SSPC: The Society for Protective Coatings

TECHNOLOGY GUIDE NO. 10

Guide to Specifying Coatings Conforming to Volatile Organic Compound (VOC) Content Requirements

1. Scope

1.1 This guide describes procedures for preparing a specification for protective coatings conforming with volatile organic compound (VOC) content requirements.

1.2 Procedures cover determining VOC content, compliance requirements, qualifying, selecting, and evaluating performance of coatings, and assembling the specification.

1.3 This guide is intended to be used by specifiers, end users, and others who are required to select, test, or specify coatings to meet VOC regulations.

2. Description and Definitions

2.1 This guide describes the major steps needed to prepare a specification to comply with VOC regulations.

2.1.1 Understanding VOC Regulations (Section 4): This section describes the basis of regulations and how VOCs are regulated. The types of regulations and the various coating categories are outlined.

2.1.2 Determining VOC Requirements (Section 5): Specific procedures include determining location of the coating application, identifying the agency having jurisdiction, determining the category of coating, determining the VOC level that must be met, and selecting the test method for determining VOC content.

2.1.3 Selecting Coatings to Meet VOC Requirements (Section 6): This section establishes the requirements for qualifying and selecting coatings to meet VOC requirements. Requirements include coating performance properties, application properties, field case histories, and supplier service. For each set of requirements the guide describes approaches for developing specific criteria and rating schemes.

2.1.4 Preparing Specifications (Section 7): This section gives guidance on assembling the specification. Key components include performance and application requirements, supplier qualification, VOC classification, thinning, and quality control provisions.

2.1.5 State Contacts for Air Quality Control Regulations (Appendix A): Information is also provided on state air quality contacts.

2.2 VOC LEVELS: Coatings are typically regulated by establishing limits on the VOC content of the coating at the time of application after addition of any thinners. (See Note 9.1)

This guide identifies six possible levels of VOC content which might be adopted for various coating categories:

- VOC Level 1 - less than or equal to 60 9/L (0.5 lbs/ gal)
- VOC Level 2 - less than or equal to 120 g/liter (1.0 lbs/ gal)
- VOC Level 3 - less than or equal to 250 g/liter (2.1 lbs/ gal)
- VOC Level 4 - less than or equal to 340 g/liter (2.8 lbs/ gal)
- VOC Level 5 - less than or equal to 420 g/liter (3.5 lbs/ gal)
- VOC Level 6 - unrestricted VOC content

(Editor's Note: As of the Eighth Edition of Volume 2 [September, 2000], these categories are no longer used in SSPC standards for paints and painting systems.)

2.3 DEFINITIONS

2.3.1 Volatile Organic Compound (VOC)

2.3.1.1 ASTM D 3960: Volatile Organic Compound (VOC): In coatings, any compound of carbon that evaporates from a paint or coating film under specific test conditions is a VOC. It thus does not include water and exempt solvents that are volatile. VOC may be determined at a specified temperature for a specified baking or air dry time and at a controlled film thickness.

2.3.1.2 U.S. Environmental Protection Agency Reference Method 24 - Volatile Organic Compound (VOC): Any organic compound which participates in atmospheric photochemical reactions is a VOC; that is, any organic compound other than those which the administrator designates as having negligible photochemical reactivity (known as "exempt solvents;" see Note 9.2). VOCs may be measured by a reference method, an equivalent method, an alternative method or by procedures specified under any subpart.

2.3.2 Transfer Efficiency: The ratio of the mass or volume of coatings solids adhering to an object to the total mass or volume, respectively, of coating solids used in the application process, expressed as a percentage (see Note 9.3).

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2.3.3 Attainment Area: An area considered to have air quality as good as or better than the national ambient air quality standards as defined in the Clean Air Act. An area may be an attainment area for one pollutant and a non- attainment area for others. For ozone, attainment requires that the ozone concentration not exceed 0.12 ppm (as a one-hour weighted average) more than once a year for three consecutive years.

2.3.4 Control Technique Guidelines (CTG): A series of EPA documents designed to assist states in defining Reasonable Available Control Technology (RACT) for major sources of volatile organic compounds.

