SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Preliminary Draft Staff Report for

PROPOSED RULE 1144 – LUBRICANTS AND RUST INHIBITORS

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EXECUTIVE SUMMARY

Lubricants and rust inhibitors are categorized under miscellaneous solvent operations. Most are currently subject to Rule 442 - Usage of Solvents, which reduces VOC emissions from VOC-containing materials that are not subject to VOC limits in any Regulation XI rule. Although the California Air Resources Board (CARB) regulates consumer lubricants, currently, there are no regulations or emissions restrictions specifically concerned with industrial lubricants in place at the local, state, or federal levels.

The proposed rule will apply to VOC emissions from steel tube and spring manufacturers, steel mills, aerospace manufacturers, automobile part manufacturers and rebuilders and machine shops including broaching, drilling, drawing, heading, honing, forging, milling, stamping, tapping, threading and turning operations. Lubricants are fluids used to reduce heat and friction to prolong the life of tools and machinery, improve product quality and carry away debris. Rust Inhibitors protect or prevent metal surfaces from corrosion.

Staff proposes the following requirements for Proposed Rule 1144:

- Establish a VOC limit of 25 grams per liter of material for the use of lubricants and rust inhibitors effective July 1, 2009.
- Prohibit the sale of non-compliant lubricants and rust inhibitors, except those subject to CARB consumer products regulation found in Title 17 of the California Code of Regulations, beginning at Section 94507.
- Allow lubricants and rust inhibitors manufactured prior to July 1, 2009 to be sold or applied until January 1, 2010.
- Require containers for lubricants and rust inhibitors to display the date of manufacture and VOC content as supplied and after recommended dilution.

If approved, the proposed rule amendments would fully implement control measure CTS-01 in the 2007 Air Quality Management Plan.

As proposed, the rule would reduce emissions by 3.08 tons per day with an estimated annualized cost of $7.5 million dollars. The overall cost-effectiveness of the proposed amendment is conservatively estimated to be $6,671 per ton of VOC emissions reduced.

BACKGROUND

Nationally, some 1.2 million workers are employed in machine finishing, machine tooling, and other metalworking and metal-forming operations. In its Fabricated Metal Sector Notebook (1995), EPA estimates 10.2 percent of the fabricated metal industry are located in California. According to listings in the California Manufacturers Register, the South Coast Air basin accounts for approximately 70 percent of the industry in California. In 2002, there were more than 7,200 machine shops in the 4 county area serviced by SCAQMD. Of these machine shops, the US Census (2002) estimates that 88 percent have fewer than twenty employees. Typical industries using lubricants and rust inhibitors include:

- Aerospace
- Machine Shop (Job Shop)
- Steel Mills
- Auto Rebuild

- Screw Machine
- Steel Tubes (Pipes)
- Steel Springs
- Maintenance
- Captive

Captive machine shops are machine shops located inside of another type of business (aerospace, automotive, etc.) that supports the business but is not the primary aspect of that business.

As small businesses that generally do not use paints, coating, inks or adhesives and routinely use very low VOC content cleaning solvents, metal working shops have limited interaction with the AQMD. Rule 219 – Equipment Not Requiring a Written Permit Pursuant to Regulation II, exempts machining equipment that use lubricants and rust inhibitors with VOC contents less than 50 grams per liter (g/l) or a VOC composite partial pressure of 20 mm Hg. Thus metal working shops rarely have permits with the District.

Lubricants, also known as metal working fluids (MWF) are used to reduce heat and friction to prolong the life of the tool, to improve product quality, and carry away debris. Rust Inhibitors are inhibitors, preventatives or protectants used to prevent the corrosion of metal substrates. Typical operations include:

- Broaching – Keyway, slots or spline utilized in gear manufacturing
- Drilling – Producing cylindrical holes
- Drawing - Forming flat sheet metal into "cup-shaped" parts. If the depth of the formed cup is equal to or greater than the radius of the cup, the process is called deep drawing.
- Heading – A metal forging process which involves rapidly punching a blank into a die to form a desired shape without adding heat. Cold heading is most frequently used to produce fasteners such as bolts and screws without adding heat.
- Honing - Manufacture of precision bores to improve the geometry, surface finish and dimensional control of the finished part.
- Forging - Shaping metal by using localized compressive forces. Cold forging is done at room temperature or near room temperature. Hot forging is done at a high temperature, which makes metal easier to shape and less likely to fracture. Common forging processes include: roll forging, swaging, cogging, open-die forging, impression-die forging, press forging, automatic hot forging and upsetting.
- Milling – A precisely controlled rotating cutter which rotates about the spindle axis and a table to which the workpiece is affixed. The cutter and workpiece move relative to each other, generating a toolpath along which material is removed.
- Rust Preventative/Inhibitor - Prevention of corrosion on ferrous materials and some nonferrous materials
- Stamping – A process by which sheet metal strips are punched using a press tool which is loaded on a press to form the sheet into a desired shape.
- Tapping – Creating threaded holes in parts or boring into parts and pipelines
- Threading - Thread cutting and thread rolling applications for pipes and bolts
- Turning - Operation that produces cylindrical parts
- Wire drawing - Reducing or changing the diameter of a wire or rod by pulling the wire or rod through a single or series of drawing die(s).

MWF are complex mixtures of oils, emulsifiers, anti-weld agents, corrosion inhibitors, extreme pressure additives, buffers (alkaline reserve), biocides, and other additives. Some products

contain extreme pressure (EP) additives containing chlorinated, sulfurized, or phosphorus-type extreme pressure ingredients. There are numerous formulations, ranging from straight oils (such as petroleum oils) to water-based fluids, which include soluble oils and semi-synthetic/synthetic fluids. In general, higher oil content provides better lubricity while higher water content allows more rapid cooling.

