisconsin have incorporated air barrier requirements into their commercial building codes and it is expected that other states will incorporate similar requirements (ABAA, 2007). The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) publishes Standard 90.1 ("Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings"). ASHRAE Standard 90.1 is used as a building energy code throughout the United States and a proposal to incorporate air barrier requirements into this standard was first introduced in 2003 (Weitz, 2006). The review and approval process is ongoing and it is expected that the update of Standard 90.1 would occur in 2010 or later. After Standard 90.1 is updated, review and implementation at the state level could take an additional three years (Weitz, 2007).

The air barrier industry is relatively new and has been primarily focused in the Northeast and Midwest. Since the use of air barrier coatings has not become very widespread in California, ARB staff has not yet obtained survey data that would be used to support a technology assessment for these products. Based on the types of products that are currently being used elsewhere, it appears that air barrier liquid coatings could potentially be covered by the Concrete/Masonry Sealer category. However, it may be necessary to evaluate these products more thoroughly to determine the appropriate VOC limit.

5.7.8. Conclusion

We recommend a 100 g/l VOC limit for Concrete Masonry Sealer coatings, effective January 1, 2010. As described above, many products that meet the proposed limit were already commercially available in 2004. Therefore, we conclude that the proposed VOC limit is technologically and commercially feasible by January 1, 2010. The proposed VOC limit is the same as the VOC limit currently in effect in the South Coast AQMD.

The proposed SCM VOC limit is lower than the national limit promulgated by the United States Environmental Protection Agency (U.S. EPA) and the VOC limit approved by the Ozone Transport Commission. Under the U.S. EPA Architectural Coating regulation, Basement Specialty Coatings would be covered by the "Waterproofing Sealers and Treatments" category which has a VOC limit of 600 g/l.

Some manufacturers requested a 250 g/l VOC limit for this category. ARB staff does not believe a 250 g/l limit is appropriate, because it would result in a 70 percent decrease in emission reductions and it is technologically feasible to formulate 100 g/l products that meet the various performance needs for Concrete/Masonry Sealers.

5.8. DRIVEWAY SEALERS

VOC Limit Table (g/l)

USEPA: 500 (Bituminous Coatings and Mastics)	Canada: N/A	OTC: N/A	SCAQMD: 100 (Traffic Coating)	SCM Proposed: 50

5.8.1. Category Definition

A coating labeled and formulated for application to worn asphalt driveway surfaces to perform one or more of the following functions:

- Fill cracks;
- Seal the surface to provide protection; or
- Restore or preserve the appearance.

5.8.2. Major Proposed Changes

- Driveway Sealer is a new category. These products were formerly covered by the "Other" default category. The proposed VOC limit decreases to 50 g/l from the default limits. For the default category, the VOC limit is dependent on whether the coating can be classified as Flat (100 g/l), Nonflat (150 g/l), or Nonflat – High Gloss (250 g/l).

5.8.3. Coating Description

Driveway Sealer is a new category that includes products formerly covered by the "Other" default category. They are coatings that are used to restore weathered asphalt driveways. Driveway Sealers can extend driveway longevity and protect against weather, erosion, oil, and gasoline. If applied and cured properly, Driveway Sealers are waterproof. These products are applied with a brush, squeegee, roller, or sprayer and they can be applied by homeowners or contractors. All of the products reported in ARB's survey are single component, asphaltic/bituminous products that leave a black finish and most are waterborne emulsions. Some Driveway Sealers must be mixed with sand or other additives to improve performance. The use of bituminous Driveway Sealers can contribute to what is known as a "heat island effect." Dark asphalt surfaces within the city can retain more heat which may result in higher mean temperatures as compared to the outlying country.

Non-bituminous Driveway Sealers (e.g., acrylic coatings) are also available throughout North America, but they do not appear to be used extensively in California for asphalt driveways. These non-bituminous products may have the ability to last longer than bituminous coatings, with potential life expectancies of up to 7 years. These coatings can also be tinted in a variety of colors, similar to the coatings applied to tennis courts. Another possible advantage for non-bituminous sealers is that they may cure faster than asphalt emulsions. With faster cure times, these products may be more suitable for application in non-temperate climates (e.g., Northeast, Midwest, etc.) that can experience unexpected rain, freezing, or heavy dew.

ARB staff identified several manufacturers that advertise acrylic sealers for asphalt driveways. These products were not sold in California during the last survey, but were sold either in Canada or the United States. These products were manufactured through USE Hickson Products Limited (Canada), Dalton Enterprise (US), and Metacrylics (San Jose, CA). The Canadian company manufactures at least three acrylic based driveway sealers that claim drying times within an hour. However, these products have VOC contents between 150 and 200 g/l. The Dalton Enterprise, Inc. company manufactures a line known as Latex-ite. This company advertises a 100% acrylic product and asphalt-emulsions with acrylic copolymers both having less than 100 g/l VOC. Metacrylics, a company located in San Jose, California, produces waterborne acrylic-bituminous emulsions that contain 50 g/l VOC. The higher VOCs reported for the above products appear to be required to maintain shorter dry times needed in the Canadian market to deal with colder, wetter climates that are more inclement.

ThorWorks Industries, Inc., manufactures acrylic sealers for pavements and concrete. These products are considered to be Concrete/Masonry Sealers because they are not specifically designed for asphaltic driveway surfaces and most had VOC contents well over 100 g/l. However, ARB staff did identify manufacturers that reported acrylic resins in the last survey, and these products were mixtures with waterborne bituminous emulsions. One of the more prevalent manufacturers of this technology is APOC/Gardner-Gibson. They produce polymer asphalt Driveway Sealers that are sold throughout California with most VOC contents near or lower than the proposed limit of 50 g/l. Therefore, it is appropriate to select a 50 g/l limit for this category in California, without adversely affecting acrylic technology in Driveway Sealers.

5.8.4. Substrates/Exposures

Driveway Sealers are used exclusively outdoors on asphalt. New asphalt driveways must cure and weather for at least 6 months prior to applying Driveway Sealers. Since driveways are continuously exposed to automotive liquids, Driveway Sealers are typically resistant to oils, gasoline, and automotive liquids.

5.8.5. Survey Results

Table 5.8-1 summarizes our estimate of sales and VOC emissions from the Driveway Sealer category based on data from the ARB survey. In 2004, the sales volume for Driveway Sealers in California was 2.2 million gallons which represents 2% of the total California sales volume for architectural coatings.

Table 5.8-1: Survey Data
Driveway Sealers

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	3	PD	PD	0%	100%	0%	0%	439	0.02
WB	38	PD	PD	0%	100%	0%	0%	2	0.02
Total	**41**	**2,205,366**		**0%**	**100%**	**0%**	**0%**	**3**	**0.04**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.8-2 shows that virtually all of the reported Driveway Sealers comply with the proposed VOC limit of 50 g/l.

Table 5.8-2: Complying Marketshare & Emission Reductions
Driveway Sealer

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
50	38	100%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

Of the six companies that reported in this category, all offered Driveway Sealers that comply with the proposed limit (ARB, 2006). Three of these companies were identified as small businesses, because they have fewer than 250 employees.

5.8.6. Conclusion

We recommend a 50 g/l VOC limit for Driveway Sealer coatings, effective January 1, 2010. The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on our review of ARB survey data , the high complying marketshare, the number of companies making compliant products, and product information from manufacturers. The proposed limit is lower than the U.S. EPA limit of 500 g/l for Bituminous Coatings. It’s also lower than the South Coast AQMD’s limit of 100 g/l for Traffic Coatings. Neither the Ozone Transport Commission (OTC) nor Canada has Driveway Sealer as a category.

5.9. DRY FOG

VOC Limit Table (g/l)

USEPA: 400	Canada: 400	OTC: 400	SCAQMD: 150	SCM Proposed:150

5.9.1. Category Definition

A coating labeled 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.

5.9.2. Major Proposed Changes

- The VOC limit for Dry Fog coatings will decrease from 400 g/l to 150 g/l.

5.9.2. Coating Description

Dry Fog coatings are similar to interior flat and nonflat coatings, but the overspray from Dry Fog coatings dries within 10 to 15 feet of application. Dry Fog (also called dry fall) coatings are used in areas where applicators want to eliminate overspray. These products will typically reflect light and provide high hiding. Conventional application is by spray, which allows excess paint drops to dry before they reach the ground. Overspray drying distances tend to be about 10 to 15 feet below the surface of application, which may vary due to weather conditions such as humidity and temperature. Overspray drying distances have increased slightly which may be due to the decrease in VOC content of the products. Some companies manufacture low-VOC Dry Fog coatings that are designed to be low-odor products that eliminate fire hazards and reduce cleanup costs.

The type of resin used has a large impact on the VOC content. Typically, Dry Fog coatings are formulated with acrylic or alkyd resins, but some products contain styrene butadiene or cellulosic resins.

The main solvent in acrylic, latex paints is water, while alkyd resins are formulated using hydrocarbon solvents. For waterborne products, coalescing agents are one of the main contributors to VOC emissions. Other contributors are additives that improve the paint, such as: resin coalescing aids, polymer plasticizers, freeze/thaw stabilizers, anti-foam agents, preservatives, thickeners and colorants. Common freeze/thaw stabilizers are glycols which prevent the paint from coagulating when frozen (Klein, 1993).

5.9.3. Substrates/Exposure

Generally, Dry Fog coatings are used in interior commercial and industrial settings. The only exterior use would be in areas such as parking garages or covered areas where the coating is not subject to weathering or moist conditions. Dry Fog coatings are applied to steel, galvanized metal and aluminum, pre-primed roof decking, concrete, and masonry. Unsuitable surfaces are high-abuse and high-corrosion areas. Application in times of high humidity is not recommended.

5.9.4. Survey Results

Table 5.9-1 summarizes our estimate of sales and VOC emissions from the Dry Fog coatings category, based on the ARB survey. In 2004, the sales volume for Dry Fog coatings was about 378,000 gallons with approximately 0.8 tpd of VOC emissions. Dry Fog coatings represent a relatively small portion of the total amount of architectural coatings in California in terms of both sales and emissions.

The sales volume for Dry Fog coatings was evenly split between waterborne and solventborne products. Solventborne Dry Fog coatings generally have VOC levels greater than 350 g/l, while waterborne coatings are around 100 g/l. The sales volume for both solventborne and waterborne Dry Fog coatings increased from 2000 to 2004. The overall sales-weighted average VOC level for Dry Fog coatings has remained relatively constant, with a negligible decrease.

Table 5.9-1: Survey Data
Dry Fog Coatings

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	36	187,112	50%	95%	0%	5%	0%	361	0.68
WB	35	190,595	50%	98%	2%	0%	2%	107	0.13
Total	**71**	**377,707**		**97%**	**1%**	**2%**	**1%**	**233**	**0.82**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.9-2 contains complying marketshare data for Dry Fog coatings, based on results from the ARB survey. This table shows that about 40 percent of the sales volume complies with the proposed VOC limit of 150 g/l. Nearly 30 of the approximately 70 products reported already comply with the proposed limit. Of the nine companies that reported in this category, eight offered Dry Fog coatings that comply with the proposed limit.

Table 5.9-2 shows that implementing the proposed 150 g/l limit would achieve approximately 0.3 tpd in VOC emission reductions for the non-South Coast AQMD portion of California, on an annual average basis.

Table 5.9-2: Complying Marketshare & Emission Reductions
Dry Fog

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
150	27	42%	0.31

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.9.5. Manufacturer Information

Several of the reported complying products were also included on Master Painter's Institute (MPI) Approved Products lists because they were certified to meet designated performance standards. MPI approved more than 25 Dry Fog coatings that comply with the proposed 150 g/l limit and meet one of the following standards: MPI #133 (Dry Fall, Water Based, for Galvanized Steel, Flat - MPI Gloss Level 1); MPI #155 (Dry Fall, Latex, "Eggshell-Like" - MPI Gloss Level 3); MPI #158 (Dry Fall, Water Based, for Galvanized Steel - MPI Gloss Level 5); and MPI #226 (Dry Fall, Latex, "Eggshell-Like" - MPI Gloss Level 5). Manufacturers of compliant, MPI-approved products include Benjamin Moore, Frazee Paint, ICI Paints, PPG, Sherwin Williams, and Vista Paint. Additional information on Dry Fog manufacturers and products is provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm).

5.9.6. Manufacturer and Industry Issues

Manufacturers claim that low-VOC waterborne products perform well on clean, newly constructed surfaces, but high-VOC solventborne products are needed for dirty surfaces that are covered in oil, dust, grease, salts and other contaminants. However, manufacturers also state that similar surface preparation is required for both low-VOC and high-VOC products. For example, Benjamin Moore and Dunn Edwards manufacture both low-VOC and high-VOC Dry Fog coatings. Both companies market their low-VOC and high-VOC Dry Fog products in exactly the same manner, and claim the same benefits for both. ARB compared product data sheets for Benjamin Moore's M50 Production Alkyd Sweep-Up Coating (high-VOC) to their M53 Sweep-Up Spray Latex Flat (low-VOC). On the product data sheet for the low-VOC product, Benjamin Moore claims that a labor saving feature is that minimal surface preparation is required, thereby reducing application cost. This is the same claim made on the product data sheet for the high-VOC coating. In addition, the low-VOC product is recommended for use in a larger variety of areas than the high-VOC product. ARB also compared the Dunn Edwards Alkylfall Alkyd Dry Fall Flat (high-VOC) to their Aquafall Latex Dry

Fall Eggshell (low-VOC) and Aquafall Latex Dry Fall Flat (low-VOC). Similar surface preparation is required for all three of the products.

5.9.7. Conclusion

ARB recommends a 150 g/l VOC limit for Dry Fog coatings, effective January 1, 2010. The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on ARB's review of survey data, the high complying marketshare, the number of companies making complying products, and product information from manufacturers. The proposed VOC limit is lower than the national limit promulgated by the U.S. EPA and OTC and the proposed limit for Canada. The proposed limit is the same as the VOC limit adopted by South Coast AQMD.

In 2004, 42% of the sales volume already complied with the proposed limit, which demonstrates the widespread use of existing low-VOC technology in formulating Dry Fog coatings. The products that are complying are also manufactured by a wide range of manufacturers, from large to small companies. The Dry Fog coatings that meet the proposed VOC limit are generally acrylic waterborne coatings. ARB staff did not identify any solventborne products that would meet the proposed VOC limit.

5.10. FAUX FINISHING

VOC Limit Table (g/l)

USEPA: 700	Canada: 350	OTC: 350	SCAQMD: 350	SCM Proposed: 350

5.10.1. Category Definition

A coating labeled and formulated to meet one or more of the following criteria:

- A glaze or textured coating used to create artistic effects including, but not limited to: dirt, suede, old age, smoke damage, and simulated marble and wood grain; or
- A decorative coating used to create a metallic, iridescent, or pearlescent appearance that contains at least 48 grams of pearlescent mica pigment or other iridescent pigment per liter of coating as applied (at least 0.4 pounds per gallon); or
- A decorative coating used to create a metallic appearance that contains less than 48 grams of elemental metallic pigment per liter of coating as applied (less than 0.4 pounds per gallon), when tested in accordance with SCAQMD Method 318-95; or
- A decorative coating used to create a metallic appearance that contains greater than 48 grams of elemental metallic pigment per liter of coating as applied (greater than 0.4 pounds per gallon) and which requires a clear topcoat to prevent the degradation of the finish under normal use

conditions. The metallic pigment content shall be determined in accordance with SCAQMD Method 318-95; or

- A clear topcoat to seal and protect a Faux Finishing coating that meets the above requirements. These clear topcoats must be sold and used solely as part of a Faux Finishing coating system and they must be labeled as such.

5.10.2. Major Proposed Changes

- The definition has been changed to clarify that Faux Finishes include metallic, iridescent, or pearlescent appearing coatings.
- The definition has been changed to include clear topcoat sealers that are exclusively sold and used for Faux Finish coating systems.

5.10.3. Coating Description

Faux Finishing coatings are used to create a variety of decorative effects. In some cases, they are used to create the illusion of natural materials (e.g., wood, marble, granite, leather, etc.) or the appearance of fabrics (denim, canvas, linen, etc.) They can also be used to make a surface look metallic, pearlescent, or aged like an antique. Faux Finishing products are often clear or translucent glazes that are mixed with Nonflat paints. The purpose of adding the Faux Finishing glaze is to increase the amount of "open time" during which the coating remains wet and workable.

Japan Finishes (or Japan Colors) are flat, quick -drying paste colors (T.J. Ronan, 2007). They are similar to the oil paints that are used by artists and they can be used as Faux Finishing coatings after mixing with a glaze.

Concrete stains are another type of product that is used to create a faux effect. On concrete floors, these stains can be used to make the concrete look like tile, marble, stone, or brick. Concrete stains are <u>not</u> included in the Faux Finishing category and are subject to the VOC limit for the Stains category.

Faux Finishing is generally a multi-stage process, as described below:

1. Apply a basecoat color and allow to dry. (Note: The coatings that are used for basecoats are usually Nonflat coatings. These coatings are <u>not</u> included in the Faux Finishing category and are subject to the VOC limit for Nonflat coatings, even though they are used as part of a Faux Finish system).
2. Mix the Faux Finishing glaze with a Nonflat paint to create a tinted glaze mixture (e.g., four quarts of Faux Finishing glaze can be mixed with one quart of a Nonflat paint).
3. Apply the Faux Finishing glaze mixture to the wall using a brush, roller, sponge, rag, or other method. While the coating is still wet, it's possible to

create a variety of effects using brushes, combs, plastic wrap, and other objects.

4. Some manufacturers recommend the use of clear topcoats to protect Faux Finishing coatings. The recommended topcoats include clear wood coatings, such as waterborne polyurethane varnishes, solventborne polyurethane varnishes, and solventborne alkyd varnishes.

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 Finishing coatings.

For the proposed SCM, the definition for Faux Finishing has been modified to include textured coatings. This modification was made to clarify that Faux Finishing coatings include textured coatings that create the look of suede, venetian plaster, granite, and other surfaces. The modification is not intended to include high-build, textured coatings that have been classified as Mastic Texture. High-build, textured coatings that are applied for waterproofing or weather resistance are subject to the VOC limits for Mastic Texture or Concrete/Masonry Sealer.

Some industry representatives requested that the Faux Finishing definition be modified to include the clear sealers that are applied over Faux Finishing coatings. Some manufacturers of Faux Finishing products recommend the use of varnishes or other clear sealers that are intended for wood. Under the proposed SCM, these types of coatings would be classified as “Wood Coatings” and their use would be restricted to wood applications only. ARB staff agreed that clear topcoat sealers should be included in the Faux Finishing definition, as long as their usage was limited to Faux Finishing coating systems only.

The definition for Faux Finishing has also been modified to clarify that it includes coatings which have a metallic appearance and contain pearlescent mica pigments. In the South Coast AQMD’s Rule 1113, “mica particles” were included in the definition for the Metallic Pigmented category. “Mica particles” can be used in a variety of coatings as a filler or extender pigment, because they are relatively inexpensive. Extender pigments can reduce coating raw material costs because they can be used as substitutes for more expensive ingredients (e.g., binders, flatting agents, thickeners, titanium dioxide pigments, etc.) (Braun, 1993). Since Rule 1113 used the term “mica particles”, some coating manufacturers interpreted the rule to mean that they could use mica to formulate Nonflat coatings and be subject to the high VOC limit for Metallic Pigmented (500 g/l), rather than the low VOC limit for Nonflat (50 g/l). South Coast AQMD found this to be an incorrect interpretation and issued a compliance advisory to that effect.

ARB's 2000 SCM did not allow for the use of "mica particles" in the definition for Metallic Pigmented; therefore, misinterpretation was not an issue. However, during the rule development efforts for the proposed SCM, ARB staff and stakeholders agreed that it would be beneficial to provide some clarification regarding the use of mica. ARB staff has proposed putting metallic-looking coatings in the Faux Finishing category and we've proposed using the term "pearlescent mica pigment", rather than "mica particles", to help prevent potential abuses. The intent is that manufacturers will only use large quantities of "pearlescent mica pigment" in coatings that are intended to create a metallic look for faux finishing types of applications. Coatings that contain non-pearlescent mica pigments will be subject to VOC limits in other categories (e.g., Flat, Nonflat, etc.)

Some Faux Finishing coatings contain a combination of pearlescent mica and metallic pigments to create metallic effects. In addition to these products, there are coatings that use only metallic pigments to create metallic effects. Some of these metallic-looking products contain less than 48 g/l of metallic pigment, so they are clearly classified under Faux Finishing and are not covered by the Metallic Pigmented category. However, there are also metallic-looking products that contain more than 48 g/l of metallic pigment, but are marketed as Faux Finishing coatings because they are used to create the appearance of aged metal (e.g., rusted iron, copper with a patina, etc.) Unlike most Metallic Pigmented coatings, these Faux Finishing products with high metal pigment contents have waterborne formulations and relatively low VOC levels (<150 g/l). For some of these products, manufacturers recommend a waterborne clear topcoat sealer (<150 g/l) to prevent damage to the surface rust or patina. The Metallic Pigmented category does not include clear topcoats and clear Wood Coatings are limited to wood substrates. In addition, the Primer, Sealer, and Undercoater category has a proposed VOC limit of 100 g/l, so the clear topcoat sealers would not be compliant in that category. Therefore, ARB staff is proposing that the Faux Finishing category include Faux Finishing products that contain more than 48 g/l of metallic pigment and require a clear topcoat sealer. Due to the relatively low VOC content of these products and their sealers, this will have a negligible impact on emission reductions.

District staff recommended that the Faux Finishing definition include a method for determining whether a coating is metallic looking and, therefore, qualifies as a Faux Finishing coating. The American Society for Testing and Materials (ASTM) has a Work Item titled "WK1164 New Standard Practice for Multiangle Color Measurement of Interference Pigmented Materials". This Work Item addresses measurement of materials containing pearlescent mica pigments (ASTM, 2003). WK1164 has not been formalized as a standard test method; therefore, ARB staff did not include it in the definition. Instead, ARB staff has proposed including definitions from ASTM E284-06b, "Standard Terminology of Appearance". If a coating has an appearance that is "metallic", "pearlescent", or "gonioapparent", as defined per ASTM E284-06b, it could qualify as a Faux Finishing coating (ASTM, 2006).

Most of the reported Faux Finishing products are waterborne coatings with acrylic or vinyl acrylic resins. There are also some solventborne products with alkyd resin and some waterborne products with polyvinyl acetate or polyvinyl alcohol. All of the Faux Finishing products are single component formulations.

5.10.4. Substrates/Exposures

Faux Finishing products are primarily used indoors, but they can also be used outdoors. These coatings are applied to wallboard, plaster, wood, concrete, masonry and brick. Clear sealers are sometimes used to provide protection over Faux Finishing coatings that are exposed to high traffic or abrasion and outdoor areas that are exposed to severe weathering.

5.10.5. Survey Results

Table 5.10-1 summarizes our estimate of sales and VOC emissions from the Faux Finishing category, as reported for the ARB survey.

Table 5.10-1: Survey Data
Faux Finishing Coatings

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	15	4,430	1%	100%	0%	0%	77%	392	0.02
WB	590	299,379	99%	98%	0%	2%	22%	255	0.32
Total	**605**	**303,810**		**98%**	**0%**	**2%**	**23%**	**257**	**0.34**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

The sales volume for Faux Finishing represents about 0.3 percent of the total California sales volume of architectural coatings in 2004. VOC emissions from Faux Finishing represent approximately 0.4 percent of the total emissions from architectural coatings. When compared to the data reported for calendar year 2000, the Faux Finishing sales volume increased 75 percent in 2004, VOC emissions increased 57 percent, and the sales-weighted average VOC content declined about 2 percent.

Table 5.10-2 contains the complying marketshare for Faux Finishing coatings in large containers, based on results from the ARB survey and the existing VOC limit of 350 g/l.

Table 5.10-2: Complying Marketshare & Emission Reductions
Faux Finishing Coatings

Existing VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
350	261	98%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

This table shows that 98 percent of the sales volume for Faux Finishing complies with the current VOC limit of 350 g/l. When considering the number of products reported, approximately 96 percent comply with the current limit. Of the 12 companies that reported in this category, 10 offered Faux Finishing products that comply with the current limit.

Faux Finishing products with VOC contents less than 100 g/l represent 42% of the sales volume for large containers and these products consist of the textured coatings (e.g., suede, granite, venetian plaster, etc.) and crackle coatings. Faux Finishing products with VOC contents less than 200 g/l represent 49% of the sales volume for large containers and these products also consist primarily of the textured and crackle coatings. Between 200-350 g/l, Faux Finishing products include pearlescent/metallic-looking coatings and the clear/translucent glazes. Faux Finishing products with VOC contents less than 300 g/l represent 60% of the sales volume for large containers.

5.10.6. Conclusion

We recommend maintaining a 350 g/l VOC limit for Faux Finishing coatings. This VOC limit is technologically and commercially feasible, based on the high complying marketshare, the number of companies making complying products, and information provided by manufacturers. It appears to be technologically feasible to formulate Faux Finishing glazes and textured coatings with VOC contents below 300 g/l. However, ARB staff is not proposing a lower VOC limit, because the potential emission reductions that would be achieved were considered to be insignificant and a lower VOC limit wouldn't capture all of the types of Faux Finishing coatings. The SCM VOC limit is lower than the national limit promulgated by the U.S. EPA. The SCM VOC limit is the same as the limit promulgated for SCAQMD and the Ozone Transport Commission and the proposed limit for Canada.

5.11. FIRE RESISTIVE

VOC Limit Table (g/l)

USEPA: 850 (clear) 450 (opaque) (includes fire-resistant and fire-retardant coatings)	Canada: 350	OTC: 350	SCAQMD: 350	SCM Proposed: 350

5.11.1. Category Definition

A coating labeled and formulated to protect structural integrity by increasing the fire endurance of interior or exterior steel and other structural materials. The Fire Resistive category includes sprayed fire resistive materials and intumescent coatings that are used to bring structural materials into compliance with federal, State, and local building code requirements. Fire Resistive coatings shall be tested in accordance with ASTM Designation E-119-07. Fire Resistive coatings and testing agencies must be approved by building code officials.

5.11.2. Major Proposed Changes

- The definition for Fire Resistive Coatings has been revised to clarify that intumescent coatings are included in this category.

5.11.3. Coating Description

The purpose of Fire Resistive coatings is to delay the onset of critical temperatures that will compromise the load-bearing capacity of the building to which the coating is applied. Fire-resistive materials and coatings themselves carry no fire-resistance rating, because a Fire Resistive coating is only one component of a total fire rated assembly. A Fire Resistive coating imparts an additional degree of resistance to the total fire rated assembly. For example, structural steel retains only about half of its design strength at 1,100^{o} F. Unprotected, a steel building structure exposed to fire may collapse under the load it was designed to carry at normal temperatures. In accordance with the acceptance criteria in ASTM E-119, a fire-resistive material must limit steel temperatures during the standard fire exposure test to 1,000 ^{o} F for columns and 1,100^{o} F for beams.

There is a critical difference between coatings defined as Fire Resistive and those defined as Fire Retardant. The latter are classified by Underwriters Laboratory under the category of Fire Retardant Coatings, and are qualified on the basis of their surface burning characteristics (such as flame spread and smoke created) and their ability to reduce the surface burning characteristics of the particular substrate to which they are applied. Unlike Fire Resistive coatings, they have not been rated for fire resistance (Falconer, 2006).

Spray-applied fire-resistant materials (SFRMs) are the most commonly used fire-resistive materials, and are referred to as low-density, gypsum-based or cementitious materials. They can be applied by means of wet spray, where the water is mixed with the dry material at the pump, or dry spray, where the water is injected at the spray nozzle. SFRMs are manufactured in various formulations designed to provide specific weights, densities, and weather resistance. Density and resistance are related to the amount of cement and other raw materials. SFRMs are classified as low-density (15 to 18 pounds per cubic foot), medium density (22 to 30 pounds per cubic foot), and high-density (+40 pounds per cubic foot). Low- and medium-density materials are generally used for interior or conditioned-space applications, although some medium-density products are designed for exterior use. SFRMs provide a thermal barrier in a fire and work to keep the temperature of the substrate from reaching a certain temperature for a given period of time. (Heemstra, 2005) This discussion on SFRMs is not intended to imply that these products are subject to the proposed SCM, but are mentioned in order to provide a more complete overview of fire-resistive materials currently in use. SFRMs that are delivered to the end-user in a dry state and mixed with water at the job site are not considered architectural coatings, and therefore are not subject to the VOC limits of the proposed SCM.

Intumescent fire-protective coatings, in contrast to conventional SFRMs, are applied in relatively thin films. (Heemstra, 2005) Intumescent coatings fall into two basic coating types: single component and multi-component coatings. The single component intumescent coating types include alkyd, acrylic, and vinyl/polyvinyl acetate products. Single component intumescent coatings are typically applied in several coats to build up thickness to the desired level. These coatings may require an exterior finish coat and must be cured prior to the finish coat being applied. Single component coatings may require mesh reinforcement, which is applied between applications of the coating. Plural-component epoxy intumescent coatings consist of high-solids materials that are typically applied in one or two applications. Plural spray is a technique that requires specialized equipment used by licensed applicators. The coatings cure very quickly and are typically ready for finish coat applications within two days. These coatings may also require mesh reinforcement, which is applied between applications of the coating. It should be noted that the required intumescent coating thickness will vary widely, depending on the specific coating product and substrate size and shape. (Helsel, 2006)

Both waterborne and solventborne commercial intumescent fire-resistive coatings are available for published fire resistance-rated assemblies for ratings up to four hours. Generally, these coatings protect structural steel by forming an intumescent char layer that insulates the structural steel from the heat of the fire. The intumescent char formation process involves the interaction of four key components:

- an acid source, typically ammonium polyphosphate;
- a carbon source that reacts with the acid to form a carbonaceous char;

- a blowing agent, such as melamine, that decomposes to liberate large volumes of non-flammable gases, including carbon dioxide, ammonia, and water vapor. The gases cause the carbonaceous char to foam, thus producing a meringue-like structure that insulates against heat; and
- a binder or resin that binds together the intumescent ingredients and provides adhesion to the substrate. The binder aids in the formation of a uniform cellular foam structure by trapping gases given off by the decomposing blowing agent, ensuring a controlled expansion of the carbonaceous char. The binder also protects the intumescent ingredients by providing resistance to water, UV light, and abrasion. (Falconer, 2006)

Fire-resistive coatings are used in the petrochemical industry for exterior surfaces at refineries and offshore platforms. They are also used in commercial areas to coat exterior and interior structural steel. Other uses include office buildings, health care facilities, multi-family housing units (such as apartments and condominiums), hotels, restaurants, and schools. They are rarely used in single family homes. (Brimo-Cox, 2005)

5.11.4. Substrates/Exposures

An important performance consideration for Fire Resistive coatings is their ability to maintain their resistive properties while exposed to environmental conditions that may exist during the material's service life. Prior to listing an intumescent Fire Resistive coating under the classification of "Mastic and Intumescent Coatings", UL requires the product to undergo a series of environmental exposures, including accelerated aging and high humidity. In addition, all products intended for exterior use, whether conventional SFRM or mastic and intumescent coatings, must be tested and qualified for exterior use to ensure that their fire-resistive performance is not compromised by exposure to weathering. Test exposures include ultraviolet light, freeze-thaw, carbon dioxide and sulfur dioxide air mixture, and salt spray. The loss of fire resistance caused by any of these interior and exterior exposure conditions cannot be greater than 25% of the fire resistance of the control sample. Fire Resistive coatings are then categorized for one or more of three purposes: conditioned interior space, interior general, or exterior. Conventional SFRMs are usually limited to interior use unless the fire test design information specifically indicates the product is qualified for exterior use. Typically, the higher-density Portland cement-based SFRMs qualify for exterior use applications. Waterborne intumescent coatings may require a topcoat to qualify for exterior and interior general use. (Falconer, 2006)

5.11.5. Survey Results

Table 5.11-1 summarizes our estimate of sales and VOC emissions from the Fire Resistive coatings category based on ARB survey results. In 2004, the sales volume for Fire Resistive coatings in California was approximately

12,500 gallons. This represents about 0.01 percent of the total California sales volume of architectural coatings.

Table 5.11-1: Survey Data
Fire Resistive

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	8	PD	PD	77%	0%	23%	0%	279	0.02
WB	1	PD	PD	100%	0%	0%	0%	18	0.00
Total	**9**	**12,557**		**91%**	**0%**	**9%**	**0%**	**123**	**0.02**

(ARB, 2006)
1. PD = Protected Data. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

For Fire Resistive coatings, the sales volume during 2000 was protected data; therefore, we are unable to comment on whether the sales volume increased or decreased from 2000 to 2004.

VOC emissions from Fire Resistive coatings are about 0.02 tpd, which represents approximately 0.02 percent of the total emissions from architectural coatings. From 2000 to 2004, the VOC emissions increased approximately 50 fold and the sales-weighted average VOC content increased 177% from 45 g/l to 123 g/l.

Table 5.11-2 contains complying marketshare data for Fire Resistive coatings, based on results from the ARB survey. This table shows that about 99 percent of the sales volume for Fire Resistive coatings complies with the existing VOC limit. Eight of the nine products reported already comply with the existing limit. Of the four companies that reported in this category, three offered Fire Resistive coatings that comply with the existing limit. Products with a VOC content equal to or lower than 350 g/l represent about 99 percent of the market. (ARB, 2006)

Table 5.11-2: Complying Marketshare & Emission Reductions
Fire Resistive

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
350	8	99%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.11.6. Conclusion

We recommend no change to the 350 g/l VOC limit for Fire Resistive coatings, based on complying marketshare, the number of companies making complying products, and product information from manufacturers. The high marketshare complying with the existing limit demonstrates widespread use of existing technology for formulating Fire Resistive coatings. Keeping the existing limit will allow for a wide range of product types, including solventborne and waterborne, necessary in the various environments in which Fire Resistive coatings are used. The existing VOC limit is lower than the national limit promulgated by the U.S. EPA for this category. A limit of 350 g/l is consistent with the limits in effect for the South Coast AQMD and the Ozone Transport Commission, and the proposed limit for Canada.

5.12. FLAT

VOC Limit Table (g/l)

USEPA: 250	Canada: 100	OTC: 100	SCAQMD: 50	SCM Proposed: 50

5.12.1. Category Definition

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).

5.12.2. Major Proposed Changes

- The VOC limit for Flat coatings will decrease from 100 g/l to 50 g/l.

5.12.3. Coating Description

Flat coatings are generally used in low traffic areas, for decorative purposes, and to provide good hiding. Flat coatings leave a matte finish, with no gloss or shine. The Flat finish tends to minimize surface irregularities and imperfections. They are widely used on both residential and commercial buildings. These coatings are typically used to paint ceilings and walls in living rooms, dining rooms, guest bedrooms, and halls that are not subject to heavy use (Consumer Reports, 2003). Flat coatings are not typically used in bathrooms or kitchens because they generally have less moisture resistance than Nonflat coatings.

Flat coatings can be brushed, rolled, or sprayed onto desired substrates. Application typically requires surfaces that are cured, firm, dry, and cleaned free of dust, dirt, oil, grease, wax, chalk, mildew or anything that could contaminate or affect the performance of the coating. Most Flat coatings are single component, waterborne products that allow for a soap and water cleanup. All of the reported products with VOC contents at or below 100 g/l are single component, waterborne formulations.

Some manufacturers market “zero VOC” Flat coatings by emphasizing environmental benefits, “low odor” qualities, and “quick return to service.”

Because of these features, manufacturers stress the coatings' suitability for use in enclosed, centrally-ventilated buildings that need to be occupied soon after painting (e.g. schools, office buildings, hospitals, restaurants, hotel rooms and residences).

Formulations for Flat coatings are similar to Nonflat formulations, but Flat coatings may contain more pigment and softer resins. With the use of softer resins, less coalescing agent is needed, which provides advantages for developing low-VOC products. When low-VOC Nonflat coatings are formulated with soft resins, the film can remain sticky and subject to dirt pickup and fingerprints, but this is less of an issue with Flat coatings which contain more pigment and less resin. The most prevalent resins for Flat coatings are vinyl acrylic and 100% acrylic, which are commonly called latex. Flat coatings are generally not used in areas of high moisture, so they can be formulated with vinyl acrylic resins that are often softer than 100% acrylic resins.

Although most Flat coatings are waterborne, the VOCs in latex coatings come from additives such as resin coalescing aids, polymer plasticizers, freeze/thaw stabilizers and anti-foam agents. These additives help create homogeneous films, improve block and print resistance, prevent coagulation, ease application, and reduce defects formed during application. Other additives that contribute to the VOC content are preservatives, thickeners and colorants. Resin coalescing aids and freeze/thaw stabilizers are the two main contributors to VOCs in Flat coatings (Klein, 1993). Currently, most Flat coating manufacturers use ester alcohols (e.g., Texanol®) as coalescing agents. Freeze/thaw stabilizers are glycols (e.g., ethylene glycol or propylene glycol) that help prevent the paint from coagulating or solidifying when exposed to freezing temperatures and provides more "open time".

Most Flat coatings are already waterborne and the proposed VOC limit will require most of these products to be reformulated using lower-VOC technology. This will involve choosing the appropriate combination of resin, coalescing agent, and additives. Many Flat coatings already contain minimal amounts of the glycols required to achieve freeze/thaw resistance, and it is expected that some reformulations will further reduce the amount of glycols and make products more vulnerable to freeze/thaw damage. However, some manufacturers have overcome this potential problem by using heated delivery vehicles and heated warehouses. In addition, a large portion of California has a relatively mild climate that is rarely subject to freezing temperatures, so freeze/thaw resistance is less critical in those areas. Other manufacturers may reduce the amount of coalescing agents because it is more technologically feasible to reduce coalescing agents from flats than non-flats. This is due to the fact that flats contain more pigment and extender pigments, they contain less resin, and they use softer resins.

5.12.4. Substrates/Exposures

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. They are also used on exterior walls and overhangs. Generally, temperatures of application are limited to above 50 degrees F.

5.12.5. Survey Results

Table 5.12-1 summarizes our estimate of sales and VOC emissions from the Flat coatings category based on the ARB survey. Flat coatings represent the largest coating category in terms of sales volume and VOC emissions. In 2004, the sales volume for Flat coatings in California was approximately 37 million gallons. This represents about 34 percent of the total California sales volume for architectural coatings. Emissions from Flat coatings in 2004 were about 14 tpd, which is about 15% of the total emissions from architectural coatings.

Waterborne Flat coatings dominate the market. There were 15 solventborne products reported in the Survey, but these products only account for about $1/100^{th}$ of a percent of the Flat coatings category. From 2000 to 2004, the sales volume for solventborne coatings decreased by 0.1%, while overall sales of Flat coatings remained relatively constant. The overall sales-weighted average VOC level for Flat coatings decreased more than 16 percent from 98 g/l to 82 g/l.

Flat coatings were one of the categories that could be included in averaging programs during 2004. Under these programs, manufacturers could sell Flat coatings with VOC levels above 100 g/l, if emissions from these products were offset by emissions from other products that had VOC levels below regulatory limits. For Flat coatings, one percent of the total sales volume consisted of high-VOC products with VOC levels above 100 g/l. These high-VOC products accounted for approximately 0.3 tpd of VOC emissions which represents two percent of the total emissions from Flat coatings.

Table 5.12-1: Survey Data
Flat Coatings

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	14	4,082	0%	2%	92%	7%	2%	331	0.02
WB	2,770	37,260,792	100%	49%	36%	15%	2%	82	13.79
Total	**2,784**	**37,264,874**		**49%**	**36%**	**15%**	**2%**	**82**	**13.80**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.12-2 contains complying marketshare data for Flat coatings, based on results from the ARB survey. This table shows that about seven percent of the sales volume for Flat coatings complies with the proposed VOC limit. Over 350 of the approximately 2,800 products reported already comply with the proposed limit. Of the 46 companies that submitted data for this category, 28 offered Flat coatings that comply with the proposed limit.

Table 5.12-2 shows that implementing the proposed 50 g/l limit would achieve approximately 3 tpd in VOC emission reductions for the non-South Coast AQMD portion of California, on an annual average basis.

Table 5.12-2: Complying Marketshare & Emission Reductions
Flat Coatings

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
50	358	7%	3.12

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.12.6. Product Testing Results

Consumers Union: Consumers Union, an independent nonprofit organization, recently published test results for interior Flat coatings. Tests were performed on 20 interior Flat coatings that were marketed as high-grade products. Each product was tested using three colors that represented the basic tint bases.

Of the 20 products that were tested, 4 products comply with the proposed VOC limit of 50 g/l. Out of a possible score of 100, the complying products scored in the range of 51-79, while the highest score for any product was 85. Coatings were tested for hiding ability, surface smoothness, staining, scrubbing, gloss change, blocking, mildew, and fading. The products that were tested performed fairly well in all of the categories tested (Consumer Reports, 2006; 2006a).

The results obtained show that current technology exists to comply with the proposed VOC limit of 50 g/l. The number of compliant products that were available at the time of ARB's 2005 survey was relatively limited but, since 2004, additional compliant products have entered the market and it is expected that a much larger number of compliant products will be available by the implementation date in 2010.

5.12.7. Manufacturer Information

There were 358 products that were submitted in the 2005 Architectural Coatings Survey that comply with the proposed VOC limit. From the information provided on manufacturers' product data sheets, the low-VOC compliant coatings have similar properties to high-VOC coatings. The low-VOC products seem to provide equal protection from staining, scrubbing and everyday use. In addition, manufacturers claim that the low-VOC compliant products possess the following properties:

Properties of Interior Flat Coatings (<50 g/l)
- Appearance/Aesthetics
- Excellent Hide
- Touch-Up
- Removal of Household Stains
- Scrub Resistance
- Fast Drying
- Scuff/Mar Resistance
- Low Odor
- Good Adhesion
- Spatter Resistance
- Non Yellowing

Properties of Exterior Flat Coatings (<50 g/l)
- Durability
- Hides Imperfections
- Color Retention
- Fade Resistance
- Chalk Resistance
- Mildew Resistance
- Dirt Pickup Resistance
- Alkali/Efflorescence Resistance over Stucco and Masonry
- Tanin Stain Resistance
- Superior Adhesion

Several of the reported complying products were also included on Master Painter's Institute (MPI) Approved Products lists because they were certified to meet designated performance standards. MPI approved 21 Flat coatings that comply with the proposed 50 g/l limit and meet the following standards: MPI #10 (Latex, Exterior Flat - MPI Gloss Level 1); MPI #53 (Latex, Interior, Flat - MPI Gloss Level 1); and MPI #143 (Latex, Interior, Institutional Low Odor/VOC, Flat - MPI Gloss Level 1). Approved products include PPG Pure Performance, Kelly Moore Enviro-Cote, and Vista Paint Coverall Exterior Flat paints.

5.12.8. Manufacturer and Industry Issues

5.12.8.1. Issue: A number of manufacturers expressed concerns about formulating a quality exterior Flat coating that can comply with the proposed VOC limit of 50 g/l and achieve consumer acceptance. Exterior Flat coatings are exposed to weathering and UV light, so consumers want products with properties such as durability, color retention, fade resistance, chalk resistance, mildew resistance, dirt pickup resistance, and alkali/efflorescence resistance.

Response: ARB staff considered separating the Flat category into interior and exterior categories, but they determined that it was unnecessary because it is technologically feasible to formulate exterior Flat coatings that can comply with a 50 g/l limit. In addition, it was believed that the enforcement of a different VOC limit for exterior and interior flats would be problematic.

In 2004, four percent of the sales volume for exterior Flat coatings complied with a 50 g/l VOC limit and nine percent of the sales volume for interior products was compliant with a 50 g/l limit. Since that time, many manufacturers have introduced new low-VOC exterior Flat coatings, because the 50 g/l limit in South Coast AQMD Rule 1113 will become effective in 2008. While there are more interior products on the market that fall below the proposed VOC limit, ARB staff believe that it is technologically feasible to formulate low-VOC exterior Flat coatings by 2010.

5.12.8.2. Issue: One manufacturer recommended that ARB increase the proposed VOC limit to 75 g/l to accommodate Flat coatings that are applied to tilt-up concrete in areas with high temperatures and desert conditions. The manufacturer claimed that these coatings will experience a decrease in adhesion, alkali resistance, flow, and leveling, if they don't contain additional VOCs.

Response: The proposed SCM contains a Concrete/Masonry Sealer category for products that are applied to new tilt-up concrete. The proposed VOC limit for this category is 100 g/l. Several manufacturers are currently providing products that can be classified as Concrete/Masonry Sealers and are intended for application on new tilt-up concrete, including Benjamin Moore, BASF Building Systems, Glidden/ICI, and Seal-Krete. These products would then be subject to the 100 g/l limit of the Concrete/Masonry Sealers. Therefore, ARB staff determined that it is not necessary to increase the proposed VOC limit for Flat coatings.

5.12.9. Conclusion

We recommend a 50 g/l VOC limit for Flat Coatings, effective January 1, 2010. The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on the number of companies making complying products, testing data, and product information from manufacturers. Based on data for calendar year 2004, the complying marketshare is 7 percent which is relatively low. However, when considering Flat, Nonflat, and Nonflat High Gloss categories, ARB staff believes that the Flat category has the best potential for meeting a 50 g/l VOC limit because Flat coatings have less resin, more pigments and extenders, and the best ability to use softer resins. Therefore, Flats can withstand the decreased quantities of coalescing solvent and propylene or ethylene glycol. In addition, ARB staff plan to conduct a technology assessment prior to 2010 to ensure that the 50 g/l limit is feasible.

The proposed VOC limit is lower than the national limit promulgated by the U.S. EPA and OTC, and the proposed limit for Canada. The proposed limit is consistent with the limit adopted by the South Coast AQMD that will become effective on July 1, 2008.

5.13. FLOOR

VOC Limit Table (g/l)

USEPA: 400	Canada: 250	OTC: 250	SCAQMD: 50	SCM Proposed: 100

5.13.1. Category Definition

An opaque coating that is labeled and formulated for application to flooring, including, but not limited to, decks, porches, steps, garage floors, and other horizontal surfaces which may be subject to foot traffic.

5.13.2. Major Proposed Changes

- The VOC limit for Floor coatings will decrease from 250 g/l to 100 g/l.
- The definition is being modified to clarify that the Floor category is intended for garage floors and porch/deck/stair applications.

5.13.3. Coating Description

Floor Coatings cover a wide range of applications and functions. However, the Floor Coating category is not intended for products that are applied to industrial/institutional/commercial floors or clear coatings for wood floors. Those types of products would be covered by other categories (e.g., Concrete/Masonry Sealer, Industrial Maintenance, Wood Coating, etc.) Provided below is a description of the primary applications, based on the products reported in ARB's 2005 Architectural Coating Survey.

Porch, Deck, and Stairs: These products are opaque coatings for patios, porches, stairs, balconies, pool decks, and other similar surfaces that may be subject to foot traffic. Many products are also recommended for basements, but they don't offer protection against water intrusion from below-grade hydrostatic pressure. Gloss levels range from flat to high gloss and some products have non-skid or anti-slip properties. Many products are designed to be resistant to abrasion, water, detergents, and oil. Application methods include brush, roller, spray, squeegee, and trowel, and products can either be applied by professional contractors or homeowners. Some floor coatings are single component solventborne or waterborne formulations with resin types that include: alkyd, urethane, polyurethane, acrylic, acrylic copolymer, and epoxy. Floor coatings are also available in multi-component solventborne formulations with resin types that include: epoxy, urethane, and polyurethane. Overall, Porch/Deck/Stair coatings that can comply with the proposed 100 g/l limit represent 69% of the reported sales volume for this group (not including small containers).

Garage Floors: These products are opaque coatings for garage floors that are designed to be resistant to abrasion, hot tire pick up, and some chemicals (e.g., oil, grease, and gasoline stains). Most of the sales volume for garage floor products consists of single component, waterborne, acrylic epoxy formulations that are compliant with the proposed 100 g/l VOC limit. Other formulation types include multi-component waterborne epoxies and single component waterborne products with acrylic and polyurethane resins. Overall, Garage Floor coatings that can comply with the proposed 100 g/l limit represent 99.9% of the reported sales volume of this group (not including small containers). Products can either be applied by homeowners or professional contractors and application methods include brush, roller, and sprayer. Prior to application, it is usually necessary to etch the concrete by using muriatic acid or some other etching solution. After etching, the surface must be neutralized or cleaned, thoroughly rinsed, and dried before coatings can be applied. Garage floor coatings need to be fully cured before they are strong enough to withstand vehicle traffic. Therefore, it is usually recommended that the coatings be allowed to cure for 5 - 7 days before allowing vehicle traffic.

Sports Surfaces: These products are used on sports surfaces (e.g., tennis courts, running tracks, playgrounds, ball courts, and gymnasium floors). The coatings are generally designed to provide abrasion resistance and withstand wear from foot traffic. Many have non-skid or anti-slip properties and some are also resistant to fading from exterior exposure to ultraviolet light. Most are opaque, but some are also available in clear formulations. Clear products that are applied to wood gymnasium floors would not be included in the Sports Surfaces group, because those coatings are covered by the Wood Coatings category. In addition, there are some products in the Concrete/Masonry Sealer category that are primarily marketed as deck coatings, but can also be used on tennis courts. Sports Surfaces products can be applied by professional contractors or homeowners and application methods include sprayer, roller, brush, and squeegee.

