Bay Area Air Quality Management District

939 Ellis Street
San Francisco, CA 94109

Bay Area Ozone Strategy
Control Measure SS 5

BAAQMD Regulation 8, Rule 32: Wood Products Coatings

Workshop Report

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Prepared by:
Guy A. Gimlen
Senior Air Quality Engineer
Planning, Rules and Research Division

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I. INTRODUCTION

This Workshop Report provides information regarding proposed amendments to Bay Area Air Quality Management District (BAAQMD or the District) Regulation 8, Rule 32: Wood Products Coatings ("Regulation 8-32"). The District proposes these amendments to Regulation 8-32 to reduce emissions of Volatile Organic Compounds (VOCs) by reducing the VOC content requirements for wood product coatings. The District committed to updating this regulation in Control Measure SS-5 in the District's 2005 Ozone Strategy.

VOCs contribute to the formation of ground-level ozone, which is the principal ingredient in smog. The Bay Area is not in compliance with State and federal ozone standards, and has committed to implement all feasible measures to reduce emissions of ozone precursors, including VOC. Regulation 8-32 regulates VOC emissions from the wood products manufacturing industry by setting standards for the amount of VOC that can be used in the surface preparation, coatings application, and cleanup for the manufacture of wood products including furniture, bathroom vanities, kitchen cabinets, picture frames, outdoor speakers, architectural millwork, and other wood products.

The proposed rule amendments will reduce the amount of VOC allowed in various types of wood products coatings. District staff is proposing more stringent VOC standards because the performance of low-VOC solvent-based coatings (using exempt solvents) and water-borne wood coating products has improved considerably over the last 10 years, and low-VOC products are now readily available that meet wood products manufacturers' needs. District staff is proposing to reduce VOC limits for sealers, fillers, wash-coats and stains. The proposed limits are consistent with standards adopted by several other California air districts in the past few years. Staff believes that such limits are similarly appropriate for the Bay Area.

Staff is also considering alternative standards based on a coating's VOC content relative to the amount of coating solids the coating contains. Coating solids are the binders, pigments, and resins that form the coating on the wood product after the VOCs have evaporated and the coating has dried. If a coating has greater solids content, less coating may be required to coat a wood product and then fewer VOCs are emitted. In order to encourage manufacturers to use coatings with higher solids content, the proposed amendments provide two alternative compliance options: one based on the VOC content in the entire volume of the coating and one based on the VOC content per unit of coating solids. Wood products manufacturers are then able to choose whichever compliance option best suits their needs.

The proposed amendments also include several related provisions to improve the implementation and enforceability of the rule. These amendments include revisions to the way coatings are classified for purposes of VOC-content regulation, enhanced labeling requirements for wood products coatings, and editorial revisions to the rule language to make it easier for wood coatings users and the public to understand what is required. In

addition, the Emissions Averaging Procedure found in the Manual of Procedures, Volume 1 is proposed to be updated to be consistent with the proposed rule amendments.

Expected VOC emission reductions from these proposed amendments are 0.46 tons per day. This represents one third of the current emissions of 1.26 tons per day from wood products coating operations. Total emissions from all wood products coating, including solvents for surface preparation and cleanup are estimated to be 1.48 tons per day.

Industry impact is expected to be moderate. While the coating technology to achieve these proposed limits is readily available, each wood products manufacturer may have to modify its individual processes and procedures, and may require some new equipment to ensure it continues to meet the quality standards for its specific products using lower-VOC coatings. Facilities may have to adjust spray techniques, drying techniques, and other production procedures to accommodate the characteristics of lower-VOC and water-borne coatings. Costs of complying with this rule may include capital for new equipment used to apply and/or dry the coatings, and higher costs for the lower-VOC coatings. Higher costs for lower-VOC coatings, particularly water-borne coatings, may be partially offset by the reduced use of solvents and cleaners, less disposal of hazardous waste, and lower insurance premiums from reduced solvent storage.

The District is publishing this report to outline and explain the proposed amendments to the public, affected facilities, and any other interested persons. The report begins with a description of the wood products industry in the Bay Area and how VOC emissions can be minimized from wood products coating operations. It then describes the current regulatory approach to VOC emissions from this industry and how it has developed over the past 25 years. The report then describes the proposed amendments that staff is considering, along with an assessment of the emissions reductions that would be achieved and the costs involved.

District staff will be holding one or more public workshop(s) to discuss the amendments, and invites participation in the workshop and written comments on any aspect of the proposals. When District staff finalizes the proposed amendments, they will be submitted for consideration by the District's Board of Directors.

II. BACKGROUND

A. The Wood Coating Industry

Information from the 2006 NAICS County Business Patterns database sorted for the nine Bay Area counties indicates that the wood coating industry in the Bay Area encompasses about 650 businesses in all nine counties, including a wide variety of products, sizes of manufacturing operations, and finishing techniques. These businesses vary in size from one and two person shops engaged in cabinet making or furniture refinishing to manufacturing facilities employing in excess of 100 people. Businesses also vary in the types of products they produce. About 300 businesses in the Bay Area produce millwork and kitchen cabinets.

Approximately 200 businesses produce household, office and public building furniture; and cabinetry for electronics, bookcases and display cases. More than 100 businesses refinish furniture and are subject to Regulation 8-32 but do not have to meet the VOC limits in the Rule because refinishing is currently exempt. More than half of the businesses that manufacture kitchen cabinetry employ 10 people or fewer, as do the majority of the furniture manufacturers.

