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## Source Category: Architectural and Industrial Maintenance Coatings

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### INTRODUCTION

The purpose of this document is to provide a forum for public review and comment on the evaluation of candidate control measures that may be considered by the States in the Midwest Regional Planning Organization (MRPO) to develop strategies for ozone, PM<sub>2.5</sub>, and regional haze State Implementation Plans (SIPs). Additional emission reductions beyond those due to mandatory controls required by the Clean Air Act may be necessary to meet SIP requirements and to demonstrate attainment. This document provides background information on the mandatory control programs and on possible additional control measures.

The candidate control measures identified in this document represent an initial set of possible measures. The MRPO States have not yet determined which measures will be necessary to meet the requirements of the Clean Air Act. As such, the inclusion of a particular measure here should not be interpreted as a commitment or decision by any State to adopt that measure. Other measures will be examined in the near future. Subsequent versions of this document will likely be prepared for evaluation of additional potential control measures.

The evaluation of candidate control measures is presented in a series of "Interim White Papers." Each paper includes a title, summary table, description of the source category, brief regulatory history, discussion of candidate control measures, expected emission reductions, cost effectiveness and basis, timing for implementation, rule development issues, other issues, and a list of supporting references. Table 1 summarizes this information for the architectural and industrial maintenance coating category.

### SOURCE CATEGORY DESCRIPTION

Architectural and industrial maintenance (AIM) coatings are used to beautify and protect homes, office buildings, factories, pavements, curbs, and their appurtenances on a variety of surfaces - metal, wood, plastic, concrete, wallboard, etc. These coatings are applied to the interior and exterior of homes and offices, factory floors, bridges, traffic signs, roofs, swimming pools, driveways, etc. AIM coatings may be applied by brush, roller or spray gun; by consumers, painting contractors, or maintenance personnel. AIM coatings include over 50 subcategories such as interior and exterior paints, traffic markings, sign paints, as well as industrial maintenance coatings. Volatile organic compound (VOC) emissions result from the evaporation of solvents in the coatings during application and drying. AIM coatings account for about 3.7% of the total anthropogenic VOC emissions in the MRPO region in 2002.

### REGULATORY HISTORY

The U.S. Environmental Protection Agency (EPA) published the AIM coatings rule on September 11, 1998 (40 CFR Part 59 Subpart D) under authority of Section 183(e) of the Clean Air Act. This rule limits the amount of VOC that manufacturers and importers of AIM coatings can put into their products. The rule also has container labeling requirements for AIM coatings. There are different options for complying with the VOC limits, including exemptions for products that may be hard to reformulate. VOC content limits in the national rule took effect on September 11, 1999. The Federal AIM rule is estimated to yield VOC reductions of 20 percent from uncontrolled levels.

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**TABLE 1 – CONTROL MEASURE SUMMARY FOR  
ARCHITECTURAL AND INDUSTRIAL MAINTENANCE COATINGS**

Control Measure Summary	VOC Emissions (tons/year) in 5-State MRPO Region	
<b>2002 existing measure: Federal AIM rules 40CFR Part 59</b> <i>Emission Reductions:</i> 20% reduction from uncontrolled levels <i>Control Cost:</i> \$250 per ton <i>Timing of Implementation:</i> Compliance required by September 1999 <i>Implementation Area:</i> Nationwide	Uncontrolled: 2002 Reduction: 2002 Base:	130,300 <u>-26,060</u> 104,240
<b>Candidate measure: Adopt more stringent VOC limits for AIM coatings based on OTC Model Rule and Wisconsin NR433.17</b> <i>Measure ID:</i> SOLV1A <i>Emission Reductions:</i> 31% beyond Federal AIM rule (for a total reduction of 36% from uncontrolled emissions) <i>Control Cost:</i> \$6,400 per ton <i>Timing of Implementation:</i> Assuming 2007 effective date of rule and 2-year sell-through period, emission reductions are achieved in 2009 <i>Implementation Area:</i> 5-state MRPO region	2002 Base:  2009 Reduction: 2009 Remaining:	104,240  <u>-20,783</u> 83,457
<b>Candidate measure: Adopt SCAQMD Phase III VOC limits in addition to OTC Model Rule</b> <i>Measure ID:</i> SOLV1B <i>Emission Reductions:</i> 13.4% beyond OTC Model Rule (for a total reduction of 44% from uncontrolled emissions) <i>Control Cost:</i> \$20,000 per ton <i>Timing of Implementation:</i> Assuming 2007 effective date of rule and 2-year sell-through period, emission reductions are achieved in 2009 <i>Implementation Area:</i> 5-state MRPO region	2002 Base:  2009 Reduction: 2009 Remaining:	104,240  <u>-31,944</u> 72,296
<b>Candidate measure: Develop Reactivity-Based Limits</b> <i>Measure ID:</i> SOLV1C <i>Emission Reductions:</i> cannot be determined at this time <i>Control Cost:</i> cannot be determined at this time <i>Timing of Implementation:</i> cannot be determined at this time	Not available (n/a)	n/a