Most of the reported sales volume for the Sports Surfaces group involves coatings that are used in conjunction with rubber granules to create a cushioned surface. These products for cushioned surfaces are either single component, solventborne polyurethanes with VOC values above 200 g/l or multi-component, solventborne polyurethanes with VOC values below 50 g/l. Other Sports Surfaces products for non-cushioned surfaces are either multi-component, solventborne polyurethanes or single component, waterborne acrylics. For cushioned surfaces only, products that meet the 100 g/l VOC limit represent 5% of the sales volume (not including small containers). For non-cushioned surfaces only, products that meet the 100 g/l VOC limit represent 77% of the sales volume (not including small containers). For all Sports Surfaces products, 11% of the sales volume meets the 100 g/l VOC limit (not including small containers).

5.13.4. Substrates/Exposures

Floor coatings are typically applied to concrete, wood, and asphalt substrates, with both interior and exterior exposures. Coatings are used on a variety of surfaces, such as wood porches and stairs; concrete garage floors; wood gymnasium floors; concrete patios and pool decks; running tracks; and concrete tennis courts.

5.13.5. Survey Results

Table 5.13-1 summarizes our estimate of sales and VOC emissions from the Floor coatings category, based on the ARB survey. In 2004, the sales volume for Floor coatings in California was 1.2 million gallons. This represents about one percent of the total California sales volume of architectural coatings.

Table 5.13-1: Survey Data
Floor Coatings

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	105	71,170	6%	1%	0%	99%	5%	239	0.19
WB	273	1,168,722	94%	7%	0%	92%	1%	98	0.53
Total	**378**	**1,239,892**		**7%**	**0%**	**93%**	**1%**	**106**	**0.72**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

ARB staff compared the results from ARB's two most recent architectural coating surveys which gathered sales data for calendar years 2000 and 2004. Sales of Floor coatings declined 13% and emissions declined 17% from 2000 to 2004. The sales-weighted average VOC Regulatory value increased 5%. These changes reflect a refinement of the products that were included in this category. As part of the SCM rule development process, ARB staff did a careful review of all products that were reported in the Floor Coating category to ensure that they were in one of the following groups: Porch/Deck/Stair; Garage Floor; or Sports Surfaces. Products that didn't fit into these groups were moved to more appropriate categories (e.g., Waterproofing Concrete/Masonry Sealer; Industrial Maintenance, etc.)

Table 5.13-2 contains the complying marketshare for Floor coatings in large containers, based on results from the ARB survey. There are more than 160 Floor coating products that comply with the proposed VOC limit. Of the 25 companies that reported in this category, 16 offered Floor coatings that comply with the proposed limit. Products with a VOC content equal to or lower than 50 g/l represented 0.4 percent of the reported sales volume.

Table 5.13-2 shows that implementing the proposed 100 g/l limit would achieve approximately 0.07 tpd in VOC emission reductions for the non-South Coast AQMD portion of California, on an annual average basis.

Table 5.13-2: Complying Marketshare & Emission Reductions
Floor Coatings

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
100	168	85%	0.07

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.13.6. Product Testing Results

The South Coast AQMD awarded KTA-Tator, Inc. a contract to perform a technology assessment of zero-and-low-VOC coatings with respect to their availability and performance characteristics on March 1, 2001. They tested six floor products, with the intention of evaluating three low-VOC products below 100 g/l and three high-VOC products above 100 g/l. The selection of these products was based on manufacturers' published VOC contents, but laboratory analysis showed that only one product actually had a measured VOC content that was below 100 g/l (zero VOC), while the remaining five had VOC contents ranging from 111 g/l to 308 g/l. Based on the data, the results indicate that the performance was comparable for the three lower VOC products (measured VOC from zero to 112 g/l) and the three higher VOC products (measured VOC from 136 to 308 g/l). Although one of the low VOC products had a very slow dry time, it had excellent abrasion resistance (SCAQMD, 2002).

5.13.7. Conclusion

We recommend a 100 g/l VOC limit for Floor coatings, effective January 1, 2010. The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on the high complying marketshare, the number of companies making complying products, and information provided by manufacturers. The proposed VOC limit is lower than the national limit promulgated by the U.S. EPA, OTC states, and Canada for this category. The proposed VOC limit is higher than the 50 g/l limit contained in SCAQMD Rule 1113. However, manufacturers that provide coatings in the SCAQMD area can still sell products which exceed the 50 g/l limit, if they participate in SCAQMD's averaging program. The proposed SCM does not contain an averaging provision, so all manufacturers will be subject to the same limit.
In addition, ARB staff research reviewed lists of low-VOC products that could be applied to floors and had VOC contents near or below 50 g/l. Under the SCM, almost all of the products that were reviewed would be classified as Concrete/Masonry Sealers or Industrial Maintenance coatings, rather than Floor

Coatings. Since Floor Coatings need to stand up to abrasion from pedestrian traffic, it has been challenging to develop resins that can be used to formulate 50 g/l products with acceptable performance. Therefore, ARB staff believes that the proposed 100 g/l VOC limit is most appropriate at this time.

5.14. FORM RELEASE COMPOUNDS

VOC Limit Table (g/l)

USEPA: 450	Canada: 250	OTC: 250	SCAQMD: 250	SCM Proposed: 250

5.14.1. Category Definition

A coating labeled 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.

5.14.2. Major Proposed Changes

- None.

5.14.3. Coating Description

Concrete forms are generally made of wood, metal, or fiberglass and they provide shape and support during the concrete pouring and curing process. Form Release Compounds are applied on the forms in a thin film to prevent the freshly poured concrete from sticking to the form. They can also help provide a smooth concrete surface by preventing bugholes or air voids. Form Release Compounds are designed so they do not stain the concrete surface or leave a residue that could interfere with the adhesion of concrete sealers or coatings. On wooden forms, repeated use of Form Release Compounds can provide a water repellent coating that can extend the useful life of the form. Some products contain rust inhibitors that help prevent rusting of metal forms. Form Release Compounds are often formulated to meet the Corps of Engineers specifications CE-204, section 3-03-K or CW-03101 (now known as the Unified Facilities Guide Specifications, section 03 11 14.00 10, “Formwork for Concrete”). Products are usually applied by professional contractors and application methods include sprayer, brush, roller, and wiping on with a cloth. All of the Form Release Compounds that were reported in the ARB survey are single component products sold in large containers and they fall into two main groups:

- Chemically Reactive: These products react with the alkali or lime in the concrete to form a slippery film.
- Non-Reactive: These products provide an oily film, but they do not react with the concrete.

Chemically Reactive: These Form Release compounds react with the alkali or lime in the concrete to form a slippery film that prevents concrete from sticking to the forms. Products are available in waterborne formulations (oleoresins and paraffin oils) and solventborne formulations (fatty acids, mineral oils, naphthenic oils, oleoresins, paraffin oils, soybean oils, and tall oils). They generally don't contain fuel oils or kerosene and some are designed to be biodegradable. Many products are not suitable for use on molds made of latex, plaster, rubber, or foam. In addition, some are not suitable for tilt-up construction. Both solventborne and waterborne formulations are available with VOC contents less than 100 g/l. For the Chemically Reactive group, these <100 g/l products represent 12% of the sales volume. Products with VOC contents less than 200 g/l represent 14% of the sales volume, while 81% of the products in this group have VOC contents between 200 -250 g/l.

Non-Reactive: These products provide an oily film, but they do not react with the concrete. Most of the reported products are solventborne formulations (naphthenic oils, paraffin oils, petroleum distillates, mineral oils, and vegetable oils), but there are also waterborne formulations (vegetable oil emulsions). Some products are not suitable for use on molds made of latex, expanded polystyrene, rubber, or styrene-butadiene rubber (SBR). In addition, some are not suitable for tilt-up construction. For the Non-Reactive group, products with VOC contents less than 200 g/l represent 0% of the sales volume, while 99% of the products have VOC contents between 200 -250 g/l.

5.14.4. Substrates/Exposures

Form Release Compounds are applied to substrates that include, but are not limited to, wood, metal, and fiberglass. They are temporary coatings, so they are not designed to withstand long-term exposure to chemicals or the elements.

5.14.5. Survey Results

Table 5.14-1 summarizes our estimate of sales and VOC emissions from the Form Release Compounds category, based on the ARB survey.

Table 5.14-1: Survey Data
Form-Release Compound Coatings

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	28	284,655	88%	0%	4%	96%	0%	243	0.79
WB	11	38,957	12%	0%	3%	97%	0%	158	0.01
Total	**39**	**323,612**		**0%**	**4%**	**96%**	**0%**	**233**	**0.80**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

The sales volume for Form Release Compounds represents about 0.3 percent of the total California sales volume of architectural coatings in 2004. VOC emissions from Form Release Compounds represent approximately 1.8 percent of the total emissions from architectural coatings. When compared to the data reported for calendar year 2000, the sales volume for Form Release Compounds increased 27 percent in 2004, VOC emissions increased 31 percent, and the sales-weighted average VOC content increased 9 percent.

Table 5.14-2 contains the complying marketshare for Form Release Compounds, based on results from the ARB survey. This table shows that 97 percent of the sales volume for Form Release Compounds complies with the current VOC limit of 250 g/l. When considering the number of products reported, approximately 87 percent comply with the current limit. Of the 11 companies that reported in this category, 9 offered Form Release Compounds that comply with the current limit.

Table 5.14-2: Complying Marketshare & Emission Reductions
Form-Release Compound Coatings

Current VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
250	34	97%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.14.6. Conclusion

For some limited applications, it appears to be technologically feasible to use products with VOC contents less than 100 g/l, if they are formulated to chemically react with the concrete. However, these low-VOC products seem to have more substrate limitations and would not be suitable for as many uses as the products with non-reactive formulations. Therefore, we recommend that the VOC limit for Form Release Compounds remain at 250 g/l at this time. The current VOC limit is technologically and commercially feasible, based on complying marketshare, number of companies making complying products, and product information from manufacturers. The current VOC limit is lower than the national limit promulgated by the U.S. EPA for this category. The current limit of 250 g/l VOC is consistent with the limits in effect for the South Coast Air Quality Management District, the Ozone Transport Commission, and the proposed limit for Canada.

5.15. GRAPHIC ARTS

VOC Limit Table (g/l):

USEPA: 500	Canada: 500	OTC: 500	SCAQMD: 500	SCM Proposed: 500

5.15.1. Category Definition

A coating labeled and formulated for hand-application by artists using brush, airbrush, or roller techniques to indoor and outdoor signs (excluding structural components) and murals including lettering enamels, poster colors, copy blockers, and bulletin enamels.

5.15.2. Major Proposed Changes

- The definition was modified to include the use of airbrushes as an application method.

5.15.3. Coating Description

Graphic Arts coatings (or sign paints) are typically used for decorative applications, such as outdoor advertising billboards, metal highway signs, commercial signs, and safety warning signs. The use of paints on billboards has declined, because most billboard signs are now pre-printed and attached to the billboard on site. The graphic arts category includes primers, topcoats, and clear finish topcoats that are used on stationary signs. It also includes copy blockers which are used to “white-out” an old sign prior to painting a new sign.

The Graphic Arts category does NOT include the following types of applications -

- Coatings that are used on the structural components of billboards. These coatings would be covered by another category (e.g., Flat, Nonflat, Rust Preventative, etc.)
- Coatings that are used to paint line markings on gym floors, athletic fields, or playgrounds. Coatings that are used to paint lines on wood gym floors would be covered by the Wood Coating category. Coatings for striping on athletic fields are usually covered by the Flat category. Coatings for playgrounds could be covered by Flat, Nonflat, or Concrete/Masonry Sealer, depending on the substrate and type of product.

- Coatings that are used to paint signs on the exterior or interior wall of a building. These coatings would be covered by another category (e.g., Flat, Nonflat, Rust Preventative, etc.).
- Coatings that are used to paint temporary vinyl banner signs or canvas backdrops for theaters. Some local air districts have specific rules that contain VOC limits for coatings used on fabrics.
- Signs painted in a shop or factory are not Architectural Coatings.

The Graphic Arts coatings that were reported in the survey are single component formulations consisting of solventborne alkyds or waterborne acrylics. All of the solventborne products have VOC contents less than 450 g/l and all of the waterborne products have VOC contents less than 300 g/l. Graphic Arts coatings can be used by professional artists or homeowners and application methods include brush, roller, and spray.

5.15.4. Substrates/Exposures

Substrates for Graphic Arts coatings include wood, metal, concrete, masonry, masonite, fiberglass, plastic, and vinyl surfaces.

5.15.5. Survey Results

Table 5.15-1 summarizes our estimate of sales and VOC emissions from the Graphic Arts category, based on ARB survey results.

Table 5.15-1: Survey Data
Graphic Arts Coatings

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	91	PD	PD	0%	0%	100%	87%	385	0.01
WB	43	PD	PD	0%	0%	100%	55%	211	0.00
Total	**134**	**PD**		**0%**	**0%**	**100%**	**80%**	**352**	**0.02**

(ARB, 2006)

1. PD= Protected Data. Sales data are protected, because fewer than three companies provided survey data.
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.15-2 contains the complying marketshare for Graphic Arts coatings, based on the ARB survey. This table shows that all of the products and all of the sales volume comply with the current limit. No emission reductions are expected because ARB staff is not proposing a change to the VOC limit.

Table 5.15-2: Complying Marketshare & Emission Reductions
Graphic Art Coatings

Existing VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
500	134	100%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.15.6. Conclusion

We recommend maintaining a 500 g/l VOC limit for Graphic Arts coatings. This VOC limit is technologically and commercially feasible, based on the high complying marketshare. It appears to be technologically feasible to formulate Graphic Arts coatings with VOC contents below 500 g/l. However, ARB staff is not proposing a lower VOC limit, because the potential emission reductions that would be achieved were considered to be insignificant. The SCM VOC limit is the same as the VOC limits promulgated for the SCAQMD, the Ozone Transport Commission, and the United States Environmental Protection Agency (U.S. EPA). The SCM VOC limit is also the same as the limit proposed for Canada.

5.16. HIGH TEMPERATURE

VOC Limit Table (g/l)

USEPA: 650	Canada: 420	OTC: 420	SCAQMD: 420	SCM Proposed: 420

5.16.1. Category Definition

A high performance coating labeled and formulated for application to substrates exposed continuously or intermittently to temperatures above 204 °C (400 °F).

5.16.2. Major Proposed Changes

- None.

5.16.3. Coating Description

High Temperature coatings are primarily used to protect metal substrates from exposure to temperatures above 204 ˚C (400 ˚F). This temperature is higher than what Industrial Maintenance coatings will withstand (250 ˚F). This type of coating will generally be used in industrial environments (e.g., chemical plants, marine structures, ships, power plants and refining plants) where metal equipment such as stacks, furnaces, piping, boilers, heat exchangers and hot process tanks are subject to high temperatures. Typical methods of application are by airless spray, conventional spray, brush, and roller. It is important to apply the coating at a dry film thickness (DFT) that is close to the DFT recommended by the manufacturer. Applying a coating that is too thick makes the coating subject to cracking, blistering and a loss of adhesion to the substrate. High Temperature coatings are available in limited colors. Pigments that vary from the “natural” aluminum decrease the heat resistance (JPCL, 1999).

The typical resin that is used to formulate High Temperature coatings is a silicone acrylic, but resin types include other forms of siloxane (e.g., aluminum or modified). Silicone acrylics soften at elevated temperatures, so manufacturers recommend that a zinc silicate primer be applied to increase corrosion resistance and the mechanical properties of the High Temperature coating. Generally, for metal surfaces that are subject to temperatures of 450 ˚C to 540 ˚C, it is recommended that one to two coats of a silicone aluminum topcoat be used over a zinc silicate primer (JPCL, 1999).

Because of the resins that are used, the carrier solvent is generally an aliphatic hydrocarbon. All of the products reported in this category are solventborne products and most have single component formulations.

5.16.4. Substrates/Exposures

The primary substrate for High Temperature coatings is metal, but other substrates include concrete and masonry. High Temperature coatings can be used on both interior and exterior substrates. Surface preparation is crucial for high temperature coatings; surfaces must be free from imperfections, halogens and any other contamination. Since surface preparation is crucial, manufacturers recommend methods that are similar to those for Industrial Maintenance coatings (e.g., abrasive blasting or other mechanical methods).

5.16.5. Survey Results

Table 5.16-1 summarizes our estimate of sales and VOC emissions from the High Temperature coatings category, based on the ARB survey. High Temperature coatings represent a small portion of sales of architectural coatings. In 2004, the sales volume for High Temperature coatings in California was approximately 12,000 gallons. This represents less than 0.01 percent of the total California sales volume of architectural coatings.

Solventborne High Temperature coatings dominate the market. Although the number of solventborne products has remained relatively constant, the sales volume for High Temperature coatings dropped approximately 50 percent from 2000 to 2004. The overall sales-weighted average VOC level for High Temperature coatings has remained relatively constant from 2000 to 2004.

VOC emissions from High Temperature coatings are about 0.05 tpd, which represents less than 0.01 percent of the total emissions from architectural coatings.

Table 5.16-1: Survey Data
High Temperature

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers [2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	83	11,736	100%	9%	0%	91%	31%	407	0.05
WB	0	0	0%	NA	NA	NA	NA	NA	0
Total	**83**	**11,736**		**9%**	**0%**	**91%**	**31%**	**407**	**0.05**

(ARB, 2006)

1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.16-2 contains the complying marketshare for High Temperature coatings, based on the ARB survey. This table shows that 90 percent of the existing sales volume for High Temperature coatings complies with the current VOC limit. Of the 9 companies that reported in this category, 5 offered High Temperature coatings that comply with the current limit. No emission reductions are expected, because ARB staff is not proposing a change to the VOC limit.

Table 5.16-2: Complying Marketshare & Emission Reductions
High Temperature

Current VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
420	18	90%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.16.6. Conclusion

We recommend maintaining a 420 g/l VOC limit for High Temperature coatings. The current VOC limit is technologically and commercially feasible based on the complying marketshare and the number of companies making complying products. It appears to be technologically feasible to formulate High Temperature coatings with VOC contents below 420 g/l. However, ARB staff is not proposing a lower VOC limit because the potential emission reductions that would be achieved were considered to be insignificant.

The current VOC limit is lower than the national limit promulgated by the U.S. EPA for this category. The current limit is consistent with the limit adopted by the South Coast AQMD and the OTC, and the proposed limit for Canada.

5.17. INDUSTRIAL MAINTENANCE

VOC Limit Table (g/l)

USEPA: 450	Canada: 340	OTC: 340	SCAQMD: 100	SCM Proposed: 250

5.17.1. Category Definition

A high performance architectural coating, including primers, sealers, undercoaters, intermediate coats, and topcoats, formulated for application to substrates, including floors, exposed to one or more of the following extreme environmental conditions labeled as specified in the SCM labeling requirements:

- Immersion in water, wastewater, or chemical solutions (aqueous and non-aqueous solutions), or chronic exposure of interior surfaces to moisture condensation; or
- Acute or chronic exposure to corrosive, caustic or acidic agents, or to chemicals, chemical fumes, or chemical mixtures or solutions; or
- Frequent exposure to temperatures above 121 °C (250 °F); or
- Frequent heavy abrasion, including mechanical wear and frequent scrubbing with industrial solvents, cleansers, or scouring agents; or
- Exterior exposure of metal structures and structural components.

5.17.2. Major Proposed Changes

- None.

5.17.3. Coating Description

Industrial Maintenance coating is a generic term for a variety of high performance coatings used to protect substrates in harsh environmental conditions. These coatings are applied to steel, concrete and other materials for the primary purpose of providing protection against corrosion, exposure to chemicals, abrasion, heat, immersion in water, and other severe conditions. Industrial Maintenance coatings are typically used to protect the infrastructure of public utilities, transportation systems, and industrial production facilities. Specific examples are: bridges and roadways; chemical manufacturing plants; chemical storage tanks and piping; oil exploration, production, and refining facilities; power generation and distribution facilities; pulp and paper mills; pharmaceutical plants; food processing plants; wastewater storage and treatment facilities; and water treatment and distribution facilities. Industrial Maintenance coatings are also applied in non-industrial areas that are subjected to extreme abrasion (e.g., scrubbing with cleaning chemicals). These areas include hospitals, schools, prisons, and warehouses. Some Industrial Maintenance coatings are intended for limited types of use while others are versatile and multifunctional. These coatings are restricted to professional use only, and it is generally recommended that personnel use respirators and other protective equipment.

Protection against corrosion is a primary function of many Industrial Maintenance coatings. Corrosion occurs when the substrate reacts with water, oxygen or other chemicals and it leads to the degradation of the material properties of the substrate. Industrial Maintenance coatings protect against this by forming a corrosion-resistant barrier between the substrate and the environment.
A specific class of coating uses zinc as a sacrificial anode to form an electrochemical cell that protects the substrate at the expense of the zinc. These coatings are categorized as Zinc-Rich Primers, and are not part of the Industrial Maintenance category.

Industrial Maintenance coatings do not include coatings used for shop application, such as for the manufacture of parts or products in a factory.
Other products that are excluded from the Industrial Maintenance category are coatings applied to vehicles, such as cars, trucks, railcars, ships, boats, and airplanes.

A variety of application methods are used to apply Industrial Maintenance coatings, including conventional air spray, airless spray, roller and brush. Sometimes, plural-component spray guns are used to apply these coatings.

Industrial Maintenance coatings can be solventborne or waterborne, single component or multi-component. Industrial Maintenance systems may consist of a single coating or they may include two coatings (primer and topcoat) or three coats (primer, midcoat, and topcoat). All of the products that comprise an Industrial Maintenance system are covered by the Industrial Maintenance category.

Formulations for Industrial Maintenance coatings vary, due to the wide range of applications for these coatings. Most coatings are based on alkyd, polyurethane, epoxy or acrylic resin technologies.

Traditional Industrial Maintenance coatings for metal substrates were solventborne alkyd coatings. Most of these products had VOC contents that exceeded 300 g/l. As VOC limits have decreased, these coatings have been replaced by other resin technologies. Alternatives to solventborne alkyds are water-reducible alkyd resins and alkyd emulsions. Although these products offer some of the attractive properties of solventborne alkyds, they have not yet obtained a significant marketshare (Mestach, 2004).

Polyurethane-based formulations are usually solventborne, and they are used for exterior industrial exposures. These coatings can exhibit good color and gloss retention, in addition to chemical and abrasion resistance, when exposed to weathering (Bayne, 2006). 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 (McNeill, 1992).

Epoxy-based formulations are often used as primers, due to their adhesion properties. These coatings are generally multi-component coatings, prepared by mixing in a hardener prior to application, and are often used as a primer with an acrylic topcoat. Epoxy coatings can be solventborne, waterborne, or contain 100% solids with no VOC. Although 100% solids epoxy coatings have shown good performance in immersion conditions, they are more difficult to apply than higher VOC coatings and usually need a sealer to be applied over concrete.

Acrylic coating technology in waterborne and solventborne formulations is used for Industrial Maintenance coatings, because of the exterior durability and chemical inertness of the coatings. Many waterborne acrylic formulations are available as single component products with low VOC contents. These coatings can be used as a primer or a topcoat.

Anti-Graffiti coatings remain in the Industrial Maintenance category. Although there are coatings under 100 g/l that are recommended for anti-graffiti purposes, staff found that coatings up to 250 g/l are being used by State and city agencies. In addition, an economic analysis of a 150 g/l limit for anti-graffiti coatings showed that the limit was not cost effective.

Antenna coatings are included in the Industrial Maintenance category. These coatings are used to coat reflector antennas. Due to the small volumes of these types of products used annually, staff believes these coatings can be sold in small containers. In the infrequent cases where a project needs larger containers, a variance can be sought from the local district.

5.17.4. Substrates/Exposures

Industrial Maintenance coatings are used both indoors and outdoors at industrial facilities or on other substrates exposed to severe environmental conditions (e.g., immersion in water, wastewater, or chemical solutions; exposure to chemicals and acids; exposure to high temperatures, etc.).

Typical substrates include: concrete; masonry; asphalt; and both ferrous and non-ferrous metal, including steel, iron, and aluminum. Due to the variety of uses and types of coatings, the recommended surface preparation and application methods vary. Some coatings recommend abrasive blasting or other mechanical means of surface preparation according to a specific reference standard. For other applications, substrate preparation with a wire brush, sandpaper or a solvent for cleaning is recommended.

5.17.5. Survey Results

Table 5.17-1 summarizes our estimate of sales and VOC emissions from the Industrial Maintenance category, based on the ARB survey. In 2004, the sales volume for Industrial Maintenance coatings in California was approximately 2.1 million gallons. From 2000 to 2004, there was a 55% decrease in sales volume. Much of the sales volume was recategorized from Industrial Maintenance to the Rust Preventative category when the 250 g/l VOC limit for Industrial Maintenance coatings took effect. The coatings that moved to Rust Preventative were primarily solventborne alkyd coatings that did not comply with the 250 g/l VOC limit, and possessed application and performance properties that made them well suited for Rust Preventative coatings.

Industrial Maintenance coatings were one of the categories that could be included in averaging programs during 2004. Under these programs, manufacturers could sell Industrial Maintenance coatings with VOC levels above 250 g/l, if emissions from these products were offset by emissions from other products that had VOC levels below regulatory limits. For Industrial Maintenance coatings, seven percent of the total sales volume consisted of high-VOC products with VOC levels above 250 g/l. These high-VOC products accounted for approximately 0.7 tpd of VOC emissions which represents 15 percent of the total emissions from Industrial Maintenance coatings.

Table 5.17-1: Survey Data
Industrial Maintenance

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	2,292	1,422,836	67%	16%	7%	77%	2%	224	3.61
WB	945	714,936	33%	9%	12%	79%	0%	168	0.65
Total	**3,237**	**2,137,772**		**13%**	**9%**	**78%**	**1%**	**205**	**4.26**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.17-2 contains the complying marketshare for Industrial Maintenance coatings, based on results from the ARB survey. Since we're proposing no change to the VOC limit, we expect no emission reductions.

Table 5.17-2: Complying Marketshare & Emission Reductions
Industrial Maintenance

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
250	1654	69%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.17.6. Product Testing Results

5.17.6.1. NTS Study

As part of the 1999 amendments to Rule 1113 (Architectural Coatings), the South Coast Air Quality Management District (SCAQMD) funded a study to compare the performance of low-VOC and high-VOC coatings. SCAQMD solicited proposals to conduct side-by-side comparisons to address issues brought up by industry members regarding low-VOC coatings. A steering committee was formed to oversee the technical aspects of the study. This committee, called the Technical Advisory Committee (TAC), was comprised of representatives from the Air Resources Board (ARB), SCAQMD, academia, and the architectural coatings industry.

In 1998, the TAC selected National Technical Systems (NTS) as the contractor to carry out the Phase II Assessment Study of Architectural Coatings. The study consisted of a laboratory portion, an accelerated weathering portion, and an outdoor exposure portion. The three portions of this study took place between 1998 and 2002. Industrial Maintenance was one of the categories examined in this study.

The laboratory portion of the study is summarized in ARB's Staff Report for the 2000 SCM (ARB, 2000a). The results of the accelerated weathering and outdoor exposure portions of the study are summarized below.

Accelerated Weathering: The accelerated weathering portion of the study was performed by Atlas Weathering Services Group. At their site in Phoenix, Arizona, Emmaqua (Equatorial Mount with Mirrors for Acceleration with Water) equipment was used to expose test panels to severe sunlight and deionized water spray for 85 days. These tests were completed in 2000.

The accelerated weathering portion of the study tested 20 Industrial Maintenance systems, including 10 above 250 g/l, and 10 below 250 g/l.
Panels were tested in triplicate. The following tests were performed: dry film thickness; pre-test and post-test gloss at 20, 60, and 85 degrees; pre-test and post-test CIE; and pre-test and post-test yellowing. CIE is an acronym for *Comission Internationale de l'Eclairage* or International Commission on

Illumination, which is a scale used to compare color. Visual observations were also noted at the end of the test. The ratings from these visual inspections were based on overall appearance, which factored in corrosion, chalkiness, blistering or cracking, gloss and color.

For the Industrial Maintenance coatings systems, complying systems under 250 g/l performed worse than non-complying systems in yellowing tests, and slightly worse in gloss, CIE tests, and visual observations than Industrial Maintenance systems over 250 g/l.

Of the 10 coating systems under 250 g/l, 5 were below 100 g/l. Compared to the coating systems between 100 g/l and 250 g/l, the systems under 100 g/l performed worse in visual observations, and better in gloss retention and yellowing tests than systems with VOC contents between 100 g/l and 250 g/l.

24-Month Outdoor Exposure: The outdoor exposure portion of the study consisted of tests performed at regular intervals of exposure, and observations made by the TAC during inspections. This portion of the study tested 20 Industrial Maintenance systems. These were the same coatings tested in the accelerated weathering portion of the study. Panels were tested in duplicate at Saugus and El Segundo in southern California. The Saugus site featured a dry, desert like climate, while the El Segundo site featured more of a coastal climate and an industrial setting, since it was next to Los Angeles International Airport. The TAC made regular visits to these sites, where the condition of the test panels was evaluated. The TAC inspected the panels 3, 6, 9, 12, 18 and 24 months after the start of the exposure. At the 12, 18 and 24 month periods of the study, ratings were given to the panels, and the results are summarized below. The ratings from these visual inspections were based on overall appearance, which factored in corrosion, chalkiness, blistering or cracking, gloss and color.

In addition to the evaluations of the panels made by the TAC, NTS performed tests on the panels at the start of the outdoor exposure, and repeated those tests after 6, 12, 18 and 24 months. Tests performed by NTS were gloss on 20, 60 and 85 degree meters, CIE color, and yellowing. Written comments were made on chalking, cracks, flakes and blisters. This portion of the study began in April 2000 and was completed in April 2002.

Overall, non-complying systems generally had equivalent performance in the gloss tests, and better performance in CIE and yellowing tests. At the Saugus test site, coating systems over 250 g/l performed slightly worse in gloss tests, and better in CIE and yellowing tests than coating systems under 250 g/l. At the El Segundo test site, coating systems over 250 g/l performed equivalent in gloss tests, and better in CIE and yellowing tests than coating systems under 250 g/l.

Considering only coatings below 250 g/l, the coating systems below 100 g/l performed better in gloss tests, and worse in CIE and yellowing tests than systems between 100 g/l and 250 g/l at the Saugus test site. At the El Segundo test site, coating systems below 100 g/l performed equivalently in gloss tests, and worse in CIE and yellowing tests.

In addition to the tests performed by NTS, the TAC rated the panels based on visual observation during the 12, 18 and 24 month site visits to the Saugus and El Segundo facilities. Ratings were based on rust, blistering, gloss, chalkiness, and overall appearance. According to the TAC rankings, the non-complying (>250 g/l) systems performed better than the complying systems at the Saugus site, consistently throughout the test period. At the El Segundo site, the complying systems performed better than the non-complying coatings at the 12 month mark, and equivalently at the 18 and 24 month marks. Considering only coatings below 250 g/l, the systems below 100 g/l were rated higher than systems between 100 g/l and 250 g/l throughout the test period at the Saugus test site. At the El Segundo test site, systems below 100 g/l were rated higher than systems between 100 g/l and 250 g/l at the 12 and 24 month reviews, and worse at the 18 month review.

During discussion of the study by the TAC, some criticisms of the testing procedures were made. One criticism was that the coatings were applied using a draw down technique in accordance with ASTM test methods, rather than by the manufacturers' recommendations. Although the draw down technique was specified in the testing protocol that was approved by the TAC, some members felt that ignoring the manufacturers' recommended application method affected the performance of the panels. Upon inspection of the panels, the scribes observed on the Industrial Maintenance panels seemed to be inconsistent. Some had multiple scribes, or scribes of varying depth and width. The rack the panels were tested on consisted of multiple rows, some of which were closer to the ground than others. Some TAC members felt that the panels on the lower rows could have been subjected to more moisture or different rates of temperature change, since they were closer to the ground than others. After the coatings were applied to the test panels, the panels were kept in storage for several months before the outdoor exposure began. According to some members of the TAC, this went against manufacturer recommendations and could have affected the performance of the coatings.

5.17.6.2. SCAP: The Southern California Alliance of Publicly-Owned Treatment Works (SCAP) evaluated low-VOC coating systems suitable for wastewater environments as a result of the May 14, 1999 amendments to SCAQMD Rule 1113. The POTWs Assessing Coating Technology (PACT) Committee was established to oversee the coating evaluation project for SCAP. The project concluded in February 2003 and is described below (SCAP, 2003).

Program Goals

1) Identify low-VOC coating systems suitable for use in wastewater treatment and conveyance facilities,
2) Evaluate coating performance in standard ASTM tests,
3) Verify ASTM accelerated laboratory tests with weathering performance in the field,
4) Compare the performance of coating systems across three VOC ranges,
5) Provide guidance to the SCAP membership regarding the rule amendment, and
6) Inform SCAQMD about the availability and performance of low-VOC industrial maintenance coatings pertinent to the wastewater industry.

Coating Selection

To kick off the program, a letter was sent to thirty-five coating manufacturers requesting recommendations for products suitable for wastewater environments. The solicitation campaign purposely included major manufacturers, specialty manufacturers utilized by the wastewater industry, as well as low-VOC specialty manufacturers identified by SCAQMD staff. Approximately half of the manufacturers responded to the request. The Committee decided that coatings with a pot-life of less than 2 hours at 77 degrees F are not practical for the wastewater industry, unless they are recommended for application with plural spray equipment. Within this parameter, the Committee selected coatings for the program with input from the manufacturers' recommendations. A total of 21 coating systems were tested in the program.

Application Challenges

Almost all of the coatings in the test program had "challenges" during application. One-third of the coatings required thinning with VOC-containing solvent. Directly due to thinning, two coatings were bumped up to a higher VOC category and six coatings had an unknown final VOC content.

SCAP found it remarkable that so many coatings required thinning for application in an environmentally controlled laboratory. In the field, they expect even more thinning due to weather variations. SCAP recommended that SCAQMD further investigate this issue and appropriately revise their assessment.

Laboratory Testing Versus Field Testing

The test program highlighted the importance of field-testing coating systems. The accelerated weather and corrosion laboratory tests did not accurately predict performance in the field. Therefore, new and reformulated coating systems will require field-testing and evaluation prior to use.

SCAP concluded that atmospheric coatings systems below 100 g/l were not readily available. In order to allow end-users enough time to test industrial maintenance coatings prior to use in 2006, these coatings would need to be available for purchase by the end of 2003. At that time, the manufacturers they regularly work with were still reformulating their coating systems below 250 g/l to meet the January 1, 2004 deadline and had not begun to reformulate coating systems to below 100 g/l. SCAP recommended SCAQMD postpone the 100 g/l VOC limit for industrial maintenance coatings several years, at least until January 1, 2008.

Shelf Life

In the Proposed Amended Rule 1113 Staff Report dated December 6, 2002, SCAQMD states on pages II-5 and II-6, "However, if all of their assessments are not complete, Essential Public Service agencies can utilize the sell-through provision provided." Most of the products included in this study have a shelf life of one-year or less. Therefore, in the wastewater industry, products are typically good only one year past their manufacture date. One year is insufficient time to complete a field test program.

Program Conclusions

1) Coating systems with VOC contents between 100-<250 g/l exposed to the atmosphere and coatings systems with VOC contents between 100-<250 g/l and <100 g/l exposed via wastewater immersion perform similarly to existing coating systems with VOC contents between 250-<340 g/l.
2) Almost all of the coating systems caused "challenges" during application in the laboratory. One-third of the coating systems had to be thinned with solvent.
3) Atmospheric coating systems with VOC contents below 100 g/l are not readily available for purchase by end-users.
4) Accelerated weathering and corrosion laboratory tests did not correlate with field exposure tests for most atmospheric coating systems. Field exposure is the best method to demonstrate coating performance since localized airborne contaminants and weather conditions significantly influence coating performance.
5) No clear trends were defined solely by the VOC contents in the coating systems. Performance varied by coating chemistry, manufacturer and product.

5.17.6.3. EPSA: Pursuant to the adoption of the June 1999 amendments to the SCAQMD's Rule 1113, Architectural Coatings, several public agencies formed a cooperative group with the SCAQMD to conduct a technology assessment of the newer, compliant, low-VOC industrial maintenance coatings that were being introduced into the market. This group, referred to as the "Essential Public

Service Agencies" (EPSA) is comprised of the Los Angeles Department of Water and Power (LADWP), the Department of Water Resources (DWR), the California Department of Transportation (CalTrans), and the Metropolitan Water District of Southern California (MWD). The EPSA tested the available low-VOC coatings and MWD compiled a summary of the results of the testing program (MWD, 2005).

The results showed considerable variability in the performance of the Industrial Maintenance coatings. Based on MWD's testing experience, several newer coating formulations showed promise for protection of our critical infrastructure. In addition, MWD's testing indicated that coating formulations utilizing solvents recently exempted by SCAQMD (e.g., TBAc) showed strong promise for high performance and VOC compliance. Although MWD was cautiously optimistic that manufacturers would introduce compliant coatings into the market that met their service and performance requirements as the July, 2006 effective date for the SCAQMD 100 g/l VOC limit drew near, the release of products has been slower than originally anticipated. They are continuing to monitor the performance of compliant Industrial Maintenance coating systems, since poor performance can result in increased maintenance of critical infrastructure.

5.17.6.4. UMR:

In 2005, the UMR Coatings Institute at the University of Missouri-Rolla conducted a coatings testing project for the SCAQMD (UMR, 2006). The project included tests on products classified as Industrial Maintenance coatings.
UMR tested some general coating properties, including: percent nonvolatile; stability; viscosity; freeze/thaw resistance; dry time; gloss; and hiding – contrast ratio. They also tested performance properties, including: Taber abrasion; impact resistance; adhesion on steel; accelerated weathering (QUV); MEK rubs; prohesion; and conical mandrel flexibility. All testing was done in accordance with ASTM standards, unless otherwise noted or agreed upon by the SCAQMD. All paints were supplied to the UMR Coatings Institute by SCAQMD.

For Industrial Maintenance, the project tested three coating systems, containing a primer, intermediate coat, and topcoat. Two systems had low-VOC products (VOC ≤100 g/l) and one system had higher-VOC products (VOC >100 g/l and ≤250 g/l), based on published VOC values. On average, the low-VOC systems performed comparably with the higher-VOC system on most tests. In fact, one of the low-VOC systems performed the best of the three systems on several tests, including: gloss retention after being exposed to UV light, condensation, and salt fog cycles.

5.17.7. Conclusion

We recommend maintaining a 250 g/l VOC limit for Industrial Maintenance coatings. The proposed VOC limit is lower than the national limit adopted by the

U.S. EPA and OTC states, and the proposed limit for Canada. The proposed VOC limit is higher than the 100 g/l SCAQMD limit. However, manufacturers that provide coatings in the SCAQMD area can still sell products which exceed the 100 g/l limit, if they participate in SCAQMD's averaging program. The proposed SCM does not contain an averaging provision, so all manufacturers will be subject to the same limit. The SCAQMD has also allowed the use of Tertiary Butyl Acetate (TBAc) as an exempt solvent for Industrial Maintenance coatings. Because of health concerns, ARB has not yet granted a VOC exemption for TBAc in an ARB regulation. In addition, the SCM needs to be technologically feasible throughout California. Since Industrial Maintenance products are applied to critical infrastructure, it is vital that they meet the performance specifications established by public agencies. ARB staff believes that additional research is needed to verify the performance of 100 g/l Industrial Maintenance coatings in a way that protects the infrastructure throughout California, without an averaging program or a TBAc exemption. The SCAQMD area has a mild climate, so climatic conditions are less of a concern. However, in other areas of California, the infrastructure is exposed to more extreme climates (e.g., mountainous areas with freezing temperatures; coastal areas with persistent cold temperatures, salt spray, high humidity, etc.). ARB staff believes that additional research is needed to develop products that perform well in these areas. Therefore, ARB staff believes that the current 250 g/l VOC limit is most appropriate at this time.

The South Coast AQMD recommended that ARB create a new category for immersion Industrial Maintenance coatings with a VOC limit of 100 g/l. Although tests show that low VOC coatings performed well in immersion environments, staff believes a 250 g/l limit is needed due to issues with application and adhesion to concrete. Therefore, ARB staff did not create a new category for immersion Industrial Maintenance coatings.

In the early stages of the SCM development, staff explored narrowing the definition of the Industrial Maintenance category. The purpose of this was to try to achieve reductions while keeping a higher limit for coatings that protected critical infrastructure without an exemption for TBAc, or a provision for averaging. Due to potential changes in marketing practices from the revised definition and feedback from industry, the original definition was retained.

5.18. LOW SOLIDS

VOC Limit Table (g/l)

USEPA: 120	Canada: 120	OTC: 120	SCAQMD: 120	SCM Proposed: 120

5.18.1. Category Definition

A coating containing 0.12 kilogram or less of solids per liter (1 pound or less of solids per gallon) of coating material as recommended for application by the manufacturer. The VOC content for Low Solids Coatings shall be calculated in accordance with SCM requirements.

5.18.2. Major Proposed Changes

- The definition has been modified to clarify how the VOC content should be calculated. Some Low Solids products are sold as concentrates and must be diluted prior to use. For these products, the VOC content should be calculated based on the manufacturer's recommended dilution rate.

5.18.3. Coating Description

Low Solids coatings are generally used to provide water repellency, stain resistance, wood protection, and for decorative purposes. These coatings are mostly waterborne, single component coatings that are sold in hardware stores and home centers. Low Solids coatings are typically applied by brush, roller, mop, or low-pressure spray. Resin types include urethanes, silanes, and siloxanes.

By definition, Low Solids coatings contain one pound (0.12 kilogram) of solids or less per gallon of coating. They can be used for a wide variety of applications (e.g., concrete sealers, stains, wood coatings, etc.), but they can be classified as Low Solids coatings if they meet the definition criteria. Being a Low Solids coating can be beneficial, because Low Solids coatings are regulated on the basis of VOC Actual (a.k.a. "Material VOC"), rather than VOC Regulatory. Therefore, the VOC content of the Low Solids coating is calculated without subtracting out the water and exempt compounds.

5.18.4. Substrates/Exposures

Low Solids coatings are used on interior and exterior surfaces. They can be applied to architectural concrete block, concrete, fired clay, sandstone, stone, quarry tile, masonry, and wood.

5.18.5. Survey Results

Table 5.18-1 summarizes our estimate of sales and VOC emissions for Low Solids coatings, based on the ARB survey. In 2004, the sales volume for Low Solids coatings in California was approximately 66,000 gallons. This represents less than 0.1 percent of the total California sales volume for architectural coatings. The Low Solids category is the fourth smallest coating category, with regard to both sales volume and VOC emission levels.

Waterborne Low Solids coatings represent 100 percent of the sales volume and have VOC Actual levels less than 120 g/l. The sales volume for waterborne Low Solids coatings increased approximately 390 percent from 2000 to 2004. The overall sales-weighted average VOC content increased 2 percent from 2000 to 2004. VOC emissions from Low Solids coatings are about 0.04 tpd, which represents less than 0.05 percent of the total emissions from architectural coatings.

It is important to note that there are many products which may meet the Low Solids criteria ($\leq$1 lb solids/gal), but the manufacturers choose to classify these products under another category because these coatings can fit the definitions of two separate categories. The data provided below only represents those products that were actually reported under the Low Solids category for the purpose of ARB's survey.

Table 5.18-1: Survey Data
Low Solids Coatings

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	0	0	0%	NA	NA	NA	NA	NA	0
WB	33	65,680	100%	0%	88%	12%	1%	60	0.04
Total	**33**	**65,680**		**0%**	**88%**	**12%**	**1%**	**60**	**0.04**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Actual (grams VOC per liter of coating, including water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.18-2 contains the complying marketshare for Low Solids coatings, based on results from the ARB survey. This table shows that all of the reported Low Solids coatings comply with the current VOC limit.

Table 5.18-2: Complying Marketshare & Emission Reductions
Low Solids Coatings

Current VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
120	33	100%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.18.6. Conclusion

We recommend maintaining the current 120 g/l VOC limit for Low Solids coatings. It may be technologically feasible to lower this limit, but the emission reduction benefits that would be gained are negligible. The current VOC limit is technologically and commercially feasible, based on the complying marketshare and product information from manufacturers. The current VOC limit is the same as the limit promulgated by the U.S. EPA, the OTC states, the SCAQMD, and the proposed limit for Canada. The U.S. EPA divides Low Solids coatings into Low

Solids Stain and Low Solids Wood Preservative categories, but the same VOC limit applies to both (U.S. EPA, 1998).

5.19. MAGNESITE CEMENT

VOC Limit Table (g/l)

USEPA: 600	Canada: N/A	OTC: 450	SCAQMD: 450	SCM Proposed: 450

5.19.1. Category Definition

A coating labeled and formulated for application to magnesite cement decking to protect the magnesite cement substrate from erosion by water.

5.19.2. Major Proposed Changes

- None.

5.19.3. Coating Description

Magnesite is a naturally occurring mineral composed of magnesium carbonate. Magnesite cement can be formed by thermally processing magnesium carbonate and mixing it with magnesium chloride or magnesium sulfate. Exterior and interior floors can be made from magnesite cement, which provides a seamless, non-combustible, durable surface. Magnesite Cement coatings include clear and pigmented sealers that are used to protect magnesite floors, decks, and stairs from exposure to water and weathering. They also cover older magnesite cement surfaces that are discolored, patched, or worn (MFS, 2007).

The Magnesite Cement coatings reported in the survey are single component, solventborne formulations with acrylic resin. Application methods include brush or roller and products can be applied by professional contractors or homeowners.

5.19.4. Substrates/Exposures

Magnesite Cement coatings are intended for exterior and interior surfaces made of magnesite cement.

5.19.5. Survey Results

Table 5.19-1 summarizes our estimate of sales and VOC emissions, as reported for the ARB survey.

Table 5.19-1: Survey Data
Magnesite Cement Coatings

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day) [4]
SB	16	PD	100%	0%	100%	0%	0%	446	0.09
WB	0	0	0%	0%	0%	0%	0%	NA	0.00
Total	**16**	**PD**		**0%**	**100%**	**0%**	**0%**	**446**	**0.09**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

VOC emissions from Magnesite Cement coatings are about 0.09 tpd, which represents approximately 0.1 percent of the total emissions from architectural coatings. When compared to the data reported for calendar year 2000, VOC emissions increased 21 percent, and the sales-weighted average VOC Regulatory content increased 1 percent.

Table 5.19-2 contains the complying marketshare for Magnesite Cement coatings, based on results from the ARB survey. This table shows that 100 percent of the sales volume for Magnesite Cement coatings complies with the current VOC limit of 450 g/l.

Table 5.19-2: Complying Marketshare & Emission Reductions
Magnesite Cement Coatings

Current VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
450	16	100%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.19.6. Conclusion

We recommend maintaining the current 450 g/l VOC limit for Magnesite Cement coatings. The current VOC limit is technologically and commercially feasible, based on complying marketshare. The current VOC limit is lower than the national limit promulgated by the U.S. EPA for this category. The current limit is consistent with the limits of the SCAQMD and the OTC states.

5.20. MASTIC TEXTURE

VOC Limit Table (g/l)

USEPA: 450	Canada: 300	OTC: 300	SCAQMD: 300	SCM Proposed: 100

5.20.1. Category Definition

A coating labeled 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 (at least 0.010 inch) dry film thickness.

5.20.2. Major Proposed Changes

- The proposed VOC limit decreases from 300 g/l to 100 g/l.
- The Mastic Texture category is targeted for eventual elimination, since products can be covered by other categories (e.g., Concrete/Masonry Sealer, Flat, etc.)

5.20.3. Coating Description

Mastic Texture coatings are applied to walls and other surfaces, primarily to provide water resistance and a long-lasting, low-maintenance, decorative coating. The main substrates are exterior concrete and masonry surfaces, but the coatings can also be applied to metal and wood. In addition, a small number of products in this category are intended for decorative applications on interior drywall and plaster. One of the primary uses of Mastic Texture products is for coating newly installed tilt-up concrete walls. New tilt-up concrete often has small cracks or holes that need to be coated or sealed to provide protection from the elements and help prevent deterioration of the concrete. Tilt-up concrete has been used extensively to construct warehouses and “big-box” retail stores. In addition, the use of tilt-up concrete has grown rapidly for many other types of building construction. When Mastic Texture coatings are applied to these structures, the thickness of the coating provides added resistance to rain and the elasticity allows the coating to maintain its integrity while stretching over small cracks that move with the expansion and contraction of the concrete. Many products are also designed to be “breathable” to allow water vapor to pass through the coating. This breathability helps prevent coatings from blistering or peeling, due to water that may be trapped in the concrete (Angelini, 2007).

While some manufacturers state that their Mastic Texture products will smooth over small cracks and minor surface imperfections, they also recommend that small cracks and holes be filled with a patching compound prior to application of the coating. Most of the products are elastomeric formulations which help cover surface imperfections and allow the coating to expand and contract over cracks. Many products claim to be resistant to wind-driven rain, in accordance with Federal Specification TT-C-555B “Coating, Textured (For Interior and Exterior

Masonry Surfaces)". This specification was officially cancelled in 2001, but manufacturers still cite it on their data sheets. The active industry standard is ASTM D6904-03, "Standard Practice for Resistance to Wind-Driven Rain for Exterior Coatings Applied to Masonry".

Although the name of this category implies that the coatings are textured, the definition does not require that products actually be textured. Some product lines are designed to provide a range of textures, including smooth, medium, and coarse. Perlite and silica sand are used to create various textures. All of the products are high-build, with most having dry film thicknesses of 10 - 15 mils.