Businesses in the wood coating industry also vary greatly in the types of coatings they use and the types of finishes they create. Wood coatings encompass a wide variety of materials, application and finishing techniques, and customers require a significant range in the quality of finishes on products made of wood. A wood product may be coated with no more than a paint or primer or may, as is often the case of high quality furniture finishes, be coated in a multi-step process involving sealer, stain, sanding sealer, more stains and finally topcoats, with surface preparation between many of the steps. Some furniture finishes consist of as many as nine separate application steps. Coating materials must be selected for resistance to common household chemicals for kitchen cabinets, abrasion and "hot print" (hot object) resistance, clarity, color, gloss and film build. The coatings must be compatible, or in some cases, incompatible where the look of the finish depends on different drying rates of solvents. A typical kitchen cabinet will typically have three applications of coatings: stain to color the wood and enhance grain, sanding sealer to seal the wood and build a smooth surface, and a clear topcoat (often nitrocellulose lacquer) to produce a resistant finish with the desired gloss and clarity. Customer requirements for furniture and custom architectural millwork are different and usually more demanding than those for cabinetry and general wood products. Applications techniques vary as well, from spray application to dipping, hand brushing or wiping. Overall, there is a much wider variety of finishing techniques used in the wood coating industry than in any other surface coating industry.

B. Regulation of Wood Coating Operations in the Bay Area

1. District Regulation 8, Rule 32

Regulation 8, Rule 32 limits VOC emissions from wood coating operations by restricting the amount of VOC in the coatings used in such operations, as well as requiring work practices that minimize the amount of coatings needed. The main elements of the regulation are as follows:

- VOC-Content Limits for Wood Coatings: The regulation limits the amount of VOCs allowed in the coatings used. The regulation has three tiers applicable to different types of coating operations, in recognition of the fact that different types of wood products have different needs in terms of the quality and durability of their finishes. The most stringent standards apply to general wood products. Somewhat less stringent standards apply to furniture, custom cabinetry and custom architectural millwork in light of the more demanding requirements. The least stringent standards apply to custom furniture, which typically require the highest quality finishes. The regulation also allows higher-VOC coatings to be used if the facility captures and controls the emissions from the coatings with an abatement device, such as a thermal

oxidizer that incinerates the VOCs before they can be emitted into the atmosphere. One wood product manufacturer in the Bay Area has a thermal oxidizer.

- High-Efficiency Application Devices: The regulation requires the use of certain coating application equipment to ensure high transfer efficiency. Businesses coating wood products must use one of the following application methods: airless spray, air-assisted airless spray, electrostatic air spray, or high-volume low-pressure spray. This equipment reduces overspray and thus is more "transfer efficient" than conventional air spray. The use of such equipment reduces VOC emissions because less total coating is required to cover a given object.

- Good Surface-Preparation and Cleanup Practices: The regulation also requires good housekeeping practices to minimize emissions from solvent storage, surface preparation and other cleanup activities.

- Averaging VOC Content of Multiple Coatings: The regulation also includes a provision to allow averaging of VOC content among all of the wood coatings used throughout a given facility as an alternate means of compliance. This provision allows a facility to use some coatings that may exceed the applicable VOC standards by averaging them against coatings that contain less than the VOC standards. This approach provides the flexibility to use a higher VOC coating to create a specific finish for one product, yet balance the emissions with use of lower VOC coating applications for that product, or for other wood products. The facility achieves the same emissions reductions as compliance with the standards set for each type of coating. The flexibility also encourages coating manufacturers to develop coating systems (typically a stain, sealer, and topcoat) with an eye toward overall emissions from the coating system as a whole, rather than strict compliance with the VOC limits for each separate component of the system.

- Limited Exemptions for Special Applications: The regulation also provides exemptions for certain uses that do not involve significant emissions and/or for which suitable low-VOC coatings have not been developed, such as furniture refinishing, crackle lacquers, and leaf finishes.

These requirements ensure that emissions from wood coating operations will be minimized to the greatest extent feasible, while ensuring that manufacturers can still produce products with durable high-quality finishes for use by the general public.

2. The History and Development of Regulation 8, Rule 32

Regulation 8, Rule 32 was originally adopted in 1983, and has evolved considerably since that time.

1983: Rule Adoption

In 1983, low-VOC technology for wood coatings was not sufficiently developed to incorporate into the rule. Instead, the rule focused on requiring transfer-efficient application equipment. The rule required that users of over 500 gallons of coating per year apply coating with airless spray, air-assisted airless spray, electrostatic air spray, low-pressure spray, or hand application methods.

1991: VOC Content Limits for Coatings Added

The District incorporated VOC content limits into Regulation 8, Rule 32 in 1991. The limits were to be implemented in several stages, culminating in the lowest VOC limits to become effective in 1994 and 1996. The District's 1991 Amendments to Regulation 8-32 were analogous to South Coast AQMD's 1988 amendments to its Rule 1136 except for two major aspects.

First, industry coating formulations to meet the South Coast requirements had shown a one ton per day increase in emissions of stratospheric ozone depleting compounds due to reformulations using 1,1,1, trichloroethane, which the South Coast rule had exempted from the VOC requirements. The 1991 Amendments therefore included 1,1,1, trichloroethane in the definition of VOC, rather than excluding it. This approach, although not prohibitory, discouraged the reformulation of coatings using ozone depletors. Although controversial with coating formulators and producers of chlorinated solvents, the rule has been effective in guiding reformulation away from ozone depleting and toxic solvents. Ultimately, this approach was validated when the Clean Air Act Amendments of 1990 required a phase out of ozone depleting solvent production, and production of chlorinated solvents was completely phased out by the end of 1995.

Second, the District created the separate regulatory tiers for different types of wood products coating operations to reflect the needs of the various wood product customers and the technologies available to meet these needs. The District adopted more stringent standards for general wood products and somewhat less stringent standards for furniture, custom cabinetry, and custom architectural millwork, which have more demanding requirements for the appearance and performance of their finishes. In addition, the District created a sub-category of the furniture category, custom cabinetry, and a custom architectural millwork category for custom and contract furniture, which were subject to the same VOC limits, but were given extra time for implementation to improve both the coatings and applications processes. The 1991 Amendments also provided exemptions for refinishing, certain types of specialty finishes, and the production of antique replicas and musical instruments.