Notes: 2002 emission reductions shown are reductions from uncontrolled levels.  
 2009 emission reductions shown are reductions for 2002 base emissions.  
 2009 emissions are not growth-adjusted.

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The South Coast Air Quality Management District (SCAQMD) originally adopted Rule 1113 on September 2, 1977, to regulate VOC emissions from the application of AIM coatings. Since its adoption, the rule has been amended numerous times to incorporate more stringent VOC limits as lower-VOC coatings have become available. The Phase I amendment to Rule 1113 (November 1996) lowered the VOC limits for some coating categories based on the concept of coating reformulation, but also increased the VOC limit for other coating categories. The Phase II amendment (May 1999) further lowered interim and final VOC limits for new and existing coating categories. On December 5, 2003, SCAQMD adopted Phase III amendments to its architectural coatings rule that lowered the VOC limits on several coating categories, including varnishes, roof coatings, stains, and waterproofing sealers. Phase III relies on near-zero or zero VOC formulations for several AIM coating categories including, but not limited to, cleanup and thinning solvents, clear wood finishes, exterior opaque stains, semi-transparent stains, sanding sealers, and waterproofing sealers.

Subsequent to the SCAQMD Phase II amendment to Rule 1113, the California Air Resources Board (CARB) developed a revised suggested control measure (SCM) in June 2000 for AIM coatings that was largely based on the SCAQMD Phase II interim limits and the averaging provision of Rule 1113. The SCM, which has a compliance date of January 1, 2003, for most coating categories, has been adopted by over half of the 35 local air districts in California (representing most of California's population).

The State and Territorial Air Pollution Program Administrators (STAPPA) and the Association of Local Air Pollution Control Officials (ALAPCO) developed a model rule for AIM coatings in 2000. The STAPPA/ALAPCO Model Rule is based on the CARB SCM. It provides more stringent but technologically and economically feasible VOC limits than the Federal AIM rule, and is intended to yield significantly more emissions reductions than the Federal rule.

Several states in the Ozone Transport Region, made up of the 12 eastern seaboard states from Virginia to Maine and the District of Columbia, are also in the process of adopting AIM coating rules. The OTC developed a Model Rule for AIM Coatings that requires manufacturers to reformulate coatings to meet specified VOC content limits, which are based on the SCM adopted by ARB and the STAPPA/ALAPCO model rule for AIM Coatings. All products manufactured for sale or use within an OTC State after January 1, 2005 would need to comply with the VOC content limits in the AIM OTC Model Rule.

Wisconsin has a rule limiting the VOC content of traffic markings. NR422.17 applies during the ozone season in nine counties and limits the VOC content of traffic markings to 91 grams per liter of coating, which is about 39 percent lower than the limit imposed by the Federal rule or the OTC model rule.

None of the other MRPO States have rules specifically regulating AIM coatings beyond the requirements of the Federal AIM rule.