Mastic Texture coatings can either be applied by professional contractors or homeowners and application methods include: sprayer, roller, and brush. Most of the reported products have single component, waterborne formulations with acrylic or vinyl acrylic resins. There are also single component, solventborne coatings with alkyd resins. Mastic Texture coatings are available in waterborne formulations that have VOC contents less than 100 g/l. These low-VOC products represent approximately 82 percent of the sales volume, excluding small containers. If this category is eliminated in the future, they may be re-classified as Concrete/Masonry Sealers, Flats, or Faux Finishing coatings.
For products with VOC contents greater than 100 g/l, it is expected that some could be re-classified as Industrial Maintenance coatings, if they comply with the Industrial Maintenance definition.

5.20.4. Substrates/Exposures

Mastic Texture coatings are typically applied to exterior walls made of brick, stucco, cinder block, and tilt-up concrete, but they can also be used for exterior metal and wood substrates. A small number of products are recommended for interior applications on drywall and plaster substrates.

5.20.5. Survey Results

Table 5.20-1 summarizes our estimate of sales and VOC emissions from the Mastic Texture coatings category based on the ARB survey. In 2004, the sales volume for Mastic Texture coatings in California was approximately 677,000 gallons. This represents less than one percent of the total California sales volume of architectural coatings.

Table 5.20-1: Survey Data
Mastic Texture

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	4	PD	PD	0%	9%	91%	0%	248	0.26
WB	58	PD	PD	0%	92%	8%	0%	70	0.25
Total	**62**	**677,063**		**0%**	**77%**	**23%**	**0%**	**101**	**0.51**

(ARB, 2006).
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

ARB staff compared the results from ARB's two most recent architectural coating surveys which gathered sales data for calendar years 2000 and 2004. Sales of Mastic Texture coatings increased 8 percent and emissions declined 25 percent from 2000 to 2004. The sales-weighted average VOC Regulatory value declined 24 percent. The decline in emissions is due to the decrease in VOC content.

Table 5.20-2 contains the complying marketshare for Mastic Texture coatings, based on results from the ARB survey. Based on reported sales volume, 79 percent of the reported Mastic Texture coatings comply with the proposed VOC limit of 100 g/l. Based on the number of products reported, 65 percent of the products comply with the proposed limit. Of the 11 companies that reported in this category, 8 offered Mastic Texture coatings that comply with the proposed limit. These data indicate that there is already widespread use of existing low-VOC Mastic Texture coatings.

Table 5.20-2: Complying Marketshare & Emission Reductions
Mastic Texture Coatings

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
100	40	79%	0.10

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.20.6. Future Issues

ARB staff's analysis indicates that there is no need to continue having a specialty category for Mastic Texture coatings in the future. Coatings that are currently under the Mastic Texture category can be covered by the Industrial Maintenance category, the new Concrete/Masonry Sealer category, the Flat category, or the Faux Finishing category. There is not adequate technological justification to maintain a higher VOC limit for the Mastic Texture coatings. Therefore, ARB staff recommends that districts eliminate the Mastic Texture category in future versions of their architectural coating rules.

5.20.7. Manufacturer Information

Product information sheets published by coatings manufacturers indicate that Mastic Texture coatings that meet the proposed VOC limit are available that possess performance characteristics similar to higher-VOC coatings. A listing of Mastic Texture products is provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm). This table includes products reported in ARB's survey and other products identified by ARB staff during a literature search. Some products in the table have been tested and approved in accordance with the Master Painter's Institute (MPI) standards, including MPI#40 "Latex, Exterior, High Build"; MPI#42 "Textured Coating, Latex, Flat"; and MPI#113 "Elastomeric, Pigmented, Exterior, Water Based, Flat".

5.20.8. Conclusion

We recommend a 100 g/l VOC limit for Mastic Texture coatings, effective January 1, 2010. This limit coincides with the VOC limit for the Concrete/Masonry Sealer category. As mentioned previously, it is expected that many Mastic Texture coatings could be covered by the Concrete/Masonry Sealer category in the future, if the Mastic Texture category is eliminated.
The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on the complying marketshare, the number of companies making complying products, and product information from manufacturers. The proposed limit is lower than the adopted limit for the U.S. EPA, SCAQMD, the OTC states, and the proposed limit for Canada.

5.21. METALLIC PIGMENTED

VOC Limit Table (g/l)

USEPA: 500	Canada: 500	OTC: 500	SCAQMD: 500	SCM Proposed: 500

5.21.1. Category Definition

A coating that is labeled and formulated to provide a metallic appearance. Metallic Pigmented coatings must contain at least 48 grams of elemental metallic pigment (excluding zinc) per liter of coating as applied (0.4 pounds per gallon), when tested in accordance with SCAQMD Method 318-95. The Metallic Pigmented Coating category does not include coatings applied to roofs or Zinc-Rich Primers.

5.21.2. Major Proposed Changes

- Aluminum Roof and Zinc-Rich Primers were removed from the Metallic Pigmented category and were established as separate categories. The Metallic Pigmented definition reflects these changes.

5.21.3. Coating Description

Metallic Pigmented coatings, after the removal of Aluminum Roof and Zinc-Rich Primer categories, are generally used for aesthetic appeal and decoration, but can be used to help alleviate corrosion, withstand high-heat applications, and improve solar reflectance. These products are used on a variety of objects, such as fences, gates, mailboxes, decks, siding, attics, tanks, and kilns. Metallic Pigmented coatings are also used as heat radiation barriers in attics and underneath decks to maintain temperate indoor conditions. Some specialty coatings in this category offer barrier protection from UV light, moisture, rust, chemicals, abrasion, industrial fumes, or extreme high heat (200 - 1,000 degrees F). If a Metallic Pigmented coating was formulated to withstand temperatures above 400 degrees F, it would still be covered by the Metallic Pigmented category (500 g/l) and would not be subject to the lower limit in the High Temperature category (420 g/l). Metallic Pigmented Coatings can be applied by a sprayer, roller, or brush and they can have an array of gloss characteristics ranging from flat to high gloss. They are predominately used by professionals for commercial and industrial applications, but homeowners also use them to protect metal surfaces or to create a metallic appearance.

Metallic Pigmented coatings are composed of a wide array of ingredients to handle the different substrates and conditions. These products can contain a variety of resin types, including: acrylics, alkyds, amines/amides, epoxies, linseed oil, oils, oleoresins, phenolic, silicone, styrene-butadiene, urethane/polyurethane, fluoropolymers, and vinyl acetate-ethylene copolymers. Metallic Pigmented coatings may also contain fibers or fillers to increase viscosity. The metallic pigments include, but are not limited to: aluminum flakes (predominately), copper powder, and iron filings.

Most products are solventborne, single component coatings, but multi-component coatings (e.g., epoxies) are available with comparable performance characteristics. Recently, waterborne emulsions have been introduced to comply with environmental needs and government regulations. Waterborne coatings have VOC Regulatory values ranging from about 150 g/l to 300 g/l, while solventborne coatings range from 150 g/l to 550 g/l. A vast majority of the solventborne products are within the range of 400 g/l to 550 g/l, with outliers below 100 g/l and above 600 g/l.

In the SCAQMD's Rule 1113, "mica particles" were included in the definition for the Metallic Pigmented category. "Mica particles" can be used in a variety of coatings as a filler or extender pigment, because they are relatively inexpensive. Extender pigments can reduce coating raw material costs because they can be used as substitutes for more expensive ingredients (e.g., binders, flatting agents, thickeners, titanium dioxide pigments, etc.) (Braun, 1993). Since Rule 1113 used the term “mica particles”, some coating manufacturers interpreted the rule to mean that they could use mica to formulate Nonflat coatings and be subject to the high VOC limit for Metallic Pigmented coatings (500 g/l), rather than the low VOC limit for Nonflat coatings (50 g/l). SCAQMD found this to be an incorrect interpretation and issued a compliance advisory to that effect.

ARB’s 2000 SCM did not allow for the use of “mica particles” in the definition for Metallic Pigmented; therefore, misinterpretation was not an issue. However, during the rule development efforts for the proposed SCM, ARB staff and stakeholders agreed that it would be beneficial to provide some clarification regarding the use of mica. ARB staff has proposed putting metallic-looking coatings in the Faux Finishing category and has proposed using the term “pearlescent mica pigment”, rather than “mica particles”, to help prevent potential abuses. The intent is to only provide the higher limit to manufacturers that use large quantities of “pearlescent mica pigment” in coatings to create a metallic look for faux finishing applications. Coatings that contain non-pearlescent mica pigments will be subject to lower VOC limits in other categories (e.g., Flat, Nonflat, etc.).

5.21.4. Substrates/Exposures

Metallic Pigmented coatings are applied indoors and outdoors. These products can be applied to a variety of substrates, including wood, metal, asphalt, concrete, and masonry.

5.21.5. Survey Results

Table 5.21-1 summarizes our estimate of sales and VOC emissions from the Metallic Pigmented category, based on the ARB survey. In 2004, the sales volume for Metallic Pigmented coatings in California was approximately 45,000 gallons, which represents less than 0.1 percent of the total California sales volume for architectural coatings. It is important to note that this sales volume does not include Aluminum Roof and Zinc-Rich Primer products. Data for these categories is provided elsewhere in this report in the Aluminum Roof and Zinc-Rich Primer sections. For the purposes of the Survey, Aluminum Roof coatings and Zinc-Rich Primers were reported as Metallic Pigmented coatings, so ARB staff used product information to pull out products that could be classified under the new categories of Aluminum Roof and Zinc-Rich Primer. Aluminum Roof products were the main contributor to VOC emissions when they were considered as part of the Metallic Pigmented category. With Aluminum Roof and Zinc-Rich Primer coatings removed from Metallic Pigmented, the category has a small sales volume with a relatively high percentage coming from small containers (one quart or less).

VOC emissions from Metallic Pigmented coatings are about 0.13 tpd, which represents less than half a percent of the total emissions from architectural coatings. A large percent of the emissions from this category (92%) is attributable to solventborne coatings which make up 72 percent of the sales volume. About 27% of sales for this category were small containers (one quart or less).

Table 5.21-1: Survey Data
Metallic Pigmented

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	71	32,842	72%	4	8	88	20%	316	0.12
WB	15	12,587	28%	22	47	31	46%	212	0.01
Total	**84**	**45,429**		**9**	**19**	**72**	**27%**	**287**	**0.13**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.21-2 contains the complying marketshare for the Metallic Pigmented category, based on results from the ARB survey. This table shows that 99 percent of the marketshare of Metallic Pigmented coatings comply with the current VOC limit.

Table 5.21-2: Complying Marketshare & Emission Reductions
Metallic Pigmented

Current VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
500	61	99%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

Of the 20 companies that reported in this category, all offered Metallic Pigmented coatings that comply with the current limit. Of these companies, 10 are considered to be small businesses because they have fewer than 250 employees.

5.21.6. Manufacturer Information

The Master Painters Institute (MPI) does not have a specific category for Metallic Pigmented coatings. However, there are three Aluminum Coating categories and one Heat-Resistant category that are pertinent to Metallic Pigmented coatings. A list of the reported Metallic Pigmented products from the 2005 Survey and MPI approved products that can meet a VOC Regulatory limit of 500 g/l is provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm). The four MPI categories that included Metallic Pigmented coatings are MPI #1 (Aluminum Paint), MPI #2 (Aluminum Paint, Heat Resistant - Up to 427 °C/800 °F), MPI #21 (Heat Resistant Coating, - Up to 205 °C/402 °F, MPI Gloss Level 5-6), and MPI #22 (Aluminum Paint, High Heat - up to 590 °C/1100 ° F).

5.21.7. Future Issues

As California works towards improving energy efficiency and reducing greenhouse gases, issues associated with Metallic Pigmented materials may become more prominent. One of these issues is discussed below:

Radiant Barriers: Attic and deck radiant barriers represent roughly 10 percent of the sales volume for Metallic Pigmented Coatings, and they are becoming more popular with consumers due to a desire to improve energy efficiency and decrease energy bills. These products generally have emissive properties that can reflect as much as 65% of radiant heat into and out of a building. Using radiant barriers coupled with a high emissive roof coating can drastically decrease the heat gain and loss of a building and substantially decrease the amount of energy needed to maintain a temperate indoor environment. Radiant barriers work bidirectionally as energy-efficient coatings. Heat from the outdoors is reflected away from the roof in summer and interior heat is reflected back into the building in winter, which can result in energy savings throughout the year. According to Zielnik, "…This is similar to the principle now used in energy-efficient 'Low-e' window systems, where outside heat is kept outside in summer and indoor heat is kept inside in winter with the window emitting very little heat outdoors…" (Zielnik, 2006). It is expected that the use of radiant barriers could increase in buildings as a means of improving energy efficiency and reducing potential temperature increases related to climate change.

5.21.8. Conclusion

We recommend maintaining the current 500 g/l VOC limit for Metallic Pigmented coatings. While it may be technologically feasible to produce metallic pigmented coatings below 350 g/l, the emission reduction benefits that would be gained are negligible. The current VOC limit is technologically and commercially feasible, based on the complying marketshare, the number of companies making compliant products, and product information from manufacturers. The current limit is the same as the limit adopted by the U.S. EPA, SCAQMD, OTC states, and the proposed limit for Canada.

5.22. MULTI-COLOR

VOC Limit Table (g/l)

USEPA: 580	Canada: 250	OTC: 250	SCAQMD: 250	SCM Proposed: 250

5.22.1. Category Definition

A coating that is packaged in a single container and that is labeled and formulated to exhibit more than one color when applied in a single coat.

5.22.2. Major Proposed Changes

- None.

5.22.3. Coating Description

Multi-Color coatings are decorative paints that contain individual flecks of different colors, against a solid background color. The visual effect can be similar to the appearance of materials such as granite, cork, leather and stone. In the paint can, pigment flecks are contained within a chemical capsule and are suspended in a base paint of a contrasting color. When the coating is sprayed on a surface, the suspended pigment capsules break open and produce a speckled textured coating with a low gloss finish. Multi-Color coatings are resistant to stains, scratches, and scuff marks and they are durable enough to withstand repeated washings. Some manufacturers recommend applying a clear topcoat to protect the coating and provide added durability. Multi-Color coatings are recommended for commercial and institutional facilities, such as hospitals, office buildings, schools, and municipal buildings.

Multi-Color coatings are primarily used by professional contractors and they are often sold directly from the manufacturer to the end user. They are generally designed for spray application only, but some products can be applied with a special roller. Most of the Multi-Color coatings that were reported in the survey were waterborne acrylics, but there were also waterborne polyurethanes and solventborne alkyds. All products were single component formulations.

5.22.4. Substrates/Exposures

Multi-Color coatings can be applied to primed drywall, gypsum board, fiberboard, wood, acoustical tile, paneling, plaster, stucco, masonry, concrete block, brick, ceramic, glass, fiberglass, metal, plastic, laminate, and vinyl wallcovering. All of the products that were reported in the survey were intended for interior exposures only, but there are also Multi-Color coatings that are formulated for exterior exposures. Multi-Color coatings are <u>not</u> recommended for the following areas:

- Floors;
- Areas subjected to excessive structural movement (e.g., expansion joints);
- Areas exposed to hydrostatic pressure (e.g., basement walls);
- Areas exposed to corrosives or high heat; or
- Areas with frequent water contact (e.g., shower stalls, commercial bathrooms, etc.).

5.22.5. Survey Results

Table 5.22-1 summarizes our estimate of sales and VOC emissions, as reported for the ARB survey.

Table 5.22-1: Survey Data
Multi-Color Coatings

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	1	PD	PD	100%	0%	0%	100%	551	0.00
WB	12	PD	PD	100%	0%	0%	0%	94	0.00
Total	**13**	**13,635**		**100%**	**0%**	**0%**	**2%**	**103**	**0.00**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

When compared to the data reported for calendar year 2000, VOC emissions decreased 37 percent, and the sales-weighted average VOC Regulatory content decreased 55 percent.

Table 5.22-2 contains the complying marketshare for Multi-Color coatings, based on results from the ARB survey. This table shows that approximately 100 percent of the sales volume complies with the current VOC limit of 250 g/l.

Table 5.22-2: Complying Marketshare & Emission Reductions
Multi-Color Coatings

Current VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
250	9	100%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.22.6. Conclusion

We recommend maintaining the current 250 g/l VOC limit for Multi-Color coatings. It may be technologically feasible to lower this limit, but the emission reduction benefits that would be gained are negligible. The current VOC limit is technologically and commercially feasible, based on complying marketshare. The current VOC limit is lower than the national limit promulgated by the U.S. EPA. The current limit is consistent with the limits adopted by the SCAQMD and the OTC states, and the proposed limit for Canada.

5.23. NONFLAT

VOC Limit Table (g/l)

USEPA: 380	Canada: 150	OTC: 150	SCAQMD: 50	SCM Proposed: 100

5.23.1. Category Definition

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).

5.23.2. Major Proposed Changes

- For Nonflat coatings, the proposed VOC limit will decrease from 150 g/l to 100 g/l.

5.23.3. Coating Description

The term Nonflat coating includes two categories that are identified in ARB's Architectural Coating survey: Nonflat - Low Gloss and Nonflat - Medium Gloss. For the purposes of the survey, Nonflat - Low Gloss has a gloss level of 5 or above and less than 20 on a 60-degree meter. Nonflat - Medium Gloss has a gloss of 20 or above and less than 70 on a 60-degree meter. This section of the report contains information for both Low Gloss and Medium Gloss products, because they are both regulated under the Nonflat category in the SCM.

Nonflat coatings are typically used in areas of high traffic where frequent cleaning is necessary or moisture is present (Consumer Reports, 2003). Residential applications include family rooms, children's rooms, kitchens, bathrooms, high traffic hallways, and other areas. For commercial buildings and institutional facilities, Nonflat coatings are used on surfaces such as walls, corridors, and stairwells. These coatings are applied by professional contractors and homeowners and application methods include brush, roller, and sprayer.

Most Nonflat coatings are waterborne, single component products. These types of coatings have been preferred by consumers for many years, because they are generally easy to use, are low odor, and can be cleaned up with soap and water. Some manufacturers of Nonflat paints are marketing "zero VOC" products by highlighting the environmental benefits and the quality of the paint. The most prevalent resins for Nonflat coatings are vinyl acrylic and 100% acrylic, which are commonly called latex. Because most Nonflat coatings are waterborne, the VOCs in latex coatings come from additives such as resin coalescing aids, polymer plasticizers, freeze/thaw stabilizers and anti-foam agents. These additives help create homogeneous films, improve block and print resistance, prevent coagulation, ease application, and reduce defects formed during application. Other additives that contribute to the VOC content are preservatives, thickeners and colorants. Resin coalescing aids and freeze/thaw stabilizers are the two main contributors to VOCs in Nonflat coatings. Currently, most coating manufacturers use ester alcohols (e.g., Texanol®) as coalescing agents. Freeze/thaw stabilizers are glycols (e.g., ethylene glycol or propylene glycol) that help prevent the paint from coagulating or solidifying when exposed to freezing temperatures and provides more “open” time.

Most Nonflat coatings are already waterborne and the proposed VOC limit will require most of these products to be reformulated using lower-VOC technology. This will involve choosing the appropriate combination of resin, coalescing agent, and additives. Many Nonflat coatings already contain small amounts of the glycols required to achieve freeze/thaw resistance, and it is expected that some reformulations will further reduce the amount of glycols and make products more vulnerable to freeze/thaw damage. They can also use softer resins which would require less coalescing agents. However, this could lead to more dirt pickup and less blocking resistance. To comply with a 100 g/l limit, it’s possible to formulate Nonflat coatings that still contain some glycol and have some freeze/thaw resistance. However, to comply with the 50 g/l limit in the SCAQMD, some manufacturers have completely eliminated the glycol and they use heated delivery vehicles and heated warehouses to prevent freeze damage. Also, the SCAQMD has a relatively mild climate, so freeze/thaw resistance is less critical.

5.23.4. Substrates/Exposures

Nonflat coatings are used for both interior and exterior applications. With proper surface preparation and priming, Nonflat coatings can be used on a large variety of substrates including drywall, plaster, concrete block, wood, and metal. They work best on smooth, well-prepared walls because the gloss may bring out imperfections present on the substrate. Generally, ambient and surface temperatures of application are limited to above 50° Fahrenheit.

5.23.5. Survey Results

Table 5.23-1a and Table 5.23-1b summarize ARB’s estimates of sales and VOC emissions, based on the ARB survey. Table 5.23-1a provides data for the Nonflat - Low Gloss subcategory and Table 5.23-1b provides data for the Nonflat Medium Gloss subcategory. In Table 5.23-2, data from these two categories are combined to determine the complying marketshare and potential emission reductions for the overall Nonflat category.

In 2004, the sales volume for Nonflat - Low Gloss coatings in California was approximately 12 million gallons. This represents about 11 percent of the total California sales volume of architectural coatings. Nonflat - Low Gloss coatings were the third largest in terms of sales volume, after Flat and Nonflat - Medium Gloss.

Waterborne coatings dominate the Nonflat - Low Gloss coatings market. From 2000 to 2004, overall sales of Nonflat - Low Gloss coatings have increased by more than 80 percent, from approximately 6.6 million to 12 million gallons. This increase in sales can be attributed to increases in new home construction and the robust repaint business. Homeowners with dual family incomes are finding it affordable to invest in beautifying their homes, which may be attributable to the increase in the professional painting market (Frost & Sullivan, 2006). Additionally, the overall increase in the coatings market could be partially due to the prevalence of home improvement television with several such television shows premiering between 2000 and 2004. Customer preference for eggshell and other low gloss nonflat coatings over flat coatings would also explain the large growth in the Nonflat - Low Gloss category.

With the increase in sales, VOC emissions from Nonflat - Low Gloss coatings have also increased more than 60% to 6.6 tpd, which represents approximately 7 percent of the total emissions from architectural coatings.

Table 5.23-1a: Survey Data
Nonflat Coatings – Low Gloss

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	26	3,856	0%	87%	2%	11%	79%	402	0.02
WB	1,309	12,019,222	100%	68%	15%	18%	3%	118	6.62
Total	**1,335**	**12,023,079**		**68%**	**15%**	**18%**	**4%**	**118**	**6.64**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

In 2004, the sales volume for Nonflat - Medium Gloss coatings in California was approximately 20 million gallons. Nonflat - Medium Gloss is the second largest coating category in terms of sales volume and it represents about 18 percent of the total California sales volume for architectural coatings.

Waterborne coatings dominate the Nonflat - Medium Gloss coatings market. From 2000 to 2004, overall sales of Nonflat - Medium Gloss coatings increased by approximately 11 percent, from about 18 million to 20 million gallons. VOC emissions from Nonflat-Medium Gloss coatings are about 12 tpd and they represent 12 percent of the total emissions from architectural coatings.

Nonflat-Medium Gloss coatings were one of the categories that could be included in averaging programs during 2004. Under these programs, manufacturers could sell Nonflat-Medium Gloss coatings with VOC levels above 150 g/l, if emissions from these products were offset by emissions from other products that had VOC levels below regulatory limits. For Nonflat-Medium Gloss coatings, five percent of the total sales volume consisted of high-VOC products with VOC levels above 150 g/l. These high-VOC products accounted for approximately 1.3 tpd of VOC emissions which represents 11 percent of the total emissions for Nonflat-Medium Gloss coatings.

Table 5.23-1b: Survey Data
Nonflat Coatings – Medium Gloss

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	194	77,878	0%	35%	6%	59%	49%	372	0.33
WB	2,218	19,994,953	100%	56%	13%	31%	4%	128	11.40
Total	**2,412**	**20,072,832**		**55%**	**13%**	**31%**	**4%**	**129**	**11.73**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.23-2 contains the complying marketshare for Nonflat coatings, including Low Gloss and Medium Gloss products, based on results from the ARB survey. The table also includes a small number of products that were reported under Rust Preventative in the survey, but are expected to be in the Nonflat category due to proposed revisions in the Rust Preventative definition. This table shows that about 28 percent of the sales volume for Nonflat coatings complies with the proposed VOC limit. Over 950 products out of approximately 3,060 reported products comply with the proposed limit. Of the 46 companies that submitted data for Nonflat coatings, 24 offered Nonflat coatings that comply with the proposed limit. ARB staff also evaluated the complying marketshare at 50 g/l and found that only four percent of the sales volume had VOC contents at or below 50 g/l.

Table 5.23-2 shows that implementing the proposed 100 g/l limit would achieve approximately 2.44 tpd in VOC emission reductions for the non-SCAQMD portion of California, on an annual average basis.

Table 5.23-2: Complying Marketshare & Emission Reductions
Nonflat Coatings

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
100	958	28%	2.44

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.23.6. Product Testing Results

5.23.6.1. Consumers Union: Consumers Union, an independent nonprofit organization, recently published test results that were performed on both interior and exterior Nonflat coatings. Tests were performed on 40 interior Nonflat coatings that were marketed as high-grade products. Each product was tested using three colors that represent the basic tint bases. Manufacturers of the paints include PPG, ICI and Sherwin Williams.

Of the 40 products tested, at least 9 products comply with the proposed 100 g/l VOC limit (VOC values were not readily available for all of the listed products). Out of a possible score of 100, the complying products scored in the range of 52-80 and the highest score for any product was 88. Most of the coatings tested performed poorly in fade resistance tests, regardless of whether they were above or below 100 g/l. Complying products scored well and performed comparably to higher-VOC products in several categories, such as: hiding, surface smoothness, staining, scrubbing, sticking, and resistance to mildew (Consumer Reports, 2006; 2006a).

Consumers Union also tested 12 exterior Nonflat coatings. Each product was tested using three colors that represent the basic tint bases. Coatings were tested for appearance after nine years, and to determine resistance to dirt, color change, and mildew. Only one exterior product (Glidden Endurance Satin) complies with the proposed 100 g/l VOC limit, but it received an overall score of 86 which was one of the highest scores given to an exterior Nonflat coating. Appearance of the coating was maintained over nine years of simulated weathering and the coating provided good resistance to dirt, mildew, and color change. The results obtained show that current technology exists to produce coatings that comply with the proposed VOC limit of 100 g/l and perform comparably to higher VOC coatings.

5.23.6.2. UMR: In 2005, the UMR Coatings Institute at the University of Missouri - Rolla conducted a coatings testing project for the SCAQMD (UMR, 2006). The project included tests on products classified as Nonflat - Low Gloss and Nonflat - Medium Gloss coatings. UMR tested some general coating properties, including: percent nonvolatile; stability; viscosity; freeze/thaw resistance; dry time; gloss; and hiding - contrast ratio. They also tested performance properties, including: scrub resistance; stain resistance; blocking resistance; flow/level and sag; accelerated weathering (i.e., QUV testing); and surface tension. All testing was done in accordance with ASTM standards, unless otherwise noted or agreed upon by the SCAQMD. All paints were supplied to the UMR Coatings Institute by SCAQMD.

For Nonflat – Low Gloss coatings, the project was intended to test four products, two low-VOC products (VOC ≤50 g/l) and two high-VOC products (VOC >50 g/l and ≤150 g/l). However, the SCAQMD conducted laboratory tests to measure the VOC contents for two of the products and the results showed that one of the low-VOC products actually had a VOC level greater than 150 g/l, which made it noncompliant with existing VOC limits. In addition, one of the low-VOC coatings was actually a medium gloss coating. Therefore, the Nonflat – Low Gloss testing actually involved two high-VOC products and one low-VOC product. For Nonflat - Medium Gloss coatings, the project originally intended to test four products, two low-VOC products (VOC ≤50 g/l) and two high-VOC products (VOC >50 g/l and ≤150 g/l). However, in addition to these four coatings, there were two coatings that were previously miscategorized. Therefore, six medium gloss coatings were tested, three low-VOC and three high-VOC.

Of the nine Nonflat coatings tested, one was noncompliant with the 150 g/l VOC limit and so was not considered in this evaluation. Of the remaining eight, the four low-VOC products overall performed comparably with the four high-VOC products on several tests. However, on average, the freeze/thaw resistance and stain/dirt pickup resistance for the low-VOC products was noticeably poorer than the high-VOC products. Also, the scrub resistance for the low-VOC products was somewhat poorer than the high-VOC products.

A 100 g/l limit will allow for more glycols for better freeze/thaw resistance and more coalescing agents for harder resins, resulting in better dirt pickup resistance and scrub resistance. Staff believes that additional time is needed to improve the technology and create 50 g/l Nonflats that can perform well throughout California.

5.23.6.3. NTS:

As part of the 1999 amendments to Rule 1113 (Architectural Coatings), the SCAQMD funded a study to compare the performance of low-VOC (≤150 g/l) and high-VOC (>150 g/l) Nonflat coating systems (ARB, 2003). A steering committee was formed to oversee the technical aspects of the study. This committee, called the Technical Advisory Committee (TAC), was comprised of representatives from the Air Resources Board (ARB), SCAQMD, academia, and the architectural coatings industry. The TAC selected National Technical Systems (NTS) as the contractor to carry out the Phase II Assessment Study of Architectural Coatings. The study consisted of laboratory analysis, accelerated weathering, and outdoor exposure. Testing took place from 1998 to 2002.

Accelerated Weathering
Accelerated weathering tests were performed by Atlas Weathering Services Group located in Phoenix, Arizona. Emmaqua (Equatorial Mount with Mirrors for Acceleration with Water) equipment was used to expose test panels to severe sunlight and deionized water spray for 85 days. These tests were completed in 2000.

The accelerated weathering portion of the project provided test results for ten Nonflat coating systems. These systems included a primer and topcoat that were designed to work together for substrate protection. The test program included products from several manufacturers, but samples were only identified by code numbers, rather than by manufacturer and product name. Manufacturers of coating systems that were used in the study included: Benjamin Moore, Dunn Edwards, Frazee Industries, ICI/Glidden, Vista Paints, Masterchem, Morwear, PPA Technologies, Aquarius Coatings, and Zehrung. The low-VOC products that were tested included two “zero VOC” topcoats and one topcoat with a VOC level of 135 g/l. The high-VOC topcoats had published VOC levels from 170-400 g/l. The gloss ranges for the products were from 7-82 degrees on a 60 degree meter. Two of the systems discussed here could be classified as high gloss Nonflats.

Panels were tested in triplicate to determine the following properties: dry film thickness; pre-test and post-test gloss at 20, 60, and 85 degrees; pre-test and post-test CIE; and pre-test and post-test yellowing. CIE is an acronym for *Comission Internationale de l'Eclairage* or International Commission on Illumination, which is a scale used to compare color. Overall, the testing revealed that the low-VOC Nonflat coating systems outperformed the high-VOC systems in gloss retention, CIE, and yellowing tests. Based on visual observations, the low-VOC coatings performed equivalently to the high-VOC coatings. It is important to note that the value of the NTS testing is less relevant for the limits being proposed now since the VOC content range is large and solventborne alkyds, known for yellowing and poorer gloss retention, were included.

24- Month Outdoor Exposure
The outdoor exposure portion of the study consisted of tests performed at regular intervals and observations made by the TAC during inspections.
The exposure portion of the study provided test results for 11 Nonflat coating systems. These were the same coatings tested in the accelerated weathering portion of the study, with the addition of a zero VOC product. Panels were tested in duplicate at Saugus and El Segundo in southern California. The Saugus site featured a dry, desert-like climate, while the El Segundo site featured more of a coastal climate and an industrial setting, since it was next to Los Angeles International Airport. The TAC made regular visits to these sites, where the condition of the test panels was evaluated. The TAC inspected the panels

3, 6, 9, 12, 18 and 24 months after the start of the exposure. At the 12, 18 and 24 month periods of the study, ratings were given to the panels, and the results are summarized below.

In addition to the evaluations of the panels made by the TAC, NTS performed tests on the panels at the start of the outdoor exposure, and repeated those tests after 6, 12, 18 and 24 months. Tests performed by NTS were gloss using 20, 60 and 85 degree meters, CIE color, and yellowing. Written comments were made on chalking, cracks, flakes and blisters. This portion of the study began in April 2000 and was completed in April 2002. In the Non-Flat Coatings category, complying systems performed similarly to non-complying systems. Complying systems showed better performance in gloss tests. At the Saugus test site, complying systems performed better in yellowing tests and equivalently in CIE tests, and at the El Segundo test site, non-complying systems performed equivalently in yellowing tests, and better in CIE tests. With regard to visual evaluations, at both the Saugus and El Segundo sites, the complying nonflat systems performed better than the noncomplying nonflat systems.

5.23.7. Manufacturer Information

ARB staff reviewed survey data and manufacturer product data sheets to identify Nonflat coatings that could comply with the proposed 100 g/l VOC limit. In some cases, survey data for calendar year 2004 indicated that a product was above 100 g/l, but the more recent product data sheets indicated that the product had subsequently been reformulated below 100 g/l.

Based on product data sheets, manufacturers claim that the low-VOC compliant products possess the following properties:

Properties of Interior Nonflat Coatings (<100 g/l)

- Stain Resistant
- Washable
- Scrubbable
- Non-Yellowing
- Hides Imperfections
- Resistant to Mildew
- Spatter Resistant
- Superior Leveling
- Excellent Adhesion
- Low Odor

Properties of Exterior Nonflat Coatings (<100 g/l)

- Resistant to weathering
- Fade and chalk resistant
- Resistant to blistering and flaking
- Alkali Resistant
- Mildew Resistant
- Durable
- Moisture Resistant
- Adhesion

Several of the reported complying products were also included on Master Painter's Institute (MPI) Approved Products lists because they were certified to meet designated performance standards (MPI, 2007). MPI approved more than 90 Nonflat coatings that comply with the proposed 100 g/l limit and meet one of the following standards: MPI #43 (Latex, Interior, "satin-like" - MPI Gloss Level 4); MPI #44 (Latex, Interior, "velvet-like" - MPI Gloss Level 2); MPI #52 (Latex, Interior, “eggshell-like” - MPI Gloss Level 3); MPI #54 (Latex, Interior, Semi-Gloss - MPI Gloss Level 5); MPI #144 (Latex, Interior, Institutional Low Odor/VOC, “velvet-like” - MPI Gloss Level 2); MPI #145 (Latex, Interior, Institutional Low Odor/VOC, “eggshell-like” - MPI Gloss Level 3); and MPI #147 (Latex, Interior, Institutional Low Odor/VOC, Semi-Gloss - MPI Gloss Level 5). Approved products include PPG Pure Performance, PPG Speedhide, Rodda Paint Unique II, Vista Paint Carefree paints; ICI Ralph Lauren Eggshell, Frazee Envirokote, and Kelly Moore Enviro-Cote.

5.23.8. Conclusion

We recommend a 100 g/l VOC limit for Nonflat coatings, effective January 1, 2010. The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on the complying marketshare, the number of companies making complying products, and product information from manufacturers. In addition, the proposed limit is supported by the results of product testing conducted by Consumers Union, MPI, UMR, and NTS.

The proposed VOC limit is lower than the national limit adopted by the U.S. EPA and the OTC states, and the proposed limit for Canada. The proposed 100 g/l VOC limit is higher than the 50 g/l limit contained in SCAQMD Rule 1113. However, manufacturers that provide coatings in the SCAQMD area can still sell products which exceed the 50 g/l limit, if they participate in SCAQMD’s averaging program. The proposed SCM does not contain an averaging provision, so all manufacturers will be subject to the same limit. In addition, the SCM needs to be technologically feasible throughout California. To comply with the 50 g/l limit, some Nonflat coating manufacturers have eliminated glycols in their formulations. As a result, their products must be transported in heated trucks and stored in heated areas, to prevent freezing. Paints with high water contents can coagulate and become unusable if they become frozen. The SCAQMD has a mild climate, so freezing temperatures are less of a concern. However, in other areas of California, freezing temperatures are more prevalent. ARB staff believes that additional research is needed to develop products that perform well in areas with more extreme climates, particularly for exterior Nonflat coatings. Therefore, ARB staff believes that the proposed 100 g/l VOC limit is most appropriate at this time.

5.24. NONFLAT – HIGH GLOSS

VOC Limit Table (g/l):

USEPA: 380	Canada: 250	OTC: 250	SCAQMD: 50	SCM Proposed: 150

5.24.1. Category Definition

A nonflat coating that registers a gloss of 70 or greater on a 60-degree meter according to ASTM Designation D 523-89. Nonflat – High Gloss coatings must be labeled in accordance with SCM labeling requirements.

5.24.2. Major Proposed Changes

- The Quick Dry Enamel category was eliminated because it is no longer necessary to have a special category for these products. Quick Dry Enamel coatings are included in the Nonflat - High Gloss category.
- For Nonflat - High Gloss coatings, the proposed VOC limit will decrease from 250g/l to 150g/l.

5.24.3. Coating Description

Nonflat - High Gloss coatings are typically used in areas subject to high traffic, because they resist stains better and are more washable than Flat coatings. Nonflat - High Gloss coatings are used both residentially and commercially, frequently for trim painting (e.g. doors, window frames, shutters, wood trim, etc.). Nonflat - High Gloss coatings are used much less than Low Gloss and Medium Gloss products. Residential applications include kitchens, bathrooms, hallways, and children’s rooms. For commercial buildings and institutional facilities, Nonflat - High Gloss coatings are used on surfaces such as walls, corridors and stairwells. These coatings are applied by professional contractors and homeowners and application methods include brush, roller, and sprayer.

Most Nonflat - High Gloss coatings are waterborne, single component products. These types of coatings have been preferred by consumers for many years because they are generally easy to use, are low odor, and can be cleaned up with soap and water. The most prevalent resins for Nonflat - High Gloss coatings are vinyl acrylic and 100% acrylic, which are commonly called latex. Other resin types include alkyds and urethanes. Because most Nonflat - High Gloss coatings are waterborne, the VOCs in latex coatings come from additives such as resin coalescing aids, polymer plasticizers, freeze/thaw stabilizers and anti-foam agents. These additives help create homogeneous films, improve block and print resistance, prevent coagulation, ease application, and reduce defects formed during application. Other additives that contribute to the VOC content are preservatives, thickeners and colorants. Resin coalescing aids and freeze/thaw stabilizers are the two main contributors to VOCs in Nonflat - High Gloss coatings. Currently, most coating manufacturers use ester alcohols (e.g., Texanol®) as coalescing agents. Freeze/thaw stabilizers are glycols (e.g., ethylene glycol or propylene glycol) that prevent the paint from coagulating or solidifying when exposed to freezing temperatures.

Nonflat - High Gloss coatings are similar to Nonflat - Low Gloss and Nonflat - Medium Gloss coatings, but there are formulation differences. Generally, more resin is needed to create a glossy appearance and, consequently, more coalescing solvent is needed to support the resin. For that reason, Nonflat - High Gloss has been broken out as a separate category with a higher VOC limit than the other Nonflat coatings.

In previous years, the SCM included a Quick Dry Enamel category which consisted of products that dried quickly and had gloss levels similar to Nonflat - High Gloss coatings. In the 2000 SCM, the VOC limit was 250 g/l for Quick Dry Enamel and Nonflat - High Gloss. To comply with this limit, manufacturers developed formulations that resulted in similar drying properties and gloss characteristics for both categories. The decreased drying time of acrylic binders has resulted in Nonflat - High Gloss coatings that meet the criteria of a Quick Dry Enamel at a lower VOC level. Quick Dry Enamel coatings were often specified when the coated surface needed to dry quickly to minimize dust contamination (e.g., new home construction), or in areas that needed to be returned to service quickly (e.g., restaurants). Nonflat - High Gloss coatings can now be used for these applications and a special category for Quick Dry Enamels is unnecessary. For that reason, ARB staff has proposed eliminating the Quick Dry Enamel category, as we indicated in the 2000 SCM Staff Report. It is assumed that products which were formerly classified as Quick Dry Enamels will now be included in the Nonflat - High Gloss category.

5.24.4. Substrates/Exposure

Nonflat - High Gloss coatings are used for both interior and exterior applications. With proper surface preparation and priming, Nonflat - High Gloss coatings can be used on a large variety of substrates including drywall, plaster, concrete block, wood, and metal. These products are commonly exposed to areas where moisture is present and are often subject to frequent cleaning. Generally, ambient and surface temperatures of application are limited to above 50° Fahrenheit.

5.24.5. Survey Results

This section includes survey data for Quick Dry Enamels and Nonflat - High Gloss coatings. Sales volume and VOC emissions are presented separately for the two categories, because they were reported separately for the survey. Data for complying marketshare and emission reductions reflects the combined data for both categories, because we are proposing that they be combined under Nonflat - High Gloss.

Table 5.24-1 summarizes our estimate of sales and VOC emissions from the Nonflat - High Gloss category, based on the ARB survey. Nonflat - High Gloss coatings have the tenth highest sales volume for architectural coatings in California. In 2004, the sales volume for Nonflat - High Gloss coatings in California was approximately 1.8 million gallons. This represents less than 2 percent of the total California sales volume for architectural coatings.

Waterborne Nonflat - High Gloss coatings represent 98 percent of the Nonflat - High Gloss sales volume and VOC levels are generally below 200 g/l. For solventborne products, a significant portion is sold in small containers and VOC levels are generally greater than 250 g/l, the current SCM VOC limit. The sales volume for Nonflat - High Gloss coatings decreased 9 percent from 2000 to 2004. The sales-weighted average VOC Regulatory value decreased 38 percent from 2000 to 2004.

VOC emissions from Nonflat - High Gloss coatings are about 1.3 tpd, which represents approximately 1 percent of the total emissions from architectural coatings.

Table 5.24-1: Survey Data
Nonflat Coatings – High Gloss

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers [2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	201	40,777	2%	13%	9%	78%	40%	373	0.17
WB	263	1,719,682	98%	42%	0%	57%	2%	146	1.17
Total	**464**	**1,760,459**		**42%**	**1%**	**58%**	**3%**	**151**	**1.34**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.24-2 summarizes our estimate of sales and VOC emissions for Quick Dry Enamels, based on the ARB survey. In 2004, the sales volume for Quick Dry Enamels in California was approximately 760,000 gallons, which represents less than one percent of the total California sales volume for architectural coatings.

Unlike the Nonflat categories, the Quick Dry Enamel category market is dominated by solventborne products which represent 93 percent of the sales volume. The sales volume for solventborne products has increased about 17 percent from 2000 to 2004, and the sales volume for waterborne products has increased more than 200 percent. For Quick Dry Enamels, the VOC levels were generally greater than 250 g/l, the current SCM VOC limit. The sales-weighted average VOC is much higher than the current VOC limit and it increased six percent from 2000 to 2004. The VOC emissions from Quick Dry Enamels were

3.23 tpd, which represents about 3 percent of the total emissions from architectural coatings.

Quick Dry Enamel was one of the categories that could be included in averaging programs during 2004. Under these programs, manufacturers could sell Quick Dry Enamels with VOC levels above 250 g/l, if emissions from these products were offset by emissions from other products that had VOC levels below regulatory limits. For Quick Dry Enamels, 90 percent of the total sales volume consisted of high-VOC products with VOC levels above 250 g/l. These high-VOC products accounted for approximately 3.1 tpd of VOC emissions which represents 95 percent of the total emissions from Quick Dry Enamels.

Table 5.24-2: Survey Data
Quick Dry Enamel

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	84	713,196	93%	32%	14%	54%	2%	390	3.17
WB	45	50,070	7%	6%	0%	94%	0%	237	0.06
Total	**129**	**763,266**		**30%**	**13%**	**57%**	**2%**	**380**	**3.23**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.24-3 contains the complying marketshare for Nonflat - High Gloss coatings based on results from the ARB survey. These data include products that were formerly classified as Quick Dry Enamels. The table shows that 28 percent of the market-share for Nonflat High Gloss coatings complies with the proposed VOC limit. Of the 28 companies that reported in this category, 15 offered Nonflat High Gloss coatings that comply with the proposed limit. Table 5.24-3 shows that implementing the proposed 150 g/l limit would achieve approximately 0.9 tpd in VOC emission reductions for the non-SCAQMD portion of California, on an annual average basis.

Table 5.24-3: Complying Marketshare & Emission Reductions
Nonflat High Gloss

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
150	94	28%	0.91

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.24.6. Product Testing Results

5.24.6.1. UMR:
In 2005, the UMR Coatings Institute at the University of Missouri - Rolla conducted a coatings testing project for the SCAQMD (UMR, 2006). The project included tests on products classified as Nonflat - High Gloss coatings.
UMR tested some general coating properties, including: percent nonvolatile; stability; viscosity; freeze/thaw resistance; dry time; gloss; and hiding – contrast ratio. They also tested performance properties, including: scrub resistance; stain resistance; blocking resistance; flow/level and sag; accelerated weathering (i.e., QUV testing); and surface tension. All testing was done in accordance with ASTM standards, unless otherwise noted or agreed upon by the South Coast AQMD. All paints were supplied to the UMR Coatings Institute by South Coast AQMD.

For Nonflat - High Gloss coatings, they intended to test four products, two low-VOC products (VOC ≤50 g/l) and two high-VOC products (VOC >50 g/l and ≤250 g/l). However, the VOC content for one of the low-VOC products was actually greater than 50 g/l and the other low-VOC product had a gloss level that was below the threshold for High Gloss. Therefore, the Nonflat – High Gloss testing actually involved three high-VOC products.

Two of the samples were around 150 g/l, and one was near the current 250 g/l limit. Since none of the products were 50 g/l or below, it was not possible to make a comparison between coatings that comply with the 50 g/l South Coast AQMD limit and the proposed 150 g/l SCM limit.

5.24.7. Manufacturer Information

ARB staff reviewed survey data and manufacturer product data sheets to identify Nonflat – High Gloss coatings that could comply with the proposed 150 g/l VOC limit. In some cases, survey data for calendar year 2004 indicated that a product was above 150 g/l, but the more recent product data sheets indicated that the product had subsequently been reformulated below 150 g/l.

Based on product data sheets, manufacturers claim that the low-VOC compliant products possess the following properties:

Properties of Interior Nonflat-High Gloss (<150 g/l)
- Washable
- Scrubbable
- High hiding
- Good Mar Resistance
- Low Odor
- Tough
- Durable
- Dries Quickly

Properties of Exterior Nonflat-High Gloss (<150 g/l)
- Provides block resistance
- Moisture resistant
- Superior gloss retention
- Flow and leveling
- Durable
- Blister, alkali and fade resistant
- Non photochemically reactive
- Adhesion

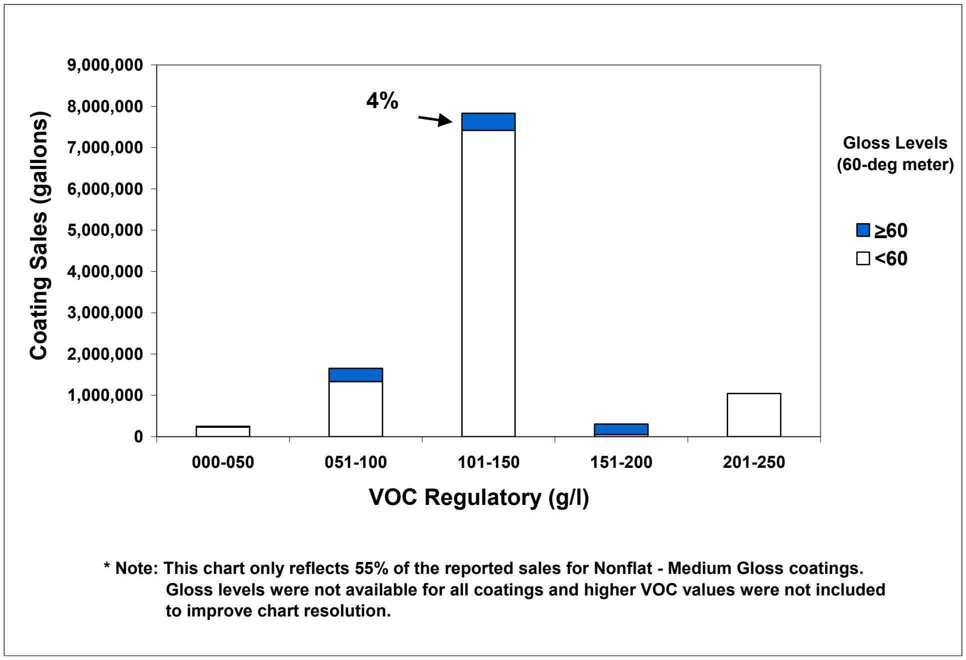
Some complying products are included on Master Painter's Institute (MPI) Approved Products lists because they have been certified to meet designated performance standards (MPI, 2007). ARB staff identified six single component products that had gloss levels above 70 and were MPI-approved to meet one of the following standards: MPI #114 (Latex, Interior, Gloss - MPI Gloss Level 6) or MPI #119 (Latex, Exterior, Gloss - MPI Gloss Level 6). Approved products include Frazee Mirro-Glide Gloss Interior/Exterior Acrylic Finish, Kelly-Moore Dura-Poxy Interior/Exterior 100% Acrylic Gloss Enamel, PPG Manor Hall Interior/Exterior Gloss Acrylic Latex, Rodda Paint Unique II Gloss Exterior Interior Latex, Sherwin Williams Pro Classic Waterborne Interior Gloss Enamel, and Vista Carefree Gloss.

5.24.8 Manufacturer Concerns

Nonflat High Gloss Definition Change: Manufacturers have expressed concerns regarding the gloss range contained in the current definition for Nonflat - High Gloss. Industry requested that ARB consider lowering the threshold for Nonflat - High Gloss coatings from 70 to 60 units on a 60-degree meter. If this occurred, products with a gloss level of 60 units or more would shift from Nonflat - Medium Gloss to Nonflat - High Gloss and they would be allowed the higher 150 g/l VOC limit. Manufacturers requested this change to accommodate product lines that have coatings in two different gloss categories (Nonflat - High Gloss and Nonflat - Medium Gloss).