1994: Implementation Dates for Future VOC Reductions Delayed One Year

In 1994 the District extended the implementation dates for the latter phases of VOC reductions by one year to give the wood coating industry sufficient time to develop compliant coatings that would meet its requirements for adherence, clarity and appearance of finish, chemical and mar resistance, and coating system compatibility. In addition, the amendments included an adjustment to the VOC limit for sanding sealers because it became clear that the VOC limit scheduled for 1994 could not be achieved until 1997.

1996: Current Rule Adopted

During 1995, many companies sought variance protection for a year to give more time for water-borne coatings to develop. Most of the companies seeking the variance protection were producing high-end furniture for home and office use, custom cabinetry and custom

millwork. Further, elimination of the exemption for 1,1,1, trichloroethane as a solvent in wood coatings greatly complicated the formulation of coatings that could meet the lower VOC limits. In 1996, the District amended Regulation 8-32 to establish achievable VOC limits for each of the three different classes of wood products, and a timetable for implementation based on progress that was being made in the development of lower VOC coatings. General wood product facilities have complied with current VOC limits since 1995. Furniture, custom cabinetry and custom architectural millwork facilities have complied with current VOC limits since 1996. The custom and contract furniture manufacturers have complied with current VOC limits since 1997.

Some solvents that had been used in wood coatings were approved as exempt from the VOC limits, based on their very low tendency to form ozone in the atmosphere. Acetone, an example of such a solvent, was exempted from the VOC calculation in late 1995. Some coatings used acetone as a substitute for other solvents in lacquers. Other exempted solvents, like parachlorobenzotriflouride, were also used. The VOC limits that were proposed in 1996 accommodated solvent-borne materials consistent with the existing technology and with use of exempt solvents.

The 1996 amendments also adopted a VOC-content averaging procedure by which businesses can use coatings with VOC content higher than the applicable standards if they offset them against other coatings they use with VOC content lower than the applicable standards. This provision was widely supported by the coating manufacturers and the wood products and furniture industry. The Emission Averaging Procedure was included in the District Manual of Procedures to provide the calculation methodology, and provided an enforceable and EPA-approved method to implement averaging. Minor updates to the Emission Averaging Procedure are included in this workshop proposal.

The 1996 amendments also exempted certain coatings from the VOC limits in the Rule:

- *Coatings used on wood forms in the foundry industry.* The exemption was based on the very small quantity of emissions involved, the exacting tolerances to which the forms must adhere, and the uniquely harsh environment where these coatings must perform.
- *General wood products that are subject to extreme environmental conditions such as unusually abrasive or corrosive conditions or temperature extremes.* These products, in certain limited circumstances, can be coated with higher-VOC coatings, allowing the use of high solids, hard film-forming coatings such as polyurethanes. Administrative requirements for petitioning for this limited exemption were included.
- *Facilities that use and keep on site only low VOC coatings.* An exemption from daily recordkeeping requirements was added for these facilities to provide an incentive to fully implement low-VOC technology, and to reduce emissions beyond the regulatory requirements.

Finally, the amendments also changed the definitions for "semi-transparent" and "opaque" stains to "low-solids" and "high-solids" stains to better reflect the regulatory requirements; added definitions for custom cabinetry, custom or contract furniture, and extreme environmental conditions to clarify the applicability of the regulatory requirements for these products; and updated references to test methods.

3. Other District Coatings Rules

In addition to Regulation 8, Rule 32, the District has adopted several other rules applicable to coating operations involving wood products, including:

- **Regulation 8, Rule 3**, which limits VOC emissions from Architectural Coatings used in on-site coating of buildings or appurtenances (including cabinets finished at the site of installation).
- **Regulation 8, Rule 4**, which limits VOC emissions from general solvent and surface coating operations. Some minor types of coatings exempt from Rule 32 are subject to Rule 4, such as the stencil coating of wood products.
- **Regulation 8, Rule 23**, which limits VOC emissions from the application of coating, adhesive and ink to wood flat stock and wood paneling.
- **Regulation 8, Rule 51**, which limits VOC emissions from Adhesive and Sealant Products by regulating adhesive applied in-shop or on-site (except adhesive used in the manufacture of laminated paneling or other flat stock such as doors).

These rules combine to limit the VOC content of all coatings used on wood, or alternatively, reduce emissions through the use of abatement equipment. The rules also establish standards for abatement efficiency where abatement devices are used, require the use of operating procedures that minimize VOC evaporation, and require recordkeeping to demonstrate compliance.

III. TECHNICAL REVIEW

This section reviews technical issues involved in air pollutant emissions from the wood products coating industry, and options available to prevent or control VOC emissions from wood coatings.

A. VOCs and Air Pollution

Wood coating operations present an air quality concern because the coatings contain VOCs, which contribute to the formation of ground-level ozone. Ozone is the primary chemical component in smog, and it creates a health concern for people who breathe it at unhealthy levels, especially in vulnerable populations such as children and people with asthma. Ozone is created when VOCs react with nitrogen oxides in the atmosphere in the presence of heat and sunlight.

B. VOC Emissions from Wood Coating Operations

Regulation of emissions from coating operations focuses on the amount of VOC present in a coating. The VOC in the coating evaporates as the coating dries, causing VOC emissions into the atmosphere where they can form ozone. Coatings regulations therefore impose restrictions on the amount of VOC allowed in various types of coatings, most often stated as a limit on the number of grams of VOC allowed per liter of coating.

Emissions occur when the solvents in the coating evaporate. The process steps may be done in single spray booth or in a series of booths, separated by flash-off areas and drying ovens. The flash-off area allows a solvent to rise to the surface of the coating before high temperature curing operations can occur. Typically it is during the flash-off and curing / drying phases that VOC is emitted to the atmosphere. It is reasonable to assume that all of the solvents used in the coating process eventually reach the atmosphere. About 20% of the manufacturers in the Bay Area currently use ovens or UV lighting for curing.