2.3.5 State Implementation Plans (SIP): EPA-approved state plans for the establishment, regulation, and enforcement of air pollution standards.

2.3.6 Material Safety Data Sheet (MSDS): A compilation of information required under the OSHA Hazard Communication Standard on the identity of hazardous chemicals, health and physical hazards, exposure limits, and precautions. Section 311 of SARA requires facilities to submit an MSDS under certain circumstances.

3. Referenced Standards

3.1 SSPC STANDARDS:

Guide 9 Guide for Atmospheric Testing of Coatings in the Field

3.2 ASTM INTERNATIONAL STANDARDS:

D 610 Standard Method for Evaluating Degree of Rusting on Painted Steel Surfaces

D 1640 Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature

D 3960 Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.

3.3 U.S. ENVIRONMENTAL PROTECTION AGENCY METHOD:

40 CFR Ch. 1, Part 60, **Appendix A, Method 24**
Determination of Volatile Matter Content, Water Content, Density, Volume Solids and Weight Solids of Surface Coatings

3.4 ENVIRONMENTAL STATUTES:

Clean Air Act 1990
Clean Air Act Amendments, 1977 and 1990
Superfund Amendment and Reauthorization Act (SARA), 1986

4. Understanding VOC Regulations

4.1 REGULATING VOCS

4.1.1 Basis of Regulation: EPA and other environmental agencies regulate the VOC emission of coatings because VOCs are a precursor to ozone (a component of smog, the adverse effects of which have been extensively demonstrated). EPA was authorized by Congress through the Clean Air Act of 1970 and the Clean Air Act Amendments of 1977 and 1990 to coordinate and guide the state efforts to assure that all citizens have air of acceptable quality. To that end Federal and State agencies are developing regulations to control the production of ozone producing VOCs.

4.1.2 How VOCS Are Regulated

a. VOC Content: The most common method for regulating VOCs is by the mass of VOC emitted per volume of liquid coating less water and exempt solvents (see 2.3.1.2 and Note 9.2). Typical units are grams of VOC per liter (g/L) of coating or pounds of VOC per gallon of coating (lb/gal) (see Note 9.2.1). As described in Section 2.3.1, it is necessary to subtract the volume of water or of exempt solvents from the overall coating volume before computing VOC content. (Note: The “less water and exempt solvent” phrase has been omitted hereafter, but it should be understood to be an integral part of all subsequent quantitative terms.)

Commonly specified VOC levels are 420 g/L (3.5 lb/gal), 340 g/L (2.8 lb/gal), and 250 g/L (2.1 lb/gal). These are defined as SSPC VOC Levels 5, 4, and 3, respectively. Other levels established by SSPC include: Level 1 - less than or equal to 60 g/L (0.5 lb/gal), Level 2 - less than or equal to 120 g/L (1.0 lbs/gal), and Level 6 - unrestricted VOC content. These levels have been established to encourage uniformity throughout the industry in regulation of VOCs and product development efforts. Other levels (such as 350 g/L [2.92 lbs/gal] or 380 g/L [3.17 lbs/gal]) have also been used by various regulatory agencies.

b. Total VOCs Emitted: Some agencies set limits on the total weight of VOCs that can be emitted from a plant or facility in a day or year (kilograms or pounds). This type of rule has been applied for regulating VOC content for miscellaneous metal parts. (See 4.3.1.)

c. Transfer Efficiency: Transfer efficiency is defined in Section 2.3.2 (see also Note 9.3). A few agencies have imposed a minimum transfer efficiency (e.g., 65%) for the application of a coating to a substrate. Any reduction in the amount of coating wasted will of necessity reduce the amount of VOC emitted into the atmosphere. There is no direct correlation between transfer efficiency and VOC content of coatings, as a high VOC coating can be applied with high transfer efficiency or low transfer efficiency.

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4.2 TYPES OF REGULATIONS

4.2.1 EPA Control Technique Guidelines: Control Technique Guidelines (CTGs) are documents prepared by EPA which establish the level of control deemed to represent "Reasonably Available Control Technology." Publication of a CTG triggers a requirement that the states develop a state rule for major industries of the type for which the CTG was written. In many cases, states promulgated the recommendation in the CTG. In other cases, states developed different rules. Typically, a state is required to develop a State Implementation Plan (SIP) describing the methods to achieve the guidelines and the means to verify compliance. Another important feature of a CTG is that it is only applicable to those areas which are designated by EPA as non-attainment for ozone. The definition of attainment for ozone is given in 2.3.3.