ARB staff analyzed the survey data and identified gloss levels for 55% of the reported sales volume for Nonflat – Medium Gloss coatings. Staff then determined how much of this sales volume subset would potentially be shifted to Nonflat – High Gloss if the gloss threshold was lowered to 60 units on a 60-degree meter. Nine percent of this subset would potentially be shifted to Nonflat - High Gloss. Three percent would be compliant with a 100 g/l limit (the Nonflat category proposed limit), four percent would be compliant with the proposed 150 g/l limit, and two percent wouldn't be able to comply with a 150 g/l limit. ARB staff decided to leave the threshold as is, since the vast majority of Nonflat - Medium Gloss products have gloss levels below 60 units and changing the threshold would make the SCM inconsistent with the existing specifications used by CalTrans and Master Painters Institute (MPI). Figure 5.24-1 illustrates the sales volume for Nonflat - Medium Gloss coatings with gloss levels above and below the suggested threshold of 60 units.

Figure 5.24-1
Nonflat – Medium Gloss Coatings: Gloss Level vs. VOC



5.24.9. Conclusion

We recommend a 150 g/l VOC limit for Nonflat - High Gloss coatings, effective January 1, 2010. The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on the complying marketshare, the number of companies making complying products, product information from manufacturers, and test data. The proposed VOC limit is lower than the national limit adopted by the U.S. EPA and the OTC states, and the proposed limit for Canada. The proposed limit is higher than the 50 g/l limit contained in SCAQMD Rule 1113. However, manufacturers that provide coatings in the SCAQMD area can still sell products which exceed the 50 g/l limit, if they participate in SCAQMD's averaging program. The proposed SCM does not contain an averaging provision, so all manufacturers will be subject to the same limit.

In addition, the SCM needs to be technologically feasible throughout California. To comply with the 50 g/l limit, some coating manufacturers have eliminated glycols in their formulations. As a result, their products must be transported in heated trucks and stored in heated areas, to prevent freezing. Paints with high water contents can coagulate and become unusable if they become frozen. The SCAQMD has a mild climate, so freezing temperatures are less of a concern. However, in other areas of California, freezing temperatures are more prevalent. ARB staff believes that additional research is needed to develop products that perform well in areas with more extreme climates, particularly for Nonflat – High

Gloss coatings. In addition, more coalescing agents allow for the use of harder resins that improve scrub resistance and dirt pickup resistance. Therefore, ARB staff believes that the proposed 150 g/l VOC limit is most appropriate at this time.

5.25. PRE-TREATMENT WASH PRIMERS

VOC Limit Table (g/l)

USEPA: 780	Canada: 420	OTC: 420	SCAQMD: 420	SCM Proposed: 420

5.25.1. Category Definition

A primer that contains a minimum of 0.5 percent acid, by weight, when tested in accordance with ASTM Designation D 1613-06 that is labeled and formulated for application directly to bare metal surfaces to provide corrosion resistance and to promote adhesion of subsequent topcoats.

5.25.2. Major Proposed Changes

- None.

5.25.3. Coating Description

Pre-Treatment Wash Primers are used as bonding agents on metal substrates to provide adhesion with topcoats, partially due to a reaction with the substrate. They also impart a corrosion resistant film and can be applied to metal alloys, ferrous metals, or nonferrous metals. These primers form very thin films and are similar to etching solutions.

Pre-Treatment Wash Primers are primarily applied with sprayers. Since these coatings typically dry very fast, brush and roller application is usually limited to small areas and touch up. Contractors and professional painters are the primary users of these products. Most products that comply with the 420 g/l VOC limit are single component waterborne coatings with acrylic resins. Non-compliant products are usually multi-component, solventborne coatings with a vinyl resin.

5.25.4. Substrates/Exposures

Pre-Treatment Wash Primers can be applied to metal alloys, ferrous metals, or nonferrous metals, including aluminum, steel, and galvanized metal. They can be used outdoors or indoors.

5.25.5. Survey Results

Table 5.25-1 summarizes our estimate of sales and VOC emissions for Pre-Treatment Wash Primers, based on the ARB survey. Pre-Treatment Wash

Primers are one of the smallest categories with regard to sales volume and VOC emissions. In 2004, the sales volume for Pre-Treatment Wash Primers in California was approximately 5,000 gallons, which represents less than 0.01 percent of the total sales volume for architectural coatings. From 2000 to 2004, the sales volume for Pre-Treatment Wash Primers decreased 93 percent and the overall sales-weighted average VOC content increased 6 percent. This decrease in sales volume is primarily due to improved quality control efforts for survey submittals.

VOC emissions from Pre-Treatment Wash Primers are about 0.01 tpd, which is about 0.01 percent of the total emissions from architectural coatings. Most of these emissions are from solventborne products.

Table 5.25-1: Survey Data
Pre Treatment Wash Primer

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers [2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	7	PD	PD	0%	0%	100%	97%	747	0.01
WB	3	PD	PD	0%	0%	100%	0%	132	0.00
Total	**10**	**4,959**		**0%**	**0%**	**100%**	**21%**	**266**	**0.01**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.25-2 contains the complying marketshare for Pre-Treatment Wash Primers. This table shows that about 99 percent of the sales volume complies with the current VOC limit. Of the five companies that reported in this category, two offered products that comply with the current limit.

Table 5.25-2: Complying Marketshare & Emission Reductions
Pre-Treatment Wash Primer

Current VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
420	2	99%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.25.6. Conclusion

We recommend maintaining a 420 g/l VOC limit for Pre-Treatment Wash Primers. This VOC limit is technologically and commercially feasible based on the complying marketshare and the number of companies making complying products. The current VOC limit is lower than the limit adopted by the U.S. EPA.

The current limit is the same as the limit adopted by the South Coast AQMD and the OTC states, and the proposed limit for Canada.

5.26. PRIMERS, SEALERS, AND UNDERCOATERS

VOC Limit Table (g/l)

USEPA: 350 g/l (primers and undercoaters); 400 g/l (sealers, including clear wood finishes)	Canada: 200	OTC: 200	SCAQMD: 100	SCM Proposed: 100

5.26.1. Category Definition

A coating labeled and formulated for one or more of the following purposes:

- To provide a firm bond between the substrate and the subsequent coatings; or
- To prevent subsequent coatings from being absorbed by the substrate; or
- To prevent harm to subsequent coatings by materials in the substrate; or
- To provide a smooth surface for the subsequent application of coatings; or
- To provide a clear finish coat to seal the substrate; or
- To block materials from penetrating into or leaching out of a substrate.

During development of the 2000 SCM, ARB staff indicated that the Quick Dry Primer, Sealer, Undercoater category would become obsolete. Products in the Quick-Dry Primer, Sealer, Undercoater category were defined in the 2000 SCM as follows:

Quick-Dry Primer, Sealer, 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.

Staff proposes to eliminate the Quick Dry Primer, Sealer, Undercoater category because there is no longer the need for a higher VOC limit to accommodate quick-drying products. The products formerly in this category will now be subject to the VOC limits of the Primer, Sealer, Undercoater or Specialty Primer, Sealer, Undercoater categories.

Although Primers, Sealers, and Undercoaters were considered one category in the 2000 SCM, the definitions were separated as follows:

Primer: A coating labeled and formulated for application to a substrate to provide a firm bond between the substrate and subsequent coats.

Sealer: A coating labeled 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.

Undercoater: A coating labeled and formulated to provide a smooth surface for subsequent coatings.

Staff proposes to combine the above three separate definitions into a single definition for the Primers, Sealers, and Undercoaters category.

5.26.2. Major Proposed Changes

- The Quick Dry Primer, Sealer, Undercoater category has been eliminated. Some of the products that were formerly in this category will be covered by the Primers, Sealers, and Undercoaters category.
- Three separate definitions for “Primer”, “Sealer”, and “Undercoater” have been combined into a single definition for “Primer, Sealer, and Undercoater”.
- The revised Primer, Sealer, and Undercoater definition includes products intended to seal the substrate without being topcoated.
- The VOC limit for the Primer, Sealer, Undercoater category has been reduced from 200 g/l to 100 g/l.

5.26.3. Coating Description

The Primers, Sealers, and Undercoaters category is a generic term that describes the initial coat which provides a suitable substrate for subsequent coatings. It also describes clear sealer coatings that do not require a topcoat. Primers, Sealers, and Undercoaters are used by homeowners and professionals and they are typically sprayed, rolled, or brushed on to the substrate.

In general, the lower-VOC Primers, Sealers, and Undercoaters typically employ the use of acrylic, acrylic copolymer, or vinyl acrylic copolymer resins, while the higher VOC coatings are formulated with alkyd, urethane, and polyurethane resins. Comparison between the ARB 2005 survey and the ARB 2001 survey indicates an increasing reliance on lower-VOC Primers, Sealers, and Undercoaters. This coating category consists primarily of single component formulations; although a very small amount (3 percent) of the solventborne products are multi-component.

5.26.4. Substrates/Exposures

Primers, Sealers, and Undercoaters are used indoors and outdoors on a wide variety of substrates. The products in this category vary widely in their purpose, from preparing walls for application of vinyl wallpaper to filling porous concrete masonry units. Substrates include drywall, previously painted porous surfaces, masonry, concrete, concrete block, brick, stone, wood, plywood, plaster, polyurethane, aluminum or galvanized siding, vinyl, composition board, ferrous metal, hardboard siding, fiberglass, plastics, spray applied polyurethane foam, organic polymers, foil/mylar, acoustic ceiling tiles, popcorn ceilings, flakeboard, acrylic based mortar systems, wallpaper, asbestos siding, polyvinyl chloride (PVC), copper, oriented strand board (OSB), and bituminous surfaces.

Because most products are topcoated, they are not exposed to substances in the environment, but must tolerate the environment of the substrate to which they are applied and the environment of the coating that serves as a topcoat. The product data sheets of many Primers, Sealers, and Undercoaters specify a time frame within which they must be topcoated. If not topcoated within the specified time frame, additional surface preparation and/or recoating prior to topcoating may be necessary. As the substrates and topcoats used with Primers, Sealers, and Undercoaters vary widely, so does the range of conditions to which they must be resistant. Primer, Sealers, and Undercoaters may need to be resistant to, and perform well, under conditions that are alkaline, acidic, etc.

A small number of the reported Primer, Sealer, Undercoater products require no topcoat. These coatings may be used to prevent toxic outgassing of the substrate, or to provide moisture, dust, and mar resistance.

5.26.5. Survey Results

Table 5.26-1a summarizes our estimate of sales and VOC emissions for Primers, Sealers, and Undercoaters, based on the ARB survey. Primers, Sealers, and Undercoaters represent the 4th largest coating category with regard to sales volume and the 5th largest coating category with regard to VOC emissions. In 2004, the sales volume for Primers, Sealers, and Undercoaters in California was approximately 10.4 million gallons, which represents about 9 percent of the total sales volume for architectural coatings.

Waterborne Primers, Sealers, and Undercoaters represent 98 percent of the sales volume. Solventborne products represent 2 percent of the market and generally have VOC levels greater than 200 g/l, the current SCM VOC limit. The sales volume for solventborne products decreased approximately 83 percent from 2000 to 2004, while overall sales volume for Primers, Sealers, and Undercoaters increased by approximately 28 percent. The overall sales-weighted average VOC level decreased 17 percent from 2000 to 2004.

VOC emissions from Primers, Sealers, and Undercoaters are about 6.4 tpd, which represents approximately 7 percent of the total emissions from architectural coatings. Because most of the products sold are waterborne, most of the emissions are from waterborne products, even though these products have a lower sales-weighted average VOC content than solventborne products.

Primer, Sealer, and Undercoater was one of the categories that could be included in averaging programs during 2004. Under these programs, manufacturers could sell Primers, Sealers, and Undercoaters with VOC levels above 200 g/l, if emissions from these products were offset by emissions from other products that had VOC levels below regulatory limits. For Primers, Sealers, and Undercoaters, one percent of the total sales volume consisted of high-VOC products with VOC levels above 200 g/l. These high-VOC products accounted for approximately 0.5 tpd of VOC emissions which represents seven percent of total emissions for Primers, Sealers, and Undercoaters.

Table 5.26-1a: Survey Data
Primers, Sealers, and Undercoaters

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers [2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	128	225,380	2%	20%	54%	26%	14%	371	0.93
WB	560	10,176,638	98%	38%	10%	52%	1%	122	5.48
Total	**688**	**10,402,018**		**38%**	**11%**	**52%**	**2%**	**128**	**6.41**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.26-1b summarizes our estimate of sales and VOC emissions from the Quick Dry Primers, Sealers, and Undercoaters category, based on the ARB survey. Quick Dry Primers, Sealers, and Undercoaters represent the 25th largest coating category with regard to sales volume and the 17th largest category in regard to VOC emission levels. In 2004, the sales volume for Quick Dry Primers, Sealers, and Undercoaters in California was approximately 250,000 gallons, which represents about 0.2 percent of the total volume for architectural coatings.

Waterborne products represent 12 percent of the Quick Dry Primers, Sealers, and Undercoaters market. Solventborne products represent 88 percent of the market and generally have VOC levels greater than 200 g/l, which is the current SCM VOC limit. The sales volume for solventborne products decreased approximately 83 percent from 2000 to 2004, while the overall sales volume for Quick Dry Primers, Sealers, and Undercoaters decreased about 85 percent. The overall sales-weighted average VOC level remained the same from 2000 to 2004.

VOC emissions from Quick-dry Primer, Sealer, Undercoater coatings are about one ton per day (tpd), which represents approximately one percent of the total emissions from architectural coatings. Virtually all of the estimated emissions in this category are attributable to the fraction comprised of the solventborne coatings.

Quick Dry Primer, Sealer, and Undercoater was one of the categories that could be included in averaging programs during 2004. Under these programs, manufacturers could sell Quick Dry Primer, Sealer, and Undercoaters with VOC levels above 200 g/l, if emissions from these products were offset by emissions from other products that had VOC levels below regulatory limits. For Quick Dry Primers, Sealers, and Undercoaters, 61 percent of the total sales volume consisted of high-VOC products with VOC levels above 200 g/l. These high-VOC products accounted for approximately 0.8 tpd of VOC emissions which represents 75 percent of total emissions for Quick Dry Primers, Sealers, and Undercoaters.

Table 5.26-1b: Survey Data
Quick Dry Primer, Sealer and Undercoater

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	30	220,361	88%	52%	0%	48%	3%	410	1.02
WB	5	29,349	12%	0%	0%	100%	4%	20	0.00
Total	**35**	**249,710**		**46%**	**0%**	**54%**	**3%**	**364**	**1.02**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.26-2 contains the complying marketshare for the Primers, Sealers, and Undercoaters category, based on results from the ARB survey. This table includes products that were previously classified as Quick Dry Primers, Sealers, and Undercoaters. This table shows that about 36 percent of the sales volume complies with the proposed VOC limit. When considering the number of products reported, almost 50 percent of the reported products comply with the proposed limit. Implementing the proposed 100 g/l limit would achieve approximately 1.1 tpd in VOC emission reductions for the non-South Coast AQMD portion of California, on an annual average basis.

Table 5.26-2: Complying Marketshare & Emission Reductions
Primers, Sealers, and Undercoaters

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
100	310	36%	1.12

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

Considering interior and exterior products separately, 56 percent of the sales volume for interior products complies with the proposed limit, 34 percent of the sales volume for exterior products complies, and 23 percent of the sales volume for dual interior/exterior use complies.

5.26.6. Product Testing Results

5.26.6.1. KTA-Tator: The KTA-Tator Study, agreed to by the joint industry-government Technical Advisory Committee of the SCAQMD, encompassed four architectural coating categories, one of which was Primers, Sealers, and Undercoaters (PSUs) (SCAQMD, 2002). Both high- and low-VOC, interior and exterior PSUs were tested to determine whether commercially-available architectural coatings that contain lower VOC content perform better, equivalent to, or worse than products with a higher VOC content. The VOC content of coatings tested ranged from 118 g/l to 457 g/l (as reported by manufacturers). “Low-VOC” products had VOC contents less than or equal to 200 g/l, while “High-VOC” products had VOC contents greater than 200 g/l. Testing was conducted to determine coating characteristics and performance.

Characteristics testing included tests to determine VOC Content, volume solids, Infrared Spectroscopic Analysis, viscosity, hiding, dry time, and sag resistance. For waterborne coatings, percent water and freeze/thaw resistance testing were also conducted. All tests to determine characteristics were based on standard ASTM testing procedures. Performance testing for interior PSUs included tests to determine grain raising, adhesion, sandability; and chemical resistance, even though these products are intended to be used on a clean substrate and covered with a top coat. Performance testing for exterior PSUs included tests to determine the degree of grain raising, adhesion, stain blocking, and weathering under accelerated conditions. Most of the testing was based on standard ASTM testing procedures. If no ASTM procedure was available, testing protocols developed by coating manufacturers were used. In the case of the sandability performance test, there was neither an ASTM method nor a coating manufacturer testing protocol available, and the testing procedure was developed by KTA-Tator.

Measured VOC Content Data

The manufacturers’ published VOC values generally agreed with laboratory analysis results, but there were some differences. Three discrepancies existed out of the eleven PSUs tested, with one testing higher in VOC content than the published value and two testing lower. One test sample with a published VOC content of 141 g/l, revealed a VOC content of 227 g/l when tested. Another test sample with a published VOC content of less than 200 g/l, tested well below that maximum at 91 g/l, making this the lowest VOC sample tested. The third discrepancy involved a sample with a published maximum VOC content of 250 g/l, but testing indicated a VOC content of 106 g/l.

Results of the KTA-Tator study indicate that low-VOC products perform as well or better than high-VOC products when tested for the following properties: dry to touch time; sag resistance; grain raising; tape adhesion; stain blocking; sandability; chemical resistance; and accelerated weathering.

Dry to Touch Time

The dry to touch time for all PSUs tested ranged from 10 minutes to 124 minutes. The average dry to touch time for low-VOC PSUs was less than 26 minutes, while the average dry to touch time for high-VOC PSUs was more than double that, at slightly more than one hour.

Sag Resistance

For sag resistance, all of the low-VOC PSUs for interior use performed better than the high-VOC PSU interior products. The majority of the low-VOC PSUs for exterior use performed better than the high-VOC PSUs in sag resistance testing.

Grain Raising

Both low- and high-VOC PSUs performed reasonably well on the substrates tested (white pine, Louisiana Pacific (LP) siding, and red cedar woods). Overall, low-VOC products tended to raise the grain less than high-VOC products. Rated on a scale where a ranking of 1 indicates no grain raising and 5 equates to severe grain raising, most products were ranked either 1 or 2, with two high-VOC PSUs being ranked a 3 on the white pine wood and one high-VOC PSU being ranked as a 3 on the red cedar wood. None of the low-VOC PSUs received a ranking of 3 or above on any of the tested substrates.

Tape Adhesion

Tape adhesion testing was performed on four substrates: drywall, white pine wood, LP siding wood, and red cedar wood. Interior PSUs were tested on drywall and white pine wood substrates, and exterior PSUs were tested on LP siding wood and red cedar wood.

Low-VOC interior PSUs adhered better to their drywall and white pine wood substrates than did the high-VOC interior PSUs, when subjected to the same tape adhesion testing. Similarly, low-VOC exterior PSUs performed better than the high-VOC exterior PSUs when applied to a red cedar substrate and a tape adhesion test conducted. High- and low-VOC exterior PSUs performed very similarly when the tape adhesion test was conducted after the products were applied to LP siding wood.

Stain Blocking Characteristics

Rated on a scale where a ranking of zero indicates severe tannin staining and 10 equates to no tannin staining, all exterior PSUs tested on LP siding wood performed well. All products, including both high- and low-VOC exterior PSUs, received a ranking of 10, with the exception of one low-VOC exterior PSU which received a ranking of 9. It should be noted that this product had the highest VOC content of the low-VOC PSUs tested.

In general, all exterior PSUs, regardless of VOC content, performed less well when blocking tannin stains from the red cedar wood substrate. Both the high (8) and low (1) rankings were captured by high-VOC exterior PSUs, with ratings for high-VOC exterior PSUs averaging 5.3. Low-VOC exterior PSUs ranked slightly better, with an average rating of 6.3.

Sandability Characteristics
Both low- and high-VOC interior PSUs performed well on the substrates tested (white pine wood and drywall), with the exception of one of the low-VOC interior PSUs, which sanded poorly.

Chemical Resistance
Both low- and high-VOC interior PSUs performed identically in all chemical resistance testing. Five products typically found in households (ketchup, mustard, crayons, blue magic maker, and lipstick) were tested on two substrates (drywall and white pine wood). For both substrates, the following results were seen for both high- and low-VOC interior PSUs: ketchup caused no noticeable effect; mustard and blue magic marker resulted in severe staining; crayons caused moderate staining; and lipstick yielded minor staining.

Accelerated Weathering
Accelerated weathering testing was conducted for all exterior PSUs using red cedar wood and LP siding wood as substrates. After 500 hours, specimens were removed from accelerated weathering testing and data on pre- and post-exposure color shift and gloss were compared. The most significant change in color was seen with a high-VOC exterior PSU, and the least amount of color change was seen in a low-VOC exterior PSU. Both high- and low-VOC exterior PSUs showed no reduction in gloss after accelerated weathering testing, with the exception of one low-VOC exterior PSU which showed a slight decrease in gloss.

5.26.6.2. UMR: In 2005, the UMR Coatings Institute at the University of Missouri - Rolla conducted a coatings testing project for the South Coast AQMD (UMR, 2006). The project included tests on products classified as Primers, Sealers, and Undercoaters. UMR tested some general coating properties, including: percent nonvolatile; stability; viscosity; freeze/thaw resistance; dry time; gloss; and hiding - contrast ratio. They also tested performance properties, including: adhesion; stain bleed through resistance; tannin stain resistance; grain raising and sandability; enamel holdout; and flow/level and sag. All testing was done in accordance with ASTM standards, unless otherwise noted or agreed upon by the South Coast AQMD. All paints were supplied to the UMR Coatings Institute by South Coast AQMD.

For Primers, Sealers, and Undercoaters, they tested four products, two low-VOC products (VOC $\leq$100 g/l) and two high-VOC products (VOC >100 g/l and $\leq$200 g/l). On average, on most tests, the two low-VOC samples below 100 g/l performed comparably with the two high-VOC samples above. However, on average, the two low-VOC samples did perform somewhat poorer on overcoat adhesion and stain bleed through (coffee) than the high-VOC samples. It is interesting to note that the low-VOC samples did perform equally well as the high-VOC samples on tannin resistance.

5.26.7. Manufacturer Information

Product information sheets published by coatings manufacturers indicate that a wide variety of Primer, Sealer, Undercoater coatings that meet the proposed VOC limit are available that possess performance characteristics similar to higher-VOC coatings. Review of the product information sheets shows that claims by some manufacturers are similar to those of Specialty Primer, Sealer, Undercoater products in that they can be used over properly prepared chalky surfaces and have the ability to block both non-water soluble and water soluble stains, such as tannins. A summary of product information for Primer, Sealer, Undercoater coatings with a range of VOC contents is provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm).

5.26.8. Conclusion

We recommend a 100 g/l VOC limit for Primers, Sealers, and Undercoaters, effective January 1, 2010. The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on the complying marketshare, testing, and product information from manufacturers. The proposed VOC limit is lower than the national limits adopted by the U.S. EPA for Primers and Undercoaters (350 g/l) and Sealers, including clear wood finishes (400 g/l). It is also lower than the limit adopted by the OTC states and the proposed limit for Canada. Our proposed limit is consistent with the limit adopted by the South Coast AQMD.

The high sales volume that already complies with the proposed limit demonstrates widespread use of existing low-VOC technology for Primers, Sealers, and Undercoaters. While almost all Primers, Sealers, and Undercoaters are currently waterborne latex coatings, the proposed limit would require more waterborne products to be formulated using lower-VOC technology.

In addition to the above factors, results of the KTA-Tator study indicate that low-VOC products perform as well or better than high-VOC products when tested for the following properties: dry to touch time; sag resistance; grain raising; tape adhesion; stain blocking; sandability; chemical resistance; and accelerated weathering.

We further recommend that the Quick Dry Primers, Sealers, and Undercoaters category be eliminated and those products formerly classified under this category be categorized under Primers, Sealers, and Undercoaters. Many products currently classified as Primers, Sealers, and Undercoaters claim the same dry time as Quick Dry Primers, Sealers, and Undercoaters. Additionally, data from the KTA-Tator study support the assertion that low-VOC Primers, Sealers, and

Undercoaters dry as rapidly as higher-VOC products, negating the need for a separate Quick Dry Primers, Sealers, and Undercoaters category.

5.27. REACTIVE PENETRATING SEALERS

VOC Limit Table (g/l)

USEPA: 600 (WST)	Canada: 400 (WCMS or WPS)	OTC: 400 (WCMS or WPS)	SCAQMD: 100 (WCMS or WPS)	SCM Proposed: 350

5.27.1. Category Definition

A clear or pigmented product that is labeled and formulated for application to above-grade concrete and masonry substrates to provide protection from water and waterborne contaminants, including but not limited to, alkalis, acids, and salts. Reactive Penetrating Sealers must penetrate into concrete and masonry substrates and chemically react to form covalent bonds with naturally occurring minerals in the substrate. Reactive Penetrating Sealers line the pores of concrete and masonry substrates with a hydrophobic coating, but do not form a surface film. Reactive Penetrating Sealers must meet all of the following criteria:

- The Reactive Penetrating Sealer must improve water repellency at least 80 percent after application on a concrete or masonry substrate. This performance must be verified on standardized test specimens, in accordance with one or more of the following standards: ASTM C67-07 (Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile); or ASTM C97-02 (Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone); or ASTM C140-06 (Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units); and

- The Reactive Penetrating Sealer must not reduce the water vapor transmission rate by more than 2 percent after application on a concrete or masonry substrate. This performance must be verified on standardized test specimens, in accordance with ASTM E96/E96M-05 (Standard Test Method for Water Vapor Transmission of Materials).

- Products labeled and formulated for vehicular traffic surface chloride screening applications must meet the performance criteria listed in the National Cooperative Highway Research Report 244 (Concrete Sealers for the Protection of Bridge Structures) (1981).

Please note that “Reactive Penetrating Sealer” is a proposed new category that includes products which were formerly covered by the following two categories in the 2000 SCM:

Waterproofing Concrete/Masonry Sealer (WCMS): A clear or pigmented film-forming coating that is labeled and formulated for sealing concrete and masonry to provide resistance against water, alkali, acids, ultraviolet light and staining.

Waterproofing Sealer (WPS): A coating labeled and formulated for application to a porous substrate for the primary purpose of preventing the penetration of water.

These two categories have been eliminated from the proposed SCM and the types of products that were previously in these categories would be covered by the following: Basement Specialty Coating; Concrete/Masonry Sealer; Reactive Penetrating Sealer; Wood Coatings; Industrial Maintenance; Primer, Sealer, Undercoater; Stone Consolidant; and Waterproofing Membrane.

Under the U.S. EPA Architectural Coating regulation, Reactive Penetrating Sealers would be covered by the “Waterproofing Sealers and Treatments (WST)” category.

5.27.2. Major Proposed Changes

- Reactive Penetrating Sealer is a new category that includes products formerly classified under Waterproofing Concrete/Masonry Sealer and Waterproofing Sealer.

5.27.3. Coating Description

These products penetrate and chemically react with concrete and masonry substrates to provide a protective hydrophobic seal that repels liquid water and is resistant to chemicals and deicing salts (chloride ions). They are often considered to be concrete treatments, rather than coatings, and some are formulated to be resistant to oils and grease. They are “breathable”, which means they repel the intrusion of liquid water but they allow water vapor to escape from the substrate without damaging the protective seal. The breathability can be measured with ASTM E96/E96M-05 (“Standard Test Methods for Water Vapor Transmission of Materials”).

Reactive Penetrating Sealers can be used on walls, roadways, bridge decks, sidewalks, driveways, historical monuments, and other surfaces. They are often specified for high-traffic areas, because they penetrate below the surface and are less likely to be worn away by surface abrasion. For these applications, silanes and siloxanes are considered to provide better protection (SHRP, 1992; RMJ, 1997). Products that are intended for use on uncured or “green” concrete are formulated for alkaline stability, because new concrete is highly alkaline.

There are numerous test methods that can be used to assess the performance of Reactive Penetrating Sealers, depending on the type of substrate and the desired properties. The Sealant Waterproofing and Restoration Institute (SWRI) has compiled a handbook of recommended performance tests that include water repellency, water vapor transmission, water absorption, durability, chloride ion intrusion, slip resistance, and depth of penetration (SWRI, 2006). Many of the products for bridges and roadways are tested in accordance with the procedures contained in the National Cooperative Highway Research Program (NCHRP) Report 244 “Concrete Sealers for Protection of Bridge Structures” published in 1981. Another common test method is the American Association of State Highway and Transportation Officials (AASHTO) T259, “Resistance of Concrete to Chloride Ion Penetration”.

Chloride screening is a term that describes the act of reducing the penetration of water that contains chlorides. When water that contains chlorides penetrates into concrete, it can cause corrosion that can damage structural integrity. The use of salts on bridges or roadways can create a solution of water that contains dissolved chlorides. Concrete sealers that are formulated for chloride screening help prevent penetration of this water and their performance can be assessed by using the criteria contained in the National Cooperative Highway Research Report 244 (“Concrete Sealers for the Protection of Bridge Structures”).

Most Reactive Penetrating Sealers are low-viscosity fluids (similar to water) and they do not fill or bridge cracks (Slaton, 2006). However, some European products are in the form of crèmes or gels, which helps the material remain in place to allow deeper penetration and prevents the material from running down a vertical or sloped surface (Wacker, 2007). Most products leave a clear finish that does not usually change the appearance of the substrate, but some clear siloxane products can cause a slight darkening on light-colored surfaces.
In addition to these clear products, there are reactive concrete stains that penetrate and chemically react with concrete to change the color. Some manufacturers have developed formulations (e.g., acrylic/silane) that provide both a decorative finish and protection against water, chloride ions, etc. Some of these stain/sealer products claim to meet the same performance criteria as the clear products, in terms of water repellency and vapor transmission. Therefore, the definition for Reactive Penetrating Sealers contains both clear and pigmented products. The Reactive Penetrating Sealer category does not cover reactive concrete stains that are formulated for decorative purposes only and need to be covered with a protective clear sealer. Decorative products that provide no water repellency and have no resistance to contaminants would be covered by the Stains category, because they do not meet the criteria for Reactive Penetrating Sealers.

Reactive Penetrating Sealers are generally applied by professional contractors and they can be used on horizontal and vertical surfaces, with interior and exterior exposures. Application methods include: low-pressure sprayer, brush, and roller. These products are not easily removed after application and they can interfere with bonding of subsequent sealants or coatings. Therefore, it is usually recommended that crack filling and repairs be completed prior to application of the sealer.

Reactive Penetrating Sealers generally have one of following formulation types: silane; siloxane; silane/siloxane blend; inorganic silicate; silane/silicate blend; or siliconate. As formulated in the can, these products often contain low levels of VOCs or zero VOCs. However, after application, silanes and some siloxanes undergo a chemical reaction that releases VOCs (e.g., ethanol or methanol). Shown below is an example of the reactions that can occur. Initially, the alkylalkoxysilane reacts with water to create an alkyl silanol and releases ethanol. The product of this initial reaction subsequently reacts with silanol groups in the concrete to bond with the substrate and create a silicone network in the concrete pores (D.B. Becker, 2007; McGettigan, 1994):

R-SiOEt + H2O → R-SiOH + CH3CH2OH (ethanol)

R-SiOH + SiOH (in concrete) → R-SiOSi-R + H2O

where
R-SiOEt = Alkylalkoxysilane
H2O = Water
R-SiOH = Alkyl Silanol
CH3CH2OH = Ethanol
SiOH = Silanol
R-SiOSi-R = Silicone Crosslinking Network

The VOCs that are released during the chemical reaction are known as cure volatiles and they should be included when determining the VOC content of a product. However, ARB staff found that there was some inconsistency in the industry regarding this matter. Some manufacturers are correctly including cure volatiles in their reported VOC contents while others are not. As a result, some products that are being marketed as low-VOC products actually have much higher VOC levels when the VOC is determined correctly. For example, during the South Coast AQMD testing project with the University of Missouri, they tested two silane-based concrete/masonry sealers. Both products had published VOC values below 100 g/l, but laboratory analysis revealed that the actual VOC contents were 200 g/l and 220 g/l (UMR, 2006). ARB staff has found that most manufacturers determine their VOC values based on formulation data, because it is less expensive than conducting a laboratory analysis in accordance with EPA Test Method 24. For silanes and siloxanes, EPA Test Method 24 refers to ASTM D5095 (Standard Test Method for Determination of the Nonvolatile Content in Silanes, Siloxanes and Silane-Siloxane Blends Used in Masonry Water Repellent Treatments), which includes measurement of cure volatiles. Since VOC data from coating manufacturers were sometimes uncertain, ARB staff worked with raw material suppliers to determine what the theoretical VOC should be for various chemistries.

Provided below are descriptions for the different types of chemicals commonly used in Reactive Penetrating Sealers (Degussa, 2007; Dow Corning, 2007; Henry, 2006; McGettigan, 1994; McGovern, 2000; Slaton, 2006):

Silane: A silicone-based monomer with four chemical attachments. For example, in an alkoxy silane (e.g., $R\text{-}Si(OCH_3)_3$), one end of the molecule has an inorganic alkoxy group that reacts with the concrete and the other end has an organic group (e.g., alkyl, phenyl, fluoro) that makes the substrate hydrophobic. This hydrophobicity makes silanes suitable for use as water repellents. Silane monomers are smaller molecules than siloxane polymers. Therefore, silanes are able to penetrate deeper into concrete and masonry substrates, which may provide greater durability. Products with a high concentration of silanes are often specified for use on dense materials that are difficult to penetrate or previously coated surfaces. Commonly used silanes include Butyltrimethoxysilane (CAS #1067-57-8); Trimethoxyoctylsilane (CAS #3069-40-7); Triethoxy(2-methylpropyl)silane (CAS #17980-47-1); and Triethoxyoctylsilane (CAS #2943-75-1). Silanes are provided in solventborne and waterborne formulations and both types of formulations generally release VOCs during cure.

Siloxane: A linear Si-O-Si polymer or pre-polymer (e.g., silicone, polydimethylsiloxane, dimethicone, simethicone). Siloxanes are less volatile than silanes and may be more appropriate for application during warm weather. Many siloxanes only contain silanol (Si-OH) as the reactive group or they possess no reactive groups and only included in the formulation to promote water beading, bulking, or other properties. In those cases, they do not release VOCs during cure. Siloxanes are provided in solventborne and waterborne formulations and both types of formulations may release VOCs during cure, depending on the type of reactive functionality.

Silane/Siloxane Blend: A product formulated with a combination of silanes, siloxanes, and other components. Silane/Siloxane Blends are provided in solventborne and waterborne formulations and both types of formulations generally release VOCs during cure.

Inorganic Silicate: A compound containing Silicon, Oxygen and one or more metals (e.g., Lithium Silicate or Sodium Silicate). Inorganic Silicates are commonly used as densifying treatments for concrete. Some inorganic silicate products can be applied on freshly poured concrete to act as a curing compound, hardener, and dustproofer. If the product is designed for curing freshly poured concrete, it would be classified as a Concrete Curing Compound. However, if the product is designed for aged or cured concrete, it could be classified as a Reactive Penetrating Sealer or a Concrete/Masonry Sealer. Inorganic Silicates can react with calcium hydroxide in the substrate or carbon dioxide in the air to create an insoluble precipitate. The precipitated compound helps prevent water penetration by physically blocking the pores, but it does not make the substrate chemically hydrophobic. Inorganic Silicates do not release VOCs during cure.

Silane/Silicate Blend: A product formulated with a combination of silanes, silicates, and other components. Silane/Silicate Blends generally release VOCs during cure.

Siliconate: A compound (e.g., potassium methylsiliconate) that results from reacting a silicone-based monomer with a metal hydroxide to create a water-soluble water repellent. Siliconates react with atmospheric carbon dioxide to form a silicone resin that acts as a barrier to water. This reaction proceeds relatively slowly as compared to silane/siloxane reactions. Dilute waterborne solutions (<2%) are recommended, because concentrated solutions can result in the formation of a visible salt on the surface (e.g., potassium carbonate). Siliconates are provided in waterborne formulations that may contain VOCs, but do not release VOCs during cure.

Some manufacturers have developed low-VOC Reactive Penetrating Sealers to comply with the 100 g/l limit in the South Coast AQMD. One technique for lowering the VOC content involves partially reacting the silane or siloxane ingredients during the manufacturing process, which causes some of the cure volatiles to be released during manufacture rather than during application. However, this technique can adversely affect product performance if the material doesn't have sufficient activity remaining to allow for effective reaction and bonding with the substrate.

Based on the reported survey data, Reactive Penetrating Sealers accounted for approximately 1% of the reported sales volume for Waterproofing Concrete/Masonry Sealers and 0% of the sales for Waterproofing Sealers. They also accounted for 0% of the VOC emissions for Waterproofing Concrete/Masonry Sealers and 1% of the VOC emissions for Waterproofing Sealers. This analysis is based on the data as reported, but it may not be entirely accurate if manufacturers determined VOC contents incorrectly.

5.27.4. Substrates/Exposures

Reactive Penetrating Sealers are intended for application to above-grade concrete and masonry substrates. Products in this category are intended for interior and exterior exposures on horizontal and vertical surfaces.

5.27.5. Survey Results

Reactive Penetrating Sealer is a new category and it was not reported separately in the ARB survey. Please refer to the Concrete/Masonry Sealer section for survey data that were reported for Waterproofing Concrete/Masonry Sealer and Waterproofing Sealer.

Table 5.27-1 contains estimated complying marketshare data for the proposed new Reactive Penetrating Sealer category. This table reflects combined data for products that seemed to be marketed as reactive penetrating materials and were reported under Waterproofing Concrete/Masonry Sealer or Waterproofing Sealer. ARB staff is not certain that all manufacturers included cure volatiles when calculating VOC values for their products. Therefore, some of the survey data may be in error. Based on the data, as reported, approximately 93 percent of the sales volume complies with the proposed VOC limit of 350 g/l. When considering the number of products reported, 91 percent of the products comply with the proposed limit.

Table 5.27-1: Complying Marketshare & Emission Reductions
Reactive Penetrating Sealer

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
350	20	93%	0.00

5.27.6. Conclusion

For the new Reactive Penetrating Sealer category, we are recommending a VOC limit of 350 g/l, effective January 1, 2010. The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on information provided by manufacturers. This would provide a consistent VOC limit for Reactive Penetrating Sealers and Concrete Curing Compounds. Both of these categories use similar reactive penetrating materials, but the products in the Concrete Curing Compound category must be suitable for use on freshly poured concrete. Other types of concrete and masonry coatings that do not meet the criteria for Reactive Penetrating Sealer would be covered by another category (e.g., Concrete/Masonry Sealer, Basement Specialty Coating, Waterproofing Membrane, etc.).

The proposed VOC limit is higher than the 100 g/l limit contained in SCAQMD Rule 1113. However, manufacturers that provide coatings in the SCAQMD can still sell products which exceed the 100 g/l limit, if they participate in South Coast AQMD's averaging program. The proposed SCM does not contain an averaging provision, so all manufacturers will be subject to the same limit. In addition, the emission reduction losses for this category are negligible for a 350 g/l limit as compared to a 100 g/l limit. The proposed SCM VOC limit is lower than the national limit of 600 g/l promulgated by the U.S. EPA. The proposed limit is lower than the limit for Waterproofing Concrete/Masonry Sealers (400 g/l) and higher than the limit for Waterproofing Sealers (250 g/l), as adopted by the OTC states and proposed by Canada.

5.28. RECYCLED COATINGS

VOC Limit Table (g/l)

USEPA: N/A	Canada: 250	OTC: 250	SCAQMD: 250	SCM Proposed: 250

5.28.1. Category Definition

An architectural coating formulated such that it contains a minimum of 50% by volume post-consumer coating, with a maximum of 50% by volume secondary industrial materials or virgin materials.

5.28.2. Major Proposed Changes

- The definition for Recycled Coatings was modified to be similar to the criteria established for Green Seal certification.

5.28.3. Coating Description

Recycled Coatings are waterborne topcoats and primers, with sheens ranging from flat to semigloss. These products are generally identified as latex coatings with acrylic resins, and some manufacturers can custom-match colors. Recycled Coatings are generally collected at community household hazardous waste collection sites. Some manufacturers sell their recycled coatings through their retail stores. Other manufacturers receive coatings from counties, then reprocess the coating, and sell the product back to the county.

Recycled Coatings are typically applied by brush, roller, or spray and are used by professional contractors and homeowners. Local governments often use Recycled Coatings in graffiti abatement programs.

The State of California has developed programs to encourage the purchase of recycled coatings. The State Agency Buy Recycled Campaign (SABRC) is a joint effort between the California Integrated Waste Management Board (CIWMB) and the Department of General Services (DGS) to implement State law that requires State agencies and the Legislature to purchase products with recycled content (CIWMB, 2007, 2007a). State regulations contain purchasing requirements for State agencies and the State legislature (CPC, 2007). Under these requirements, at least 50 percent of paint purchases made by state agencies must be recycled products which contain at least 50% post-consumer content.

Environmentally Preferable Purchasing (EPP) is another State program that promotes the procurement of recycled products that have a reduced impact on human health and the environment (CPC, 2007a).

In August 2006, Green Seal published GS-43, "Environmental Standard for Recycled-Content Latex Paint", which defined two categories of recycled coatings (GS, 2006):

- Consolidated Paint - Contains a minimum of 95% by volume post-consumer paint with a maximum of 5% by volume secondary industrial materials or virgin materials.
- Reprocessed Paint - Contains a minimum of 50% by volume post-consumer paint, with a maximum of 50% by volume secondary industrial materials or virgin materials.

As of June 2007, Green Seal had not yet published a certified product list for recycled paints.

Master Painter's Institute (MPI) has also defined standards for two classes of recycled coatings (Remanufactured and Consolidated) at various gloss levels (MPI, 2007):

- MPI Standards for Latex Recycled (Remanufactured) Coatings - Contains a minimum of 50% by volume post-consumer paint and a maximum of 50% by volume secondary industrial materials or virgin materials. MPI Standards for Remanufactured Coatings include MPI #10RR (Exterior Flat); MPI #15RR (Exterior Low Sheen); MPI #44RR (Interior MPI Gloss Level 2); and MPI #53RR (Interior MPI Gloss Level 1).
- MPI Standards for Latex Recycled (Consolidated) Coatings - Contains a minimum of 95% post consumer paint, with a maximum of 5% by volume secondary industrial materials, or virgin material. MPI Standards for Consolidated Coatings include MPI #10RC (Exterior Flat); MPI #15RC (Exterior Low Sheen); MPI #44RC (Interior MPI Gloss Level 2); and MPI #53RC (Interior MPI Gloss Level 1).

As of June 2007, Master Painter's Institute was accepting products for certification, but they had not yet published lists of approved recycled paints.

5.28.4. Substrates/Exposures

Recycled Coatings can be used on a variety of interior and exterior surfaces, such as drywall, concrete/masonry (e.g., concrete block, stucco, etc.), wood, and metal.

5.28.5. Survey Results

Table 5.28-1 summarizes our estimate of sales and VOC emissions from the Recycled Coatings category, as reported for the ARB survey.

Table 5.28-1: Survey Data
Recycled Coatings

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	0	0	-	-	-	-	-	-	-
WB	7	223,381	100%	0%	46%	54%	0%	193	0.00
Total	**7**	**223,381**		**0%**	**46%**	**54%**	**0%**	**193**	**0.00**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

The sales volume for Recycled Coatings represents about 0.2 percent of the total California sales volume of architectural coatings in 2004. No VOC emissions are calculated for Recycled Coatings, because it is assumed that the emissions have already been accounted for, based on the original coating. When compared to the data reported for calendar year 2000, Recycled Coating sales volume decreased 31 percent in 2004 and the sales-weighted average VOC content decreased 5 percent.

Table 5.28-2 contains the complying marketshare for Recycled Coatings, based on results from the ARB survey. This table shows that 100 percent of the sales volume for Recycled Coatings complies with the current VOC limit of 250 g/l. When considering the number of products reported, approximately 100 percent comply with the current limit.

Table 5.28-2: Complying Marketshare & Emission Reductions
Recycled Coatings

Current VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
250	7	100%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.28.6. Manufacturer Information

The California Integrated Waste Management Board has developed a Recycled Content Product Directory in support of the State Agency Buy Recycled Campaign. This directory lists several suppliers of Recycled Coatings that have been certified as “SABRC Compliant”, including: Amazon Environmental, Inc.; Kathleen and Company; Kelly-Moore; Visions Recycling; and Xstream Coatings.

5.28.7. Conclusion

We recommend maintaining a 250 g/l VOC limit for Recycled Coatings. This VOC limit is technologically and commercially feasible, based on the high complying marketshare. The SCM VOC limit is the same as the VOC limits adopted by the South Coast AQMD and the OTC states. The SCM VOC limit is also the same as the limit proposed for Canada.

The proposed limit for Recycled Coatings is higher than the proposed limits for Flat, Nonflat, and Nonflat - High Gloss coatings, because to encourage recycling, the limit needs to accommodate older coatings that consumers have yet to turn over to recycling collection events. As recently as 2002, the VOC limits for many latex house paints were 250 g/l, and in the non-SCAQMD portion of California, the current VOC limit for Nonflat - High Gloss coatings is 250 g/l. Accordingly, we believe it makes sense to keep the VOC limit for Recycled Coatings at 250 g/l, to accommodate the VOC contents of the “feedstock” coatings.

5.29. ROOF COATING

VOC Limit Table (g/l)

USEPA: 250	Canada: 250	OTC: 250	SCAQMD: 50	SCM Proposed: 50

5.29.1. Category Definition

A non-bituminous coating labeled and formulated for application to roofs for the primary purpose of preventing water penetration, reflecting ultraviolet light, or reflecting solar radiation.

5.29.2. Major Proposed Changes

- The proposed VOC limit for Roof Coatings would decrease from 250 g/l to 50 g/l.
- The definition has been revised for clarification purposes.

5.29.3. Coating Description

Roof Coatings are used to prevent water penetration and UV absorption to increase the longevity of a roofing system. Roof Coatings can be applied without primers and can adhere well to old coatings, including oil-based paints (AJ, 2006). Roof Coatings can be used to restore or rehabilitate a roof, which may be a more cost-effective option than completely replacing the roof system (Daisey, 2006). Depending on the product composition, Roof Coatings will lose some reflectance, due to dirt pickup, over several years of exposure. Therefore, recoating is recommended every 7 to 10 years to improve reflectivity (Zielnik, 2006; Zielnik, 2006b).

Roof Coatings are designed to possess many different properties to withstand environmental and substrate material stresses. Desired characteristics of a well-performing roof coating include: elongation to deal with thermal-mechanical stresses; tensile strength to handle potential tears and rips from foot traffic and impactions; and solar reflectivity and thermal emissivity to reduce roof and building heat gain. Solar reflectance is the amount of solar radiation not absorbed and thermal emittance is the amount of heat given off of the surface. The advantage of high thermal emissivity and solar reflectivity is that it reduces energy use during peak demand when rates are highest, and helps reduce the demand charge that a facility owner or homeowner pays year-round on the basis of peak demand use (Zielnik, 2006). Metal roofs can benefit greatly from white roof coatings since they are naturally reflective, but exhibit poor emissive properties. Uncoated bare metal roofs have an emissivity of about 10 percent while roofs that are coated with white reflective elastomeric paints have an emissivity as high as 80+ percent (Daisey, 2006). These coatings can also be used to extend the life of many traditional roofing systems. Applying protective solar reflective coatings can be advantageous, not only for energy savings from cooling demand, but also because they have the potential to improve the longevity of a roof by adding a barrier to water damage and UV light (Radiation Control Fact Sheet, 2005).

Roof Coatings can be applied by brush, roller, and sprayer but specialized equipment may be required, depending on the resin and substrate. When applied, these coatings are naturally smooth and vary from flat to high gloss, but texture is dependent on roofing substrate and system. Since they can be used for residential, commercial, and industrial purposes, they are generally applied by contractors and professional roofers. However, homeowners can also apply these coatings. Application limitations that may hinder adhesion and coating properties are rain within 24 hours of application, and newly laid asphalt/bituminous coatings that must cure at least 30 to 90 days prior to application to ensure “tobacco juices” are removed. Newly mixed and poured concrete must cure for at least 14 to 30 days prior to application of Roof Coatings.

Roof Coatings can also be applied over spray polyurethane foam (SPF) systems. These systems are unique in that they provide both insulation and waterproofing characteristics, while performing as a long service life coating with periodic repairs and maintenance (JAC, 2007a). Some advantages of these coatings are a high strength-to-area ratio coupled with energy savings. With polyurethane foam as an insulator/waterproofer, reflective Roof Coatings could potentially perform substantially better and have improved longevity due to the ease of repair, maintenance, and low roof load. An example of such an application is within a Dallas school district. Since the 1980s, this district has applied SPF with white reflective topcoats to roughly 140 schools, due to the associated benefits of energy savings, serviceability, and renewability (JAC, 2007b). This is advantageous because costly roof removal and installation is eliminated. Many Roof Coatings are suitable for the application over SPF roofs.