Coatings can require only one coat, or several coats, depending on the finished effect needed. Generally, multiple coatings are applied in the following order: stain, wash coat, filler, sealer, and top coat. Each coating typically contains both solids and liquid solvents. The solids portion contains pigments and resins (binders or film formers) and at times plasticizers. The solvent portion may include VOCs, exempt solvents, and water. Conventional (high VOC) coatings normally contain 70 – 80 percent solvent. Water-borne coatings are those that contain water as a solvent or diluent. Merely having water in a coating, however, does not ensure that the coating complies with applicable VOC regulations, as many water-borne coatings also contain VOCs. Coatings with "high solids" content (solids content greater than 60%) usually have a reduced VOC content. Exempt solvents are those organic compounds that do not play a significant role in forming ozone. Since they don't react with nitrogen oxides in the air to form ozone, they are desirable substitutes for organic compounds that do form ozone (provided they do not have other negative effects, such as toxicity or depletion of stratospheric ozone). The most prominent exempt solvents used in wood coatings are acetone, and parachlorobenzotriflouride. Each of these solvents has played a large role in developing low VOC wood coatings that work effectively to produce the desired wood finishes (although coatings that use acetone as a solvent substitute often require alterations to spray equipment to accommodate the rapid evaporation rate of highly volatile acetone).

Application techniques vary from airless and High Volume Low Pressure spray to hand wiped finishes. This variance in applications can have significant emissions ramifications. Coatings applied with compliant application equipment have higher transfer efficiency; consequently, less coating is wasted through overspray. Maximum transfer efficiency and therefore minimum emissions are achieved through hand application methods: brush, wipe, pour and drain or dip and drain. However, the high transfer efficiency is partially offset by solvent evaporation from open containers.

Organic compound emissions from surface preparation and cleanup are easily minimized by good housekeeping practices. Surface preparation of wood products is almost entirely by physical processes such as sanding, and rarely is an organic solvent used. Clean up can use a

significant amount of the solvent that provides the base solvent in the coating, such as lacquer thinner. Good housekeeping practices include keeping solvent containers closed when not in use, and using closed solvent recirculation for tool and spray gun cleanup. Strippers are typically only used in furniture refinishing. Most strippers consist of methylene chloride as the active agent, which is toxic, but has been determined to have negligible photochemical reactivity by the US EPA. Exposure to the toxicity of methylene chloride strippers is minimized by the use of gels which reduce evaporation. Nevertheless, refinishers using methylene chloride based strippers are subject to the District's risk assessment requirements before obtaining permits.

C. VOC Control Technologies

There are four major categories of control strategies that can be used to reduce VOC emissions from wood coating operations. They are:

1. Low-solvent and water-borne reformulated coatings
2. Add-on control devices
3. Emerging technologies
4. Improved work practices

1. Reformulated Coatings

Nitrocellulose resin lacquer technology had provided the benchmark for expectations of many wood finishers over the last several decades. It was easily applied, inexpensive and provided a beautiful finish. These lacquers also provided the advantage of always being resoluble in their original solvent, so minor "touch-up" repairs to the coating surface could be made easily. However, nitrocellulose resin lacquers were only soluble in large amounts of organic solvent. Reductions in wood coating VOC limits have driven development of alternatives like water-borne technology, and improvement in some solvent-borne technologies like high-solids urethanes and polyester resins. The primary focus for improvement of emissions from wood coatings continues to be development of low VOC coatings, including water based coatings.

Low-solvent Reformulated Coatings

Low-solvent reformulated coatings that contain less solvent will reduce VOC emissions. Currently, low-VOC reformulated coating alternatives are available and can be used for general wood coating applications. The greater challenge is using these coatings for the more demanding applications like furniture and custom wood products manufacture, refinishing, and antiques.

Typically wood finishes must pass a variety of tests to produce an acceptable finish. The first of these tests, and ultimately the most important, is appearance. Conventional nitrocellulose lacquer has unique refractive properties that give richly colored woods a "warm" appearance. Furniture manufacturing in the United States tends to favor this natural appearance. Water-borne finishes have traditionally suffered from an appearance often described as "plastic", due to the resin systems used. The finishing of fine furniture is different from finishing cabinetry because the desired appearance is different. In furniture, often the intent is to allow the natural beauty of the wood to be accentuated; cabinetry,

particularly kitchen cabinetry, demands a finish that gives the appearance of a protective coat. Some cabinetry is finished to accentuate the natural beauty of the wood, while other finishes conceal the wood.

Secondary but no less important considerations for wood coating concern the protective nature of the coating. Specifically, scratch or mar resistance, hot imprint resistance, and chemical resistance are of concern. Furniture is subject to scrapes and scratches from any object set on a desk, dresser or coffee table. Whereas a deep scratch in any surface coating would be expected to need repair, furniture must be able to withstand minor scratches from everyday use. In addition, since wood is a relatively soft substrate, a coating must be able to have some flexibility. A coating that is overly hard or brittle will shatter from object impact, much like glass. A successful coating must flex slightly to "give" along with the underlying wood. Hot print resistance is the ability of a coating to resist "melting" or softening when a warm object such as a hot cup of coffee comes into contact with the surface. Otherwise, a hot coffee cup will stick to a table or desk. Hot print resistance is not a problem of solvent borne coatings that chemically polymerize, such as urethanes, polyester resins or conversion varnishes. Conventional nitrocellulose lacquers are also heat resistant. However, hot print resistance does tend to be a problem of coatings that form films by coalescence or fusion of adjacent particles as the volatile portion evaporates, which is typical of water emulsified coatings. In addition, coatings must also be resistant to a variety of chemicals, particularly household chemicals such as vinegar (acetic acid), alcohol, water, oils, detergent and ammonia. Products intended for home or office use must meet standardized or company specific tests, often using specific household products, such as hot coffee, cola, grape juice, tomato juice, mustard, lipstick, nail polish remover and ethanol. In addition, a "lipids acid" test has been developed to mimic the effects of human skin oils. All coatings, including the traditional lacquers, show varying degrees of resistance to different chemicals, but many of the water-borne coating have tended to be less resistant to household chemicals than solvent borne coatings.