CARB is in the process of updating the 2000 Suggested Control Measure (SCM) for Architectural Coatings. They are currently completing a 2004 survey of AIM coating usage and VOC contents. They will not begin the formal SCM update process until the survey is completed, and are expected to propose revisions to the SCM in mid to late 2007. It cannot be determined at this time whether CARB's updated SCM will be as stringent as the SCAQMD Phase III limits.

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## CANDIDATE CONTROL MEASURES

In general, VOC emission reductions can be obtained through product reformulation - modifying the current formulation of the coating to obtain a lower VOC content. Product reformulation can involve one or several of the following approaches:

- Replacing VOC solvents with non-VOC solvents;
- Increasing the solids content of the coating;
- Altering the chemistry of the resin so that less solvent is needed for the required viscosity; and,
- Switching to a waterborne latex or water-soluble resin system.

The regulatory approach for reducing emissions is to establish VOC content limits for specific coatings that manufacturers are required to meet either through reformulating products or substituting products with compliant coatings.

Three specific candidate control measures are discussed below.

*Measure SOLVIA – Adopt More Stringent VOC Content Limits for AIM Coatings.* This measure establishes more stringent VOC limits than the Federal AIM rule and achieves VOC emission reductions through the use of product reformulation and product substitution. For architectural coatings, the more stringent limits could be based on the OTC limits, which ultimately are based on the CARB suggested control measure and the SCAQMD Rule 1113 Phase I and Phase II VOC rules. The OTC Model Rule contains more stringent VOC limits than the Federal rule. Reference 4 indicates that the OTC Model Rule will provide a 31 percent VOC emissions reduction beyond the reductions obtained from the Federal rule. The VOC content of industrial maintenance coatings in the OTC rule is 46.6 percent lower than the Federal rule. Since the VOC content of traffic markings in the OTC rule is equivalent to the Federal rule, a more stringent VOC content limit for traffic markings is based on Wisconsin rule NR422.17, which is about 39 percent lower than the limit imposed by the Federal rule or the OTC model rule.

*Measure SOLVIB – Adopt SCAQMD Phase III VOC Emission Limits in addition to the OTC Model Rule.* Implementation of Phase 3 of the SCAQMD Rule 1113 will rely on near-zero or zero VOC formulations for several architectural coating categories including, but not limited to, cleanup and thinning solvents, clear wood finishes, exterior opaque stains, semi-transparent stains, sanding sealers, and waterproofing sealers. Reference 5 indicates that the Phase III limits will provide a 51 percent reduction beyond the reductions obtained from the Phase II limits. Since the OTC Model Rule is based on the Phase II limits, we have assumed that the SCAQMD Phase III limits will provide a 51 percent reduction beyond the reductions obtained from the OTC Model Rule. This reduction seems to apply only to solvent-based architectural coatings.

*Measure SOLVIC – Develop Reactivity-Based Limits.* CARB has funded a \$300,000 research project with the University of California, Riverside that includes conducting chamber experiments to verify the chemical mechanisms used to identify the maximum incremental reactivities for some key solvents in architectural coatings. Mass-based emission reductions are becoming more difficult because architectural coatings have already been reformulated to some extent. CARB believes reactivity-based limits offer a new opportunity to achieve additional ozone reductions. CARB expects an equal or greater air quality benefit compared to a mass-based strategy, because VOCs with the greatest ozone forming potential will be targeted rather than treating each VOC equally.

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## EXPECTED EMISSION REDUCTIONS

We calculated the approximate emission reductions expected from adoption of the more stringent VOC limits based on the OTC Model Rule/NR422.17 and the SCAQMD Phase III VOC Limits in the following manner:

- MACTEC calculated the emissions for solvent-based architectural coatings, water-based architectural coatings, industrial maintenance coatings, and special purpose coatings using the latest emission factors from EPA's *Documentation for the Draft 2002 Nonpoint Source National Emission Inventory for Criteria and Hazardous Air Pollutants (March 2005 Version)*. The factors are 1.609 lbs/person for solvent-based architectural coatings, 1.513 lbs/person for water-based coatings, 0.64 lbs/person for industrial maintenance coatings, and 0.64 lbs/person for special purpose coatings. These emission factors reflect the impact of the Part 59 AIM rules. Emissions from traffic markings came from the MRPO's 2002 inventory.
- Assume the OTC Model Rule and NR422-17 limits are adopted in 2007 by all five MRPO states and that full implementation will be achieved by 2009;
- Assume that the SCAQMD Phase III limits, in addition to the OTC Model Rule and NR422.17 limits are adopted in 2007 by all five MRPO states and that full implementation will occur by 2009.