Most Roof Coatings are waterborne single component products with resins that include: acrylic, acrylic copolymer, epoxy, silicones, vinyl acrylic copolymer, polyvinyl acetate, or a combination of these resins for varied properties and environmental conditions. Waterborne Roof Coatings have achieved greater market acceptance because of features related to performance, cost, and health and safety (Sosinski, 2006). Acrylics are resistant to chemically- and photochemically-induced polymer degradation, because their main polymer chain is a carbon-to-carbon single bond, making them relatively inert and not as susceptible to chemical change (Sherwin-Williams, 2001). This durability promotes good weathering performance, due to resistance to hydrolysis and lack of UV absorption (AJ, 2006).

Solventborne Roof Coatings are usually single component, but multi-component products are available. Solventborne single component roof coatings have resins that include: amines/amides, chlorinated rubber, epoxy, urethane, polyurethane, silicones, and acrylic copolymers. Multi-component Roof Coatings are solventborne products with resins such as urethane, polyurethane, amides/amines, and epoxies. These multi-component urethanes are the only solventborne products that will meet the proposed VOC limit of 50 g/l.

All Roof Coatings have volume percent solids that range from around 30 percent to 100 percent, with an average of 50 percent. Solventborne products contain the highest volume solids on average with a range of 39 to 100 percent, while the volume solids for waterborne products ranges from 14 to 66 percent. Typically, thicker coating layers correlate to better performance because it takes longer for the coating to degrade. Some manufacturers recommend that two coats be applied to create a relatively thick coating to ensure development of protective properties. Application temperatures for both waterborne and solventborne products typically range from 50 to 100 degrees F, with extremes of 35 to 120 degrees F.

Some manufacturers commented that solventborne Roof Coatings are needed for cold temperature applications. Application temperatures are generally the same for solventborne and waterborne coatings, but solventborne coatings typically have shorter curing times due to solvent evaporation, even in temperatures near freezing. Evaporation of water from waterborne coatings is not ideal in cold temperatures, especially near freezing. The faster cure time for solventborne coatings can be advantageous in unpredictable weather conditions, because it helps prevent the coating from washing off if unexpected rain or freezing temperatures occur within the first 24 hours of application. Waterborne products can potentially be ruined when subjected to similar weather conditions. However, in general, roof coatings should be applied when the temperature is at least 5 degrees F above the dew point for best adhesion and cure.

Some manufacturers expressed concern that the proposed 50 g/l VOC limit will induce premature coating failures because low-VOC coatings can be difficult to apply in cold, humid, or rainy climates. Most of California's residents live in temperate climatic conditions that are suitable for the application of lower VOC products. However, residents of the Sierra Nevada, Northern California, and other parts of the country (e.g. the Northeast and Midwest) are subject to less temperate climates that may not permit the use of lower VOC products during certain times of the year. Roof Coating application and adhesion can be adversely impacted by unexpected rain, heavy dew, thick fog, and extremely cold temperatures.

5.29.4. Substrates/Exposures

Roof Coatings are applied to exterior residential, commercial, and industrial roofs. Roof Coatings can be applied on a wide array of substrates such as metal, concrete, primed wood, cured asphalt roofs, and polyurethane foam. Polyurethane foam is becoming a more popular substrate for roof applications due to its low roof load weight and insulating capacity.

Roof Coatings are not intended for use on roof systems that are susceptible to ponding water, and they require a surface that is clean and free of dirt, dust, oil, surface chemicals, or other contaminants for best adhesion. However, some products can have excellent resistance to ponding water.

5.29.5. Survey Results

Table 5.29-1 summarizes our estimate of sales and VOC emissions from Roof Coatings, based on the ARB survey. In 2004, the sales volume for Roof Coatings in California was 1.4 million gallons which represents 1.3 percent of the total California sales volume for architectural coatings. Waterborne Roof Coatings represent 97 percent of the market and have a sales-weighted average (SWA) VOC Regulatory value of 40 g/l, which is below the proposed 50 g/l VOC limit. The overall sales-weighted average VOC Regulatory value for Roof Coatings is 46 g/l and it has decreased 33 percent from 2000 to 2004.

In 2004, VOC emissions from Roof Coatings were about 0.4 tpd, which represents approximately 0.4 percent of the total emissions from architectural coatings. Solventborne coatings produce about 30 percent of the emissions, but only account for 3 percent of the sales volume. According to the ARB survey, roughly 3 tpd of VOCs are released from coatings related to roofing, including emissions from Aluminum Roof, Bituminous Roof, Bituminous Roof Primer, and Roof Coatings.

Table 5.29-1: Survey Data
Roof Coatings

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	32	42,967	3%	0%	100%	0%	2%	232	0.11
WB	180	1,363,922	97%	0%	100%	0%	0%	40	0.28
Total	**212**	**1,406,889**		**0%**	**100%**	**0%**	**0%**	**46**	**0.39**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.29-2 contains the complying marketshare for Roof Coatings, based on the ARB survey. This table shows that 83 percent of the sales volume for Roof Coatings complies with the proposed VOC limit. The expected VOC emission reductions for the proposed limit are 0.07 tpd.

Table 5.29-2: Complying Marketshare & Emission Reductions
Roof Coatings

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
50	112	83%	0.07

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

A listing of Roof Coating manufacturers and products that comply with the proposed VOC limit is provided on ARB's website (www.arb.ca.gov/coatings/arch/docs.htm). Of the 38 companies that reported in this category, 23 offered Roof Coatings that comply with the proposed limit. Of these 23 companies, 13 are considered to be small businesses because they have fewer than 250 employees.

5.29.6. Manufacturer and Industry Issues

Many manufacturers and industry representatives have expressed concerns about certain aspects of the proposed SCM regarding VOC limits, definitions, and other technical issues. Below are key issues that have been brought to our attention during our interactions with the industry representatives.

5.29.6.1. Issue: The Roof Coatings Manufacturers Association (RCMA) and the National Paint and Coatings Association (NPCA) have expressed concerns about premature performance failures of low-VOC roof coating products, because they are not designed for colder, humid, and/or rainy climates. Also, they believe that premature application failures are a result of applying coatings in temperatures or humid conditions not suitable for lower VOC coatings. They believe that these premature failures could reduce life cycle performance and increase waste generation.

Response: Based on manufacturer product data sheets, total sales volume, and complying marketshare, it appears that some waterborne products are more prone to an application temperature minimum of 50 degrees Fahrenheit. However, the high complying marketshare indicates that waterborne products are just as effective as higher VOC solventborne coatings while providing adequate protection from cold, humid, and/or rainy climates.

5.29.6.2. Issue: The NPCA and RCMA recommend the use of a reactivity-based approach for regulating Roof Coatings. Some industry representatives have suggested that the ARB use the units of grams of ozone generated per gallon of coating to establish a reactivity-based standard. Industry representatives have also suggested that low-reactive products with higher VOC contents should be exempt from future SCM limits because they have lower ozone formation potential. Industry representatives have suggested that lower-reactivity products could be formulated by replacing some hydrocarbon solvents with other hydrocarbon solvents that have a lower maximum incremental reactivity (MIR) value.

Response: ARB staff analyzed industry's proposed approach for developing Roof Coatings with a reduced ozone formation potential. The maximum ozone formation potential can be determined based on the MIR value for each of the chemicals contained in a coating. Since hydrocarbon (HC) solvents are mixtures of several chemicals, ARB developed a bin system to assign MIR values to hydrocarbon solvents, based on boiling point and chemical characteristics (ARB, 2007). For hydrocarbon solvents, the assigned MIR values range from 0.81 grams ozone per gram product (g O^3/g product) for Bin 12 up to 8.01 g O^3/g product for Bin 23. The most common hydrocarbon solvents reported for Roof Coatings are Bin 15 (MIR = 1.82 g O^3/g product) and Bin 22 (MIR = 7.51 g O^3/g product).

Using data from the ARB Survey, ARB staff determined that the maximum ozone formation potential (OFP) for all Roof Coatings was 0.64 tpd Ozone in 2004, outside of the South Coast AQMD (ARB, 2007). Implementing a 50 g/l VOC limit is expected to achieve an emission reduction of 0.07 tpd and a corresponding ozone reduction of 0.20 tpd, outside of the South Coast AQMD.

ARB staff identified all of the Roof Coatings that contained hydrocarbon solvents with MIR values greater than 1.82 g O^3/g product. Based on industry recommendations, staff assumed that all of these higher-MIR solvents were replaced with Bin 15 hydrocarbon solvents that had an MIR value of 1.82 g O^3/g product or with a blend of hydrocarbon solvents that had an MIR value of 2.50 g O^3/g product. If this type of substitution occurred, ARB staff estimates that the maximum ozone formation potential would be 0.62 tpd, outside of the South Coast AQMD. This indicates that about 0.02 tpd of ozone reduction could occur by reformulating existing Roof Coatings at current VOC levels. This analysis assumes that the hydrocarbon substitution would be on an equivalent mass basis. However, industry representatives acknowledge that they might need to use larger amounts (e.g., 20% more) of the low-MIR hydrocarbon solvents to achieve a solvency that is comparable to the higher-MIR solvents. Therefore, the amount of ozone reduction from a reactivity-based limit would likely be less than 0.02 tpd. This amount is less than the reduction that would be expected from establishing a mass-based VOC limit at 50 g/l. Based on this analysis, it does not appear that a reactivity-based limit would achieve emission reductions beyond what could be achieved by implementing the proposed mass-based limit of 50 g/l. Since a reactivity-based limit would require additional district resources, without providing an increase in reductions, ARB staff determined that the proposed mass-based limit was preferable.

5.29.6.3. Issue: RCMA stated that, in California, waterborne emulsions are applied as part of regular roof maintenance during summer while solventborne coatings are used during storms to repair leaking roofs.

Response: Although waterborne emulsions can be applied as part of regular roof maintenance and solventborne coatings can be used during storms to repair leaks, this may not always be the case. The ARB has recognized the need for emergency repair and has omitted adhesives, sealants, and cements from this SCM as they fall under districts' adhesion rules. These coatings are subject to district rules, and generally, have higher VOC limits to ensure a proper application, cure, and repair to handle unpredictable roof incidents during inclement weather.

5.29.6.4. Issue: RCMA believes that lowering the VOC content may result in greater quantities of coating used per square foot, because compliant coatings have a higher viscosity and using them could increase solvent release, ozone formation, and consumer costs. They believe this could also lead to higher ozone formation by forcing manufacturers to switch to highly reactive solvents.

Response: Staff believes manufacturers will comply with the 50 g/l limit through the use of waterborne products that have a lower viscosity. The high complying marketshare consists of waterborne emulsions. Therefore, staff doesn't expect an increase in quantities used per square foot.

5.29.6.5. Issue: RCMA believes that lowering the VOC content may result in the use of toxic solvents such as ethylene glycol as a replacement for propylene glycol.

Response: The change from propylene glycol to ethylene glycol has already occurred. More than 27% of the solvent use in this category is ethylene glycol versus less than 0.1% use of propylene glycol. Thus, ARB does not believe that lowering the VOC limit will result in coatings that are more toxic than presently exist.

5.29.7. Conclusion

We recommend a 50 g/l VOC limit for Roof Coatings, effective January 1, 2010. The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on the complying marketshare, the number of companies making compliant products, and product information from manufacturers. The proposed limit is lower than the limit adopted by the
U.S. EPA and OTC states, and the proposed limit for Canada. The proposed limit is consistent with the limit adopted by the South Coast AQMD.

5.30. RUST PREVENTATIVE

VOC Limit Table (g/l)

USEPA: 400	Canada: 400	OTC: 400	SCAQMD: 100	SCM Proposed: 250

5.30.1. Category Definition

A coating formulated to prevent the corrosion of metal surfaces for one or more of the following applications:

- Direct-to-metal coating; or
- Coating intended for application over rusty previously coated surfaces.

The Rust Preventative category does not include the following:

- Coatings that are required to be applied as a topcoat over a primer; or
- Coatings that are intended for use on wood or any other non-metallic surface.

Rust Preventative coatings are for metal substrates only and must be labeled as such, in accordance with the labeling requirements in the SCM.

5.30.2. Major Proposed Changes

- The Rust Preventative category is limited to direct-to-metal (DTM) coatings and coatings that can be applied over rust.
- Rust Preventative coatings are not limited to non-industrial uses. The definition has been revised to allow the use of Rust Preventative coatings for industrial applications.
- The proposed VOC limit for Rust Preventative Coatings is decreasing from 400 g/l to 250 g/l.

5.30.3. Coating Description

Rust Preventative coatings are used to provide corrosion protection for metal substrates. This category does not include coatings that are recommended for nonmetallic substrates (e.g., wood, masonry, plaster, drywall, fiberglass, etc.). Rust Preventative coatings are applied directly to metal, or over previously coated surfaces that exhibit corrosion. The finish can range from flat to glossy and the coatings can be applied with a brush, roller, or spray gun. Rust Preventative coatings are used by homeowners, contractors, maintenance personnel, and professional painters.

This category was originally intended for those who are not professional paint contractors, such as homeowners and maintenance personnel. The intent was to provide an effective, single component product that would prevent corrosion of metal substrates for residential and commercial uses. However, after implementation of the 2000 SCM, ARB staff found that products from other categories were shifted to the Rust Preventative category which still allowed for the use of higher VOC solventborne alkyd technology. After the Industrial Maintenance 250 g/l limit became effective, many Industrial Maintenance products were re-labeled as Rust Preventative coatings. Based on ARB's survey, the Rust Preventative category is primarily comprised of solventborne coatings that would not meet the Industrial Maintenance VOC limit. The Rust Preventative category also includes products that were shifted from other categories with lowered VOC limits (e.g., Primers, Sealers, and Undercoaters).

Some products in the category contain a corrosion inhibitor. Corrosion inhibitors are additives which alleviate or slow down the electrochemical oxidation of metals by forming an electrically insulating and/or chemically impermeable coating on exposed metal surfaces to suppress electrochemical reactions. Common materials used for this purpose are chromates, phosphates, and a wide range of specially-designed chemicals that resemble surfactants. Some inhibitors are added to waterborne Rust Preventative coatings to prevent corrosion that occurs during the drying process (Halox, 2006).

Traditional coatings in this category use alkyd resins for their good performance combined with ease of application. Most of these are solventborne and have

VOC contents above 300 g/l. Under the proposed SCM, small containers (one quart or less) of solventborne alkyd coatings can still be used for residential applications and small projects.

Rust Preventative coatings that comply with the proposed 250 g/l limit are predominantly single component waterborne coatings using acrylic latex resins. These types of coatings are currently used in light and medium Industrial Maintenance applications, including the protection of metal substrates from exterior exposure. For Rust Preventative coatings that were sold in 2004, ARB's survey shows a low complying marketshare. However, most of the products using waterborne acrylic technology were reported in the Industrial Maintenance category. Advantages of this technology include ease of cleanup, less hazardous waste disposal, fewer concerns with flammability, single component ease of use, and corrosion resistance performance (AJ, 2006; Medford, 1995; Procopio, 2003).

5.30.4. Substrates/Exposures

Rust Preventative coatings are used indoors or outdoors on a variety of metal substrates that are exposed to corrosive environments, or on previously coated surfaces that show existing signs of corrosion. These substrates include iron, steel, aluminum, galvanized iron, galvanized steel, etc. Coatings that are intended for use on non-metal substrates are not included in the Rust Preventative category. Substrates are prepared by sanding, high pressure wash, wire brush, or cleaning with a solvent.

5.30.5. Survey Results

Table 5.30-1 summarizes our estimate of sales and VOC emissions for Rust Preventative coatings, based on the ARB survey. Solventborne coatings represent about 96 percent of the Rust Preventative sales volume. The total sales volume for Rust Preventative coatings has increased from about 63,000 gallons in 1996, to about 210,000 gallons in 2000, and to about 2,000,000 gallons in 2004. About 11 percent of the sales volume for 2004 came from small containers.

Table 5.30-1: Survey Data
Rust Preventative

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	498	2,004,661	96%	30%	4%	66%	11%	376	8.59
WB	126	90,839	4%	5%	38%	56%	14%	198	0.09
Total	**624**	**2,095,500**		**29%**	**6%**	**66%**	**11%**	**368**	**8.68**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.30-2 contains the complying marketshare for Rust Preventative coatings, based on the ARB survey. This table shows that about 3 percent of the sales volume for Rust Preventative coatings complies with the proposed VOC limit. Although the complying marketshare from the survey data is low, several products in the Industrial Maintenance category exist that reflect the characteristics and use of complying Rust Preventative coatings. Complying waterborne acrylic latex coatings that can be applied to metal in the Industrial Maintenance category represent about 270,000 gallons from 288 products. If added to the existing complying products in the Rust Preventative category, the complying marketshare would increase to about 16 percent.

Table 5.30-2 shows that implementing the proposed 250 g/l limit would achieve approximately 1.6 tpd in VOC emission reductions for the non-South Coast AQMD portion of California, on an annual average basis.

Table 5.30-2: Complying Marketshare & Emission Reductions
Rust Preventative

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
250	52	3%	1.57

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.30.6. Conclusion

We recommend a 250 g/l VOC limit for Rust Preventative coatings, effective January 1, 2012. This extra time is needed to provide Rust Preventative manufacturers time to reformulate low VOC alkyd technologies. Under the proposed VOC limit and the proposed definition, most solventborne coatings and topcoats would be excluded from the category. Lowering the VOC limit from 400 g/l to 250 g/l will eliminate many high-VOC solventborne coatings that were shifted to the Rust Preventative category after VOC limits were implemented from the 2000 SCM. New products in this category and existing products that comply with the proposed limit are expected to use waterborne acrylic latex technology. These types of products have previously been used in the Industrial Maintenance category to protect metal substrates from corrosion. These coatings generally have VOC contents under 250 g/l and are predominantly single component. Although the current Rust Preventative category is primarily comprised of solventborne alkyd coatings, it is technologically feasible to protect metal substrates from corrosion with waterborne acrylic coatings.

The proposed VOC limit for the Rust Preventative category is higher than the 100 g/l limit in the SCAQMD. However, coating manufacturers who sell in the SCAQMD can continue to sell high-VOC Rust Preventative coatings if they participate in the SCAQMD averaging program. Since the SCM does not have an averaging provision, we believe a 250 g/l VOC limit is appropriate for this category.

5.31. SHELLACS

VOC Limit Table (g/l)

USEPA:	Canada:	OTC:	SCAQMD:	SCM Proposed:
730 Clear 550 Opaque	730 Clear 550 Opaque	730 Clear 550 Opaque	730 Clear 550 Opaque	730 Clear 550 Opaque

5.31.1. Category Definition

A clear or opaque coating formulated solely with the resinous secretions of the lac beetle (Laciffer lacca), and formulated to dry by evaporation without chemical reaction.

5.31.2. Major Proposed Changes

- The definition for Shellac has been revised to remove the words “thinned with alcohol”, which allows for the inclusion of products that are not thinned with alcohol.

5.31.3. Coating Description

Shellac is a natural organic resin that comes from a beetle (Laciffer lacca) about the size of an apple seed. The beetle alights on certain trees indigenous to India and Thailand and, during its reproductive cycle, feeds on the sap of the tree. The beetle secretes an amber colored resinous substance called lac, which forms a cocoon around the beetle. This cocoon is the raw material for shellac, and is called sticklac because it contains resin, parts of the twig and bug remains. The sticklac is washed and then refined.

Dried shellac resin is dissolved in solvent (typically ethanol) to produce Shellac coating. Once the dry flakes are dissolved in ethanol, esterificaton begins.

Esterification proceeds more rapidly when the unused Shellac coatings are stored at high temperatures and, over time, the alcohol modifies the shellac resins causing the unused coating to become gummy and lose the ability to dry (Jewitt, 2007). For this reason, Shellac coatings should not be stored above 75 ^{0} F (Zinsser, 2004).

The ratio of dry shellac flakes dissolved in solvent is referred to as the “cut”, and refers to the amount (in pounds) of dry shellac flakes dissolved in one gallon of solvent. For example, a 3-pound cut would consist of 3 pounds of shellac dissolved in 1 gallon of alcohol.

Because Shellac coatings re-dissolve in alcohol, newly applied Shellac coating “melts” into previously applied Shellac coatings. This ease of repair on finished substrates is frequently cited as an advantage of Shellac coatings. The ability of Shellac coatings to withstand damage by water decreases as the film coating ages (Jewitt, 2007).

Aqueous solutions of inorganic alkalis readily dissolve shellac. Shellac is insoluble in ester, ethers (except glycol ethers), hydrocarbons, chlorinated solvents, and water. It can be dispersed in water with soda ash, borax, ammonia, morpholine, or triethanolamine (Zimmer, 1997). Usually the milder alkalis such as ammonia, borax, and sodium carbonate are used to prepare aqueous solutions (Indian Shellac, 2007). The details of a water-dispersed Shellac coating, which was not reported in the survey, are provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm).

All products reported in this category are solventborne single component coatings. Shellac coatings can be applied with a brush, pad, sprayer, or wiping cloth, and are used by professionals, homeowners, and hobbyists.

5.31.4. Substrates/Exposures

Clear Shellac coatings are typically used on new unsealed wood or over existing wood finishes, and for sealing metal surfaces. Opaque Shellac coatings are primarily used on substrates where light transmission is not necessary and masking of discolored surfaces is desired, such as stain damaged drywall. Shellac coatings can also be used on metal, vinyl, polyvinyl chloride (PVC), fiberglass, and masonry. Due to water sensitivity, Shellac coatings that can be used indoors and outdoors typically limit exterior use to spot priming, to be followed by full-surface priming with a waterborne or solventborne primer.

Shellac coatings should not be used on surfaces where hot items are to be placed because Shellac coatings are sensitive to heat, beginning to soften at about 150 ^{0} F. Depending on the wax content of the Shellac coating, white areas may form on the surface of the coating when subjected to water. Because of their acidic composition, alkaline compounds such as those found in some household cleaning products will mar and discolor Shellac coatings (Jewitt, 2007).

5.31.5. Survey Results

Information on Clear Shellac coatings and Opaque Shellac coatings was collected separately in the ARB survey, and is presented as reported in this section.

Table 5.31-1a summarizes ARB survey data for Clear Shellac coatings. We are unable to state the 2004 sales volume for Clear Shellac coatings as these data are protected to preserve confidentiality.

Solventborne Clear Shellac coatings represent 100 percent of the market and generally have VOC levels lower than 730 g/l, the current SCM VOC limit. We are unable to comment on the relative increase/decrease in sales volume for Clear Shellac coatings from 2000 to 2004, because sales data from both surveys are protected. The overall sales-weighted average VOC level for Clear Shellac coatings has increased slightly (about 3 percent) from 2000 to 2004. While it is technologically feasible to produce Clear Shellac coatings at 600 g/l, the emission reduction benefits that would be gained from a 600 g/l VOC limit are negligible.

VOC emissions from Clear Shellac coatings are about 0.35 tpd, which represents approximately 0.37 percent of the total emissions from architectural coatings. All of the products sold in this category are solventborne; therefore all of the emissions are attributable to solventborne coatings.

Table 5.31-1a: Survey Data
Shellacs - Clear

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	8	PD	100%	100%	0%	0%	27%	617	0.35
WB	0	0	-	-	-	-	-	-	-
Total	**8**	**PD**		**100%**	**0%**	**0%**	**27%**	**617**	**0.35**

(ARB, 2006)
1. PD= Protected Data. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.31-1b summarizes ARB survey data for the Opaque Shellac coatings category. We are unable to state the 2004 sales volume for Opaque Shellac coatings as these data are protected to preserve confidentiality.

Solventborne Opaque Shellac coatings represent 100 percent of the market and generally have VOC levels lower than 550 g/l, the current SCM VOC limit. We are unable to comment on the relative increase/decrease in sales volume for Opaque Shellac coatings from 2000 to 2004, because sales data from both surveys are protected. The overall sales-weighted average VOC level for Opaque Shellac coatings has decreased slightly (about 3 percent) from 2000 to 2004.

VOC emissions from Opaque Shellac coatings are about 0.81 tpd, which represents approximately 0.86 percent of the total emissions from architectural coatings. All of the products sold in this category are solventborne; therefore, all of the emissions are attributable to solventborne coatings.

Table 5.31-1b: Survey Data
Shellacs - Opaque

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	2	PD	100%	0%	0%	100%	2%	521	0.81
WB	0	0	-	-	-	-	-	-	-
Total	**2**	**PD**		**0%**	**0%**	**100%**	**2%**	**521**	**0.81**

(ARB, 2006)
1. PD = Protected Data. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.31-2a contains the complying marketshare for Clear Shellac coatings, based on results from the ARB survey. This table shows that 100 percent of the sales volume for Clear Shellac coatings complies with the existing VOC limit of 730 g/l.

Table 5.31-2a: Complying Marketshare & Emission Reductions
Shellacs - Clear

Current VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
730	8	100%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

Table 5.31-2b contains the complying marketshare for Opaque Shellac coatings, based on results from the ARB survey. This table shows that 100 percent of the marketshare of Opaque Shellac coatings complies with the existing limit of 550 g/l. While it is technologically feasible to produce Opaque Shellacs coatings at 500 g/l, implementing a VOC limit of 500 g/l would achieve negligible emission reductions.

Table 5.31-2b: Complying Marketshare & Emission Reductions
Shellacs - Opaque

Current VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
550	2	100%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.31.6. Future Considerations

With the proposed changes to the Wood Coatings category, Shellacs remain as the only architectural coatings category defined by its resin content. We anticipate that in the future, districts may elect to phase out the Shellac categories, and the products reported in these categories will default to the categories for which they are formulated (primarily Wood Coatings and Specialty Primers, Sealers, and Undercoaters). Many Shellac coatings claim to block water stains and smoke odors, fitting within the definition of Specialty Primers, Sealers, and Undercoaters. Clear Shellac coatings are also sold as clear wood finishes, which are covered by the Wood Coatings category.

One manufacturer asserts that Shellac coatings are necessary because professional contractors rely on them to block smoke odors and severe staining from smoke damage. Two sources contradict the assertion that Shellac coatings are the only coatings that can effectively block smoke stains. A representative of the Institute of Inspection, Cleaning and Restoration Certification, a nonprofit organization that certifies firms and technicians in cleaning and restoration, indicates that smoke particles are about 0.01 to 1 micron in size, penetrate surfaces, and are difficult to remove. It is suggested that the surface should be cleaned and then painted with a stain-blocking primer (Kenny, 2005). Others suggest that the application of gloss or semi-gloss latex coatings, which have less of a tendency to “breathe” than flat latex coatings, is sufficient to seal in odors from smoke (Joseph, 2004).

In addition to this category being somewhat redundant due to overlapping functions defined by other coating categories, the sales weighted average VOC content is extremely high. However, during a literature search, ARB staff found a water-dispersed shellac coating with a VOC content of 87 g/l.

5.31.7. Conclusion

At this time, we are not seeking to lower the existing limits of 730 g/l for Clear Shellac and 550 g/l for Opaque Shellac, because of the relatively low emissions from these categories. In the future, districts may decide to eliminate the Clear Shellac and Opaque Shellac categories. If this occurs, products that were formerly categorized as Clear Shellac coatings or Opaque Shellac coatings would have to comply with other category limits, such as Wood Coatings or Specialty Primers, Sealers, and Undercoaters.

The current limit of 730 g/l for Clear Shellac coatings and 550 g/l for Opaque Shellac coatings is consistent with the limits adopted by the U.S. EPA, the South Coast AQMD, the OTC states, and with the proposed limit for Canada.

5.32. SPECIALTY PRIMERS, SEALERS, AND UNDERCOATERS

VOC Limit Table (g/l)

USEPA: 350 (primers and undercoaters) or 400 (sealers, including interior clear wood sealers)	Canada: 350	OTC: 350	SCAQMD: 100	SCM Proposed: 100

5.32.1. Category Definition

A coating that is formulated for application to a substrate to block water-soluble stains resulting from: fire damage; smoke damage; or water damage.

5.32.2. Major Proposed Changes

- The Specialty Primer, Sealer, and Undercoater category no longer includes those products that are used for general purpose stain blocking or to condition excessively chalky surfaces. This category now includes only those products designed to block water-soluble stains that result from fire, smoke, or water damage.
- The proposed VOC limit for the Specialty Primer, Sealer, and Undercoater category would decrease from 350 g/l to 100 g/l.

5.32.3. Coating Description

The Specialty Primer, Sealer, and Undercoater category describes coatings that are typically applied as the initial coat to block or cover water-soluble stains resulting from fire, smoke, or water damage. These products help provide a suitable substrate for subsequent coatings by providing a good bonding surface and preventing stains from being seen through the topcoat. Specialty Primers, Sealers, and Undercoaters are typically sprayed, rolled, or brushed on to the substrate and are used in residential and commercial settings by homeowners and professionals.

All of the reported Specialty Primers, Sealers, and Undercoaters were single component products and most were solventborne. Most of the reported lower-VOC (waterborne) coatings were formulated with acrylic, acrylic copolymer, or vinyl acrylic copolymer resins, while the higher-VOC (solventborne) products typically contained alkyd or styrene butadiene resins.

Note that the proposed Specialty Primer, Sealer, and Undercoater category would no longer include those products for use on excessively chalky surfaces, or those used for general purpose stain blocking. Stain blocking, for the purposes of this category, is limited to water-soluble stains resulting from fire, smoke, and water damage. Many of the coatings that fall within the Primer, Sealer, and Undercoater category have characteristics similar to those coatings previously defined as Specialty Primer, Sealer, Undercoater products. Specifically, they claim to block tannin stains, condition excessively chalky surfaces, and conceal stains that are not water-soluble.

5.32.4. Substrates/Exposures

Specialty Primers, Sealers, and Undercoaters can be used on a large variety of interior and exterior substrates including drywall, plaster, brick, concrete block, wood siding, and stucco. Because these products are topcoated, they are not exposed to substances in the environment, but must tolerate the environment of the substrate to which they are applied and the environment of the coating that serves as a topcoat. The product data sheets for many Specialty Primers, Sealers, and Undercoaters specify a time frame within which they must be topcoated. If not topcoated within the specified time frame, additional surface preparation and/or recoating prior to topcoating may be necessary. As the substrates and topcoats used with Specialty Primers, Sealers, and Undercoaters vary widely, so does the range of conditions to which they must be resistant. Specialty Primers, Sealers, and Undercoaters may need to be resistant to and perform well under conditions that are alkaline, acid, porous, non-porous, etc.

5.32.5. Survey Results

Table 5.32-1 summarizes our estimate of sales and VOC emissions for Specialty Primers, Sealers, and Undercoaters, based on the ARB survey. Specialty Primers, Sealers, and Undercoaters represent the 8th largest coating category with regard to sales volume and the 7th largest coating category with regard to VOC emissions. In 2004, the sales volume for Specialty Primers, Sealers, and Undercoaters in California was approximately 2 million gallons. This represents about 1.8 percent of the total California sales volume for architectural coatings.

Waterborne Specialty Primers, Sealers, and Undercoaters represent approximately 24 percent of the sales volume. Solventborne products represent 76 percent of the sales volume and generally have VOC levels less than 350 g/l, the current SCM VOC limit. The sales volume for solventborne Specialty Primers, Sealers, and Undercoaters has increased approximately 7,000 percent from 2000 to 2004, while the overall sales volume has increased more than 400 percent. These large increases can be attributed to the introduction of new products into the market. In addition, part of the increase resulted when manufacturers re-classified Quick Dry Primers, Sealers, and Undercoaters and

Primers, Sealers, and Undercoaters as Specialty Primers, Sealers, and Undercoaters, because the VOC limits for Quick Dry Primers, Sealers and Undercoaters and Primers, Sealers, and Undercoaters were reduced. This disproportionate increase in the use of solventborne coatings has caused an increase in the overall sales-weighted average VOC level for Specialty Primers, Sealers, and Undercoaters of 136 percent, rising from an overall SWA of 120 g/l in 2000 to an overall SWA of 283 g/l in 2004.

VOC emissions from Specialty Primers, Sealers, and Undercoaters are about 6.2 tpd, which represents approximately 6.6 percent of the total emissions from architectural coatings. Over three-quarters of the Specialty Primers, Sealers, and Undercoaters are solventborne and they account for more than 96 percent of the VOC emissions from this category.

Table 5.32-1: Survey Data
Specialty Primers, Sealers and Undercoaters

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	74	1,532,541	76%	0%	7%	93%	2%	343	6.01
WB	45	476,924	24%	8%	4%	88%	2%	89	0.23
Total	**119**	**2,009,464**		**2%**	**6%**	**92%**	**2%**	**283**	**6.23**

(ARB, 2006)

1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.32-2 contains the complying marketshare for Specialty Primers, Sealers, and Undercoaters, based on the ARB survey. This table shows that about 22 percent of the sales volume for Specialty Primers, Sealers, and Undercoaters complies with the proposed VOC limit. When considering the number of products reported, approximately 26 percent of the reported products comply with the proposed limit.

Table 5.32-2 shows that implementing the proposed 100 g/l limit would achieve approximately 2.6 tpd in VOC emission reductions for the non-South Coast AQMD portion of California, on an annual average basis.

Table 5.32-2: Complying Marketshare & Emission Reductions
Specialty Primers, Sealers and Undercoaters

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
100	25	22%	2.62

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

Considering Specialty Primers, Sealers, and Undercoaters formulated for interior and exterior use separately, the survey data indicate that 54 percent of the sales volume for interior products complies with the proposed limit, 4 percent of the sales volume for exterior products complies, and 22 percent of the sales volume for dual use products complies.

5.32.6. Product Testing Results

5.32.6.1. Kimerling and Bhatia Study

Kimerling and Bhatia conducted research to identify block copolymers for use in waterborne primer coatings (Kimerling and Bhatia, 2004). In the study titled "Block copolymers as low-VOC coatings for wood: characterization and tannin bleed resistance", they investigated three amphiphilic (containing both hydrophobic and hydrophilic groups) block copolymers as potential waterborne coating components that could create a hydrophobic barrier to block tannin extraction. The three amphiphilic block copolymers were examined and compared to three commercially available primers, one of which was a solventborne alkyd primer. This research found that amphiphilic block copolymer coatings are capable of preventing tannin bleed, and in fact performed better than the solventborne alkyd primer tested. It should also be noted that the commercially available waterborne tannin blocking polymer, Rhoplex® PR-33, performed as well as the block copolymers when tested for topcoat discoloration.

5.32.6.2. KTA-Tator Study

The KTA-Tator Study, agreed to by the joint industry-government Technical Advisory Committee of the SCAQMD, encompassed four architectural coating categories, one of which was Primers, Sealers, and Undercoaters (PSUs) (SCAQMD, 2002). Both high- and low-VOC, interior and exterior PSUs were tested to determine whether commercially-available architectural coatings that contain lower VOC content perform better, equivalent to, or worse than products with a higher VOC content. The VOC content of coatings tested ranged from 118 g/l to 457 g/l (as reported by manufacturers). "Low-VOC" products had VOC contents less than or equal to 200 g/l, while "High-VOC" products had VOC contents greater than 200 g/l. Testing was conducted to determine coating characteristics and performance.

Characteristics testing included tests to determine VOC content, volume solids, Infrared Spectroscopic Analysis, viscosity, hiding, dry time, and sag resistance. For waterborne coatings, percent water and freeze/thaw resistance testing were also conducted. All tests to determine characteristics were based on standard ASTM testing procedures. Performance testing for interior PSUs included tests to determine grain raising, adhesion, sandability; and chemical resistance, even though these products are intended to be used on a clean substrate and covered with a top coat. Performance testing for exterior PSUs included tests to determine the degree of grain raising, adhesion, stain blocking, and weathering under accelerated conditions. Most of the testing was based on standard ASTM testing procedures. If no ASTM procedure was available, testing protocols developed by coating manufacturers were used. In the case of the sandability performance test, there was neither an ASTM method nor a coating manufacturer testing protocol available, and the testing procedure was developed by KTA-Tator.

Measured VOC Content Data
The manufacturers' published VOC values generally agreed with laboratory analysis results, but there were some differences. Three discrepancies existed out of the eleven PSUs tested, with one testing higher in VOC content than the published value and two testing lower. One test sample with a published VOC content of 141 g/l, revealed a VOC content of 227 g/l when tested. Another test sample with a published VOC content of less than 200 g/l, tested well below that maximum at 91 g/l, making this the lowest VOC sample tested. The third discrepancy involved a sample with a published maximum VOC content of 250 g/l, but testing indicated a VOC content of 106 g/l.

Stain Blocking Characteristics
Product testing results from the KTA-Tator Study indicate that low VOC products are similar to high-VOC products in their ability to block tannin stains. Rated on a scale where a ranking of zero indicates severe tannin staining and 10 equates to no tannin staining, all exterior PSUs tested on LP siding wood performed well. All products, including both high- and low-VOC exterior PSUs, received a ranking of 10, with the exception of one low-VOC exterior PSU which received a ranking of 9. It should be noted that this product had the highest VOC content of the low-VOC PSUs tested.

In general, all exterior PSUs, regardless of VOC content, performed less well when blocking tannin stains from the red cedar wood substrate. Both the high (8) and low (1) rankings were reported for high-VOC exterior PSUs, with ratings for high-VOC exterior PSUs averaging 5.3. Low-VOC exterior PSUs ranked slightly better, with an average rating of 6.3.

5.32.6.3. UMR

In 2005, the UMR Coatings Institute at the University of Missouri - Rolla conducted a coatings testing project for the South Coast AQMD (UMR, 2006). The project included tests on products classified as Primers, Sealers, and Undercoaters. UMR tested some general coating properties, including: percent nonvolatile; stability; viscosity; freeze/thaw resistance; dry time; gloss; and hiding - contrast ratio. They also tested performance properties, including: adhesion; stain bleed through resistance; tannin stain resistance; grain raising and sandability; enamel holdout; and flow/level and sag. All testing was done in accordance with ASTM standards, unless otherwise noted or agreed upon by the

South Coast AQMD. All paints were supplied to the UMR Coatings Institute by South Coast AQMD.

For Primers, Sealers, and Undercoaters, they tested four products, two low-VOC products (VOC $\leq$100 g/l) and two high-VOC products (VOC >100 g/l and $\leq$200 g/l). On average, on most tests, the two low-VOC samples below 100 g/l performed comparably with the two high-VOC samples above. However, on average, the two low-VOC samples did perform somewhat poorer on overcoat adhesion and stain bleed through (coffee) than the high-VOC samples. It is interesting to note that the low-VOC samples did perform equally well as the high-VOC samples on tannin resistance.

5.32.7. Manufacturer Information

Product information sheets published by coatings manufacturers indicate that a wide variety of Specialty Primer, Sealer, Undercoater coatings that meet the proposed VOC limit are available that possess performance characteristics similar to higher-VOC coatings. A summary of product information for Specialty Primer, Sealer, Undercoater coatings with a range of VOC contents is provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm).

For information on products that can be used on excessively chalky surfaces or over general stains, please see the table for general Primer, Sealer, Undercoater coatings that is provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm).

5.32.8. Conclusion

We recommend a 100 g/l VOC limit for Specialty Primers, Sealers, and Undercoaters, effective January 1, 2012. Most of the proposed VOC limits in the SCM are effective in 2010. The later effective date for Specialty Primers, Sealers, and Undercoaters is intended to allow manufacturers to develop appropriate stain-blocking test methods. The proposed VOC limit is technologically and commercially feasible by January 1, 2012, based on the complying marketshare, test data, the number of companies making complying products, and product information from manufacturers. The proposed VOC limit is consistent with the limit adopted by the South Coast AQMD. The proposed limit is lower than the limits adopted by the U.S. EPA and the OTC states and the proposed limit for Canada. The U.S. EPA divides Specialty Primers, Sealers, and Undercoaters into two categories, one for primers and undercoaters with a VOC limit of 350 g/l, and one for sealers, including clear wood finishes, with a VOC content limit of 400 g/l. (U.S. EPA, 1998).

5.33. STAINS

VOC Limit Table (g/l)

USEPA: 550 (semitransparent) ; 350 (opaque)	Canada: 250	OTC: 250	SCAQMD: 100 (exterior); 250 (interior)	SCM Proposed: 250

5.33.1. Category Definition

A semitransparent or opaque coating labeled and formulated to change the color of a surface but not conceal the grain pattern or texture.

5.33.2. Major Proposed Changes

- The definition for Stains has been revised. Clear stains and clear penetrating oils previously included in the Stains category are now included in the Wood Coatings category.

5.33.3. Coating Description

The Stains category includes products for both wood and concrete surfaces. Wood stains are used for aesthetic purposes while providing some protection from water, UV radiation, and tannin bleed. These coatings come in a variety of different colors to enhance the natural characteristics of the wood without completely hiding them. Semitransparent stains change the color of the surface without concealing the grain pattern or texture. Opaque stains completely conceal the natural grain pattern while allowing the texture of the surface to be seen.

Stains are all single component coatings that are sprayed, wiped, rolled, or brushed on. If stains are applied with a sprayer, back brushing is recommended to achieve good penetration. Excess is often wiped off with a cloth, leaving a flat finish with little or no sheen. Stains are generally easy to apply for the typical homeowner and they are also applied by professional contractors.

Semitransparent wood stains often contain drying oils, such as linseed or tung oil, which penetrate the wood surface and solidify upon exposure to air. They commonly contain water repellents, usually paraffin wax or wax-like chemicals, to prevent wood from absorbing water, which causes the wood to crack, warp, and split. UV stabilizers are usually included in exterior wood stains to protect the surface from degradation caused by UV radiation. High quality stains may also contain preservatives to protect wood from decay, discoloration, and insect attack (Feist, 1996). The majority of solventborne, semitransparent stains contain alkyd resins, but they may also contain acrylic, urethane, polyurethane, or phenolic resins. These coatings penetrate the surface of the wood and do not form a film that flakes off over time. Semitransparent penetrating stains can also be reapplied without extensive surface preparation. Waterborne latex stains, which contain acrylic and/or alkyd resins, may not penetrate the surface of the wood as well as solventborne products. Instead, they may form a thin film on the surface that provides less durability, and tends to degrade and flake from the surface (Williams, 1999). Technology for latex penetrating stains continues to progress and many products currently available are able to provide good penetration.

Opaque wood stains are most commonly latex waterborne formulations that contain synthetic resins, primarily acrylic or vinyl acrylic. These stains have a higher concentration of pigment, which protects wood from degradation caused by exposure to UV radiation. Waterborne latex opaque stains contain a higher amount of solids and form a thicker film than solventborne opaque stains. They are also more flexible, have better color retention, and are less prone to mildew. Although they are easy to clean up, extensive surface preparation is required for proper adhesion. Solventborne opaque stains usually contain alkyds or oil, tend to be less flexible, and are more prone to crack and flake, but require less surface preparation (Williams, 1999).

Stains can be applied to both wood and concrete surfaces and staining can be accomplished through the use of pigments, dyes, or chemicals. Many concrete stains are formulated to penetrate and react chemically with the concrete substrate to produce a variety of color effects. Reactive concrete stains contain inorganic metallic salts dissolved in an acid and water solution. Non-reactive concrete stains can contain drying oils and acrylic resins. Progress has been made in the development of UV-stable reactive stains for exterior applications. Newer technologies offer better durability and color retention (JAC, 2005a).

Stained surfaces are often coated with a protective clear topcoat. Concrete/Masonry Sealers are used as protective topcoats on concrete, while clear Wood Coatings are used on wood.

Clear, penetrating oil finishes and clear stains are no longer included in the Stains category as they are used primarily for protective purposes and do not change the color of the wood surface. These finishes are included in the Wood Coatings category.

5.33.4. Substrates/Exposures

Stains are used indoors and outdoors in residential, commercial, and institutional areas. Semitransparent stains are used on a variety of interior wood surfaces including cabinets, floors, paneling, trim, doors, molding, and stairs. Semitransparent and opaque stains are commonly applied to exterior wood surfaces such as decks, shakes, shingles, siding, boat docks, and fences.
In addition to wood, stains can also be applied to interior or exterior concrete, cement, asphalt, masonry, and stucco. Concrete driveways, garage floors, sidewalks, and patios are all common areas for application of concrete stains.

Most stains have some resistance to UV radiation and are water repellent. Because opaque stains contain more pigment, they are more resistant to UV radiation than semitransparent stains. Deck stains are formulated to withstand foot traffic and standing water.

5.33.5. Survey Results

Table 5.33-1 summarizes our estimate of sales and VOC emissions for Clear/ Semitransparent Stains, based on the ARB survey. Clear/Semitransparent Stains represent the ninth largest category with regard to sales volume. In 2004, the sales volume for Clear/Semitransparent Stains in California was approximately 1.9 million gallons. This represents just less than 2 percent of the total California sales volume for architectural coatings.

VOC emissions from Clear/Semitransparent Stains are about 6.3 tpd, which represents approximately 6.6 percent of the total emissions from architectural coatings. Because most of the products sold are solventborne, most of the emissions are from solventborne products.

Table 5.33-1: Survey Data
Stains – Clear/Semitransparent

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	1,049	1,462,300	78%	29%	47%	24%	33%	367	5.95
WB	287	402,937	22%	14%	86%	0%	13%	240	0.32
Total	**1,336**	**1,865,237**		**26%**	**55%**	**19%**	**29%**	**339**	**6.28**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Waterborne Clear/Semitransparent Stains represent 22 percent of the sales volume. Solventborne products represent 78 percent of the sales volume and generally have VOC levels greater than 250 g/l, the current SCM VOC limit.

Table 5.33-2 shows the breakdown of solventborne and waterborne Clear/Semitransparent Stains above and below 250 g/l. With 43 percent of the overall sales volume, the majority of the market is comprised of solventborne stains above 250 g/l. This is followed by solventborne stains less than or equal to 250 g/l (high solids stains) with 35 percent of the overall sales volume.

Table 5.33-2
Stains – Clear/Semitransparent: Solventborne & Waterborne Data

	Number of Products	Sales in California (gal/year)	% Sales
SB ≤ 250 g/l	137	660,939	35%
SB > 250 g/l	912	801,361	43%
WB ≤ 250 g/l	176	309,065	17%
WB > 250 g/l	111	93,871	5%
Total	**1336**	**1,865,237**	**100%**

Two solventborne and seven waterborne Clear/Semitransparent Stains with VOC levels below 100 g/l represented less than 0.5 percent of the overall sales volume.

The sales volume for solventborne Clear/Semitransparent Stains has decreased approximately 14 percent from 2000 to 2004. This change is also reflected in the overall sales volume for Clear/Semitransparent Stains, which also decreased 14 percent. The overall sales-weighted average VOC Regulatory value has decreased 3 percent from 2000 to 2004.

Table 5.33-3 contains the complying marketshare for Clear/Semitransparent Stains, based on the ARB survey. This table shows that 74 percent of the sales volume complies with the current VOC limit. When considering the number of products reported, approximately 40 percent comply with the current limit. Of the 32 companies that reported in this category, 22 offered Clear/Semitransparent Stains that comply with the current limit.

Table 5.33-3: Complying Marketshare & Emission Reductions
Stains – Clear/Semitransparent

Current VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
250	308	74%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

Table 5.33-4 summarizes our estimate of sales and VOC emissions for Opaque Stains, based on the ARB survey. In 2004, approximately 960,000 gallons of Opaque Stains were sold in California. This represents just less than 1 percent of the total California sales volume for architectural coatings.

Waterborne Opaque Stains represent almost all of the market with 98 percent of the reported sales volume. Solventborne Opaque Stains represent only 2 percent of the sales volume and generally have VOC levels greater than 250 g/l. The sales volume for solventborne Opaque Stains decreased approximately 91 percent from 2000 to 2004 and the overall sales volume declined 12 percent. The overall sales-weighted average VOC Regulatory value decreased 41 percent from 2000 to 2004.

VOC emissions from Opaque Stains are about 0.5 tpd, which represents approximately 0.5 percent of the total emissions from architectural coatings. Because most of the products sold are waterborne, most of the emissions are from waterborne products.

Table 5.33-4: Survey Data
Stains - Opaque

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	104	20,627	2%	0%	95%	5%	2%	300	0.07
WB	327	936,880	98%	0%	98%	2%	0%	103	0.42
Total	**431**	**957,506**		**0%**	**98%**	**2%**	**0%**	**107**	**0.48**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.33-5 contains complying marketshare data for opaque stains, based on results from the 2005 ARB survey. This table shows that 98 percent of the sales volume for Opaque Stains complies with the current VOC limit. When considering the number of products reported, approximately 77 percent comply with the current limit. Of the 21 companies that reported in this category, 19 offered Opaque Stains that comply with the current limit.

Table 5.33-5: Complying Marketshare & Emission Reductions
Stains - Opaque

Current VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
250	327	98%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.33.6. Product Testing Results

5.33.6.1. Consumer Reports: Consumers Union tested a number of exterior opaque and semitransparent stains. The stains were ranked by their effectiveness at resisting dirt, color change, and mildew. The tests showed that opaque finishes hold up the longest when compared to clear or semitransparent stains. They typically last at least three years while clear stains don’t offer more than a year of protection before their appearance begins to degrade. Semitransparent stains, which have a small amount of pigment usually last 2-3 years before reapplication. The downside of an opaque stain is the film can peel, chip, and crack like a paint film and extensive preparation may be needed before application of subsequent coats. Top-rated opaque stains can reportedly last about nine years. Olympic Premium 596 opaque latex stain, with a VOC content of 98 g/l according to the ARB survey, outperformed all other stains and received a good rating after nine years. Behr Plus 10 opaque alkyd stain also received a good rating after nine years, but did not perform as well, due to the lack of resistance to dirt and color change. According to the product data sheet, Behr Plus 10 is an oil/latex emulsion that cleans up with water and has a VOC content less than 135 g/l. Olympic Water Repellent alkyd semitransparent stain lasted about six years and received a fair rating, while other semitransparent stains lasted up to three years. In the ARB survey, Olympic Water Repellent stain had a reported VOC level of 533 g/l. Alkyd semitransparent stains outperformed latex semitransparent stains, while latex opaque stains outperformed alkyd opaque stains. Testing still underway shows that Thompson's Water Seal Deck and House latex semitransparent stain has received a very good rating after three years and a good rating after six years, better than previously tested alkyd semitransparent stains (Consumer Reports, 2006b).