Low-VOC coatings have been developed that can satisfy these requirements for many operations, although even where there are satisfactory low-VOC alternatives adopting them is not as simple as just switching to a new coating supply. Often application processes and curing equipment need to be changed as well.

Water-Borne Reformulated Coatings

Coatings that use water instead of solvent as a medium have also been developed. These water-borne coatings are normally very low in VOC content. The overriding problem water-borne formulations face is the basic interaction between water and the wood. The absorptive nature of wood and the tendency of wood grain to swell when wet is the reason that water-borne technology for wood coatings has been slower to develop than for any other type of substrate. Swelling grain results in the necessity to sand a surface smooth, which in turn removes coating, resulting in the necessity of re-application, and, potentially, renewed swelling. This tends to be a much greater problem with "open grain" woods such as oak, walnut and mahogany than with "closed grain" woods such as birch, cherry and maple. Partial solutions to this problem have been found in modification of application techniques,

including humidity control, the use of heat lamps or drying ovens, and control of room air flow. Improvements in the water-borne coatings themselves have made excellent progress over the last several years in greatly reducing, and in some cases eliminating this problem.

Staff discussed the use of coatings in the manufacture of wood products with several businesses and suppliers. Some use solvent-based coatings, and some use water-borne (very low-VOC) coatings. The conversion from solvent based coatings to water-borne coatings involves more than simply changing the coating being applied. Water-borne coatings require the use of spray guns designed for spraying water-borne coatings, or existing spray guns must be retrofitted to include stainless steel or plastic parts to prevent rust. Application of water-borne coatings requires additional steps, and new techniques. The cool and somewhat damp climate in the Bay Area during the winter months is not conducive to drying water-borne coatings, leading to longer drying times.

While there have been no "breakthrough" improvements in water-borne technology for wood coatings, incremental improvements have enabled several coatings manufacturers to develop water-borne coatings, combined with application and drying techniques that meet the needs of most of their customers.

2. Add-On Abatement Devices

Add-on control devices are incorporated into a process to remove or destroy VOCs after the coating process occurs. There are three add-on control methods: thermal oxidation, catalytic oxidation, and adsorption. Although these add-on controls are effective at eliminating air pollution after it is emitted, the preventive approach of reformulating coatings to reduce VOC content is generally favored because it eliminates the pollution altogether rather than capturing it after the fact. In addition, most abatement devices are relatively costly compared to switching to low-VOC coatings. They also require energy to construct and operate, contributing to the generation of greenhouse gases.

- Thermal oxidation: Thermal oxidation involves incinerating VOCs to prevent them from being emitted. Incinerators are usually operated at a high temperature to efficiently destroy most VOCs found in the exhaust stream. Factors affecting incinerator performance are residence time in the combustion zone and incinerator temperature. Thermal oxidizers can achieve close to 100% VOC destruction for most VOCs. The major concern with thermal oxidation, in addition to capital cost, is that large amounts of fuel (usually natural gas) must be burned to destroy a dilute stream of VOCs, resulting in additional carbon dioxide from use of fuel, as well as the carbon dioxide generated from burning the VOCs. Carbon dioxide is a greenhouse gas, implicated in global warming.
- Catalytic Oxidation: Catalytic oxidation is similar to thermal oxidation, but it introduces a catalyst to dramatically increase the oxidation rate. The catalyst itself is not altered during the reaction. The increased reaction rate can greatly reduce the temperatures required, resulting in significant fuel savings. Catalytic units include higher installation costs and the possibility of catalyst poisoning by sulfur, metals, and phosphorous. Catalytic units can achieve in excess of 95% VOC destruction

efficiency. Greenhouse gas emissions are less than with thermal oxidation, but still a concern with this control technology. There is one facility in the Bay Area that uses catalytic oxidation to reduce VOC emissions.

- Adsorption: Adsorption is a mass-transfer operation involving the conversion of VOC from a gas to a liquid or solid. The most common adsorption system uses activated carbon, which is effective in capturing most VOCs through physical adsorption. In addition, activated carbon can be regenerated by steam, nitrogen stripping, or by drawing a vacuum on the carbon. At minimum, two adsorption beds and a regeneration facility are required for an adsorption process. VOC removal efficiency can be as high as 95%. This control technology results in energy consumed in regenerating the activated carbon, as well as creating, transporting, and disposing of the activated carbon – all contributing to greenhouse gas emissions.

3. Emerging Technologies

Emerging technology efforts are underway to improve the techniques that show promise in the wood product coating industry. These developments include advances in spray booth design, new curing methods that involve three dimensional UV curing, and research into bio-filtration that will improve add-on controls. While many of these show potential, there have not been any breakthroughs that revolutionize the development of low VOC coatings, or application or drying techniques.

4. Improved Work Practices

Improved work practices, such as employing high transfer efficiency application methods and reducing the volume of clean-up solvent, can lower VOC emissions by minimizing the quantity of VOC-containing materials used. Most wood product facilities currently employ these practices to minimize VOC emissions.

D. VOC Content Averaging

More strict VOC content limits can have differing impacts on the wood coating facilities in the Bay Area depending on their specific coating products and finishing techniques. In addition, some companies find low-VOC content coatings are effective with some but not all products. To provide flexibility in achieving compliance, an averaging provision is provided in the rule. Staff proposes to continue to provide this averaging option. Guidance for averaging calculations is included in the Manual of Procedures, Volume I: Enforcement Procedures. A facility can average as many coatings as necessary to achieve compliance. Larger facilities that emit more than 25 tons per year are subject to the EPA Economic Incentive Program, and must discount any averaged emissions by 10%. This affects only a few facilities in the Bay Area.

In addition to the flexibility the averaging provision provides, it also encourages the ability to consider different mixtures of coatings that can result in lower emissions. The ability to offset these coatings with higher VOC technologies provides a driving force for facilities to continue experimentation with lower VOC (and water-borne) coatings. Coating systems can be created with overall emissions in mind, rather than compliance with individual categories.