4.2.2 EPA National Rule: A National Rule establishes a national requirement for controlling VOCs (i.e., by setting a standard level of compliance for total amount of VOC emitted, or limitations of VOC content of a coating). Unlike the CTG, a National Rule applies to all areas of the U.S. National Rules may be preemptive or non-preemptive. Preemptive rules prevent any air quality district (e.g., state, county, district) from having a rule more restrictive than the Federal rule. In a non-preemptive rule, individual states or air quality districts are permitted to have more stringent rules. Any local rule must be at least as stringent as the National Rule. To date, EPA has not issued any National Rules regarding protective coatings for structures.

4.2.3 State and Local Regulations: Most states have environmental agencies charged with protecting air quality. In many cases, they issue statewide regulations to meet EPA CTGs. However, because the CTGs do not mandate specific VOC levels or total emissions, the states are required to develop their own approaches to controlling VOCs from different surface coating operations. Many states have designated air quality districts based on geographical factors or population distributions. Thus, areas with higher potential for air pollution will tend to have stricter regulations regarding VOCs and other ozone-producing activities. For example, California has established approximately 30 air quality districts, each of which has authority to regulate the VOC content of coatings. Also, most large metropolitan areas (e.g., New York area, Chicago area) have air quality jurisdictions which may overlap cities, counties, or states. Any facility or structure owner requiring surface coating must be aware of the jurisdictions within which the coating application (and hence the VOC emissions) will occur.

4.3 COATING CATEGORIES: EPA has established a variety of categories for coatings typically used for heavy-duty industrial maintenance and new construction and architectural coating applications. The principal ones are as follows:

4.3.1. Miscellaneous Metal Parts and Products: This category includes coatings applied to various factory finished metals, including fabricated metal structures. Typical applications include shop-applied primers for bridges, water towers, and other steel structures, and coatings applied in railcar shops.

Typically, these rules are based on a CTG issued in 1978 by EPA as a guidance document for areas that have been designated as exceeding the national ambient air quality standard (NAAQS) for ozone. Coatings are classified as follows, with their recommended VOC limits:

- Air-dried coatings: 3.5 lbs/gal (420 g/L) - dried by the use of air or forced warm air at temperatures up to 194 ˚F (90 ˚C).
- Clear coatings: 4.3 lbs/gal (520 g/L) - unpigmented or transparent coating lacking color and opacity.
- Extreme performance coatings: 3.5 lbs/gal (420 g/L) - designed for harsh exposure or extreme environmental conditions.
- All other coatings: 3.0 lbs/gal (360 g/L) - any other type of coating.

4.3.2 Marine Coatings: These are coatings applied to ships, boats, and their appurtenances, and to buoys and oil drilling rigs intended for the marine environment. (See Note 9.2.2.)

4.3.3 Architectural and Industrial Maintenance (AIM) Coatings: This category, which is often referred to as Architectural Coatings, is a broad category encompassing most field-applied coatings for residential, commercial, or industrial applications. It also includes pavement marking coatings. Because of this diversity, it is useful to subdivide this category as follows:

a. Architectural Coatings: These are coatings applied to exteriors and interiors of residential and commercial structures, including houses, warehouses, commercial buildings, stadiums, hospitals, and schools. Coatings are intended to provide good appearance properties and to protect against wear and weather in normal indoor and outdoor environments. (see Note 9.2.3).

b. Industrial Maintenance: These are coatings applied to steel and concrete industrial facilities or structures. The coatings are intended to provide long-term protection against corrosion and weathering in exposures ranging from mild to severe atmospheric, salt or potable water immersion, intermittent or continual immersion in chemicals or solvents, abrasive conditions, and extremes of pH, temperature, and pressure. (See Section 9.4 for a definition from the California Air Resources Board.)

5. Determining VOC Requirements

5.1. DETERMINE LOCATION OF PAINT APPLICATION: Identify the location or locations where paint will be applied, as

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