Consumers Union also tested a number of stains for use as deck treatments. Twenty products were tested on CCA (chromated copper arsenate) pressure-treated lumber at a facility in Yonkers, New York for three years. The treatments were ranked by their effectiveness at resisting dirt, color change, mildew, and cracking. Two opaque stains performed the best. Alkyd-based Cabot Decking Stain, with a reported VOC content of 248 g/l in the ARB survey, received a very good rating for resisting dirt, color change and mildew, but did not resist cracking. Latex-based Cabot Solid Color stain at 108 g/l also received a very good rating, and was able to resist cracking. The best semitransparent product was Wolman DuraStain, a waterborne alkyd/acrylic stain with a maximum VOC content of 250 g/l that received a good rating and resisted dirt and cracking, but not color change and mildew. Testing still underway indicates that latex opaque stains continue to outperform alkyd opaque stains. Though latex semitransparent stains continue to improve, alkyds still performed better (Consumer Reports, 2006c).

5.33.6.2. KTA-Tator Study: The KTA-Tator Study, agreed to by the joint industry-government Technical Advisory Committee of the SCAQMD, encompassed four architectural coating categories, one of which was Interior Stains (SCAQMD, 2002). Both high- and low-VOC Interior Stains were tested to determine whether commercially-available architectural coatings that contain lower VOC content perform better, equivalent to, or worse than products with a higher VOC content. The VOC content of coatings tested ranged from zero g/l to 350 g/l (as reported by manufacturers). Testing was conducted to determine coating characteristics and performance.

Six interior stains were tested: three "low-VOC" products had VOC contents less than or equal to 250 g/l and three "high-VOC" products had VOC contents greater than 250 g/l. General characteristics tested included VOC content, volume solids content, viscosity, dry time (to touch), and sag resistance. For waterborne interior stains, the percent water and freeze/thaw properties were also determined. All tests to determine characteristics were based on standard ASTM testing procedures. Performance tests included open time/lapping, grain raising, adhesion, stain blocking, and scrub resistance. Most of the testing was based on standard ASTM testing procedures. If no ASTM procedure was available, testing protocols developed by coating manufacturers were used.

General Characteristics Testing
The measured VOC content varied widely from published VOC contents for products in the "low-VOC" (≤250 g/l) group. All three stains in this group actually had VOC contents above 250 g/l. One product with a published VOC content of 0 g/l actually tested at 315 g/l. Another that was reported to have a VOC content of 15 g/l had a measured value of 261 g/l. Despite these discrepancies, the three stains in the "low-VOC" group all had lower VOC contents than the three stains in the "high-VOC" group. The measured VOC content of the interior stains in the "high-VOC" group ranged from 328 g/l to 489 g/l, compared to the measured content in the "low-VOC" group, which ranged from 261 g/l to 315 g/l. Because none of the "low-VOC" stains had VOC contents below 250 g/l, these tests would not support a proposed reduction of the VOC limit for the Stains category.

After five freeze/thaw cycles, none of the waterborne interior stains exhibited changes in hiding, gloss, or color. Viscosity remained the same and the stains did not exhibit pigment agglomerations or coagulation. The stains with higher VOC contents had drying times much greater than those with lower VOC contents. The stain with the lowest VOC level of 261 g/l had a drying time of just 7.5 minutes, while the average drying time for "high-VOC" stains was 180 minutes. "Low-VOC" stains performed the same as the "high-VOC" stains in the sag resistance test. Only the stain with the highest VOC content had a higher sag resistance.

Performance Testing
The interior stains were tested for open time/lapping characteristics on white pine, oak, and maple wood. No visible overlap was observed in any of the stains. The tape adhesion test showed that all stains showed no disbonding when applied to all three types of wood.

Both groups performed well in the grain raising test. One stain from the "low-VOC" group had slight grain raising on white pine wood, while one stain from each group had slight grain raising on oak wood. When the stains were tested on maple wood, a stain from the "low-VOC" group showed minimal grain raising.

In the stain blocking test lower VOC products performed about the same as higher VOC products. Stains with lower VOC contents were able to block staining better on oak and maple wood than on white pine. Higher VOC stains did the best on oak, while also faring well on white pine and maple. The best performers on white pine and oak were both products from the "high-VOC" group. Lower VOC stains slightly outperformed higher VOC stains on maple.

The final test for interior stains was the scrub resistance test. It was performed on pine, oak, and maple wood to determine the number of scrub cycles carried out before there was visible wear-through. One clear stain in the lower VOC group was left out because it could not be rated visually. The best performer on all three types of wood was a "high-VOC" stain. Two different "high-VOC" stains also accounted for the worst performers. One stain from the "low-VOC" group with a measured VOC content of 315 g/l performed second best on all three wood types. The stain with the highest VOC content of 489 g/l was the worst performer on oak, but was average on pine and maple.

5.33.6.3. AVES Report: South Coast AQMD awarded AVES, an affiliate of ATC Associates Inc., a contract to develop architectural coatings with a VOC content at or near zero g/l for a variety of coating categories, including exterior opaque stains and exterior and interior semitransparent stains (AVES, 2001). These coatings were then tested next to three commercially available coatings from each category. Three new coatings systems were also tested, and were each comprised of a semitransparent stain, a sanding sealer, and either a varnish, two coats of lacquer, or three coats of lacquer. All of the coatings were tested for performance, repair, and refinishing. The new zero-VOC stains were composed of ultra-fine acrylic resin dispersions with surfactants and zero-VOC pigment dispersions. The exterior semitransparent stain also contained fungicides and UV absorbers. The new coatings with VOC contents at or near zero g/l generally did not perform as well for freeze/thaw properties, mildew/fungus resistance, dirt pick-up, and stain blocking, but the near zero coatings generally performed better when tested for color change and moisture/UV resistance.

Compared to the commercially available stains, the near zero-VOC Opaque Stain did as well or better in grain raising, stain blocking, moisture resistance, coating penetration, UV resistance, and color change. It did poorer in freeze/thaw resistance, dirt pickup resistance, and mildew/fungus resistance.

The near-zero VOC Exterior Semitransparent Stain did as well or better in dry times, grain raising, coating penetration, moisture resistance, UV resistance, and color change. It did worse in mildew/fungus resistance, freeze/thaw resistance, stain blocking, and dirt pickup resistance.

The near zero-VOC Interior Semitransparent Stain did as well or better in freeze/thaw resistance, finish, and dry times. It did worse in grain raising and grain definition.

5.33.6.4. UMR Results:

Exterior Stains
Of the four coatings tested, all were penetrating coatings, one had a VOC content of 250 g/l, and the remaining three were zero VOC. Although there were few exterior stain-specific tests performed, on average, the low VOC coatings performed comparably to the one higher VOC coating on most tests, although there was some variation. For example, one of the zero VOC coatings had no freeze/thaw resistance, yet performed well on abrasion resistance. Because of the small number of stains that were tested and the few stain-specific tests that were performed, the UMR results did not hold as much weight as the other testing and the near-zero complying marketshare convinced ARB staff to retain the existing VOC limit for Stains.

5.33.7. Manufacturer Information

Several complying products are included on Master Painter's Institute (MPI) Approved Products lists because they were certified to meet designated performance standards. MPI approved several Stains that comply with the current 250 g/l limit and meet one of the following standards: MPI #16 (Stain, Exterior, Water Based, Solid Hide); MPI #33 (Stain, for Exterior Wood Decks); MPI #58 (Stain, Interior, for Concrete Floors); and MPI #156 (Stain, Exterior, Water Based Semi-Transparent). Manufacturers of compliant, MPI-approved products include Coronado Paint, ICI Paints, Kelly-Moore, and Rodda Paint. Additional information on manufacturers and products is provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm).

5.33.8. Conclusion

We recommend maintaining the current 250 g/l VOC limit for Stains, based on the complying marketshare, the number of companies making complying products, testing data, and product information from manufacturers. The current VOC limit is lower than the national limits promulgated by the U.S. EPA. The U.S. EPA divides stains into three categories, based on opacity. Clear stains and semitransparent stains both have a VOC limit of 550 g/l, while opaque stains have a limit of 350 g/l (U.S. EPA, 1998). The South Coast AQMD adopted a 100 g/l limit for Exterior Stains while the limit for Interior Stains has remained at 250 g/l. Our recommended limit for Exterior Stains is higher than South Coast AQMD limit, while our recommended limit for Interior Stains is the same as the South Coast AQMD. Our recommended limit is consistent with the limit adopted by the OTC states and the proposed limit for Canada.

ARB staff believes that additional research and testing is needed to develop exterior semistransparent stains that can comply with a 100 g/l VOC limit and perform well throughout California. Based on performance testing results in the AVES report, zero-VOC exterior semitransparent stains generally do not perform as well in freeze/thaw, mildew/fungus resistance, stain blocking, and dirt pickup, though they generally perform better in color change and moisture/UV resistance. South Coast AQMD did not adopt a 100 g/l limit for interior stains, due to appearance and depth issues related to the use of low-VOC clear wood coatings (SCAQMD, 2003).

According to the ARB survey, exterior Semitransparent Stains with VOC contents below 100 g/l represented close to zero percent of the overall sales volume. Based on these data, ARB staff do not believe that there is sufficient complying marketshare to support a 100 g/l limit for exterior Semitransparent Stains. We also believe that there are enforcement concerns with splitting the Stains category into Interior and Exterior subcategories.

5.34. STONE CONSOLIDANTS

VOC Limit Table (g/l)

USEPA: 600 (WST)	Canada: 400 (WCMS)	OTC: 400 (WCMS)	SCAQMD: 100 (WCMS)	SCM Proposed: 450

5.34.1. Category Definition

A coating that is labeled and formulated for application to stone substrates to repair historical structures that have been damaged by weathering or other decay mechanisms. Stone Consolidants must penetrate into stone substrates to create bonds between particles and consolidate deteriorated material. Stone Consolidants must be specified and used in accordance with ASTM E2167-01 (Standard Guide for Selection and Use of Stone Consolidants). Stone Consolidants are for professional use only and must be labeled as such.

Please note that "Stone Consolidant" is a proposed new category that includes products which were formerly covered by the following two categories in the 2000 SCM:

> Waterproofing Concrete/Masonry Sealer (WCMS): A clear or pigmented film-forming coating that is labeled and formulated for sealing concrete and masonry to provide resistance against water, alkali, acids, ultraviolet light and staining.
>
> "Other": A default category for products that do not fit in any of the listed coating categories. VOC limits are based on the gloss level of the product.

Waterproofing Concrete/Masonry Sealer has been eliminated from the proposed SCM and the types of products that were previously in these categories would be covered by other categories (e.g., Concrete/Masonry Sealer; Reactive Penetrating Sealer; etc.).

5.34.2. Major Proposed Changes

- Stone Consolidant is a new category that includes products formerly classified under Waterproofing Concrete/Masonry Sealer and “Other”.

5.34.3. Coating Description

Stone Consolidants penetrate into stone substrates to help restore the integrity of crumbling or decayed materials. These products are often considered to be concrete treatments, rather than coatings, and are not for general purpose use. The intent of establishing the Stone Consolidant category is to support historical preservation efforts by allowing limited use of these products under the direction of a stone conservation specialist, such as an architect, conservator, or engineer. Stone Consolidants are clear products that are designed to leave the surface appearance unchanged. After the consolidation process is complete, manufacturers often recommend that the substrate be coated with a water repellent to provide protection from the elements. Stone Consolidants can be used on a variety of historical structures, including statues, monuments, and buildings. They are applied by professional contractors or conservators and application methods include sprayer, brush, pipette, and immersion (Price, 1996).

There are a variety of chemistries that are used for consolidation purposes, depending on the type of substrate, method of decay, and environmental exposures. Solventborne products are generally preferred, because it is believed that the solvent can penetrate deeper into the substrate and distribute the consolidant down to the undeteriorated stone. Provided below are descriptions for some of the chemicals commonly used in Stone Consolidants.

Silanes: Silanes have been used extensively for consolidation purposes. They react with water to release VOCs and form silanols, which then undergo a condensation reaction with the substrate to produce a silicone polymer (see Reactive Penetrating Sealers for additional details). The resulting polymer increases the cohesion of the substrate and strengthens the decayed stone (Price, 1996). The VOCs that are released during the chemical reaction (e.g., ethanol or methanol) are known as cure volatiles and they should be included when determining the VOC content of a product.

Some of the silanes used as consolidants also provide some water repellency. Commonly used consolidants are solventborne products that contain ethyl silicates (or silicic ethyl esters) and a neutral catalyst. After the silicate solution is applied to a substrate, the catalyst promotes a reaction between the ethyl silicate and water from the atmosphere to produce a glass-like silicon dioxide gel that binds the stone particles together. This curing process generates ethanol and it may take weeks or months for the reaction to be complete. Methyltrimethoxysilane (MTMOS) and tetraethoxysilane (TEOS) are also used extensively for consolidation. Examples of silane products include: Conservare H100 and OH100 (Prosoco); Silex OH-100 (KEIM); and Tegovakon V 100 (by Goldschmidt Industrial Specialties).

Epoxy and Acrylic Resins: Solventborne epoxy and acrylic resins have also been used for consolidation purposes, but they are sometimes described as adhesives, rather than consolidants (Selwitz, 1992). Acrylic resins which have been used for stone consolidation include methylacrylate, methyl methacrylate, ethyl methacrylate and butyl methacrylate (Young, 1999). Some conservators have mixed acrylic resin with alkoxysilane to combine the consolidant and adhesive properties (Price, 1996). Examples of resins include: Acryloid B72 or Paraloid B72 (Rohm & Haas); and Impregnating Agent – EP 2101 Eurostac Strengthener (Bresciani Srl).

A wide variety of consolidant materials is needed to accommodate different substrates and site-specific conditions. In addition to the chemicals described above, consolidants have been formulated from vinyls (e.g., polyvinylchloride and polyvinylacetate); polyurethanes; polyesters; perfluoropolyethers; fluosilicates; barium hydroxide; and lime (Young, 1999).

5.34.4. Substrates/Exposures

Stone Consolidants are intended for application to a variety of stone substrates, including limestone, sandstone, marble, travertine, granite, and slate. Many are also suitable for other concrete and masonry substrates (e.g., brick, terra cotta tile, etc.) Products in this category are intended for interior and exterior exposures on horizontal and vertical surfaces.

5.34.5. Survey Results

Stone Consolidant is a new category, so it was not reported separately in the ARB survey. Please refer to the Concrete/Masonry Sealer section for survey data that were reported for Waterproofing Concrete/Masonry Sealer.

For the survey, all of the reported products that were identified specifically as Stone Consolidants were ethyl silicate formulations with VOC levels that exceed 400 g/l, the current SCM limit. In addition to these high-VOC products, there were some inorganic silicate products that are primarily marketed as sealers, but also can have a consolidating effect on certain substrates. These inorganic silicates are zero-VOC products, but they have some substrate limitations as compared to the ethyl silicates. Since these products are primarily marketed as sealers, ARB staff classified them under the new Reactive Penetrating Sealer category, rather than as Stone Consolidants.

Based on the survey, all of the reported Stone Consolidants comply with the proposed VOC limit.

Table 5.34-1: Complying Marketshare & Emission Reductions
Stone Consolidant

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume	Emission Reductions (excluding South Coast AQMD) (tons/day)
450	2	100%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.34.6. Conclusion

For the new Stone Consolidant category, we are recommending a VOC limit of 450 g/l, effective January 1, 2010. The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on information provided by raw material suppliers and coating manufacturers. The proposed VOC limit is higher than the 100 g/l limit contained in South Coast AQMD Rule 1113. However, manufacturers that provide coatings in the South Coast AQMD area can still sell products which exceed the 100 g/l limit, if they participate in South Coast AQMD's averaging program. The proposed SCM does not contain an averaging provision, so all manufacturers will be subject to the same limit.
In addition, this is a very small category and the emission reduction losses for this category are negligible for a 450 g/l limit as compared to a 100 g/l limit. The proposed SCM VOC limit is lower than the national limit of 600 g/l promulgated by the U.S. EPA. The proposed limit is higher than the 400 g/l limit adopted by the OTC states and proposed by Canada.

ARB staff is also proposing labeling requirements for Stone Consolidants.
Each container must be labeled with the phrases "Stone Consolidant" and "For Professional Use Only". Under the current SCM, labels must also include the VOC content. For Stone Consolidants, the VOC content should be based on the material composition, as recommended for application by the manufacturer.
If the manufacturer recommends dilution prior to application, the VOC content on the label must reflect the diluted solution.

5.35. SWIMMING POOL COATINGS

VOC Limit Table (g/l)

USEPA: 600	Canada: 340	OTC: 340	SCAQMD: 340	SCM Proposed: 340

5.35.1. Category Definition

A coating labeled and formulated to coat the interior of swimming pools and to resist swimming pool chemicals. Swimming Pool coatings include coatings used for swimming pool repair and maintenance.

Please note that the Swimming Pool coating category is now a consolidation of the following two categories contained in the 2000 SCM:

> Swimming Pool Coating: A coating labeled and formulated to coat the interior of swimming pools and to resist swimming pool chemicals.
>
> Swimming Pool Repair and Maintenance Coating: A rubber based coating labeled and formulated to be used over existing rubber based coatings for the repair and maintenance of swimming pools.

5.35.2. Major Proposed Changes

- The Swimming Pool coating category now contains those products previously covered by the Swimming Pool Maintenance and Repair category. The definition for the Swimming Pool coating category has been modified accordingly.

5.35.3. Coating Description

Swimming Pool coatings are generally used for protective and aesthetic purposes, and they fall into three main categories; acrylic; chlorinated or synthetic rubber; and epoxy (Poolcenter, 2007). The lower-VOC Swimming Pool coatings reported in the ARB survey were formulated with epoxy, acrylic/acrylic copolymer or urethane/polyurethane resins. All of the chlorinated or synthetic rubber coatings reported had a VOC content of 500 g/l or more. The former category of Swimming Pool Repair and Maintenance, for which no complying products were reported, had resin systems of either chlorinated or synthetic rubber or styrene butadiene. The Swimming Pool Repair and Maintenance category has been combined with the Swimming Pool coating category because there is no need for a higher VOC limit to accommodate repair and maintenance products. In the 2000 SCM, to avoid confusion with existing district rules, we created two categories of swimming pool coatings; Swimming Pool coatings and Swimming Pool Repair and Maintenance coatings, both with a VOC limit of 340 g/l. We recommended at that time that the districts eventually eliminate the Swimming Pool Repair and Maintenance coating category from their architectural coating rules in anticipation of the current proposed SCM, in which the Swimming Pool Repair and Maintenance category no longer exists.

Compliant epoxy coatings are generally touted as the most durable and long-lasting of the three types of Swimming Pool coatings, the next most durable being the non-compliant chlorinated or synthetic rubber coatings. In general, the acrylic Swimming Pool coatings are considered the least durable, and least costly, of the three main types of Swimming Pool coatings. The coatings are assumed to last approximately 7-10 years, 3-5 years, and 2-3 years, respectively (Poolcenter, 2007).

The majority of the waterborne and solventborne Swimming Pool coatings are multi-component products. Typically, Swimming Pool coatings can be brushed, rolled, or sprayed on the surface to be painted. They are used by both homeowners and professionals on the interior of residential and commercial swimming and wading pools, ponds, and fountains.

In addition to the types of Swimming Pool coatings described above, the South Coast AQMD has reported the use of polyester resins to repair and recoat existing swimming pools. As the polyester resins are field-applied (as opposed to being applied in a facility), the South Coast AQMD has determined that Rule 1162 “Polyester Resin Operations” does not apply, and that the field-applied coatings are subject to Architectural Coatings Rule 1113. Due to their design flexibility, these polyester resins are also being applied to structures other than swimming pools. The South Coast AQMD is currently investigating appropriate methods for determining the VOC content of polyester resins used as architectural coatings.

5.35.4. Substrates/Exposures

Not all Swimming Pool coatings are suitable for use on every swimming pool; manufacturer recommendations vary depending upon the substrate to be coated. Swimming pool surfaces may be concrete, plaster, gunite (pneumatically propelled mortar or concrete), fiberglass, steel, or aluminum. For concrete, gunite, and plaster substrates, an acrylic, chlorinated or synthetic rubber, or epoxy Swimming Pool coating may be used. For fiberglass, steel and aluminum, epoxies are generally recommended (Kelley, 2007).

If a swimming pool has been previously coated, a determination must be made as to what type of coating was applied. If a sample of the existing coating dissolves in denatured alcohol, it is assumed to be a waterborne acrylic coating. Chlorinated or synthetic rubber coatings will dissolve in xylene, and epoxy coatings will not dissolve in either alcohol or xylene. (Kelley, 2007) In general, if a Swimming Pool coating has been previously used on a surface, manufacturers recommend using the same type of coating for subsequent applications. However, ARB staff found several manufacturers whose product data sheets indicate that their product can be used to prime chlorinated or synthetic rubber coatings, in preparation for an epoxy topcoat.

As with all architectural coatings, proper substrate preparation is essential. After draining the swimming pool, a determination of the soundness of the surface must be made. If the surface to be coated was previously coated with epoxy, any glossy areas must be sanded until dull. Regardless of the previous coating used, sandblasting or sanding to bare substrate may be necessary if the existing coating is severely damaged or very thick. All previously painted pool surfaces must be treated with trisodium phosphate to remove oils, rinsed, and then acid washed to etch the substrate and remove stains. Finally, the acid is washed off, trisodium phosphate is used to neutralize the acid, the pool surface is rinsed again, and allowed to dry.

Swimming Pool coatings are subject to degradation from ultraviolet rays, fluctuating temperatures, pH levels, chemicals, and abrasions, and must be resistant to moisture penetration from constant immersion.

5.35.5. Survey Results

Survey data were provided separately for the Swimming Pool category and the Swimming Pool Repair and Maintenance category. Table 5.35-1a summarizes our estimate of sales and VOC emissions for Swimming Pool coatings, based on the ARB survey. The Swimming Pool coating category is a very minor category with regard to the sales volume as it represents less than 0.02 percent of the total sales volume for architectural coatings in California.

Solventborne Swimming Pool coatings generally have VOC levels less than 340 g/l, the current SCM VOC limit. The overall sales volume for Swimming Pool coatings decreased about 8 percent from 2000 to 2004. The overall sales-weighted average VOC Regulatory value declined about 9 percent from 2000 to 2004.

VOC emissions from Swimming Pool coatings are about 0.04 tpd, which represents approximately 0.04 percent of the total emissions from architectural coatings.

Table 5.35-1a: Survey Data
Swimming Pool

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	25	9,828	48%	0%	22%	78%	0%	304	0.03
WB	12	10,536	52%	0%	25%	75%	0%	199	0.01
Total	**37**	**20,364**		**0%**	**24%**	**76%**	**0%**	**250**	**0.04**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Three products were reported in the category of Swimming Pool Repair and Maintenance, all of which were solventborne, single component formulations based on chlorinated rubber or styrene butadiene resins. None of the reported Swimming Pool Repair and Maintenance coatings complied with the 2000 SCM VOC limit of 340 g/l. The sales-weighted average VOC Regulatory content for the reported products is 588 g/l, an increase of 3 percent from 2000 to 2004. We are unable to comment on the relative increase/decrease in the sales volume of Swimming Pool Repair and Maintenance from 2000 to 2004 as the sales data are protected.

Table 5.35-1b: Survey Data
Swimming Pool Repair and Maintenance

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	3	PD	100%	0%	77%	23%	0%	588	0.01
WB	0	0	-	-	-	-	-	-	-
Total	**3**	**PD**		**0%**	**77%**	**23%**	**0%**	**588**	**0.01**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.35-2 contains the complying marketshare for the revised Swimming Pool category, which reflects data for both Swimming Pool and Swimming Pool Maintenance and Repair coatings. About 89 percent of the combined sales volume complies with the current VOC limit. When considering the number of products reported, approximately 73 percent comply with the current limit.

Table 5.35-2: Complying Marketshare & Emission Reductions Swimming Pool Coatings

Current VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
340	29	89	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.35.6. Manufacturer Information

Product information sheets published by coatings manufacturers indicate that a wide variety of Swimming Pool coatings that meet the current VOC limit are available that possess performance characteristics similar to higher-VOC coatings. Multiple small manufacturers produce complying products, including Ellis Paint Company, Jones-Blair Company, Kelley Technical Coatings, and Tremco, Incorporated. A summary of product information for Swimming Pool and Swimming Pool Repair coatings is provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm).

5.35.7. Conclusion

We recommend maintaining the current 340 g/l VOC limit for Swimming Pool coatings, based on the complying marketshare and product information from manufacturers. The high complying marketshare demonstrates widespread use of existing low-VOC technology for formulating Swimming Pool coatings. The current VOC limit is lower than the national limit promulgated by the U.S. EPA. The current VOC limit is consistent with the limits adopted by the South Coast AQMD and the OTC states, and the proposed limit for Canada.

We recommend elimination of the Swimming Pool Repair and Maintenance coating category, effective January 1, 2010. At that time, products formerly categorized as Swimming Pool Repair and Maintenance would be categorized as Swimming Pool coatings. Elimination of this category will not change the VOC limit for Swimming Pool Repair and Maintenance coatings.

5.36. TRAFFIC MARKING

VOC Limit Table (g/l)

USEPA: 150	Canada: 150	OTC: 150	SCAQMD: 100	SCM Proposed: 100

5.36.1. Category Definition

A coating labeled 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.

5.36.2. Major Proposed Changes

- The proposed VOC limit for Traffic Marking coatings would decrease from 150 g/l to 100 g/l.

5.36.3. Coating Description

Traffic Marking coatings are primarily used to mark roadways, streets, and parking lots. They are also used for zone marking in industrial plants and sport venues. These coatings can be applied in small patches with a roller or brush, but are typically applied with air-atomized machines, airless sprayers and conventional sprayers. Traffic Marking coatings can have flat, glossy, and/or reflective properties depending on their desired use. Direct reflectance can be improved with the addition of glass beads to enhance visibility for applications such as airport runways and highway systems. Since most Traffic Marking coatings are used on roads and require specialty equipment, they are most often applied by the California Department of Transportation (Caltrans), local highway maintenance crews, striping contractors, municipalities, shopping center management, airport contractors, plant maintenance personnel, and other industries that desire the use of striping or marking. However, these coatings are also sold in hardware stores and do-it-yourself centers and can be applied by homeowners or business owners for curbs, driveways, sport courts, or anything requiring zone marking or traffic marking. Typically Traffic Marking coatings are single component waterborne products with acrylic resins, but resin types also include vinyl copolymers, alkyds, chlorinated rubbers, polyvinyl acetates and cellulosics. There are also multi-component products which contain methyl methacrylate (MMA) resin that creates a strong exothermic reaction. These products are used for high-traffic areas.

ARB staff contacted personnel from Caltrans to determine potential impacts associated with the proposed 100 g/l VOC limit. Caltrans is a large user of Traffic Marking coatings and Caltrans staff has indicated that they can meet the proposed 100 g/l VOC limit with their regular traffic coatings (Caltrans, 2007). Most cities and counties generally follow Caltrans specifications for their traffic coatings. The Caltrans "pre-qualified products" list for Traffic Paint Coatings would not be adversely impacted by the proposed VOC limit (Caltrans, 2007a). All of the listed products are high solids products that were tested and approved by the Caltrans Transportation Laboratory. ARB staff found that the published VOC levels for these products are substantially lower than the proposed SCM limit.

Some areas of California (e.g., the Northern Coast) have the type of climate where moisture and cold weather can inhibit the proper application of Traffic Marking coatings. To help minimize application failure, Caltrans has opted to apply coatings in these areas only during good weather (Caltrans, 2007c). This may limit them to only a few months per year in this type of climate, but it prevents application failures by giving the paint sufficient time to dry. In Northern Coast areas near Crescent City, Caltrans previously used acetone-based products, but they eventually phased these products out, due to flammability and occasional machine plugging. Machine plugging can be caused by a multitude of problems ranging from the type of solvent, lack of solvent, temperature, humidity, or other factors.

When Caltrans performs Traffic Marking maintenance or repairs within cities and counties, they usually do so without road closures (Caltrans, 2007c). Therefore, the coatings must dry quickly. If a waterborne product is applied, roughly 5 minutes of drying time is required to ensure minimal tracking. In cities or counties with high traffic loads, 5 minute drying is not effective and higher-VOC products or faster-drying coatings may be needed to meet the demands of the area. Solid thermoplastics, which are not considered coatings under the SCM, are an alternative to liquid Traffic Marking coatings. Thermoplastics come in 50 pound bags that contain pigments, fillers, and other ingredients. During application, this bag is poured into a machine that melts the bagged components at about 400 degrees F. Upon hitting the ground, the molten material cools instantly, which minimizes dry times, reduces or eliminates tracking, and emits minimal if any VOCs because it doesn't contain any solvents (Caltrans, 2007c). This type of coating application requires equipment and thermoplastic materials that can be relatively expensive for counties or cities, as compared to liquid traffic coatings.

5.36.4. Substrates/Exposures

Traffic Marking coatings can be used indoors and outdoors at a variety of locations (roadways, curbs, inside factories, gaming surfaces, airports, etc.). They are applied to concrete, asphalt, stone, masonry, brick, and cinder block substrates that are exposed to pedestrian and vehicle traffic. Usually, these products cannot be applied to substrates that have excessive dirt, debris, and oil/gasoline residues. Application temperatures vary, but most are applied in ambient temperatures ranging from 50-110 ˚F. Some can be applied with temperatures dropping to 40 ˚F and rising to as high as 120 ˚F. In general, it is recommended to apply when the temperature is at least 5 degrees F above the dew point. Since these coatings are intended for roadways that are exposed to vehicle traffic, they are usually designed to be resistant to a variety of items, including tire marks, skidding, antifreeze, motor oil, diesel fuel, gasoline, calcium chloride, and transmission fluid.

5.36.5. Survey Results

Table 5.36-1 summarizes our estimate of sales and VOC emissions for Traffic Marking coatings, based on the ARB survey. In 2004, the sales volume for Traffic Marking coatings was approximately 2.2 million gallons which represents 2 percent of the total California sales volume for architectural coatings. The sales volume for Traffic Marking coatings declined about one-third from 2000 to 2004. We believe this is due to the increased use of melted thermoplastic materials which are not classified as architectural coatings. Thermoplastics last longer and perform better on roadways with high traffic volumes. Another difference between 2000 and 2004 is the significant decrease in dual-use products (i.e., products that can be used for both interior and exterior applications). In 2000, 68 percent of the sales volume was classified as dual use, but this declined to 4 percent in 2004 when most products were classified for exterior use only.

Waterborne Traffic Marking coatings represent 85 percent of the sales volume and have a sales-weighted average VOC level of 93 g/l, which is below the proposed 100 g/l VOC limit for this category. The overall sales-weighted average VOC level for Traffic Marking coatings decreased 13 percent from 2000 to 2004.

VOC emissions from Traffic Marking coatings are about 1.7 tpd, which represents approximately 2 percent of the total emissions from architectural coatings. Since most of the sales volume is waterborne, most of the emissions (78 percent) are from waterborne coatings. Solventborne coatings make up only 15 percent of the sales volume, but they contribute about 22 percent of the emissions.

Table 5.36-1: Survey Data
Traffic Marking

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	48	329,369	15%	0%	100%	0%	0%	147	0.36
WB	198	1,885,082	85%	0%	96%	4%	0%	93	1.31
Total	**246**	**2,214,451**		**0%**	**96%**	**4%**	**0%**	**101**	**1.67**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.36-2 contains the complying marketshare for Traffic Marking coatings, based on the ARB survey. This table shows that 74 percent of the sales volume complies with the proposed VOC limit.

Implementing the proposed 100 g/l limit would achieve 0.09 tpd in VOC emission reductions for the non-South Coast AQMD portion of California, on an annual average basis. This is a 5 percent reduction in emissions for Traffic Marking coatings.

Table 5.36-2: Complying Marketshare & Emission Reductions Traffic Marking

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
100	158	74%	0.09

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

Of the 25 companies that reported in this category, 19 offered Traffic Marking coatings that comply with the proposed limit. Ten companies that produce compliant coatings are considered to be small businesses, because they have fewer than 250 employees.

5.36.6. Manufacturer Information

The Master Painters Institute (MPI) has two pertinent categories for Traffic Marking coatings: MPI #32 (Traffic Marking Paint, Alkyd) and MPI #97 (Traffic Marking Paint, Latex). Only products on the approved list for MPI #97 can comply with the proposed 100 g/l VOC limit. A list of the reported products from the ARB Survey and MPI-approved products that can meet the proposed VOC limit is provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm). Three of the products reported in the survey qualify for the MPI Green Performance Standards.

5.36.7. Conclusion

We recommend a 100 g/l VOC limit for Traffic Marking coatings, effective January 1, 2010. The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on the complying marketshare, the number of companies making compliant products, and product information from manufacturers. The proposed VOC limit is lower than the limits adopted by the U.S. EPA and the OTC states and the proposed limit for Canada. The proposed limit is consistent with the limit adopted by the South Coast AQMD.

5.37. TUB AND TILE REFINISH

VOC Limit Table (g/l)

USEPA: 450	Canada: N/A	OTC: N/A	SCAQMD: N/A	SCM Proposed: 420

5.37.1. Category Definition

A clear or opaque coating that is labeled and formulated exclusively for refinishing the surface of a bathtub, shower, sink, or countertop. Tub and Tile Refinish coatings must meet all of the following criteria:

- The coating must have a scratch hardness of 3H or harder and a gouge hardness of 4H or harder. This must be determined on bonderite 1000, in accordance with ASTM D3363-05 (Standard Test Method for Film Hardness by Pencil Test); and
- The coating must have a weight loss of 20 milligrams or less after 1000 cycles. This must be determined with CS-17 wheels on bonderite 1000, in accordance with ASTM D4060-07 (Standard Test Methods for Abrasion Resistance of Organic Coatings by the Taber Abraser); and
- The coating must withstand 1000 hours or more of exposure with few or no #8 blisters. This must be determined on unscribed bonderite, in accordance with ASTM D4585-99 (Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation) and ASTM D714-02e1 (Standard Test Method for Evaluating Degree of Blistering of Paints); and
- The coating must have an adhesion rating of 4B or better after 24 hours of recovery. This must be determined on unscribed bonderite, in accordance with ASTM D4585-99 (Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation) and ASTM D3359-02 (Standard Test Methods for Measuring Adhesion by Tape Test).

Please note that “Tub and Tile Refinish” is a proposed new category that includes products which were formerly considered to be in the “Other” category for the 2000 SCM.

Under the U.S. EPA Architectural Coating regulation, Tub and Tile Refinish products may be subject to the VOC limit for Industrial Maintenance coatings. Alternatively, they could be covered by the small container exemption or the tonnage exemption (EPA, 1998a).

5.37.2. Major Proposed Changes

- Tub and Tile Refinish is a new category that includes products formerly classified under the “Other” default category.

5.37.3. Coating Description

Tub and Tile Refinish coatings include primers and topcoats that are used to refurbish bathtubs, showers, sinks, countertops, and other tile and porcelain surfaces. These products are designed to provide a hard surface that can withstand abrasion and immersion in hot water. However, they are not generally recommended for pools or hot tubs. Most products provide a glossy sheen, but some leave a satin finish. Tub and Tile Refinish coatings can either be applied by professional contractors or homeowners. Contractors can obtain specialized training from manufacturers of these coatings and many contractors operate franchise businesses that are licensed by coating manufacturers. For the "do-it-yourself" market, some manufacturers sell refinishing kits that include cleaners, etching solutions, primers, and topcoats. Manufacturers generally recommend that the coatings be applied with a sprayer, but they can also be applied with a brush or roller.

Most of the products identified by ARB staff are multi-component, solventborne formulations with acrylic urethane topcoats and epoxy primers. Other types of products include multi-component, solventborne formulations with amine resins and single component, solventborne, urethane primers. Products are available in solventborne formulations that have VOC contents less than 420 g/l.

5.37.4. Substrates/Exposures

Tub and Tile Refinish coatings are intended for interior applications on substrates that include porcelain, fiberglass, ceramic tile, formica, and cultured marble. These products are exposed to frequent moisture, including submersion in hot water.

5.37.5. Survey Results

Tub and Tile Refinish coating is a new category, so it was not reported separately in the ARB survey. Manufacturers of Tub and Tile Refinish coatings are in a niche market that has not traditionally been targeted for participation in the Architectural Coating Surveys. In addition, some manufacturers may have thought that the "do-it-yourself" refinishing kits should qualify as "consumer products", rather than architectural coatings. For these reasons, only a small number of Tub and Tile Refinish products were reported in the ARB survey, primarily in the "Other" category. ARB staff does not believe that these data are necessarily representative of the overall market in California. Using survey data and information provided by industry representatives, ARB staff estimates that sales are between 3,000 - 16,000 gallons per year and VOC emissions are between 0.02 - 0.08 tpd (ARB, 2006).

In the past, it was assumed that most of the sales for Tub and Tile Refinish products consist of small containers that would be exempt from the SCM VOC limits. However, the limited survey data indicate that this may not be the case. In addition, many manufacturers limit their sales to professional refinishing contractors only and they offer their products in container sizes ranging from one pint up to 55 gallons.

5.37.6. Manufacturer Information

ARB staff identified the following manufacturers of Tub and Tile Refinish products that meet the proposed VOC limit: North American Polymer Co., Ltd.; Pandalai Coatings Company; Specialty Coatings & Chemicals, Inc.; and XIM Products.

5.37.7. Conclusion

ARB staff recommends that a new category be established for Tub and Tile Refinish coatings to clarify how these products should be classified and regulated. ARB staff does not believe that it is technologically feasible for Tub and Tile Refinish products to be formulated to meet the VOC limit for the "Other" category. In addition, it does not appear that the products being sold in California are primarily being sold in small containers. The proposed definition for the Tub and Tile Refinish category includes strict performance requirements to help prevent this category from becoming a loophole for Nonflats and other categories. While U.S. EPA considers Tub and Tile Refinish products to be covered by Industrial Maintenance, ARB staff does not believe that this is appropriate.

For the new Tub and Tile Refinish category, we are recommending a VOC limit of 420 g/l, effective January 1, 2010. The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on the number of companies making complying products and information provided by manufacturers. The proposed SCM VOC limit is lower than the national limit of 450 g/l promulgated by the United States Environmental Protection Agency (U.S. EPA). Tub and Tile Refinishing is not currently listed in architectural coating rules for the South Coast AQMD, the OTC states, or Canada.

Establishment of the Tub and Tile Refinish category is being proposed for clarification purposes, rather than for obtaining emission reductions. While some products would need to be reformulated to meet the proposed 420 g/l limit, the resulting emission reductions would be relatively negligible.

5.38. WATERPROOFING MEMBRANES

VOC Limit Table (g/l)

USEPA: 600	Canada: 400	OTC: 400	SCAQMD: 100	SCM Proposed: 250

5.38.1. Category Definition

A clear or opaque coating that is labeled and formulated for application to concrete and masonry surfaces to provide a seamless waterproofing membrane that prevents any penetration of liquid water into the substrate. Waterproofing Membranes are intended for the following waterproofing applications: below-grade surfaces, between concrete slabs, inside tunnels, inside concrete planters, and under flooring materials. Waterproofing Membranes must meet the following criteria:

- Coating must by applied in a single coat of at least 25 mils (0.025 inch) dry film thickness; and
- Coatings must meet or exceed the requirements contained in ASTM Standard C836-06 (Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course).

The Waterproofing Membrane category does not include topcoats that are included in the Concrete/Masonry Sealer category (e.g., parking deck topcoats, pedestrian deck topcoats, etc.).

Please note that "Waterproofing Membrane" is a proposed new category that includes products which were formerly covered by the following two categories in the 2000 SCM:

> <u>Waterproofing Concrete/Masonry Sealer</u>: A clear or pigmented film-forming coating that is labeled and formulated for sealing concrete and masonry to provide resistance against water, alkali, acids, ultraviolet light and staining.
>
> <u>Waterproofing Sealer</u>: A coating labeled and formulated for application to a porous substrate for the primary purpose of preventing the penetration of water.

These two categories were eliminated from the proposed SCM and the types of products that were previously in these categories would be covered by the following: Basement Specialty Coating; Concrete/Masonry Sealer; Wood Coatings; Industrial Maintenance; Primer, Sealer, Undercoater; Reactive Penetrating Sealer; Stone Consolidant; and Waterproofing Membrane.

Under the U.S. EPA Architectural Coating regulation, Waterproofing Membranes would be covered by the "Waterproofing Sealers and Treatments" category.

5.38.2. Major Proposed Changes

- Waterproofing Membrane is a new category for high-build, high-performance products. It includes products that were formerly included in the Waterproofing Concrete/Masonry Sealer and Waterproofing Sealer categories.
- For products that were formerly in the Waterproofing Concrete/Masonry Sealer category, the proposed VOC limit decreases from 400 g/l to 250 g/l.
- For products that were formerly in the Waterproofing Sealer category, the proposed VOC limit is the same.

5.38.3. Coating Description

These products are applied to concrete and masonry to provide a seamless waterproofing coating for both interior and exterior exposures. These coatings can be applied for a variety of waterproofing uses, such as:

- Between concrete slabs (e.g., parking decks, roof decks, bridges)
- Below-grade exterior walls, foundations, basements
- Inside tunnels
- Inside concrete planters
- Underneath tile flooring

The Waterproofing Membrane category is intended for non-wearing surfaces (e.g., between slabs) and it does not include products that are used to coat the surface of parking decks, roof decks, bridges, etc. Those types of deck coatings are covered under the Concrete/Masonry Sealer category.

Waterproofing Membrane products accounted for 27% of the reported sales volume for Waterproofing Concrete/Masonry Sealers and 4% of the sales volume for Waterproofing Sealers. They also accounted for 42% of the VOC emissions for Waterproofing Concrete/Masonry Sealers and 0% of the VOC emissions for Waterproofing Sealers. Most Waterproofing Membrane products are either single component, moisture-cure, elastomeric polyurethanes or single component bituminous coatings. There are also some multi-component elastomeric coatings. Many products are applied as high-build coatings with wet film thicknesses ranging from 40 mils to more than 100 mils. Coatings are generally applied by professional contractors and application methods include: brush, squeegee, trowel, roller, or spray. Resin types include: acrylic, amines/amides, asphaltic/bituminous, polyurethane, and styrene-butadiene. Single component, solventborne products are available with VOC contents below 250 g/l and they represent approximately 56 percent of the sales volume for the Waterproofing Membrane group (excluding small containers). Products with VOC contents at or below 100 g/l represent six percent of the reported sales volume for large containers, but they appeared to have various application limitations. Single component waterborne products with VOC contents below 100 g/l have limitations which include: they are only suitable for above-grade applications; they require unique, specialized application equipment; or they are intended for use with mesh or a mat. Most of the reported solventborne products with VOC contents below 100 g/l also had limitations, including: the products are hot-applied asphaltic coatings that require the use of heating kettles; or the products are intended for above-grade applications only.

5.38.4. Substrates/Exposures

Waterproofing Membranes are intended for application to concrete and masonry substrates in non-wear locations (e.g., between concrete slabs; on exterior below-grade surfaces; inside tunnels; inside planters; under flooring; etc.). Products in this category provide a waterproofing seal to prevent water intrusion and they can be applied to wet surfaces. The products are not designed to be resistant to abrasion from pedestrian traffic or vehicle traffic.

5.38.5. Survey Results

Waterproofing Membrane is a new category; therefore, it was not reported separately in ARB's 2005 Architectural Coating Survey. Please refer to the Concrete/Masonry Sealer section for survey data that were reported for Waterproofing Concrete/Masonry Sealer and Waterproofing Sealer (ARB, 2006).

Table 5.38-1 contains the complying marketshare for the proposed new Waterproofing Membrane category, based on the ARB survey. This table reflects combined data for Waterproofing Membrane products that were reported under two previous categories: Waterproofing Concrete/Masonry Sealer and Waterproofing Sealer. Based on reported sales volume, 68 percent of the reported Waterproofing Membrane coatings comply with the proposed VOC limit of 250 g/l. Based on the number of products reported, 65 percent of the products comply with the proposed limit. Of the eight companies that reported in this category, seven offered Waterproofing Membrane coatings that comply with the proposed limit.

Table 5.38-1: Complying Marketshare & Emission Reductions
Waterproofing Membrane

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
250	24	68%	0.09

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.38.6 Conclusion

We are recommending a new Waterproofing Membrane category with a VOC limit of 250 g/l, effective January 1, 2010. This proposed limit will apply to the higher-build (>25 mil) products that comply with the requirements in the Waterproofing Membrane definition provided above. Thinner coatings that provide a waterproofing membrane, but do not comply with the above definition, will be covered by the new Concrete/Masonry Sealer category and will need to comply with a VOC limit of 100 g/l. The proposed limit for Waterproofing Membranes is consistent with the VOC limit for Industrial Maintenance coatings. It is expected that there may be some overlap between these two categories for products that are used in water/wastewater facilities and other applications that are covered by the Industrial Maintenance definition. Therefore, we believe that a consistent VOC limit makes the SCM more enforceable.

For Waterproofing Membrane products that were previously classified as "Waterproofing Sealers" (250 g/l), the VOC limit remains the same. For products that were previously classified as "Waterproofing Concrete/Masonry Sealers" (400 g/l), the proposed limit will be a significant decrease. ARB staff's analysis supports the conclusion that the proposed limit is technologically and commercially feasible.

In the South Coast AQMD, it is expected that Waterproofing Membrane products could fall under Industrial Maintenance or Waterproofing Sealer, both of which have a VOC limit of 100 g/l. The proposed SCM VOC limit is higher than the South Coast AQMD limit. However, manufacturers that provide coatings in the South Coast AQMD can still sell products which exceed the 100 g/l limit, if they participate in the South Coast AQMD averaging program. The proposed SCM does not contain an averaging provision, so all manufacturers will be subject to the same limit. South Coast AQMD also grants a VOC exemption for the use of tertiary-Butyl Acetate to help manufacturers formulate Industrial Maintenance coatings that will meet the 100 g/l limit. The proposed SCM does not include a VOC exemption for tertiary-Butyl Acetate.

ARB staff believes that additional research is needed to verify the performance of 100 g/l Waterproofing Membranes in a way that protects the infrastructure throughout California. The South Coast AQMD area has a mild climate, so climatic conditions are less of a concern. However, in other areas of California, the infrastructure is exposed to more extreme climates (e.g., mountainous areas with freezing temperatures; coastal areas with persistent cold temperatures, salt spray, high humidity, etc.). ARB staff believes that additional research is needed to develop products that perform well in these areas. Therefore, ARB staff believes that the current 250 g/l VOC limit is most appropriate at this time.

5.39. WOOD COATINGS

VOC Limit Table (g/l)

USEPA: 400-725	Canada: 350-725	OTC: 350-725	SCAQMD: 275	SCM Proposed: 275

5.39.1. Category Definition

Coatings labeled and formulated for application to wood substrates only. The Wood Coatings category includes the following clear and semi-transparent coatings: lacquers; varnishes; sanding sealers; penetrating oils; clear stains; wood conditioners used as undercoats; and wood sealers used as topcoats. The Wood Coatings category also includes the following opaque wood coatings: opaque lacquers; opaque sanding sealers; and opaque lacquer undercoaters. The Wood Coatings category does not include the following: clear sealers that are labeled and formulated for use on concrete/masonry surfaces; or coatings intended for substrates other than wood. Wood Coatings must be labeled “For Wood Substrates Only”.

Please note that “Wood Coatings” is a new category that is a consolidation of the following four categories that were contained in the 2000 SCM:

> Clear Brushing Lacquer: 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.
>
> Lacquer: A clear or opaque wood coating, including clear lacquer sanding sealers, formulated with cellulosic or synthetic resins that dry by evaporation without chemical reaction and to provide a solid, protective film.
>
> Sanding Sealer: A clear or semi-transparent wood coating labeled and formulated for application to bare wood to seal the wood and to provide a coat that can be abraded 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.
>
> 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.

5.39.2. Major Proposed Changes

- Wood Coatings is a new category to replace Clear Brushing Lacquers, Lacquers, Sanding Sealers, and Varnishes.
- The category definition has been revised to include penetrating oils, clear stains, lacquer undercoaters, varnish stains, wood conditioners used as undercoats, and wood sealers used as topcoats.
- Clear waterproofing sealers applied to wood substrates that were previously included in the Waterproofing Sealers category and clear stains previously included in the Stains category are now in the Wood Coatings category.
- For products that were formerly categorized as Clear Brushing Lacquers (680 g/l), Lacquers (550 g/l), Sanding Sealers (350 g/l), and Varnishes (350 g/l), the proposed VOC limits decrease to 275 g/l.
- For products that were formerly categorized as Waterproofing Sealers, the proposed VOC Limit increases from 250 g/l to 275 g/l.
- For products that were formerly categorized as Stains, the proposed VOC Limit increases from 250 g/l to 275 g/l.