This is especially important for products that currently require several steps of surface preparation and several layers of coatings. Many companies continue to support this added flexibility.

IV. RULE AMENDMENTS BEING CONSIDERED

The District is now considering the following amendments to Regulation 8, Rule 32. The District is seeking input from affected industry and from the public on these changes.

A. More Stringent Limits for VOC Content

The main purpose of the amendments the District is considering is to reduce the amount of ozone formed as a result of VOC emissions from wood products coatings. The primary mechanism for achieving this goal would be to reduce the amount of VOCs allowed in various types of wood coatings, as several other air districts have done.

The proposed amendments would impose more restrictive VOC limits for wood products coatings. For most coating types, the proposed new limits are 275 g/l (2.3 lb/gal) for high-solids coatings and 120 g/l (1.0 lb/gal) for low-solids coatings. This represents a significant reduction for some coatings. The current limits for most high-solids coatings are 500 or 550 g/l, double the proposed new limits; and the current limit for low-solids coatings is 480 g/l (4.0 lb/gal), four times the proposed new limit.

For three specific types of high-solids coatings where a 275 g/l limit would not be feasible, the District is proposing somewhat less stringent limits. First, for high-solids stains, the District is proposing a new limit of 350 g/l (2.9 lb/gal). High-solids stains generally require more VOCs to work effectively because solvent is required to provide penetration of the stain into the wood substrate. One air district in California has a VOC limit of 240 g/l, but CARB and every coating manufacturer has indicated there are on-going implementation issues with these high solids stains. Second, furniture, custom cabinetry and custom architectural millwork require more demanding finishes in both appearance and durability. Conversion varnish is a coating that uses a chemical reaction rather than evaporation to adhere to the wood and form a solid protective coating. Conversion varnish has the inherent advantage that it can serve as a sealer as well as a topcoat, so the sealing and topcoat steps are done together. The proposed conversion varnish VOC limit is 550 g/l (4.6 lb/gal) VOC when used as both a sealer and a topcoat. This 550 g/l conversion varnish provides manufacturers more flexibility for coating non-custom furniture, custom cabinetry, and custom architectural millwork. For general wood products, the conversion varnish VOC limit would remain at 275 g/l. Third, the proposed amendments for clear topcoats used on custom furniture leave the VOC limit at 550 g/l, instead of reducing it to the 275 g/l limit proposed for clear topcoats for other types of wood products. Staff has found that it is not be feasible at this time to require the use of lower-VOC clear topcoats for custom furniture because custom furniture must meet very high standards and demanding customer expectations.

These proposed new VOC-content limits are consistent with limits that have been successfully implemented in other California air districts. Coatings can be manufactured to meet these more restrictive VOC limits by using water or exempt solvents – primarily acetone and parachlorobenzotriflouride – in place of regulated VOC-based solvents. For the furniture manufacturing industry, which requires very high quality finishes for its products, improvements in topcoats, pigmented coatings, sealers, and stains, coupled with the ability to use a higher VOC conversion varnish, will allow them to meet their customers' demanding requirements while still complying with the more restrictive VOC limits.

B. Revised Regulatory Categorization of Coating Types

The District is also revising the terminology it uses to categorize the various types of coatings. Staff is proposing alternate VOC limits (discussed below, in grams of VOC per gram of solid) to provide flexibility and continue to encourage development of new and innovative low VOC / high solids coatings. These alternate VOC limits require differentiating the broad category of sanding sealers into clear and pigmented sealers. These alternate VOC limits also require differentiating the broad category of pigmented coatings into pigmented topcoats and pigmented primers, sealers, and undercoats. The proposed categories are consistent with South Coast AQMD Rule 1136 that also provides the alternate VOC limits in grams of VOC per gram of solids.

In addition, conversion varnish is a type of coating that had not previously been uniquely identified. Conversion varnish is included as a specific identifiable coating because it can play an important role in reducing overall VOC emissions because it can serve as both a sealer and topcoat. Multi-colored coatings are also uniquely identified now, because they are becoming more of a commodity product rather than a specialty coating. In the general category of low solids coatings, toner was added in with wash-coat to more fully characterize that category of low solids coatings. Definitions for conversion varnish and toner are included in rule.

C. Alternative Compliance Option Based on Solids Content

The District is proposing alternative VOC standards based on the solids content of the coating rather than the overall volume of the coating. The ability to beautify and protect wood is dependent on the coating solids content (the resins and pigments that remain after the volatile portion evaporates). The higher the solids content, the less coating is needed to cover the wood. High solids content provides more layer of finished coating (called film build) in a gallon of coating and thereby reduces the total gallons of coating needed, which also reduces the total VOC emissions. Staff is therefore proposing to add an alternative compliance option for high solids coatings in the form of VOC standards expressed as grams of VOC per gram of coating solids. This form of a standard will continue to encourage coating manufacturers to develop high-solids coatings that maximize coverage with minimum solvent evaporation.

To incorporate this alternate compliance option, the proposed amendments would allow coatings to comply with either of the alternative VOC limits, one expressed as grams (or pounds) of VOC per liter (or gallon) of coating, and one expressed as grams (or pounds) of

VOC per gram (or pound) of coating solids. The proposed limits for each category of high-solids coating are shown in Table 1. The proposed VOC limits are consistent with similar limits in South Coast AQMD Rule 1136, and will not create any unique requirements that could cause a disruption in the coatings industry.