Current emissions from AIM coatings and expected emission reductions are summarized in Table 2. Adoption of the OTC Model Rule and NR422.17 limits would result in a reduction of 22,891 tpy of VOC in 2009 across the 5-state region. If the SCAQMD Phase III limits are adopted in addition, there would be an incremental reduction of 11,585 tpy of VOC. We cannot determine at this time the additional reductions that might be obtained by developing reactivity-based emission limits for AIM coatings.

It should be noted that EPA, states, and stakeholders are currently reviewing the emission calculation procedures for AIM coatings, both in terms of the baseline emission levels (with and without Part 59) as well as the emission reductions from the OTC Model Rule (See Federal Register notice dated August 31, 2005, entitled *Advance Notice to Solicit Comments, Data, and Information for Determining the Emission Reductions Achieved in Ozone Nonattainment Areas from the Implementation of Rules Limiting the VOC Content of AIM Coatings*). In this notice, the EPA is encouraging all interested parties to submit information on how to best calculate the VOC emission reductions from the adoption of AIM coating rules. We recommend that the MRPO track the results of EPA's analysis to better quantify the baseline emission levels and reductions attributable to the OTC Model Rule.

## COST EFFECTIVENESS AND BASIS

The analysis for the OTC Model Rule estimated a cost of \$6,400 per ton of VOC reduced based on CARB's SCM cost analysis.

The SCAQMD calculated the cost effectiveness of this control measure to be approximately \$20,000 per ton. This value is based on an incremental reformulation cost of \$8.00 per gallon for the architectural coating categories targeted by this control measure.

We cannot determine at this time the additional reductions that might be obtained by developing reactivity-based emission limits for AIM coatings.

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**TABLE 2 – COMPARISON OF 2002, OTC MODEL RULE, AND SCAQMD PHASE III EMISSION SCENARIOS**