5.39.3. Coating Description

We are proposing a single category that combines several categories under Wood Coatings, because the current definitions for Lacquer and Varnish describe traditional solventborne technology that is not necessarily accurate for both waterborne and solventborne products.

Wood Coatings are used for decorative purposes and to provide some protection from abrasion, staining, moisture, dirt, and common chemicals. Wood Coatings cover a wide range of applications and functions. Clear Wood Coatings include lacquers, sanding sealers, penetrating oils, varnishes, stain controllers/wood conditioners, clear stains, and waterproofing sealers. Most opaque Wood Coatings are lacquers and lacquer undercoaters, but opaque sanding sealers and opaque conversion varnishes are also available. Provided below is a description of the various applications, primarily based on the products reported in ARB's 2005 Architectural Coating Survey.

Lacquers: Clear lacquers are used for protective and decorative purposes. They are film-forming coatings that protect wood from abrasion, staining, moisture, dirt, and common chemicals. Clear lacquers leave a smooth, high-gloss finish that allows the natural wood grain and color to show through. Pigments can also be added to the coating to produce a variety of different colors. Opaque lacquer topcoats and undercoats are similar to clear lacquers, but contain opaque pigments that obscure the wood grain and texture. These coatings leave an opaque finish with various levels of gloss.

Clear lacquers are usually applied by professionals and are generally sprayed on because they dry very quickly. Brushing is not recommended, since brush marks may be left in the finish due to fast-evaporating solvents. Clear brushing lacquers are specifically formulated with slower drying solvents, making application easier for do-it-yourself homeowners. Clear brushing lacquers dry quickly but leave enough open time to get a smooth, streak-free finish. None of the clear brushing lacquers reported in the survey meet the proposed 275 g/l limit, but at least one major manufacturer has developed complying waterborne products.

Traditional lacquers are single component solventborne coatings composed of nitrocellulose (or cellulose nitrate), which is made by mixing cellulose from wood or cotton pulp with nitric and sulfuric acid. Nitrocellulose lacquers dry completely by evaporation of the solvent, leaving a hard, brittle finish. These solventborne formulations have rewetting capabilities, which means that subsequent coats of lacquer will partially redissolve the previous dry coat, making the coating easy to repair. Traditional clear lacquers also have an amber cast that darkens with time. Nitrocellulose derivatives, including ethyl cellulose, cellulose acetate, and cellulose acetate butyrate (CAB), may also be used. Nitrocellulose or its derivatives can be modified with acrylic, alkyd, or polyester resins. CAB acrylic lacquer is one of the more common cellulosic coatings. There are a few traditional clear lacquer products that can meet the proposed 275 g/l limit. Two opaque solventborne cellulosic lacquer undercoaters reported in the survey had VOC contents below the proposed 275 g/l limit.

Catalyzed lacquer is another common type of lacquer. These coatings can be solventborne or waterborne and dry by both evaporation and chemical reaction. Pre-catalyzed lacquer consists of two components that are mixed prior to being sold, while components of post-catalyzed lacquer are mixed immediately before application. Catalyzed lacquer often contains nitrocellulose, amino resins (urea formaldehyde or melamine formaldehyde), alkyd resins, and an acid catalyst. Once applied, curing can take several days to several weeks and catalyzed lacquer will provide more resistances than traditional lacquer. Catalyzed finishes are more difficult to repair and refinish because they do not have rewetting capabilities. Similarly to traditional lacquers, very few catalyzed clear lacquers meet the proposed limit. None of the catalyzed opaque lacquers reported in the survey meet the proposed VOC limit, but they could be sold under the small container exemption.

Waterborne clear lacquers most commonly contain acrylic resins, or a combination of acrylic and polyurethane. Almost all clear lacquers that have VOC contents below the proposed VOC limit of 275 g/l are waterborne acrylics or waterborne acrylic/polyurethane dispersions. For waterborne clear lacquers, 93 percent of the sales volume complies with the proposed VOC limit. When considering the number of products reported, 88 percent of the clear lacquer products meet the proposed limit.

Opaque lacquer undercoaters can often be used as a finish coat or can be topcoated with an opaque or clear lacquer. Applying a clear nitrocellulose-based lacquer over an opaque lacquer or lacquer undercoater can present problems due to its rewetting capabilities. Lacquer thinner from the clear topcoat can partially dissolve some of the colorant pigment from the opaque undercoat. These pigments can "float" into the clear coat and change the color of the coating (R.J. McGlennon, 2006). Many opaque lacquer sanding sealers and undercoaters meet the proposed 275 g/l limit. Almost all of these are waterborne formulations that contain acrylic resins.

Sanding Sealers: Sanding sealers are applied to bare or stained wood to seal the wood and provide a coat that can be easily sanded to create a smooth surface for subsequent applications of coatings. Sanding sealers can minimize grain raise, block stain bleed into the topcoat, and prevent the finish from penetrating into the wood surface. They dry quickly, thus reducing the time it takes to finish a project. Some sanding sealers can be used as a sealer prior to the application of a finish topcoat or as both a sealer and finish.

Typically, sanding sealers are brushed, sprayed, or rolled on, but can be applied to floors with a T-bar, trowel, or lambswool applicator. A T-bar is an applicator that is shaped like a "T" with a long handle and a rounded metal bar at the end that can swivel. The bar has a cover made of a synthetic material that is used to spread the coating over the floor. The sanding sealer is sanded smooth and leaves a matte or low-gloss, transparent finish that is usually topcoated with a varnish, lacquer or other film-forming coatings. Sanding sealers are applied by homeowners and professional contractors.

Sanding sealers usually contain additives that make the coating easier to sand. These include waxes, metallic soaps, and other lubricating materials. Zinc stearate is a metallic soap that is used as a lubricant, flattening agent, coupling agent, waterproofing agent, or viscosity modifier. Additives that make the coating easy to sand can also prevent adequate adhesion of the clear finish topcoat, especially urethane and polyurethane topcoats. Vinyl is a common resin used in sanding sealers because it helps seal the wood from moisture and creates a smooth surface for the topcoat. Common solventborne resins include vinyl toluene, alkyd, urethane and polyurethane. Alkyds are often modified with vinyl toluene or urethane. The majority of waterborne sanding sealers contain acrylic resins, while some contain urethane and polyurethane. Many lacquer sanding sealers are formulated with cellulosic resins to be compatible with lacquer topcoats. Sanding sealers can also contain driers, other additives, and solvents, such as mineral spirits. Most sanding sealers are single component, but some may be two-component to increase durability, especially on high-wear surfaces. All sanding sealers that meet the 275 g/l limit are waterborne acrylics and urethane/polyurethanes.

<u>Penetrating Oils</u>: Penetrating oils are natural wood finishes that are used on bare wood surfaces to help protect wood from weather damage and to enhance the natural characteristics of the wood. They provide a durable finish that helps wood withstand moisture and the graying and fading effects of the sun. Little surface preparation is required before application. These are single component coatings that are sprayed, wiped, rolled, or brushed on by homeowners. If spraying, back-brushing is recommended to achieve good penetration. Penetrating oils leave a matte finish that can darken the color of the wood, but does not mask wood color, grain, or texture. Penetrating oil finishes are clear and do not contain any pigment that would change the color of the wood.

These products contain drying oils, usually tung or linseed oil. Drying oils are reactive finishes that penetrate the wood surface and solidify upon exposure to the air. Clear, penetrating oil finishes commonly contain water repellents, such as paraffin wax or wax-like chemicals, to prevent wood from absorbing water, which causes the wood to crack, warp, and split. They usually contain mildewcides or UV stabilizers to help prevent discoloration or damage from the sun. Penetrating oil finishes may also contain alkyds or other resins. Penetrating oils include teak and Danish oils. Some penetrating oil products meet the proposed 275 g/l VOC limit. Because these products penetrate the wood substrate and do not leave a film, they were usually included in the Stain category. These products are now included in the Wood Coatings category because they do not contain any pigments that change the color of the wood surface.

<u>Varnishes</u>: Clear or semitransparent varnishes are used to protect wood without hiding the natural color or grain pattern. They are single- or multi-component coatings that may be brushed, sprayed, or rolled on. Brushing is the preferred method over spraying because varnishes usually set up slowly and have a tendency to run if applied too heavily. A T-bar or lambswool applicator is commonly used to apply varnish to floors. Varnishes are applied by homeowners and professional contractors, and leave a smooth finish with various levels of gloss. Two-component varnishes, including conversion varnishes, are usually applied by professionals, due to the need for exact mixing ratios and the toxicity of the coating components.

There are many types of varnishes. The most common varnish is composed of a resin and a drying oil. Drying oils, usually linseed, tung or soya, penetrate the wood surface and solidify upon exposure to the air. Synthetic resins are often preferred over natural resins because of their better performance and reliable supply. Solventborne varnishes commonly contain alkyd, urethane, polyurethane, polyester, or phenolic resins, while waterborne varnishes usually contain acrylic, polyurethane, or a blend of the two. Some waterborne varnishes may contain alkyd dispersions. Polyurethane has become very common, due to its durability and resistance to abrasion. Two-component polyurethane coatings are especially known for their excellent properties and resistances. Epoxy resins are also used in some varnishes for wood floors because they provide a durable, chemical-resistant finish.

Other varnish formulations contain a resin, oil, solvent or water, metallic driers, antiskinning agents, and other additives. Long oil varnishes, which contain a higher percentage of oil, are more flexible and soft and are usually applied to exterior surfaces that are subjected to temperature extremes. Short oil varnishes, with lower concentrations of oil, are usually applied indoors. Spar varnish, a long oil varnish used to protect surfaces in environments exposed to moisture and UV radiation on exterior surfaces, is often composed of alkyd- or urethane-modified tung or soya oil and phenolic resins. Conversion varnishes, or catalyzed varnishes, are similar to post-catalyzed lacquer. Both are two-component coatings that are usually composed of alkyd and amino resins, and require an acid catalyst that is added immediately prior to application. Varnishes can also cure through moisture absorption or exposure to heat or UV radiation. Moisture-cured urethane is a common clear coating used on wood surfaces, which dries when its components react with atmospheric moisture to form the finished cross-linked polymer film.

Conventional solventborne oil-modified urethanes have long been a popular choice for coating wood flooring and various other wood surfaces, but are decreasing in use, due to their higher VOC content. Waterborne two-component urethanes and polyurethane dispersion (PUD)/acrylic blend varnishes are both used as alternatives to traditional oil-modified urethane coatings. Waterborne two-component polyurethane systems are formulated with VOC contents at or below 275 g/l. PUD/acrylic blend varnishes dry entirely by evaporation without any crosslinking. Higher levels of PUD give better abrasion, mar, and scuff resistance, while blending a PUD with styrene acrylic improves chemical resistance. Oil-modified urethane alternatives to conventional oil-modified urethanes have also been formulated. These coatings have either a high solids content, exempt solvents, or replace solvents with water. The typical waterborne oil-modified urethane varnish has a VOC content of 200 g/l (Caldwell, 2005). Some alkyd formulations can also meet the proposed 275 g/l VOC limit.

Semitransparent varnishes contain pigments that color the surface of the wood without concealing the wood grain. Semitransparent varnishes leave a protective film, unlike semitransparent stains. Varnish stains are considered to be semitransparent varnishes because they leave a film on the wood surface. Most varnishes that meet the 275 g/l limit are waterborne. They contain acrylic, vinyl acrylic, urethane/polyurethane, and alkyd resins.

Opaque conversion varnishes, or catalyzed varnishes, have similar formulations to post-catalyzed lacquers, but do not contain nitrocellulose. Both are two-component coatings that are usually composed of alkyd and amino resins, and require an acid catalyst that is added immediately prior to application. None of the opaque conversion varnishes reported in the survey meet the proposed limit, but they could be sold under the small container exemption.

Stain Controllers: Stain controllers or wood conditioners are applied to new or bare wood surfaces to prevent uneven absorption of semitransparent stains. These products were reported under the Primers, Sealers, and Undercoaters category, but ARB staff is proposing that they be included in the new Wood Coatings category. Stain controllers are single component coatings that are brushed or wiped onto the surface of the wood. Excess coating that does not penetrate the substrate is wiped off, leaving a matte finish. Stain is usually applied within two hours, while the stain controller is still wet. If allowed to dry, the stain controller will inhibit the absorption of stain and the surface must be sanded before the stain is applied. Waterborne stain controllers are usually sanded off the surface because they do not penetrate the wood as readily as solventborne products. Solventborne stain controllers are usually composed of oils, while waterborne products usually contain synthetic resins. Almost all stain controllers have VOC contents above the proposed 275 g/l limit. One waterborne stain controller reported in the survey meets the proposed limit.

Waterproofing Sealers: Waterproofing sealers are applied to bare wood to prevent the substrate from absorbing water, which causes the wood to crack, warp, and split. These coatings are all single component coatings that are sprayed, wiped, rolled, or brushed on. Back brushing is recommended, if spraying, to achieve good penetration. Excess is often wiped off with a cloth, leaving a flat finish with little or no sheen. These coatings are applied by homeowners or professional contractors. Waterproofing sealers do not contain any pigments that would help protect the wood surface from degradation caused by UV radiation. Instead, UV stabilizers are usually included in waterproofing sealers to protect the wood surface. They may also contain mildewcides to protect wood from discoloration caused by the growth of mildew. Solventborne waterproofing sealers often contain drying oils such as tung or linseed oil, alkyd, or phenolic resins. Waterborne products usually contain acrylic resins. Waterborne waterproofing sealers are usually formulated with VOC contents below the 275 g/l proposed limit, while solventborne products usually have VOC contents above the proposed limit.

5.39.4. Substrates/Exposures

Lacquers are used on interior wood surfaces in kitchens, entryways, bedrooms, bathrooms, living rooms, and offices in residential and commercial areas. They are most commonly applied to wood cabinets, doors, molding, trim, paneling, fixtures, and floors. Many lacquers may also be applied to metal or other substrates where a clear coating is desired. These coatings are not covered by the Wood Coatings category. Instead, they are categorized as Nonflat or Nonflat high gloss coatings, depending on the gloss level. All solventborne and most waterborne lacquers cannot be used outdoors because they have little resistance to moisture and UV radiation. Catalyzed lacquers provide some resistance to abrasion, heat, water, solvents, and household chemicals.

Sanding sealers are generally used indoors in residential and commercial areas. Some can be applied outdoors in protected areas where there is little exposure to UV radiation and moisture. They are applied to bare or stained wood surfaces such as floors, doors, trim, paneling, and cabinets. Sanding sealers cannot be applied to surfaces previously finished with a film-forming coating like a varnish or a non-penetrating stain. Most sanding sealers are compatible with a specific finishing system. Lacquer sanding sealers are formulated for application under lacquers, while stearated or vinyl sanding sealers are often not compatible with urethane or polyurethane coatings. Sanding sealers have little resistance to the environment, as any resistances are provided by subsequent applications of varnish or lacquer.

Penetrating oils are applied indoors or outdoors in residential and commercial areas. These coatings are used on a variety of exterior wood surfaces, including decks, shakes, shingles, siding, boat docks, and fences. They are also used on a variety of interior wood surfaces including cabinets, floors, paneling, trim, doors, molding, and stairs. Penetrating oil finishes usually provide some resistance to moisture and UV radiation.

Varnishes are usually applied to wood on a variety of interior and exterior surfaces in residential and commercial areas. They are used on floors, cabinets, doors, trim, and paneling. Many varnishes, especially polyurethanes, can also be applied to various other wood surfaces where a clear, protective coating is desired. These coatings can be applied over a sanding sealer or directly to bare or stained wood surfaces. Most have excellent resistance to chemicals, abrasion, marring, heat, solvents, water, and stains. Some varnishes are not durable enough to be applied to floors. Exterior varnishes will usually have some resistance to UV radiation to protect the wood surface from degradation. Without UV absorbers, film-forming varnishes applied to exterior surfaces will tend to crack and flake off because they have little or no pigment to prevent UV rays from penetrating the wood surface. Multiple coats of exterior varnishes need to be applied to increase UV resistance and they also need to be reapplied frequently to extend the life of the coating.

Stain controllers or wood conditioners are applied to interior and exterior wood surfaces wherever penetrating stains are to be applied. They are applied to soft or porous wood substrates that have the potential for uneven stain penetration. Stain controllers do not have any resistances.

Waterproofing sealers are applied in residential areas to exterior wood decks, porches, fences, boat docks, siding, paneling, shakes, and shingles. These coatings have some resistance to UV radiation and mildew growth.

Opaque Wood Coatings usually cannot be used outdoors, because they have little resistance to moisture and UV radiation. Opaque catalyzed lacquers and varnishes provide resistance to abrasion, heat, water, solvents, stains and household chemicals. Some are not durable enough to be applied to floors.

5.39.5. Survey Results

5.39.5.1. Clear Lacquers: Table 5.39-1a summarizes our estimate of sales and VOC emissions for Clear Lacquers, including clear lacquer sanding sealers, based on the ARB survey. Clear Lacquers are a medium-sized category with regard to sales volume. In 2004, the sales volume for Clear Lacquers in California was approximately 959,000 gallons, which represents just less than 1 percent of the total California sales volume for architectural coatings.

Waterborne products represent 14 percent of the sales volume for Clear Lacquers. Solventborne products represent 86 percent of the sales volume for Clear Lacquers and generally have VOC levels greater than 550 g/l, the current SCM VOC limit. The sales volume for solventborne Lacquers (clear and opaque) has increased approximately 150 percent from 2000 to 2004. This change is also reflected in the overall sales for all Lacquers, which increased almost 190 percent. The major reasons for the significant increase in sales volumes are the introduction of new products and the submittal of data by new companies and divisions. The overall sales-weighted average VOC Regulatory value for all Lacquers decreased 20 percent from 2000 to 2004.

VOC emissions from Clear Lacquers are about three tpd, which represents approximately three percent of the total emissions from architectural coatings. Because most of the products sold are solventborne, most of the emissions are from solventborne products.

Table 5.39-1a: Survey Data
Lacquers – Clear Only

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	440	825,911	86%	100%	0%	0%	1%	576	2.83
WB	115	133,132	14%	89%	1%	10%	19%	268	0.17
Total	**555**	**959,044**		**98%**	**0%**	**1%**	**4%**	**533**	**3.00**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

5.39.5.2. Opaque Lacquers: Table 5.39-1b summarizes our estimate of sales and VOC emissions for Opaque Lacquers, based on the ARB survey. In 2004, the sales volume for Opaque Lacquers in California was approximately 333,000 gallons. Waterborne Opaque Lacquers represent 66 percent of the sales volume. Solventborne products represent 34 percent of the sales volume and generally have VOC levels less than 550 g/l, the current SCM VOC limit.

VOC emissions from Opaque Lacquers are about 0.6 tpd, which represents less than 1 percent of the total emissions from architectural coatings. Although waterborne products account for most of the sales volume, most of the emissions are from solventborne products.

Table 5.39-1b: Survey Data
Lacquers – Opaque Only

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	126	111,944	34%	100%	0%	0%	0%	531	0.51
WB	48	220,583	66%	74%	0%	26%	0%	80	0.09
Total	**174**	**332,527**		**83%**	**0%**	**17%**	**0%**	**232**	**0.60**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

5.39.5.3. Clear Brushing Lacquers: Table 5.39-1c summarizes our estimate of sales and VOC emissions for Clear Brushing Lacquers, based on the ARB survey. Clear Brushing Lacquers are a very small category with regard to sales volume.

All Clear Brushing Lacquers are interior solventborne coatings, with 24 percent sold in small containers. VOC emissions from Clear Brushing Lacquers are about 0.5 tpd, which represents approximately 0.6 percent of the total emissions from architectural coatings.

Table 5.39-1c: Survey Data
Clear Brushing Lacquers

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	4	PD	100%	100%	0%	0%	24%	666	0.53
WB	0	0	-	-	-	-	-	-	-
Total	**4**	**PD**		**100%**	**0%**	**0%**	**24%**	**666**	**0.53**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

5.39.5.4. Sanding Sealers: Table 5.39-1d summarizes our estimate of sales and VOC emissions for Sanding Sealers, based on the ARB survey. In 2004, the sales volume for Sanding Sealers in California was approximately 84,000 gallons, which represents less than 0.1 percent of the total California sales volume for architectural coatings. Only one opaque Sanding Sealer product was reported in the ARB survey.

Waterborne Sanding Sealers represent 28 percent of the sales volume. Solventborne products represent 72 percent of the sales volume and they generally have VOC levels greater than 350 g/l, the current SCM VOC limit. A large number of solventborne products are sold in small containers. The sales volume for solventborne and waterborne Sanding Sealers increased almost 200 percent from 2000 to 2004. This increase was primarily due to the introduction of new products and increased sales for existing products. In addition, ARB staff improved quality control efforts to ensure that Sanding Sealers were not included in the Primer, Sealer, and Undercoater category. The overall sales-weighted average VOC Regulatory value for Sanding Sealers decreased 11 percent from 2000 to 2004.

VOC emissions from Sanding Sealers are about 0.4 tpd, which represents approximately 0.4 percent of the total emissions from architectural coatings. Because most of the products sold are solventborne, most of the emissions are from solventborne products.

Table 5.39-1d: Survey Data
Sanding Sealers - Clear

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	39	60,457	72%	100%	0%	0%	73%	516	0.35
WB	15	23,816	28%	100%	0%	0%	2%	170	0.01
Total	**54**	**84,273**		**100%**	**0%**	**0%**	**53%**	**418**	**0.37**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

5.39.5.5. Varnishes – Clear: Table 5.39-1e summarizes our estimate of sales and VOC emissions for Clear Varnishes, based on the ARB survey. In 2004, the sales volume for Clear Varnishes in California was approximately 971,000 gallons, which represents slightly less than 1 percent of the total California sales volume for architectural coatings.

Waterborne Clear Varnishes represent 28 percent of the sales volume. Solventborne products represent 72 percent of the sales volume and generally have VOC levels greater than 350 g/l, the current SCM VOC limit. The majority of solventborne Clear Varnishes are sold in small containers. The sales volume for solventborne Clear Varnishes decreased approximately 3 percent from 2000 to 2004. This change is also reflected in the overall sales of Clear Varnishes, which decreased 11 percent. The overall sales-weighted average VOC Regulatory value for Clear Varnishes increased 6 percent from 2000 to 2004.

VOC emissions from Clear Varnishes are about four tpd, which represents approximately four percent of the total emissions from architectural coatings. Because most of the products sold are solventborne, most of the emissions are from solventborne products.

Table 5.39-1e: Survey Data
Varnishes - Clear

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	430	694,415	72%	71%	12%	17%	68%	458	3.63
WB	188	276,280	28%	89%	8%	2%	11%	243	0.29
Total	**618**	**970,695**		**76%**	**11%**	**13%**	**52%**	**397**	**3.92**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

5.39.5.6. Varnishes – Semitransparent: Table 5.39-1f summarizes our estimate of sales and VOC emissions for Semitransparent Varnishes, based on the ARB survey. In 2004, the sales volume for Semitransparent Varnishes in California was approximately 89,000 gallons, which represents less than 0.1 percent of the total California sales volume for architectural coatings. The ARB survey did not have a category for opaque varnishes, so the Semitransparent Varnishes category actually included a small number of products that were opaque products. Sales data for these products are protected, so they are not provided separately.

Waterborne Semitransparent Varnishes represent three percent of the sales volume. Solventborne products represent 97 percent of the sales volume and generally have VOC levels greater than 350 g/l, the current SCM VOC limit. The sales volume for solventborne Semitransparent Varnishes increased 48 percent from 2000 to 2004, while the overall sales volume increased 54 percent. Almost all solventborne Semitransparent Varnishes are sold in small containers. The overall sales-weighted average VOC Regulatory value remained approximately the same from 2000 to 2004.

VOC emissions from Semitransparent Varnishes are about 0.4 tpd, which represents almost 0.5 percent of the total emissions from architectural coatings. Because the majority of the products sold are solventborne, most emissions are from solventborne products.

Table 5.39-1f: Survey Data
Varnishes - Semitransparent

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day) [4]
SB	85	86,302	97%	99%	1%	0%	97%	439	0.43
WB	38	3,001	3%	11%	89%	0%	4%	260	0.00
Total	**123**	**89,303**		**96%**	**4%**	**0%**	**94%**	**433**	**0.43**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.39-2 contains the complying marketshare for Wood Coatings, based on the ARB survey. For Clear Wood Coatings, this table reflects combined data for products that were reported under the following categories: Clear Brushing Lacquers; Lacquers; Primers, Sealers, and Undercoaters (stain controllers); Sanding Sealers; Stains (clear only); Varnishes (Clear and Semitransparent); and Waterproofing Sealers. For Opaque Wood Coatings, this table reflects combined data for products that were reported under Lacquers, Sanding Sealers, and Varnishes (Semitransparent).

This table shows that about 50 percent of the sales volume for Wood Coatings complies with the proposed VOC limit. When considering the number of products reported, 25% of the reported products comply with the proposed limit. Of the 47 companies that reported in this category, 33 offered Wood Coatings that comply with the proposed limit.

Table 5.39-2 shows that implementing the proposed 275 g/l limit would achieve approximately 1.4 tpd in VOC emission reductions for the non-South Coast AQMD portion of California, on an annual average basis.

Table 5.39-2: Complying Marketshare & Emission Reductions
Wood Coatings

	Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
Clear	275	256	48%	1.21
Opaque	275	51	66%	0.20
All	275	307	50%	1.41

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.39.6. Product Testing Results

5.39.6.1. Consumer Reports: Consumers Union tested 11 waterborne and 12 solventborne varnishes meant for application to wood floors by do-it-yourself homeowners (Consumer Reports, 2002). All products contained polyurethane, a common resin designed to resist surface wear. Both types of varnish were subjected to various liquids known to cause damage to floor finishes, including vodka, wine, coffee, cola, and common surface cleaners, such as liquid detergent, ammonia, and white vinegar. The waterborne Flecto (Rustoleum) Varathane Waterborne Gloss was the only finish able to resist all types of liquids, as well as provide excellent UV resistance. It had a smooth finish, free of brush marks, bubbles, and other flaws, and scored a good rating in the abrasion resistance test. Rustoleum currently markets two waterborne Varathane floor finishes, Diamond Floor Finish (270 g/l) and Diamond Polyurethane (275 g/l), both of which meet the proposed VOC limit. In the Consumers Union testing, all waterborne products were able to withstand intense exposure to ultraviolet light without changing color, while solventborne products left an amber finish that darkened with time. Solventborne varnishes were better able to resist wear and scratches, and less dirt became embedded in the finish. Waterborne varnishes all had faster dry times and were easier to clean up. Zinsser's Pro Finisher Waterborne Polyurethane Satin (214 g/l) also rated well.

5.39.6.2. AVES Report: South Coast AQMD awarded AVES, an affiliate of ATC Associates Inc., a contract to develop architectural coatings with a VOC content at or near zero g/l for a variety of coating categories, including waterproofing sealers, lacquers, varnishes, and sanding sealers (AVES, 2001). These coatings were then tested next to three commercially available coatings from each category. Three new low-VOC coating systems were also tested and each system was comprised of a semitransparent stain, a sanding sealer, and either two coats of varnish, two coats of lacquer, or three coats of lacquer. All of the coatings were tested for performance, repair, and refinishing. In general, the new coatings with VOC contents at or near zero g/l performed as well as the commercially available coatings.

Lacquer: The new zero-VOC lacquer was composed of a water reducible, air-dry polyurethane and acrylic copolymer. It was found to be equivalent to the commercial lacquers (which included a nitrocellulose lacquer) in wet film thickness, gloss, grain raising, orange peel, adhesion, color, and sprayability, and equivalent or better in terms of depth and hot/cold check. The new lacquer was superior in the color change test, but inferior in the freeze/thaw test.
Dry times were similar to the commercial waterborne lacquers, but slower than the nitrocellulose lacquer. The zero-VOC lacquer was also equivalent to the commercial waterborne lacquers in print resistance (tendency of a film to take on the imprint of an object that is placed on it), flow, and sag, but the nitrocellulose lacquer did the best in print resistance and sag.

Varnish: The varnish was composed of a two-part, chemically-cured, water-reducible, air-dry epoxy coating. It was found to be equivalent to the commercial varnishes in wet film thickness, orange peel, print resistance, color, hot/cold check, and sprayability. While it was superior in grain raising, color change, and sag, it was inferior in flow and freeze/thaw tests. The zero-VOC varnish had similar dry times to the waterborne varnish, but took longer to dry than the solventborne commercial varnish. The solventborne varnish also had a higher gloss and superior depth than the other varnishes.

Sanding Sealer: The sanding sealer was composed of a water reducible, air-dry acrylic copolymer. It was found to be equivalent to the commercial sanding sealers in flow and sprayability. A minimal amount of grain raising occurred, which was equivalent to or worse than the commercial products. It also performed as well as the commercial sanding sealers in the freeze/thaw test. The zero-VOC sanding sealer tested better for color change.

Comparative Repair/Refinishing: Three popular commercially available coating systems were tested side-by-side with zero-VOC lacquer and varnish topcoat systems to compare repair and refinishing. All coating systems were composed of a semitransparent stain, sanding sealer, and topcoat. The same technique was used to repair a single scratch in all coating systems tested. The scratch area was lightly sanded to improve adhesion. Then a topcoat was brushed on and allowed to dry, followed by a second coat that was sprayed on. The new zero-VOC varnish system showed the best overall appearance after repair, while the zero-VOC lacquer system was the easiest to repair and had the best gloss after repair.

5.39.6.3. UMR Results: In 2005, the UMR Coatings Institute at the University of Missouri - Rolla conducted a coatings testing project for the South Coast AQMD (UMR, 2006). The project included tests on products classified as Clear Wood Finishes. UMR tested some general coating properties, including: percent nonvolatile; stability; viscosity; freeze/thaw resistance; dry time; and gloss. They also tested performance properties, including: friction coefficient; stain resistance; mar resistance; taber abrasion; accelerated weathering (QUV); flow and leveling; and sag. All testing was done in accordance with ASTM standards, unless otherwise noted or agreed upon by the South Coast AQMD. All paints were supplied to the UMR Coatings Institute by South Coast AQMD.

For Clear Wood Finishes, they tested six film-forming products, four waterborne low-VOC products (VOC $\leq$275 g/l) and two solventborne high-VOC products (VOC >275 g/l and $\leq$450 g/l). On average, all of the low-VOC coatings performed comparably on most tests to the high-VOC coatings. The low-VOC coatings performed somewhat poorer compared to the high-VOC coatings in gloss retention on aluminum after being exposed to UV light and condensation cycles. However, on wood, they performed comparably to the high-VOC coatings.

5.39.7. Manufacturer Information

Several complying products are included on Master Painter's Institute (MPI) Approved Products lists because they have been certified to meet designated performance standards. MPI approved several Wood Coatings that comply with the proposed 275 g/l limit and meet one of the following standards: MPI #6 (Primer, Latex for Exterior Wood [Stain Controller]); MPI #39 (Primer, Latex for Interior Wood [Stain Controller]); MPI #128 (Varnish, Water Based, Clear, Satin); MPI #129 (Varnish, Water Based, Clear, Semi-Gloss); MPI #130 (Varnish, Water Based, Clear, Gloss); and MPI #181 (Varnish, Water Based, Clear, Eggshell-Like, MPI Gloss Level 3). Manufacturers of compliant, MPI-approved products include Cloverdale Paint, ICI Paints, Frazee Paint, Insl-X, PPG, Pratt & Lambert, and Rodda Paint. Additional information on manufacturers and products is provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm).

5.39.8. Comments

5.39.8.1. Labeling. Some coating manufacturers did not agree that Wood Coatings must be labeled "For Wood Substrates Only" because their coatings are applied to other substrates besides wood. Under the SCM, coatings that are applied to non-wood surfaces would be covered by other categories (e.g., Nonflat). ARB staff does not believe that coatings applied to non-wood surfaces require the same 275 g/l VOC limit as coatings applied to wood. Therefore, staff proposed that the Wood Coatings category be limited to wood substrates, to prevent the category from becoming a loophole for Nonflats and other categories. One company agreed with ARB that it was not necessary to include non-wood substrates. ARB staff is not proposing that the Wood Coatings category include products applied to non-wood substrates (e.g., metals, plastics, and other synthetic materials).

5.39.8.2. Definition of Wood Substrate. One coating manufacturer wanted composite wood decking to be included as a wood substrate because it is composed of wood and synthetic material. Composite wood is usually better protected from damage due to moisture, UV rays, and insects, but can degrade over time due to natural wood fibers it contains. Clear coatings or stains can be used on wood composite material to better protect composite wood from degradation. ARB staff is proposing that the definition of wood include substrates that contain exposed wood.

Some coating manufacturers wanted the definition of wood to include wood-like substrates (e.g., particle board, Formica, chip board, composite wood decking, etc.) ARB staff found that the majority of manufacturers list wood as the primary substrate. A very small number of manufacturers list wood-like substrates. These include particle board, wood composite, hardboard, and cork. ARB staff developed a definition for wood products that includes various wood-like substrates.

5.39.8.3. Specialized Varnishes. ARB staff met with industry to discuss their concerns regarding the future VOC limit for some specialized varnishes. Some manufacturers make conversion varnishes and tung oil based varnishes that have difficulty meeting the proposed 275 g/l limit. These products are generally used by professionals and they are sold in relatively small volumes. In California, these products have been sold in small containers because they exceed the current 350 g/l SCM VOC limit that has been in effect for 10-15 years. In the OTC states, there is a Conversion Varnishes category with a 725 g/l VOC limit and the manufacturers are concerned that OTC states will adopt ARB's proposed 275 g/l limit. The manufacturers claimed that their coatings are specialty products that cannot be reformulated to meet the proposed 275 g/l limit and they requested that the SCM include a new specialty category that gives them a VOC limit higher than the current 350 g/l limit. ARB staff agrees that these formulations have unique characteristics that cannot be duplicated at lower VOC contents with current technology. However, the proposed SCM still contains the small container exemption that would continue to allow these products to be sold in California. In addition, ARB staff does not believe that it is necessary to develop a new high-VOC specialty category, because it would be a relaxation of an existing VOC limit that has been in effect in California for some time. Regarding their concerns about the OTC states, ARB staff believes that the proposed limit is feasible for California, but the manufacturers will need to work with the OTC states to resolve their issues for products sold outside of California.

5.39.8.4. Lacquer Blushing. Industry representatives requested that the SCM retain a "lacquer blushing" provision. Lacquers that contain acetone can experience "blushing", which is a defect that makes the film look milky or white. Blushing can be caused by rapid evaporation of solvent or by the presence of excessive moisture that can become trapped in the lacquer film. Blushing can also be caused by solvent or resin incompatibility. Under certain atmospheric conditions, acetone can evaporate more quickly than other solvents in a lacquer and this can result in blushing. This defect can be prevented by slowing down the drying process with a retarder solvent that dries more slowly than acetone.

The 2000 SCM contained a special provision that allowed for the use of retarder solvents in Lacquers that contained acetone. Under this provision, a person could add solvent to an acetone-based Lacquer, during days with relative humidity greater than 70 percent and temperatures below 65 degrees F, as long as the VOC content did not exceed 550 g/l prior to the addition of the solvent.

In the proposed SCM, products that were formerly classified as Lacquers would be included in the new Wood Coatings category and the proposed VOC limit would decrease from 550 g/l to 275 g/l. ARB staff reviewed survey data to determine what types of lacquer formulations would comply with the proposed 275 g/l limit. Products that contained acetone accounted for only 0.4 percent of the complying sales volume (excluding small containers). Since the vast majority of compliant products do not contain acetone, the lacquer blushing provision no longer seems necessary and it has been proposed for elimination.

ARB staff also reviewed product data sheets for lacquers that comply with the proposed 275 g/l limit. Generally, manufacturers do not recommend any thinning and they state that their products can be applied when the humidity is below 85 percent and the temperature is above 50 degrees F or 5 degrees F above the dew point. This would indicate that these products are suitable for application under relatively cool and humid conditions, without the need for additional solvent. Therefore, it does not appear that the lacquer blushing provision is needed.

5.39.9. Conclusion

We recommend a 275 g/l VOC limit for Wood Coatings, effective January 1, 2010. The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on the complying marketshare, the number of companies making complying products, product information from manufacturers, and test results. The proposed VOC limit is lower than the limits adopted by the U.S. EPA and the OTC states, and the proposed limits for Canada. The U.S. EPA divides wood coatings into several categories, including Lacquers at 680 g/l, Sanding Sealers at 550 g/l, Varnishes at 450 g/l, Conversion Varnishes at 725 g/l, and Stain Controllers at 720 g/l (U.S. EPA, 1998). The proposed limit is consistent with the limit adopted by the South Coast AQMD.
It is important to note that the vast majority of products reported in the survey with VOC limits below 275 g/l are waterborne. Few solventborne products meet the proposed VOC limit so they would either have to be reformulated, replaced by waterborne products, or use the small container exemption.

5.40. WOOD PRESERVATIVES

VOC Limit Table (g/l)

USEPA: 550 (clear/semitransparent); 350 (opaque)	Canada: N/A	OTC: 350	SCAQMD: 350	SCM Proposed: 350

5.40.1. Category Definition

A coating labeled 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.

5.40.2. Major Proposed Changes

- None.

5.40.3. Coating Description

Wood Preservatives perform a variety of functions, including: protecting wood against discoloration and decay caused by mildew and other fungi; protecting wood against damage caused by wood-destroying insects; reducing discoloration caused by extractive bleeding in certain highly colored wood species; and minimizing iron stains from the reaction of iron with tannins in the wood. Wood Preservatives are often used as a pretreatment for wood before staining or painting, which improves paint adhesion and helps prevent peeling and flaking of the coating. Wood Preservatives are also used as a supplemental treatment for wood that has been pressure treated with commercial preservatives (Feist, 1996).

Wood Preservatives are single component coatings that are brushed, sprayed, wiped, or rolled on to bare wood. The wood is often dipped into the coating to maximize penetration. Wood Preservatives leave a matte finish that can darken the color of the wood, but does not mask wood grain or texture. Certain products will turn the wood green or brown, but these are usually applied to below-ground wood. Wood Preservatives can be applied by homeowners, but those that contain highly toxic pesticides are applied by professional contractors. Often, after wood is pressure treated in a factory, construction crews apply Wood Preservatives to fresh-cut ends at the construction site (Groenier, 2006).

Wood can also be pressure treated with Wood Preservatives in factories during the manufacturing process. Factory coating applications are not subject to architectural coating rules. The products that are used during the factory process, such as alkaline copper quaternary (ACQ) and copper boron azole (CBA), are used under controlled conditions by trained professionals. Other Wood Preservatives are only for industrial use and cannot be used on wood in residential areas because of their toxicity (Groenier, 2006).

Most Wood Preservatives are solventborne because they penetrate the wood substrate much more easily than waterborne products. Solventborne products contain alkyd resins and/or drying oils, and a solvent such as mineral spirits. Waterborne products usually contain acrylic or alkyd resins. Wood Preservatives contain one of many fungicides or mildewcides such as zinc or copper naphthenate, borates, 3-iodo-2-propynyl butyl carbamate, or copper-8-quinolinolate (Ibach, 1999). Wood Preservatives commonly contain water repellents, usually paraffin wax or wax-like chemicals, to prevent wood from absorbing water, which causes the wood to crack, warp, and split. They can also contain UV stabilizers to prevent damage from the sun (Feist, 1996).

5.40.4. Substrates/Exposures

Wood Preservatives are used outdoors in residential and commercial areas, in places where wood is exposed to moisture or insects. They are applied to above- or below-ground wood siding, shakes, shingles, decks, doors, trim, and fences. Some products may not be applied to wood below-ground, as they do not adequately protect wood from decay or insects.

5.40.5. Survey Results

Table 5.40-1 summarizes our estimate of sales and VOC emissions for Wood Preservatives, based on the ARB survey. In 2004, the sales volume for Wood Preservatives in California was approximately 174,000 gallons, which represents less than 0.2 percent of the total California sales volume for architectural coatings.

Waterborne Wood Preservatives represent only 6 percent of the sales volume. Solventborne products represent 94 percent of the sales volume and generally have VOC levels under 350 g/l, the current SCM VOC limit. The overall sales volume for Wood Preservatives decreased approximately 2 percent from 2000 to 2004. The overall sales-weighted average VOC Regulatory value decreased 6 percent from 2000 to 2004.

VOC emissions from Wood Preservatives are about 0.6 tpd, which represents approximately 0.7 percent of the total emissions from architectural coatings. Because most of the sales volume is solventborne, most of the emissions are from solventborne products.

Table 5.40-1: Survey Data
Wood Preservatives

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	19	164,236	94%	0%	100%	0%	8%	327	0.61
WB	11	9,610	6%	0%	100%	0%	14%	292	0.00
Total	**30**	**173,846**		**0%**	**100%**	**0%**	**9%**	**325**	**0.62**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.40-2 contains the complying marketshare for Wood Preservatives, based on the ARB survey. This table shows that 98 percent of the sales volume complies with the current VOC limit. When considering the number of products reported, 90 percent of the products comply with the current limit. Of the 11 companies that reported in this category, 7 offered Wood Preservatives that comply with the current limit.

Table 5.40-2: Complying Marketshare & Emission Reductions
Wood Preservatives

Existing VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
350	26	98%	0.00

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

5.40.6. Manufacturer Information

The Master Painter's Institute (MPI) Approved Products list for wood preservatives contains four products, two of which comply with the existing VOC limit. MPI standard #37 (Preservative, for Exterior Wood) contains compliant products manufactured by Columbia Paint and Spectra-Tone. Additional information on manufacturers and products is provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm).

5.40.7. Conclusion

We recommend maintaining a 350 g/l VOC limit for Wood Preservatives, based on the complying marketshare, the number of companies making complying products, and product information from manufacturers. The current VOC limit is lower than the national limit adopted by the U.S. EPA for this category.
The U.S. EPA divides wood preservatives into three categories. Below ground and clear/semitransparent wood preservatives have a VOC limit of 550 g/l, while opaque wood preservatives have a VOC limit of 350 g/l (U.S. EPA, 1998). The current limit is consistent with the limit adopted by the South Coast AQMD and the OTC states. Canada is proposing that Wood Preservatives be under the jurisdiction of their Pest Management Regulatory Agency, rather than being regulated as architectural coatings.

5.41. ZINC-RICH PRIMERS

VOC Limit Table (g/l)

USEPA: 500 (Metallic Pigmented)	Canada: 500 (Metallic Pigmented)	OTC: 500 (Metallic Pigmented)	SCAQMD: 100	SCM Proposed: 340

5.41.1. Category Definition

A coating that meets all of the following specifications:

- Coating contains at least 65 percent metallic zinc powder or zinc dust by weight of total solids; and

- Coating is formulated for application to metal substrates to provide a firm bond between the substrate and subsequent applications of coatings; and
- Coating is intended for professional use only and is labeled as such.

5.41.2. Major Proposed Changes

- Zinc-Rich Primer is a new category for coatings that were formerly covered by Metallic Pigmented.
- The proposed VOC Limit would decrease from 500 g/l to 340 g/l.

5.41.3. Coating Description

Zinc-Rich Primers were formerly part of the Metallic Pigmented category. Zinc-Rich Primers are used to protect steel surfaces from corrosion. Regular coatings resist corrosion by forming a barrier between the metal and the atmosphere, but Zinc-Rich Primers provide corrosion protection via electrochemical reactions. They are sacrificial coatings that provide corrosion control similar to how a galvanic cell creates electricity, through electron migration (or redox reactions) between metals. In the presence of water, all oxidation is confined to the zinc which serves as the anode, while the steel substrate behaves entirely as a cathode and remains unaffected (Hare, 1998a).

Little corrosion risk exists, as long as the zinc coating remains bonded to the steel and the cathodic protection is correctly applied, monitored, and maintained. For pipeline coatings, it appears that corrosion is usually the consequence of coatings disbonding from the substrate due to impact. Disbonding may also occur when rocks or stones constitute a barrier to the cathodic protection (Roche, 2006).

Organic and Inorganic Zinc-Rich Primers can be either single component or multi-component. Single component coatings made up only about a fifth of the products reported in the ARB survey. In general, organic zinc-rich coatings are usually solventborne, single component, and are based on organic resins, such as epoxies, urethanes, vinyls, chlorinated rubber, and alkyds. Inorganic zinc-rich coatings can be waterborne or solventborne, are generally multi-component, and are based on inorganic silicate binders such as alkyl silicates or alkali silicates (Tator, 2006).

Inorganic Zinc-Rich Primers come in two parts: a small quantity of a clear silicate resin and a large volume of zinc powder. The mixed coating must be spray applied. Ideally, the coating is properly mixed and each zinc dust particle is coated with the resin, but this can be difficult considering the concentration of zinc per volume of resin. Therefore, suitable mixing equipment is required and the painters must be properly trained (Tator, 2006). Inorganic Zinc-Rich Primers do not necessarily have to be topcoated and can provide steel protection equal to that of organic Zinc-Rich Primers that are topcoated. However, they are less tolerant of poor surface preparation. Since most inorganic coatings are alkali or alkyl silicates, they react with carbon dioxide in the presence of water and produce carbonic acid that reduces the alkalinity of the coating. This reaction and the formation of acidic (and sometimes alkaline) compounds on the coating can destroy the integrity of the primer and induce premature failure (Hare, 1998b; Hare 1998c). According to Caltrans, low-VOC inorganic Zinc-Rich Primers can prematurely fail, due to improper curing and acidic conditions (Caltrans, 2007a).

Organic Zinc-Rich Primers contain a variety of resins, such as epoxy/polyamide, urethane, vinyl, or chlorinated rubber. Generally, they can be applied by brush, roller or spray. If not topcoated, they will not protect the steel as well as an inorganic primer, but will offer the same degree of protection if they are topcoated. Organic Zinc-Rich Primers are forgiving of poor surface preparation and are commonly topcoated with polyurethane and epoxies (Tator, 2006). Caltrans generally uses organic Zinc-Rich Primers for touch-ups and galvanizing repair over inorganic and organic zinc coatings (Caltrans, 2007b; Caltrans, 2007c). According to Caltrans, effective organic Zinc-Rich Primers are not available below 100 g/l (Caltrans, 2007a).

Waterborne Inorganic Zinc-Rich Primers may experience stability problems during storage because zinc dust can react with water to make hydrogen, similar to the reactions that can occur in waterborne aluminum roof coatings. All of the waterborne Zinc-Rich Primers reported in the ARB Survey are multi-component products that are mixed at the job site, rather than being pre-mixed and stored. While waterborne products are of particular concern, stability problems can occur in organic or inorganic products with single component or multi-component formulations. These problems can be caused by the intrusion of water or other contaminants that contribute to oxidation within the zinc pail and induce adverse gas formation (Hare, 1998b; Caltrans, 2007b; Caltrans, 2007c).

Proper dispersion of the zinc pigment is a key issue for both single component and multi-component products. Single component Zinc-Rich Primers can experience settling or sedimentation problems during storage and shipping. Multi-component products can result in coarse finishes or clogged spray tips if the zinc dust is not properly screened and mixed prior to application (Hare, 1998b).

5.41.4. Substrates/Exposures

Zinc-Rich Primers are used both indoors and outdoors on iron or steel at industrial facilities, bridges, or other locations where resistance to corrosion is needed. These coatings are applied to bare metal and abrasive blasting is usually recommended to prepare the substrate prior to application.

Zinc-Rich Primers are generally applied to substrates that are subject to long-term atmospheric exposure. They can also be exposed to immersion in water, wastewater, or chemical solutions. However, they are not recommended for wet environments that are outside the pH range of 5 to 10, because the zinc dust can be highly reactive. Acids and alkalis may react with the zinc dust, which can result in pinholes, voids, and scratches (Tator, 2006). For immersion applications, it is typically suggested that the primer be topcoated with a product that is compatible with the immersion liquid.

Application must be done when surface temperature is at least 5 degrees F above the dew point and the humidity is at an acceptable level. Some Zinc-Rich Primers require at least 40% relative humidity or higher for curing and settling, especially with self-curing primers. Prior to topcoating for either immersion applications or enhanced protection, it is typical to mist the Zinc-Rich Primer with water to increase the humidity and ensure a better cure.

KTA-Tator conducted a review of the life cycle costs for zinc-rich coating systems used in moderate industrial environments (Helsel, 2007). They compared single-coat inorganic Zinc-Rich Primers with ten other systems, including: 2-coat systems (Zinc-Rich Primer and topcoat); 3-coat systems (Zinc-Rich Primer, intermediate coat, and topcoat); hot dip galvanizing; galvanizing with topcoat; and metallizing/thermal spray coating systems. When compared to the other systems, they found that the single-coat inorganic Zinc-Rich Primer and the 2-coat system were considered cost effective for both shop-applied and field-applied applications, if regular maintenance painting is conducted. However, other factors could influence the use of the single-coat Zinc-Rich Primer on prominent structures (such as bridges) without a topcoat. This could include aesthetics such as color and salting from the corrosion of the coating or climatic factors that make it unsuitable to use the Zinc-Rich Primer without a top-coat (Helsel, 2007). Typically, repair maintenance over old zinc primers is done with organic primers because they are more forgiving and have better adhesion on ill-prepared surfaces (Hare, 1998c). Therefore, both organic and inorganic Zinc-Rich Primers can be integral components that contribute to effective long-term corrosion protection on steel and other metal substrates.