Table 1: Proposed Wood Coating VOC Limits

Coating Category	Current VOC Limits	Proposed VOC Limits		
		General Wood Products	Furniture, Custom Cabinets and Millwork	Custom Furniture
High Solids	g/l (#/gal)	g/l (#/gal) [g/g]	g/l (#/gal) [g/g]	g/l (#/gal) [g/g]
Clear Sealer	–	275 (2.3) [0.36]	275 (2.3) [0.36]	275 (2.3) [0.36]
Clear Topcoat	275 (2.3)	275 (2.3) [0.35]	275 (2.3) [0.35]	550 (4.6) [0.70]
Conversion Varnish	–	275 (2.3) [0.60]	550 (4.6) [1.20]	550 (4.6) [1.20]
Sanding Sealer	550 (4.6)	–	–	–
Pigmented Coating	275 (2.3)	–	–	–
Pigmented Primer, Sealer, and Undercoater	–	275 (2.3) [0.21]	275 (2.3) [0.21]	275 (2.3) [0.21]
Pigmented Topcoat	–	275 (2.3) [0.25]	275 (2.3) [0.25]	275 (2.3) [0.25]
Multicolored Coating	–	–	275 (2.3) [0.33]	275 (2.3) [0.33]
High Solids Stain	700 (5.8)	350 (2.9) [0.42]	350 (2.9) [0.42]	350 (2.9) [0.42]
Filler	500 (4.2)	275 (2.3) [0.18]	275 (2.3) [0.18]	275 (2.3) [0.18]
Low Solids	g/l (#/gal)	g/l (#/gal)	g/l (#/gal)	g/l (#/gal)
Low Solids Stain	480 (4.0)	120 (1.0)	120 (1.0)	120 (1.0)
Toner and Wash-coat	480 (4.0)	120 (1.0)	120 (1.0)	120 (1.0)

- g/l = grams VOC per liter of coating
- #/gal = pounds VOC per gallon of coating
- g/g = grams VOC per gram of solids in the coating

Under these proposed limits, a coating would be in compliance if it meets either of the alternative limits. The proposed regulation would create a rebuttable presumption that a coating is in violation if there is evidence that the coating is over either one of the limits.

For low-solids coatings, the District is not proposing an alternative standard based on solids content at this time because low solids coatings are used to lightly tint, stain or prepare the surface for further coatings. A thick coating to form a protective film is not the primary objective, so there is no need to establish a VOC limit based on solids content.

D. Enhanced Labeling Requirements

Effective July 1, 2010, the proposed amendments would require manufacturers and re-packagers of wood coatings and components to label all containers with the coating VOC

content. Any product in the distribution system manufactured before July 1, 2010 may continue to be sold within the District in spite of not meeting the labeling requirements, but the user must meet the new VOC limits for the coating, as applied after manufacturer thinning recommendations. In addition, each manufacturer shall provide product data sheets (or an equivalent medium) for their wood coatings, and solvents subject to this rule, with sufficient information to determine compliance with the rule. This information shall include VOC contents of each coating and solvent in grams per liter (or pounds per gallon), VOC content in grams per gram (or pounds per pound) of coating solids for high solids coatings, and thinning recommendations and VOC content of each coating after thinning.

E. Cleanup of Spray Equipment

A proposed amendment establishes new requirements for cleanup of spray equipment and coating supply lines. Facilities must use solvent with less than 50 grams VOC per liter; or use special practices to clean spray guns that minimize solvent evaporation or have a spray gun washer that meets the requirements of Regulation 8, Rule 16.

F. Emissions Averaging Procedure

Staff proposes revisions to the existing Manual of Procedures, Volume 1, Procedure 6 to incorporate the revised categories of wood coatings and update the EPA reference related to averaging.

G. Exemptions

Staff reviewed the existing exemptions in the rule, and proposes to maintain them without any significant revisions.

H. Other Minor Changes

In addition to the substantive revisions outlined above, Staff is proposing certain minor editorial changes to the language of the rule and to the way in which the various regulatory provisions are organized within the rule's overall structure. These include minor language changes to make provisions grammatically consistent; updating SIC codes to NAICS codes; removal of redundant language such as in the phrase "custom or contract furniture" (as all contract furniture is custom); moving the provisions establishing the 120 g/l threshold for "high-solids" coatings to stand-alone definitions of "high solids" and "low solids" coatings; and removing redundant language in the definition of "Volatile Organic Compounds" regarding whether VOC-content standards should be applied by including or excluding water and exempt compounds.

V. EMISSION REDUCTION BENEFITS AND COMPLIANCE COSTS

A. Emission Reductions Expected

The primary focus of the proposed amendments to 8-32 is the reduction in VOC emissions from wood coatings. These emissions reductions assume the use of transfer-efficient spray application equipment as currently required.

There are approximately 200 business permitted in the District that use a significant amount of wood products coatings. The District inventory is based on information from the 2006 NAICS County Business Patterns sort for the nine Bay Area counties. Emissions estimates include 1.26 tpd estimated VOC emissions from wood coatings, with an additional 0.22 tpd emissions from surface preparation and cleanup. Total emissions from wood coating operations are estimated to be 1.48 tpd.

Emissions expected after implementation of these amendments will total 1.02 tpd, a reduction of 0.46 tpd, or 31%. The most significant reductions come from the proposed reduction of VOC content in sanding sealers. The proposed amendments require both clear and pigmented sealers to reduce VOC content from 550 g/l to 275 g/l for all wood product types. Sealers represent approximately 40% of the wood coatings sold in the Bay Area. In addition, use of lower VOC topcoats or conversion varnish for furniture, custom cabinets and custom architectural millwork also make a significant reduction in VOC emissions. Additional reductions are achieved by reducing the VOC content of stains and fillers.

B. Costs of Compliance

The proposed amendments have economic impacts in five potential areas.

1. Higher Coating Costs: Low VOC coatings generally cost more than higher VOC coatings. Coating suppliers and users indicate that low-VOC solvent based and new water based formulations cost approximately 1.3 to 2 times the cost of higher-VOC coatings that comply with the current rule. The additional cost of water-borne formulations is based on development costs of water-borne resin systems. Using this range of higher coating costs, cost effectiveness of reducing VOC emissions appears to range from $7,000 - $22,000 per ton. In high-solids formulations, these costs can be offset by the additional coverage of high-solids materials. Anecdotal information from both coating suppliers and users indicate that higher coating costs can also be offset by reduced costs based on cleanup with water rather than solvent (in some cases), reduced hazardous waste costs, and reduced insurance rates from the storage and use of flammable materials. Staff hopes to be able to better quantify these potential offsets during the workshop process.