SCC			VOC Emissions (tons per year)				
			With Federal Part 59 Limits	With OTC Model Rule and Wisconsin NR422.17 Limits		With additional SCAQMD Phase III Limits	
			2002 Actual	Incremental Reduction	2009 Remaining	Incremental Reduction	2009 Remaining
IL	2401002000	Arch. Coatings Solvent Based	9,991	2,478	7,513	3,065	4,448
IL	2401003000	Arch. Coatings Water Based	9,395	0	9,395	0	9,395
IL	2401008000	Traffic Markings	802	252	550	0	550
IL	2401100000	Industrial Maint. Coatings	3,974	1,412	2,563	0	2,563
IL	2401200000	Special Purpose Coatings	<u>3,974</u>	<u>1,412</u>	<u>2,563</u>	<u>0</u>	2,563
Subtotal for Illinois			28,137	5,553	22,584	3,065	19,519
IN	2401002000	Arch. Coatings Solvent Based	4,892	1,213	3,679	1,501	2,178
IN	2401003000	Arch. Coatings Water Based	4,600	0	4,600	0	4,600
IN	2401008000	Traffic Markings	1,245	390	855	0	855
IN	2401100000	Industrial Maint. Coatings	1,946	691	1,255	0	1,255
IN	2401200000	Special Purpose Coatings	<u>1,946</u>	<u>691</u>	<u>1,255</u>	<u>0</u>	1,255
Subtotal for Indiana			14,628	2,986	11,642	1,501	10,141
MI	2401002000	Arch. Coatings Solvent Based	7,995	1,983	6,013	2,453	3,559
MI	2401003000	Arch. Coatings Water Based	7,518	0	7,518	0	7,518
MI	2401008000	Traffic Markings	499	156	343	0	343
MI	2401100000	Industrial Maint. Coatings	3,180	1,130	2,051	0	2,051
MI	2401200000	Special Purpose Coatings	<u>3,180</u>	<u>1,130</u>	<u>2,051</u>	<u>0</u>	2,051
Subtotal for Michigan			22,374	4,399	17,975	2,453	15,522
OH	2401002000	Arch. Coatings Solvent Based	9,134	2,265	6,868	2,802	4,066
OH	2401003000	Arch. Coatings Water Based	8,589	0	8,589	0	8,589
OH	2401008000	Traffic Markings	2,218	696	1,522	0	1,522
OH	2401100000	Industrial Maint. Coatings	3,633	1,290	2,343	0	2,343
OH	2401200000	Special Purpose Coatings	<u>3,633</u>	<u>1,290</u>	<u>2,343</u>	<u>0</u>	2,343
Subtotal for Ohio			27,206	5,542	21,665	2,802	18,862
WI	2401002000	Arch. Coatings Solvent Based	4,315	1,070	3,245	1,324	1,921
WI	2401003000	Arch. Coatings Water Based	4,058	0	4,058	0	4,058
WI	2401008000	Traffic Markings	49	0	49	0	49
WI	2401100000	Industrial Maint. Coatings	1,716	610	1,107	0	1,107
WI	2401200000	Special Purpose Coatings	<u>1,757</u>	<u>624</u>	<u>1,133</u>	<u>0</u>	<u>1,133</u>
Subtotal for Wisconsin			11,895	2,319	9,576	1,324	8,252
<b>MRPO 5-State Total</b>			<b>104,240</b>	<b>20,783</b>	<b>83,457</b>	<b>11,131</b>	<b>72,311</b>

Note: the 2009 emission estimates presented here are not growth-adjusted.

## **TIMING OF IMPLEMENTATION**

The Federal AIM rule was promulgated on September 11, 1998, and required all coatings manufactured after September 13, 1999 to meet the VOC content limits specified in the rule (or to comply using either the exceedance fee provision or the tonnage exemption). The rule allows coatings manufactured prior to September 13, 1999 to continue to be sold until the stocks are depleted.

The OTC Model Rule includes a “sell-through” provision that allows a three-year window during which manufacturers and distributors may continue to sell products that were produced before a set deadline, even if they do not meet the more stringent VOC limits. This three-year window creates time for manufacturers to reformulate while continuing to sell their existing products. It should be noted, however, that many manufacturers are currently manufacturing products that meet the California and OTC limits. In addition, product inventories turn over quickly. Thus, it seems reasonable that a two-year window creates time for manufacturers to reformulate while continuing to sell their existing products in the MRPO region. As a result, the full emission reduction potential achieved by adoption of the OTC Model Rule could be realized within two years of adoption of the rule (i.e., 2009).

Similarly, the 2003 SCAQMD Air Quality Management Plan allows a 3-5 year window for manufacturers to fully comply with the more stringent Phase III VOC limits. If the MRPO states adopted similar requirements, it is unlikely that the majority of emission reductions achieved by adoption of the SCAQMD requirements would be realized by 2009.

## **CONTROL EFFICIENCY, RULE PENETRATION, AND RULE EFFECTIVENESS**

Table 3 shows the control factors that will be applied to simulate the effects of the adoption of the OTC Model Rule or the OTC Model Rule plus SCAQMD Phase III limits. For purposes of modeling, we have assumed that rules will be adopted in 2007 and that the rules will allow a 2-year “sell-through” period, with full compliance occurring in 2009.

The control efficiency (CE) is the weighted average emission reduction efficiency for the entire category. The rule effectiveness is an adjustment to the CE to account for failures and uncertainties that affect the actual performance of the control measure. Because emissions will be controlled via reformulations, the EIIP guidance recommends that the rule effectiveness (RE) can be assumed to be 100 percent for all coating types affected by the rule. The rule penetration (RP) is the percentage of the area source category that is expected to be complying with the regulation. Not all products will be expected to be reformulated by 2009, so the rule penetration (RP) is estimated to be 80 percent.