5.41.5. Survey Results

Table 5.41-1 summarizes our estimate of sales and VOC emissions for Zinc-Rich Primers, based on the ARB survey. For the purposes of the survey, Zinc-Rich Primers were included in the Metallic Pigmented category and they were not considered to be a separate category. Therefore, the survey data provided below is a subset of the data reported for Metallic Pigmented. In 2004, the sales volume for Zinc-Rich Primers in California was almost 23,000 gallons, which represents less than 0.1 percent of the total California sales volume for architectural coatings. This sales volume includes the volume of the zinc dust that is sold as one of the components in multi-component products.

VOC emissions from Zinc-Rich Primers are about 0.1 tpd, which represents less than 0.1 percent of the total emissions from architectural coatings. Almost 100 percent of the emissions from this category are attributed to solventborne products but they only account for 78 percent of the sales volume.

Table 5.41-1: Survey Data
Zinc-Rich Primers

	Number of Products	Sales in CA (gals/year) [1]	% SB/ WB	% Int	% Ext	% Dual	% in Small Containers[2]	SWA VOC (g/l)[3]	VOC Emissions (tons/day)[4]
SB	62	17,508	78%	0%	15%	85%	5%	368	0.07
WB	6	5,048	22%	0%	1%	99%	0%	10	0.00
Total	**68**	**22,556**		**0%**	**12%**	**88%**	**4%**	**288**	**0.07**

(ARB, 2006)
1. Statewide sales volume in California in 2004, including SCAQMD (gallons per year).
2. Percentage of sales volume in small containers, one quart or less.
3. Sales-Weighted Average VOC Regulatory (grams VOC per liter of coating, less water and exempt compounds).
4. Statewide VOC Emissions, including SCAQMD (tpd). Does not include emissions from thinning solvents, cleanup solvents, or additives.

Table 5.41-2 contains the complying marketshare for Zinc-Rich Primers, based on the ARB survey. Approximately 54 percent of the sales volume complies with the proposed 340 g/l VOC limit and the estimated emission reductions are about 0.01 tpd.

Table 5.41-2: Complying Marketshare & Emission Reductions
Zinc-Rich Primer

Proposed VOC Limit (g/l)	Number of Complying Products	Complying Marketshare (%) by Volume [1]	Emission Reductions (excluding South Coast AQMD) (tons/day) [2]
340	30	54%	0.01

1. Complying Marketshare: Percentage of sales volume that complies with the VOC limit. The Complying Marketshare does not include small containers that are exempt from VOC limits.
2. Emission Reductions: Estimated reductions in VOC emissions that will result from implementation of the SCM VOC limit. Emission Reduction calculations do not include small containers that are exempt from VOC limits.

Of the 11 companies that reported in this category, 7 companies offered Zinc-Rich Primers that comply with the proposed limit. Of these seven companies, three are considered to be small businesses because they have fewer than 250 employees.

5.41.6. Manufacturers Information

The Master Painters Institute (MPI) has developed approved product lists for the following standards: MPI #18 (Primer, Zinc Rich, Organic); MPI #19 (Primer, Zinc Rich, Inorganic); and MPI #20 (Primer, Zinc Rich, Epoxy). They've also established MPI #200 (Primer, Zinc Rich, Moisture Cured), but have not yet published a list of approved products. A list of compliant Zinc-Rich Primers, including those reported in the survey and MPI-approved products is provided on ARB's website (http://www.arb.ca.gov/coatings/arch/docs.htm). One of the products reported in the survey qualifies for the MPI Green Performance Standards, which indicates a more environmentally-friendly coating.

5.41.7. Manufacturer and Industry Issues

Some manufacturers and industry representatives have expressed concerns about the proposed Zinc-Rich Primer category. Below are some of the key issues that have been brought to our attention.

Issue: The NPCA does not believe that the Zinc-Rich Primer category should have a VOC limit lower than 340 g/l.

Response: ARB staff agrees. The South Coast AQMD has adopted a 100 g/l VOC limit for Zinc-Rich Primers, but ARB staff does not believe that this limit is necessarily appropriate throughout the remainder of California due to differing climatic conditions. Caltrans has stated that a VOC limit of 340 g/l is appropriate, based on their experiences with these types of coatings. They believe that some, if not most, manufacturers can comply with a 340 g/l limit and produce quality products (Caltrans, 2007a). ARB staff reviewed the Caltrans pre-qualified product list for both inorganic and organic Zinc-Rich Primers, and determined that the proposed 340 g/l limit will not have an adverse impact on the listed coatings (Caltrans, 2007a; Caltrans, 2007b; Caltrans, 2007c). At 340 g/l, both inorganic and organic Zinc-Rich Primers are effective, technologically feasible, and have a high complying marketshare. According to Caltrans, the use of 100 g/l Zinc-Rich Primers is possible and may be applicable in Southern California, but it is not necessarily effective elsewhere. Recently, Caltrans witnessed the failure of multi-million dollar coating projects, due to the improper curing of 100 g/l waterborne, inorganic Zinc-Rich Primers (Caltrans, 2007a).

5.41.8. Conclusion

We recommend a 340 g/l VOC limit for Zinc-Rich Primers, effective January 1, 2010. The proposed VOC limit is technologically and commercially feasible by January 1, 2010, based on the complying marketshare, the number of companies making compliant products, and product information from manufacturers. The proposed limit is lower than the limit adopted by the U.S. EPA and the OTC states, and the proposed limit for Canada. For these agencies Zinc-Rich Primers are covered by the Metallic Pigmented category with a 500 g/l VOC limit.

The proposed VOC limit is higher than the 100 g/l South Coast AQMD limit. However, manufacturers that provide coatings in the South Coast AQMD can still sell products which exceed the 100 g/l limit, if they participate in the averaging program. The proposed SCM does not contain an averaging provision, so all manufacturers will be subject to the same limit. In addition, the SCM needs to be technologically feasible throughout California. Since Zinc-Rich Primers are often applied to critical infrastructure, it is vital that they meet the performance specifications established by public agencies. Based on our discussions with Caltrans and others, ARB staff believes that additional research is needed to verify the performance of 100 g/l Zinc-Rich Primers in a way that protects the infrastructure throughout California. The South Coast AQMD area has a mild climate, so climatic conditions are less of a concern. However, in other areas of California, the infrastructure is exposed to more extreme climates (e.g., mountainous areas with freezing temperatures; coastal areas with persistent cold temperatures, salt spray, high humidity, etc.).

ARB staff believes that additional research is needed to develop 100g/l products that perform well throughout California. Research is also needed to address potential safety issues associated with the production of hydrogen gas, caused by chemical reactions with zinc dust and water. Therefore, ARB staff believes that the proposed 340 g/l VOC limit is most appropriate at this time.

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CHAPTER 6. ENVIRONMENTAL IMPACTS

6.A. BACKGROUND

Both the California Environmental Quality Act (CEQA) and ARB policy require ARB to evaluate the potential adverse environmental impacts of proposed projects. For the 2000 SCM, staff prepared a formal environmental impact report (EIR), which is incorporated by reference herein (ARB, 2000). The EIR included an analysis of environmental impacts that could potentially result from the implementation of the 2000 SCM throughout California (excluding the South Coast AQMD). Staff investigated 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 2000 SCM would have no significant adverse impacts, but would have a net air quality benefit.

The intent of the proposed SCM is to reduce the public's exposure to ozone and particulate matter (PM) by reducing emissions of volatile organic compounds (VOC), which are precursors to both ozone and PM. An additional consideration is the impact the proposed SCM may have on the environment. Based on available information, the ARB has determined that no significant adverse environmental impacts should occur as a result of districts adopting the proposed SCM. This chapter summarizes the potential impacts that the proposed SCM may have on air quality, wastewater treatment, hazardous waste disposal, and hazards to human health. For a more detailed discussion on these topics, please refer to the EIR for the 2000 SCM (ARB, 2000). Staff believes that districts can use the information in this chapter and the EIR from the 2000 SCM to support their environmental impact analyses when they adopt local rules based on the proposed SCM.

6.B. ANALYSIS OF REASONABLY FORESEEABLE ENVIRONMENTAL IMPACTS OF THE METHODS OF COMPLIANCE

6.B.1. Air Quality Impacts

No State or federal ambient air quality standards have been set for VOCs because they are not classified as criteria pollutants. However, VOCs are regulated because they contribute to the formation of ozone, PM_{10} and $PM_{2.5}$, which are criteria pollutants. VOCs are also transformed into organic aerosols in the atmosphere, contributing to lower visibility levels. Although health-based standards have not been established for VOCs, health effects can occur from exposures to high concentrations of VOCs due to interference with oxygen uptake. In general, ambient VOC concentrations in the atmosphere are suspected to cause coughing, sneezing, headaches, weakness, laryngitis and bronchitis, even at low concentrations.

The California Clean Air Act requires air districts that have been designated nonattainment for the State ambient air quality standard for ozone to prepare and submit plans for attaining and maintaining the standard. In addition, the federal Clean Air Act requires air districts designated nonattainment for the federal ambient air quality standards to prepare air quality management plans to demonstrate attainment with the federal standards. In some air districts, substantial additional emission reductions will be necessary if attainment is to be achieved.

Numerous VOCs have also been identified as toxic air contaminants and are regulated through the ARB's Toxic Air Contaminant Control Program. Benzene, for example, one hydrocarbon component of VOC emissions, is known to be a human carcinogen and has been identified as a toxic air contaminant.

The adoption and implementation of this SCM is expected to produce substantial long-term VOC emission reductions, and staff has concluded that adverse air quality impacts associated with this SCM will be insignificant. Adverse air quality impacts are considered to be significant if the proposed SCM would: conflict with or obstruct implementation of the applicable air quality plan; violate any air quality standard or contribute to an existing or projected air quality violation; expose sensitive receptors to substantial pollutant concentrations; expose off-site receptors to significant concentrations of hazardous air pollutants; result in a cumulatively considerable net increase of any criteria pollutant for which the project region is nonattainment; diminish an existing air quality rule or future compliance requirement resulting in a significant increase in air pollutants; or create objectionable odors affecting a substantial number of people. No significant adverse air quality impacts are anticipated; therefore, no mitigation measures are necessary.

Based on the analysis of potential direct and indirect air quality effects of implementing this SCM, it is concluded that once the lower-VOC content limits are implemented the overall air quality effects of the SCM will be a VOC emission reduction of approximately 15 tpd by the year 2012.

Historically, some members of industry identified seven areas of potential concern that they believe could result in increased indirect VOC emissions due to a requirement to lower the VOC content of architectural coatings. These are:

The use of lower-VOC coatings will result in a thicker film coating

Some industry representatives have asserted that low-VOC coatings are formulated with high-solids contents and are difficult to handle during application, resulting in a thick film when applied. A thicker film indicates that a smaller surface area is covered with a given amount of material, thereby increasing VOC emissions per unit area covered, as compared to higher-VOC coatings. Review of manufacturers' product data sheets shows currently available low-VOC coatings are not necessarily formulated with higher solids contents, and low-VOC coatings do not result in a significant reduction in coverage area. Although high-solids, low-VOC coatings are being used, the recommended film thickness for these coatings is similar to that for higher-VOC coatings. Thus, a lower-VOC coating would cover the same surface area as a higher-VOC coating, resulting in fewer VOC emissions.

The use of lower-VOC coatings will result in excessive thinning of the coating

Excessive thinning is not expected to be a problem because many coatings currently in use comply with the SCM limits. Additionally, the VOC limit for architectural coatings is expected to be met primarily with the use of waterborne formulations. Even if some thinning occurs, thinning would likely be done with water. As a result, concerns about significant adverse air quality impacts are unfounded.

The use of lower-VOC coatings requires the use of additional primer for proper adhesion to the substrate

Manufacturers' product data sheets show that substrate preparation is similar for lower-VOC coatings and for higher-VOC coatings, therefore the time and materials necessary to prepare a surface for coating is approximately equivalent for high- and low-VOC coatings. More priming is not needed because lower-VOC coatings possess comparable coverage to higher-VOC coatings, and have similar adhesion qualities and resistance to stains, chemicals and corrosion.

Lower-VOC coatings will require the use of more coats

The claim has been made by some industry representatives that the proposed lower-VOC limits would yield products that result in inferior coverage, resulting in the use of more low-VOC coatings to provide the same coverage as their higher-VOC counterparts. Product data sheets provided by manufacturers listing coverage rates do not indicate that lower-VOC architectural coatings provide less coverage than higher-VOC architectural coatings. Both lower-VOC and higher-VOC coatings have comparable coverage and performance. With comparable coverage and equivalent durability qualities, more coats of low-VOC coatings should not be required.

The use of lower-VOC coatings will require more frequent recoating, touch-up, and repair work

Based on the durability characteristics information contained in manufacturers' product data sheets, lower-VOC coatings and higher-VOC coatings have comparable durability characteristics. Low-VOC architectural coatings have been used successfully for many years and are considered to be as durable and long lasting as higher-VOC coatings. Therefore, it is not anticipated that lower-

VOC coatings will require more frequent recoating. Because qualities of the low-VOC coatings are comparable to the higher-VOC coatings, it is not anticipated that more touch-up and repair work will be needed.

The use of lower-VOC coatings will result in product substitution by end-users

There are currently available low-VOC architectural coatings with performance characteristics comparable to higher-VOC architectural coatings. Therefore, it is not anticipated that end-users will substitute products from a higher-VOC category. The SCM prohibits the application of certain coatings in specific settings, and the type of performance desired in some settings would prohibit the use of certain coatings in those settings. Products within a given architectural coating category may differ from those of another category to a significant degree, making substitution difficult and therefore less likely. The SCM also requires that when a coating can be used in more than one coating category, the lower limit of the two categories is applicable.

The use of lower-VOC coatings may result in coatings with higher reactivity

When using the Maximum Incremental Reactivity (MIR) scale as the basis for comparing reactivities of VOCs, it is true that on a per gram basis, some VOCs used in waterborne coatings are more reactive than some VOCs used in solventborne coatings. For example, using the MIR scale as a basis, a typical VOC used in waterborne coatings, such as propylene glycol, is two to three times more reactive than a typical solventborne coating component such as mineral spirits. Toluene and xylenes, also commonly used in solventborne coatings, are approximately three times as reactive, on a gram for gram basis, as propylene glycol. So while some of the components of waterborne coatings are of a higher reactivity than some components of solventborne coatings, the reverse is also true. In addition, very small amounts of VOCs are used in waterborne coatings, while large amounts are used in solventborne coatings. Therefore, the reactivity of a waterborne coating on an ozone per gallon of product or gallon of solids basis is much lower than that of a solventborne coating. Because it is anticipated that manufacturers will incorporate the use of water and exempt solvents when formulating coatings to meet the lower-VOC limits of the proposed SCM, we have concluded that the total reactivity of the lower-VOC architectural coatings will be less than the reactivity of the higher-VOC architectural coatings.

6.B.2. Human Health Hazards

It is expected that future compliant coatings will contain less hazardous materials, or nonhazardous materials, as compared to solventborne coatings, resulting in a net benefit. The human health impacts analysis performed in the EIR for the 2000 SCM 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. It was concluded that the general public and coating applicators would not be exposed to either long-term or short-term health risks due to the application of compliant coatings as a result of the SCM.

ARB staff also considered the potential health impacts that might result from the increased use of tertiary butyl acetate (TBAc) in architectural coatings. TBAc has a strong odor that precludes its use in interior architectural coatings and it has a low flash-point making it unsuitable for coatings that have high flash point requirements. TBAc also has low water-solubility and fast evaporation, making it unsuitable for use in water-based coatings. However, it could be used in industrial coatings, wood lacquers, and epoxies (Pourreau, 2006).

In 2004, the U.S. EPA exempted TBAc from their list of VOCs because they determined that TBAc had low photochemical reactivity and low potential for adverse environmental impacts. In areas that have adopted a VOC exemption for TBAc, users are required to report emissions but they do not have a limit on the amount of TBAc used. Most of California has not exempted TBAc, due to questions of its toxicity. California's Office of Environmental Health Hazard Assessment (OEHHA) is concerned that long-term toxicity data are significantly lacking for TBAc, and that TBAc is metabolized into tert-butanol (TBA) (ARB, 2006a). After analyzing a National Toxicology Program bioassay for tert-butanol, OEHHA has concluded that the data are sufficient to conclude that tert-butanol is an animal carcinogen, and may be considered to pose a potential cancer risk to humans (ARB, 2006b).

ARB staff is not proposing to exempt TBAc in this proposed SCM, because of OEHHA's concerns regarding toxicity. In addition, staff does not believe that the use of TBAc is required to comply with the SCM. Since TBAc is not miscible with water, it would only be used as an exempt solvent for solventborne coatings. Even though nearly 90% of architectural coatings are waterborne, there are still solventborne architectural coatings used by do-it-yourselfers and contractors without the use of respirators. ARB staff is concerned that these users could potentially experience adverse health impacts if they use products containing TBAc without the proper protective equipment. ARB staff exempted TBAc in ARB's Automotive Refinish Coatings SCM because all of the coatings applied in that industry are to be applied using respirators. Similarly, the South Coast Air Quality Management District (SCAQMD) exempted TBAc for Industrial Maintenance coatings only, because Industrial Maintenance coatings are typically applied by professionals using respirators. In addition, some industry representatives said they needed TBAc to comply with the SCAQMD's 100 g/l VOC limit for some types of Industrial Maintenance products. ARB is not proposing a 100 g/l limit for Industrial Maintenance coatings, and industry is already complying with the 250 g/l limit without the use of TBAc. While ARB is not proposing a TBAc exemption, districts may exempt TBAc for certain applications. ARB staff encourages districts to conduct their own analyses to determine whether or not the use of TBAc would pose unacceptable exposures.

6.B.3. Potential Water Resources Impacts

The State Water Resources Control Board (SWRCB) and nine regional water quality control boards (RWQCB) are responsible for protecting surface and groundwater supplies in California, regulating waste disposal, and requiring cleanup of hazardous conditions (California Water §§13000 - 13999.16). In particular, the SWRCB establishes water-related policies and approves water quality control plans, which are implemented and enforced by the RWQCBs. These agencies also regulate discharges to State waters through federal National Pollution Discharge Elimination System (NPDES) permits. Discharges to publicly owned treatment works (POTW) are regulated through federal pre-treatment requirements enforced by the POTWs.

The proposed SCM is not expected to adversely impact water quality since the use of less toxic exempt solvents is expected to result in equivalent or lesser water quality impacts than currently used solvents. Water resources impacts are considered significant if they cause changes in the course of water movements or of drainage or surface runoff patterns; substantially degrade water quality; deplete water resources; significantly increase toxic inflow to public waste water treatment facilities; or interfere with groundwater recharge efforts. No significant adverse impacts are anticipated, therefore, no mitigation measures are necessary.

ARB's assessment for the proposed SCM is based upon the analyses performed in the EIR for the 2000 SCM (ARB, 2000). The EIR performed in 2000 indicated that the increased water demand associated with implementation of the SCM is *de minimus*. The SCM is also not expected to adversely impact water quality because the use of exempt solvents is expected to result in equivalent or lesser water quality impacts than currently used solvents due to the exempt solvents being less toxic. Further, because currently available compliant coatings are already based on waterborne technology, no additional water quality impacts from future compliant waterborne coatings are expected because these coatings are also expected to be waterborne. Finally, the SCM is not expected to promote the use of compliant coatings formulated with hazardous solvents that could create water quality impacts.

6.B.4. Hazardous Waste Disposal

The Department of Toxic Substances Control (DTSC) is the lead agency in California for hazardous waste management. DTSC enforces California's Hazardous Waste Control laws, issues permits to hazardous waste facilities, and mitigates contaminated hazardous waste sites. In California, leftover liquid waterborne and solventborne coatings are considered a hazardous waste and must be disposed of with a facility that is registered with DTSC. Hazardous materials as defined in 40 CFR 261.20 and California Title 22 Article 9 (including listed substances, 40 CFR 261.30) are disposed of in Class I landfills.

After collection at household hazardous waste collection sites, waterborne coatings may be consolidated for reuse. Consolidation of waterborne paint is a key way to reuse waterborne paint that is in good condition, and may effectively reduce the volume of waterborne paint for disposal by 50 percent or more. Some communities use this consolidated waterborne paint in anti-graffiti campaigns. Post-consumer paints can also be used in reprocessed recycled paints, resulting in high quality recycled paints.

Because waterborne paint is not considered a household hazardous waste when dried, small quantities of waterborne paint deemed not recyclable can be allowed to dry and disposed of in the household trash container, which is transferred to municipal solid waste landfills (Cal/EPA, 2007).

Solventborne paint is generally not a good candidate for reuse because of complexity and incompatibility as well as other paint formulation considerations. Cement kilns can use waste solventborne paints as a fuel source provided they have a high enough british thermal unit (BTU) value. If the collected solventborne paint is not suitable for use as a fuel source, it must be disposed of as a household hazardous waste through a licensed contractor (NPCA, 2007).

Solventborne coatings require the use of additional other hazardous materials (paint thinner, mineral spirits or turpentine) for cleanup and thinning, and thus generates more hazardous waste for disposal. Additionally, solventborne coatings and their associated cleaners and thinners are fire hazards due to their flammability, and rags used to clean up solventborne paints can easily catch fire, or even spontaneously combust, if stored improperly.

The solid waste/hazardous waste analysis performed in the EIR for the 2000 SCM examined increased disposal of compliant coatings due to the possibility of shorter shelf or pot lives or lesser freeze/thaw capabilities. Adverse solid waste/hazardous waste impacts associated with the SCM are expected to be insignificant.

6.B.5. Other Environmental Impacts

ARB staff has determined that there will be no significant adverse impacts to the following environmental resources in California as a result of implementing the SCM (ARB, 2000):

- Public Services
- Transportation/Circulation
- Land Use and Planning
- Population and Housing

- Geophysical
- Biological Resources
- Energy and Mineral Resources
- Noise
- Aesthetics
- Cultural Resources
- Recreation

6.C. REASONABLY FORESEEABLE FEASIBLE MITIGATION MEASURES

ARB is required to do an analysis of reasonably foreseeable mitigation measures. We have concluded that no significant adverse environmental impacts should occur from implementation of the proposed SCM. As a result, no mitigation measures would be necessary.

6.D. ALTERNATIVES TO THE PROPOSED SCM

As alternatives to the proposed SCM, ARB staff evaluated taking no action and delaying the effective dates. ARB staff determined that neither of these alternatives would be as effective at reducing VOC emissions from architectural coatings as the proposed SCM. The no action alternative was rejected because it would not achieve emission reductions necessary to attain the State and federal ambient air quality standards. The delayed effective date alternative was rejected because compliant coatings are currently available or will be available before the proposed effective dates of the SCM.

6.E. COMMUNITY HEALTH AND ENVIRONMENTAL JUSTICE

The ARB is committed to evaluating community impacts of proposed regulations, including environmental justice concerns. ARB's goal is to reduce or eliminate any disproportionate impacts of air pollution on low-income and minority populations so that all individuals in California can live, work, and play in a healthful environment. The proposed SCM is not expected to result in significant negative impacts in any community. The result of the proposed SCM will be reduced exposure to VOCs for all California communities, including those with large populations of low-income and minority residents.

6.F. REFERENCES

Air Resources Board. "Final Program Environmental Impact Report Suggested Control Measure for Architectural Coatings." June, 2000. (ARB, 2000)

Air Resources Board. Staff Report. "Environmental Impact Assessment of Tertiary –Butyl Acetate". Online, Internet at http://www.arb.ca.gov/research/reactivity/tbacf.pdf January 2006. (ARB, 2006a)

Air Resources Board. Staff Report. “Environmental Impact Assessment of Tertiary –Butyl Acetate Appendix A-1 Response to Public Comments”. Online, Internet at http://www.arb.ca.gov/research/reactivity/tbaca1.pdf January 2006. (ARB, 2006b)

California Environmental Protection Agency (Cal/EPA), Letter from Linda S. Adams, Secretary for Environmental Protection, to Mr. David Allaway, Oregon Department of Environmental Quality regarding Regulation of Waste Latex Paints in California. June 13, 2007. (Cal/EPA, 2007)

National Paint and Coatings Association. “Leftover Paint: Protocol for Management of Post Consumer Paint” Online, Internet at http://www.paint.org/protocol/index.cfm (NPCA, 2007)

CHAPTER 7. ECONOMIC IMPACTS

7.A. BACKGROUND

This chapter discusses the economic impacts we anticipate from implementation of the proposed SCM VOC limits. ARB staff quantified the economic impacts to the extent feasible, but economic impact analyses can be inherently imprecise by nature. Therefore, some projections are necessarily qualitative or semi-quantitative, based on general observations about the architectural coatings industry. The economic impacts analysis for the proposed SCM provides a general picture of the economic impacts that typical businesses might encounter, but staff recognizes 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:

- Summary of Economic Impacts
- General Approach
- Sources and Treatment of Cost Data
- Annual Cost and Cost Effectiveness
- Impact to Businesses
- Impact to Consumers
- 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 1998 U.S. EPA National Architectural Coatings Rule, the 1999 SCAQMD Rule 1113 (SCAQMD, 1999), and ARB's 2000 Suggested Control Measure (SCM) for Architectural Coatings. 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; ARB, 2004).

7.B. SUMMARY OF ECONOMIC IMPACTS

Overall, most affected businesses will be able to absorb the costs of the proposed VOC limits and requirements with no significant adverse impacts on their profitability. Profitability impacts were estimated by calculating the decline in the return on owner's equity (ROE). Assuming that coating manufacturers will have to absorb all costs associated with the SCM, the proposed SCM is expected to result in an average ROE decline of 2.1 percent, which is not considered to be a significant impact on the profitability of affected businesses. However, the proposed VOC limits may impose economic hardship on some small businesses with very little or no margin of profitability.

Overall, we expect the proposed SCM to have no significant impact on employment; business creation, elimination or expansion; or business competitiveness in California. We also expect no significant adverse fiscal impacts on any local or State agencies.

We estimate the total cost of the proposed SCM to affected architectural coatings manufacturers to be approximately 4 million dollars per year in nonrecurring costs and 8.3 million dollars in annual recurring costs. This corresponds to a total annualized cost of 12.3 million dollars per year in 2007 dollars.

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, as well as other existing ARB regulatory programs. We estimate that the overall cost-effectiveness of the proposed SCM ranges from a net savings to $13.90 per pound of VOC reduced, with an overall cost-effectiveness of $1.12 per pound of VOC reduced in 2007 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. The 2000 architectural coatings SCM had an overall cost effectiveness of $3.20 per pound of VOC reduced.

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 cost increase ranging from a net savings to $6.82 per reformulated gallon, with an average increase of about 30 cents 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), the maximum retail price increase ranges from a net savings to about $27.30 per reformulated gallon, with an average increase of about $1.21 per gallon. Assuming the average retail price per gallon of noncompliant coating currently ranges from $11.80 to $38.70 with an average of about $19.20, the maximum retail price increase would range from a net savings to a 47 percent increase, with an average increase of about six percent.

However, it is important to note that most individual consumers buy Flats, Nonflats, and Primers, Sealers and Undercoaters. For these categories, if all costs were passed on to consumers, staff estimates a maximum retail price increase from a net savings to about $4.40 per reformulated gallon, with an average potential increase of about $1.65 per gallon. Assuming the average retail price per gallon of noncompliant coating currently ranges from $16.90 to $19.40 with an average of about $18.30, the maximum retail price increase would range from a net savings to a 26 percent increase, with an average increase of about nine percent.

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 current prices. These products will still be available with no expected price increase. 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.

The results are summarized in Table 7-1.

Table 7-1
Summary of Economic Impacts

Average ROE Decline	2.1%
Total Annual Cost in 2007 Dollars	12.3 million
Overall Cost Effectiveness Range (Dollars per Pound VOC Reduced)	Net savings to $13.90
Overall Average Cost Effectiveness (Dollars per Pound VOC Reduced)	$1.12
Maximum Retail Price Increase Range (Dollars per Gallon)	Net savings to $27.30
Average Maximum Retail Price Increase (Dollars per Gallon)	$1.21
Maximum Retail Price Increase for Flats (Percent Increase per Gallon)	-7%
Maximum Retail Price Increase for Nonflats (Percent Increase per Gallon)	15%
Maximum Retail Price Increase for Primers, Sealers, and Undercoaters (Percent Increase per Gallon)	10%

7.C. GENERAL APPROACH

7.C.1. Legal Requirements

Section 11346.3 of the Government Code requires State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination or creation, and the ability of California business to compete with businesses in other states.

Because the staff's proposal is a SCM rather than an administrative regulation, the business impacts assessment is not required. However, ARB staff conducted the normally required business impacts assessment to provide the Board and 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.

In addition, 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.

7.C.2. Methodology

The economic impacts analysis consists of several parts. First, because we do not expect the SCAQMD to adopt this SCM, we calculated the total non-SCAQMD annual costs of the proposal. An analysis was conducted to determine the annual costs impacts to manufacturers based on raw material costs of typical complying and noncomplying coatings. A sensitivity analysis was conducted to determine the impacts on the annual costs from assumed changes to resin costs, the primary variable that influences raw material costs. In addition, we estimated the cost to market and distribute coatings that comply with the limits of the proposed SCM based on discussions with manufacturers. 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 impact analysis employs two scenarios under which all costs incurred to meet the proposal are absorbed by the coating manufacturers, and then by assuming that all costs incurred are passed on to consumers in the form of increased cost of coatings at the retail level. 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 by the manufacturer, with the remaining costs passed on to consumers). Thus, the actual business impacts and price increases will likely be less than predicted in this analysis. The methodology is explained in detail in Appendix G.

Contractors, raw material suppliers, distributors, and retailers of architectural coatings may also be impacted by the proposed VOC limits.

7.D. SOURCES AND TREATMENT OF COST DATA

The cost analysis relies on various sources of information. Discussions were held with coating manufacturers and resin manufacturers. For cost information specific to manufacturers, we relied on industry responses to the 2007 ARB Economic Impacts Survey. We sent this survey out in April 2007 to all manufacturers who would be impacted by the proposed VOC limits, based on ARB's 2005 Architectural Coatings Survey. From this group of 147 manufacturers, we received 36 responses. This survey elicited manufacturers' best estimates of the costs of meeting the proposal, including their estimates of the nonrecurring and recurring costs involved.

The 2007 ARB Economic Impacts Survey was intentionally broad so manufacturers could report all reasonably expected costs incurred to reformulate products for sale in non-SCAQMD areas of California. The respondents include a variety of large, medium, and small manufacturers, representing about 39 percent of the architectural coatings market in California based on ARB's 2005 Architectural Coatings Survey (ARB, 2006). Table 7-2 is a list of the respondents.

Table 7-2
2007 Economic Impact Survey Respondents

1	3M Company	19	Jones Blair
2	Ace Hardware Paint Division	20	Kelly Moore Paint Co.
3	Bay Systems North America LLC	21	Life Paint Co.
4	Bonakemi	22	Minuteman International - Multi Clean Div.
5	Carlise Coating & Waterproofing Inc.	23	Mortex Mfg. Co. Inc.
6	Connlin Company Inc.	24	Pacific Polymers International Inc.
7	Ellis Paint Company	25	Ponderosa Paint Co. Inc.
8	Epmar Corporation	26	RJ McGlennon Co., Inc.
9	ER Systems Inc.	27	Sherwin Williams
10	Frazee	28	Specialty Coatings and Chemical
11	Gemini Industries, Inc.	29	Technical Roofing Solutions Inc.
12	Griggs Paint of Domcom Enterprises, Inc.	30	The Garland Company Inc.
13	Henry Company	31	United Gilsonite Laboratories
14	Hillyard	32	United States Gypsum
15	Ingels, Inc.	33	Valspar Architectural Coatings
16	Insl-X Products Corp.	34	Waterlox Coatings Corporation
17	Jasco Chemical Corp.	35	XIM Products Inc.
18	JFB Hart Coatings Inc.	36	ZRC Worldwide

Many companies will not be impacted by the proposed SCM. These companies may have already reformulated their products to meet the SCAQMD limits, or do not market products that will be impacted by the proposed limits. Out of the 36 respondents to the survey, 12 reported that they would not incur any costs to meet the proposed SCM.

Sample complying and noncomplying product formulations were developed based on responses to ARB's 2005 Architectural Coatings Survey, product data sheets, and input from manufacturers. To determine the cost from changes in raw materials, we relied on information from chemical manufacturers, distributors of raw materials, and Chemical Market Reporter Magazine. In cases where a price range or multiple prices were found for a particular ingredient, we used the highest price available in the analysis. Finally, in 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.

7.E. ANNUAL COSTS AND COST-EFFECTIVENESS OF THE PROPOSED LIMITS

7.E.1. 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.

7.E.2. Methodology

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, literature 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:

$$Cost\text{-}Effectiveness = \frac{Annualized\ Nonrecurring\ Costs + Annual\ Recurring\ Costs}{Annual\ Emission\ Reductions}$$

where,

$$Annualized\ Nonrecurring\ Costs = CRF \text{ x} \sum (Nonrecurring\ Costs)$$

where,

$$Cost\ Recovery\ Factor\ (CRF) = \frac{i\,(i+1)^n}{(i+1)^n - 1}$$

i = discount rate, assumed 5%
n = project horizon, assumed 5 years

$$Annual\ Recurring\ Costs = Non\text{-}Raw\ Material\ Costs + Raw\ Material\ Costs$$

The Capital Recovery Method for annualizing fixed costs is recommended by California Environmental Protection Agency (Cal/EPA) guidelines (Cal/EPA, 1996), and is consistent with the methodology used in previous cost analyses for ARB regulations, including the 2000 SCM for Architectural Coatings (ARB, 2000).

With regard to the discount rate, Cal/EPA recommends 2 percent plus the current yield for a U.S. Treasury Note of similar maturity to the project horizon. Cal/EPA recommends a 5-year project horizon when conducting cost-effectiveness analysis. In 2007, treasury yields have been about 5 percent for a 5 year bond (CNN, 2007), and when adjusted for an inflation rate of 2 percent, the corresponding discount rate is 5 percent.

In this analysis, each proposed limit was analyzed as a separate, stand-alone regulation. This means the annual costs and the cost-effectiveness of each limit are calculated independently. This approach, approved by the 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).

ARB staff believes 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 independently is that each limit is, in reality, generally independent of all the other limits. 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 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 the proposed limits. These calculations and the associated assumptions are presented in more detail in Appendix G.

7.E.3. Results

The total cost of the proposed limits is estimated to be 12.3 million dollars per year in 2007 dollars. As shown in Table 7-3, the cost-effectiveness of individual categories ranges from -$1.37 (a net savings) to a net cost of $13.90 per pound of VOC reduced. The $13.90 per pound value for Floor Coatings is due to the fact that a large number of noncomplying products are sold in small volumes. Because the complying marketshare for Floor Coatings is 85 percent, many manufacturers have already reformulated their coatings to meet the proposed VOC limit. Therefore, staff believes that it is appropriate for the remaining manufacturers to reformulate their products to meet the proposed limit.

The overall average cost-effectiveness of the proposed limits is estimated to be $1.12 per pound of VOC reduced. This compares favorably with the cost-effectiveness of similar regulations.

Table 7-3
Cost-Effectiveness and Maximum Per-Gallon Cost Increases

Coating Category	Individual Cost-Effectiveness for Each Limit (Dollars per Pound VOC Reduced)	Calculated Cost per Gallon to Consumers [1] (Dollars per Gallon)	Cost Increase Per Gallon to Consumers (Dollars per Gallon)
Aluminum Roof	$0.41	$14.63	$1.16
Bituminous Roof	$1.02	$11.84	$6.43
Concrete Masonry Sealer	-$0.36	$14.09	-$0.88
Dry Fog	-$0.52	$34.86	-$3.96
Flat	-$0.69	$17.81	-$0.33
Floor	$13.90	$16.96	$27.30
Mastic Texture	$2.38	$17.72	$8.61
Non Flat	$7.03	$19.44	$4.40
Non Flat High Gloss	-$1.38	$23.96	-$3.39
PSU	$2.73	$16.90	$2.51
Roof	$1.38	$29.94	$1.95
Rust Preventative	-$0.46	$30.30	-$2.51
Specialty PSU	-$0.71	$25.19	-$6.32

Table 7-3 Cost-Effectiveness and Maximum Per-Gallon Cost Increases			
Coating Category	**Individual Cost-Effectiveness for Each Limit (Dollars per Pound VOC Reduced)**	**Calculated Cost per Gallon to Consumers [1] (Dollars per Gallon)**	**Cost Increase Per Gallon to Consumers (Dollars per Gallon)**
Traffic Marking	$4.76	$14.18	$4.00
Waterproofing Membrane	$6.55	$33.38	$17.00
Wood Coatings	-$1.13	$38.70	-$6.34
	Cost-Effectiveness ($ Per Lb VOC Reduced)	**Cost per Gallon ($ Per Gallon)**	**Cost Increase ($ Per Gallon)**
OVERALL RESULTS	**$1.12**	**$19.20**	**$1.21**

1 – Costs per gallon were calculated based on raw material costs, and do not necessarily reflect actual retail prices.

Table 7-4 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)**
2007 Architectural Coatings Suggested Control Measure	$1.12	Net savings to $13.90
SCAQMD 2003 Amended Rule 1113	$2.11 to $5.70	Not Determined
2000 Architectural Coatings Suggested Control Measure	$3.20	Net savings to $7.65
2005 Automotive Refinishing Suggested Control Measure	$1.45	Not Determined
SCAQMD 1999 Rule 1113	$2.45	$0.50 to 5.60
1989 AIM Suggested Control Measure	net savings to $6.90	Not Determined
Aerosol Coating Products	$2.85 to $3.20	Not Determined
Mid-Term Measures II Consumer Products	$0.40	$0.00 to $6.30
Mid-Term Measures I Consumer Products	$0.25	$0.00 to $7.10
Phase II Consumer Products	<$0.01 to $1.10	Not Determined

(ARB, 1989; ARB, 1990; ARB, 1991; ARB, 1997; ARB, 1999; ARB, 2004; SCAQMD, 1999; ARB, 2005; ARB, 2000; SCAQMD, 2003)

7.F. ECONOMIC IMPACTS ON BUSINESSES

7.F.1. 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. 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.

7.F.2. Affected Businesses

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 2005 ARB Architectural Coatings Survey, and the staff's cost-effectiveness analysis discussed earlier in this chapter.

Any business that manufactures or markets architectural coatings would potentially be affected by the proposed SCM. Also potentially affected are businesses that supply resins, solvents, other ingredients and equipment to these manufacturers or marketers, or distribute, sell or use architectural coatings. The focus of this analysis, however, is on manufacturers, because these businesses would be directly affected by the proposed SCM.

According to the 2005 ARB Survey, 197 companies nationwide manufacture or market architectural coatings in California. Of these 197 companies, 164 manufacture or market coatings in one of the categories with a proposed change in VOC limit. These 164 companies are represented in Table 7-5. Of the 164 companies that manufacture or market coatings in one of the categories with a proposed change in VOC limit, 147 manufacture noncompliant products, according to the 2005 ARB Survey. These 147 companies were the recipients of the economic survey.

Architectural coating manufacturers generated about $19.5 billion in national sales in 2004, of which an estimated $2.4 billion was in California (NPCA, 2007). The bulk of this sales volume was generated by a few companies; ten of the 197 manufacturers account for 81 percent of the volume, with the remaining 187 companies accounting for the remaining 19 percent (ARB, 2006).

The 164 architectural coatings companies that manufactured or marketed non-complying products in California marketed about 56 million gallons of coatings outside the SCAQMD in 2004, of which 15 million gallons were compliant and 41 million gallons were noncompliant (*Id.*). California based companies accounted for 39 percent of compliant gallons, 62 percent of noncompliant gallons, and 56 percent of the overall sales volume for coatings marketed in California as shown in Table 7-5 (*Id.*).

Table 7-5
Sales Volume for Compliant and Non-Compliant Coatings in Categories with a Change in VOC Limit (excluding the South Coast AQMD)

Sales Volume in 2004	**California Manufacturers (45)**		**Non-California Manufacturers (119)**		**All Manufacturers (164)**	
Compliant Products (Gallons)	5,882,182	19%	9,107,287	37%	14,989,469	27%
Non-Compliant Products (Gallons)	25,328,260	81%	15,595,976	63%	40,924,236	73%
Total	**31,210,442**		**24,703,263**		**55,913,705**	

All affected categories of coatings are classified under Standard Industrial Classification (SIC) 2851 or new North American Industry Classification System (NAICS) 325510.

7.F.3. Study Approach

Of the 197 manufacturers or marketers of architectural coatings included in the ARB 2005 Survey, a total of 164 companies manufactured or marketed noncompliant paints and coatings in California in 2004. 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 representative businesses of different sizes was selected from the list of 164 affected businesses based on the size of their sales and quantity of noncompliant coatings they manufactured or marketed. Based on the number of employees, revenue and sales volume, three large businesses, 4 medium, and 2 small businesses were included in this analysis.
(2) If applicable, survey reported compliance cost was used, otherwise the 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 2004 through 2006 (Dunn and Bradstreet, 2007). 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; ARB, 2000; ARB, 2005). This threshold is consistent with the thresholds used by the United States Environmental Protection Agency and others.

7.F.4. Assumptions

The ROEs before and after the subtraction of the adjusted compliance costs were calculated for each size business using financial data for 2004 through 2006. The calculations were based on the following assumptions:

(1) Selected businesses are representative of affected businesses;
(2) All affected businesses are subject to the highest federal and State corporate tax rates of 35 percent and 9.3 percent respectively; and
(3) Affected businesses are not able to increase the prices of their products, nor can they lower their costs of doing business through short-term, cost-cutting measures.

Given the limitation of available data, staff believes these assumptions are reasonable for most businesses at least in the short run; however, they may not be applicable to all businesses.

7.F.5. 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 section 7.E.

Staff estimated profitability impacts by calculating the decline in the return on owner's equity (ROE). Assuming that coating manufacturers will have to absorb all of the costs associated with the SCM, the proposed SCM is expected to result in an average ROE decline of 2.1 percent, as shown in Table 7-6, which is not considered to be a significant impact on the profitability of affected businesses.

Table 7-6
Changes in Return on Owner's Equity (∆ROEs)
for Typical Businesses in Architectural Coatings Industry

Size	∆ROE
Large	1.1%
Medium	1.5%
Small	4.7%
Average	**2.1%**

Note: All ∆ROEs shown are negative which indicates a decline in profitability.

As shown in Table 7-6, the projected change in profitability of typical businesses in the architectural coatings industry varied widely. The predicted decline in profitability of sample businesses ranged from a high of about 4.7 percent for a typical small business to a low of 1.1 percent for a typical 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 coatings they manufacture or market. 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 2004 through 2006 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.

7.F.6. Potential Impact on Suppliers

Companies which supply resins, solvents, other chemicals and equipment for use in reformulating architectural 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 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 two-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.

7.F.7. Potential Impact on Employment

The proposed SCM is not expected to cause a noticeable change in California employment and payroll. According to the 2004 U.S. Census Bureau, 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 4,137 in 2004, or about 9 percent of the national employment in the industry. This also represents only about 0.3 percent of the total manufacturing jobs in California. These employees working in 173 establishments generated about $192 million in payroll, accounting for less than 0.3 percent of the total California manufacturing payroll in 2004. Forty-nine establishments had 20 employees or more; the rest had less than 20 employees each (BLS, 2007).

Professional painters and contractors may also be impacted by the proposed SCM. According to 2002 data from the U.S. Census Bureau, California employment of painting and wall covering contractors (NAICS 238320, which includes establishments engaged in interior or exterior painting or interior wall covering. The work performed may include new work, additions, alterations, maintenance, and repairs) was 32,888, or about 14 percent of the national employment in the industry. This represents about 4 percent of the total construction jobs in California. These employees generate about $880 million in payroll (BLS, 2007).

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 56 percent of the California market for architectural coatings. Thus, its impact will be even smaller than indicated above. In addition, as shown above, most affected manufacturers or marketers would be able to absorb the reformulation costs with no significant impact on their profitability.

7.F.8. 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 most 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.

7.F.9. 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 the non-SCAQMD portion of California regardless of their location, the staff's proposal should not present any economic disadvantages specific to California businesses. Of a total of 197 companies involved in manufacturing or marketing architectural coatings, 45 are located in California.

The competitiveness of small businesses is not likely to be adversely affected by the fact that larger manufacturers can lower their costs 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, 81 percent of the total sales volume of coatings in California is sold by only 10 manufacturers, while the other 187 manufacturers sell 19 percent 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.

7.F.10. Potential Impacts on California State or Local Agencies

Some public agencies would be minimally impacted by the SCM. The California Prison Industry Authority (PIA) manufactures and markets products for use in State service, but none of their products fall under the proposed SCM (PIA, 2007). The Department of General Services (DGS) encourages the use of recycled coatings, which fall into a category that does not have a proposed new limit. Other State or local agencies that use architectural coatings in their ordinary course of business such as the California Department of Transportation, will have the same variety of coatings available to purchase as any other industrial, commercial, or household consumer in California. Based on the above, we have determined that the proposed limits will not create costs or savings, as defined in Government Code section 11346.5(a)(6), to any State agency or in federal funding to the State, costs or mandate to any local agency or school district whether or not reimbursable by the State pursuant to Part 7 (commencing with section 17500) Division 4, Title 2 of the Government Code, or other nondiscretionary savings to local agencies.

7.G. POTENTIAL IMPACTS ON CALIFORNIA CONSUMERS

If businesses are unable to reduce their costs of doing business, they would pass their cost increases on to consumers. Staff estimates an average potential increase of about $1.21 per gallon, if all costs were passed on to the consumer. Currently, the average cost per gallon for consumers is about $19.20. Therefore, the maximum increase in the cost per gallon could be about six percent.

However, it is important to note that most individual consumers buy Flats, Nonflats, and Primers, Sealers and Undercoaters. For these categories, if all costs were passed on to consumers, staff estimates an average potential increase of about $1.65 per gallon. Currently, the average cost per gallon for consumers for these categories is about $18.30. Therefore, the maximum increase in the cost per gallon could be about nine percent.

As noted earlier, consumers who do not wish to purchase these reformulated coatings would still be able to buy the currently available complying coatings at 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.

7.H. MITIGATION OF POTENTIAL IMPACTS THROUGH ADDITIONAL REGULATORY FLEXIBILITY

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. In addition, with over two years to reformulate and an additional three 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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CHAPTER 8. 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.

8.A. ARCHITECTURAL COATINGS SURVEY

Staff currently plans to conduct another architectural coatings survey in 2011 to gather data from calendar year 2010. Staff expects the survey to be similar to the survey conducted in 2005 to gather data from calendar year 2004. This survey will reflect the products that have been reformulated to meet the VOC limits that took effect in the South Coast AQMD from 2005 to 2008, and the proposed SCM limits that take effect in 2010.

8.B. TECHNOLOGY ASSESSMENTS FOR PROPOSED LIMITS

ARB staff plans to conduct technology assessments for each coating category with a lower proposed VOC limit. These assessments will be conducted one year prior to the effective date of the lowered limits. The affected categories include:

- Aluminum Roof
- Bituminous Roof
- Concrete/Masonry Sealer
- Driveway Sealer
- Dry Fog
- Flat
- Floor
- Mastic Texture
- Nonflat
- Nonflat – High Gloss
- Primers, Sealers, and Undercoaters
- Reactive Penetrating Sealer
- Roof
- Rust Preventative
- Specialty Primers, Sealers, and Undercoaters
- Traffic Marking
- Waterproofing Membrane
- Wood Coatings
- Zinc-Rich Primer

Staff believes the proposed limits are feasible, based on all the evidence that we examined. Staff is committing to these technology assessments because it is standard practice for the ARB to ensure that unanticipated problems do not arise.

8.C. REACTIVITY-BASED LIMITS

Staff expects to explore the feasibility of reactivity-based limits in the future. Successful development of such limits relies heavily on receiving detailed, product-specific ingredient data from the next architectural coatings survey.

8.D. VOC TEST METHOD IMPROVEMENT

In 2005, the ARB contracted with the California Polytechnic State University at San Luis Obispo, California (Cal Poly) to develop an improved volatile organic compound (VOC) test method for architectural coatings. Currently, U.S. EPA Method 24 is used to test the VOC content of coatings. It is widely accepted that Method 24 is not reliable for the analysis of low VOC waterborne coatings, nor is it suitable for determining the VOC content of solventborne coatings with high levels of exempt compounds. In both cases, Method 24 is unreliable because it indirectly measures VOCs in these coatings.

There are also concerns with Method 24 when it comes to testing the VOC content of multi-component coatings, reactive diluent-containing coatings, high solids coatings, and low solids coatings. The intent of the project is to develop a test method, or suite of test methods, that can be used for all the major types of architectural coatings, whether they are low VOC waterborne, high VOC waterborne, low VOC solventborne, high VOC solventborne, low exempt containing solventborne, high exempt containing solventborne, high build, low build, single component, multi-component, low solids, high solids, film-forming, or penetrating, and in as many of the 40 or so regulatory architectural coating categories as possible.

For several of the solventborne types of coatings, Method 24 works well. For the remaining coatings, Cal Poly will be developing a direct VOC test method, or methods, most likely based on ASTM D6886, a test method that Cal Poly developed.

Staff anticipates the project to be completed in 2008. Cal Poly has collected samples from manufacturers representing many of the various types and categories of coatings described above. Cal Poly will continue to develop and refine the test method(s) in 2007. Several air quality districts, other agencies, and industry laboratories have volunteered to participate in “shadowing” Cal Poly’s testing, to help validate the method(s). Staff expects that to occur in 2007, with a final report to ARB in 2008.