2. New Spray Application Equipment: In some cases, a facility may need to modify their spray application equipment and manufacturing processes to adapt to the lower VOC coatings. Since all facilities now have compliant spray application equipment, adjustments, modifications or re-configurations of these spray guns (including converting to stainless steel or plastic to accommodate water-borne coatings) may be necessary but the costs will be relatively minor, typically less $500 per spray gun, and less than $5,000 per facility.

3. Adjustments to Manufacturing Processes: A facility may have to alter its drying techniques, or adapt to additional sanding and coating steps when it switches to

water-borne or low-VOC solvent based coatings. Manufacturers of water-borne coatings generally recommend air temperatures of 65-80^{o}F, and less than 80% humidity. These conditions are not common during the winter months in the Bay Area. Additional drying time may have an impact on manufacturing capacity if the facility is constrained by space. Staff estimates that 5 – 10% of the wood product manufacturers in the Bay Area may have to buy additional drying racks to provide additional drying time. District staff does not anticipate any facility will need to install additional drying equipment, such as enhanced ventilation, ultra-violet lights, or heaters. Estimated costs of construction for enhanced drying facilities, if necessary, can range from $25,000 – $100,000 in capital costs, with additional costs for electricity and maintenance. In addition, these facilities use energy and therefore contribute to greenhouse gas emissions. Staff hopes to clarify during the workshop process whether any additional drying equipment will be required, any impacts on manufacturing capacity, and estimated capital and operating costs.

4. Installation and Operation of Control Equipment: For large facilities where control equipment is feasible based on economy of scale, costs of complying with this rule could include capital to install the control equipment, and then operating and maintenance costs to operate the control equipment. This approach allows the facility to continue to use higher VOC coatings. Although this is an option in the rule, staff does not believe any facility in the Bay Area will choose to install control equipment, rather than adjust their manufacturing processes to use the low-VOC coatings. Discussions with users that have already switched to low-VOC solvent-based or water-borne coatings say they have been pleasantly surprised that the conversion was less troublesome than expected. Cost of capital equipment can be quite high, depending on the size and capacity of the facility. Green Environment, Inc. in San Carlos estimates control equipment costs would range between $500,000 and $2 million, and fuel costs to oxidize the VOC is estimated at 0.2 – 1 MMBtu/hr or roughly $5,000 – $15,000 per year. This fuel consumption also creates the additional concern of generating additional greenhouse gases. Staff anticipates that no facility in the Bay Area would need to install control equipment to meet the proposed amendments to this rule, and hopes to confirm that expectation during the workshop process.

5. Manufacturers' Labeling Costs. Coatings manufacturers may have to add information to their product labels (or accompanying material). This will be a one-time cost for each specific product.

C. Other Impacts

Reduction of VOC limits on wood coatings is not expected to have any other adverse impact on the public, or the staff and resources of BAAQMD.

VI. RULE DEVELOPMENT / PUBLIC CONSULTATION PROCESS

The District has developed these proposed amendments and has documented its rationale for them in this workshop report. These proposals are based on existing regulations in the Sacramento, San Joaquin Valley, and South Coast air districts. Potential impact on coatings manufacturers and the wood products industry was assessed through e-mail information exchange, discussions with coatings manufacturers, cabinet makers, furniture manufacturers, and antique refinishers, and visits to five different furniture and cabinet coating operations. The public workshop is the next step in the rule development process. Based on the input staff receives at the workshop and during the comment period, staff will decide whether changes to this proposal are necessary prior to a public hearing before the District's Board of Directors.

Reactivity-Based Option

Reactivity refers to a VOC's potential to form ozone once it is released into the atmosphere, which can vary greatly among different types of VOCs. For example, a pound of xylene emitted into the atmosphere has the potential to form up to 7.5 pounds of ozone. By contrast, a pound of acetone emitted to the atmosphere has the potential to form only 0.5 pounds of ozone. Acetone is therefore said to be less reactive than xylene because it has less potential to react to form ozone. The reactivity of a VOC used in a coating therefore provides a much more direct measure of its contribution to ozone formation than does the mass amount of the VOC used. From an air quality perspective, it would be desirable to encourage the use of wood coatings made with low-reactivity VOCs over coatings made with high-reactivity VOCs.

The District would like to learn whether industry and other interested parties would be interested in a rule provision for innovative products that do not meet VOC limits, but, because of low-reactivity formulations, produce equivalent or greater ozone reductions with no other adverse impacts. Such a provision for reactivity-based standards is not currently included in the proposed amendments, but could possibly be proposed at a future date.

VII. PRELIMINARY FINDINGS

VOC reductions will reduce ozone precursors, and are the primary objective of these amendments. The proposed amendments will improve VOC emissions by 0.46 tpd. Preliminary work indicates these amendments are feasible, and can be implemented with wood coatings that are currently available. District staff is proceeding with a Public Workshop to gather facility-specific input on proposed amendments to Regulation 8, Rule 32.

Manufacturers appear to have made good progress on developing low-VOC coatings. These proposed rule amendments will require the use of these low-VOC coatings. During the workshop and through dialog with the affected parties, staff would like to elicit feedback:

- from both the wood products manufacturers and coating manufacturers to ensure these proposals will allow wood products manufacturers to create products that continue to meet their customer expectations;
- from coating manufacturers on the alternate compliance option of VOC limits expressed in grams of VOC per gram of coating solids;
- from the wood products manufacturers on the advantages of using VOC averaging for compliance;
- from the wood products manufacturers and coating manufacturers on increased cost of low VOC coatings, manufacturing process modifications and associated costs, any impact on manufacturing capacity; and
- on any other changes necessary to accommodate these proposed coating requirements that will be useful in assessing costs and economic feasibility of the proposed amendments.

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