## **RULE DEVELOPMENT ISSUES**

The Federal AIM rule in no way prevents states from adopting more stringent VOC content limits. In California, over half of the local districts have adopted or amended their AIM coatings rules to reflect the CARB-suggested control measure. Many of the OTC states have or will soon adopt the OTC Model Rule. The MRPO states could use the OTC Model Rule or SCAQMD Phase III limits as frameworks for developing state-specific regulations. CARB is updating the 2000 Suggested Control Measure (SCM) for Architectural Coatings, and expect to propose revisions to the SCM in mid to late 2007. It cannot be determined at this time whether CARB’s updated SCM will be as stringent as the SCAQMD Phase III limits.

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## GEOGRAPHIC APPLICABILITY

In an effort to maintain consistency and uniformity for the manufacturers of AIM coatings, it is preferable that any rules specifying more stringent VOC limits (whether the OTC Model Rule or the SCAQMD Phase III limits) be implemented across the MRPO region. Thus, emission reductions would be realized in both ozone attainment and nonattainment counties.

**TABLE 3 – CONTROL FACTORS BY YEAR AND CONTROL MEASURE**

<b>Year</b>	<b>Control Measure</b>	<b>CE</b>	<b>RP</b>	<b>RE</b>	<b>Emission Reduction % from Uncontrolled</b>
2002 (Base) and 2003-2008	Federal AIM rule:				
	Arch. Coatings Solvent-based	20	100	100	20
	Arch. Coatings Water-based	20	100	100	20
	Traffic Markings	20	100	100	20
	Industrial Maint. Coatings	20	100	100	20
	Special Purpose Coatings	20	100	100	20
2009-2018	Federal AIM rule plus OTC Model Rule & WI Traffic Markings Rule:				
	Arch. Coatings All	38.8	80	100	31.0
	Arch. Coatings Solvent-based	49.8	80	100	39.8
	Arch. Coatings Water-based	20.0	100	100	20.0
	Traffic Markings	56.4	80	100	45.1
	Industrial Maint. Coatings	60.5	80	100	48.4
	Special Purpose Coatings	60.5	80	100	48.4
2009-2018	Federal AIM rule plus OTC Model Rule & WI Traffic Markings Rule plus SQAQMD Phase III limits:				
	Arch. Coatings All	55.0	80	100	44.0
	Arch. Coatings Solvent-based	80.5	80	100	64.4
	Arch. Coatings Water-based	20.0	100	100	20.0
	Traffic Markings	56.4	80	100	45.1
	Industrial Maint. Coatings	60.5	80	100	48.4
	Special Purpose Coatings	60.5	80	100	48.4

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## TEMPORAL APPLICABILITY

Emission reductions would be realized throughout the year. However, AIM coating operations (especially outdoor coating applications) are typically more prevalent during the warmer months during the ozone season. The OTC applied a seasonality factor of 1.3 to reflect higher ozone season activity for coating operations, meaning that the average daily emissions should be multiplied by 1.3 to estimate ozone season daily emissions.

## AFFECTED SCCs

24-01-001-000	Surface Coating, Architectural Coatings
24-01-002-000	Surface Coating, Architectural Coatings – Solvent Based
24-01-003-000	Surface Coating, Architectural Coatings – Water Based
24-01-008-000	Surface Coating, Traffic Markings
24-01-100-000	Surface Coating, Industrial Maintenance Coatings
24-01-200-000	Surface Coating, Other Special Purpose Coatings

## OTHER IMPACTS

No potential negative environmental impacts have been identified.

## REFERENCES

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10. U.S. EPA. *Documentation for the Draft 2002 Nonpoint Source National Emission Inventory for Criteria and Hazardous Air Pollutants (March 2005 Version)*. March 2005.

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