- **Straight oil (neat oil) MWF** are refined petroleum or vegetable oils. Straight oils are not designed to be diluted with water.
- **Soluble oil (emulsifiable oil) MWF** are combinations of 30 percent to 85 percent straight oils and emulsifiers that may include other performance additives. Soluble oils are diluted with 5 to 40 parts water.
- **Semi-synthetic MWF** contain a lower amount of straight oil in the concentrate (5 percent to 30 percent), more emulsifiers, and 30 percent to 50 percent water. The concentrate is further diluted with 10 to 40 parts water.
- **Synthetic MWF** contain no petroleum oils and may be water soluble or water dispersible. The synthetic concentrate is diluted with 10 to 40 parts water.

In preparation for potential rule making activity, the AQMD and U.S. EPA Region IX co-sponsored a report by the Institute for Research and Technical Assistance to identify, test and demonstrate alternative low-VOC materials for vanishing oils and rust inhibitors. The report, Assessment, Development and Demonstration of Alternatives to VOC-Emitting Lubricants, Vanishing Oil and Rust Inhibitors concludes that "alternative low-VOC materials for a variety of different types of metal working operations are available and cost effective". Thirteen facilities participated in the study that reviewed stamping, honing, cutting, forming and rust inhibitor applications. In each high-VOC application, a low-VOC alternative was demonstrated to have equivalent performance. Some of the participants found that their cost increased with the alternatives, but the majority realized a cost-savings.

PROPOSED RULE

Staff proposes the following requirements for PR 1144:

Purpose and Applicability

The purpose of the proposed rule is to reduce VOC emissions from lubricant and rust inhibitor use at commercial, institutional and industrial facilities during manufacturing operations. Such operations would include metal working or metal removal activities during the manufacturing and assembly of products and goods. Examples of these activities include, but are not limited to, broaching, drilling, drawing, heading, honing, forging, milling, stamping, tapping, threading, turning and wire drawing. Likewise, fluids used for rust and corrosion prevention and inhibition during manufacturing and assembly of products and goods are included in the purview of this regulation.

The proposed rule is not intended to regulate the use of lubricants or rust inhibitors for household use. Likewise, general maintenance and rust inhibition of buildings, vehicles or equipment is not subject to the rule. Examples of these activities include motor oil, elevator grease, and care and maintenance of door hinges and the like.

Operations already subject to VOC limits in Regulation XI would not be subject to the limits, labeling requirements and prohibition of sales proposed in this rule. These would include solid film lubricants, dry lubricative materials and barrier coatings subject to Rule 1124 - Aerospace

Assembly and Component Manufacturing Operations. Paints and coatings intended to completely cure and leave a solid, permanent film to beautify and protect metal surfaces are subject to other coating rules in Regulation XI and are not subject to this rule. Examples include aerospace, architectural, auto body, and metal paints and coatings with applicable VOC limits in Rules 1113 – Architectural Coatings, Rule 1124, Rule 1151 - Motor Vehicle and Mobile Equipment Non-Assembly Line Coating Operations and Rule 1107 – Coating of Metal Parts and Products respectively.

A prohibition of sale is included in the rule and thus the proposed rule also applies to anyone who manufactures for use, supplies, solicits, sells or offers for sale lubricants and rust inhibitors subject to the rule. Consumer products subject to the CARB consumer products regulation found in Title 17 of the California Code of Regulations, beginning at Section 94507 are exempted from the prohibition of sale. As noted above, their use in households and general maintenance of buildings, vehicles or equipment is also not subject to this rule. However, consumer product lubricants and rust inhibitors used during manufacture and assembly of products and goods are subject to this regulation and facilities using such products must meet the applicable VOC content limits.

Requirements

The proposed rule would establish a VOC limit of 25 g/l of material for lubricants effective July 1, 2009. The VOC content limit applies to the lubricants as they are used, including dilution. Water or exempt solvents are not removed when calculating VOC content. Thus a lubricant concentrate with a VOC content of 75 g/l that is diluted with water at a ratio of two parts water to one part lubricant concentrate (2:1) would have a VOC content of 25 g/l. Many of soluble, semi-synthetic and synthetic MWF (lubricants) are heavily diluted with water when used. Typical dilution ratios range from five parts water to one part MWF concentrate to 40 or more parts water to one part concentrate.

An estimated 90 percent of MWF have a VOC content of 25 g/l of material or less after dilution. The soluble, semi-synthetic and synthetic MWF have low VOC because of the high water content of those fluids. However, many straight oils have low VOC because they are essentially non-volatile. Laboratory testing showed that 19 of 21 MWF samples had VOC contents that would meet the proposed limit. The results are summarized in Table I.

Table I – Laboratory Results for Lubricants

Type	**VOC Results Method 313**
Coolants	28* - 210* g/l
General Lubricants	<10 - 19* g/l
Cutting/Grinding Lubricants	
Cold heading	2 g/l
Cutting	<10 - 13 g/l
Grinding	<10 - 146* g/l
Machining	<25 - 162* g/l
Milling	70 g/l
Stamping (Vanishing)	750 g/l
Other	Pending

*Before dilution

The products that would not meet the limit are stamping oils designed to evaporate off quickly leaving no residue, otherwise known as vanishing oils. These vanishing oils are typically comprised primarily of solvent such as kerosene or mineral spirits and commonly are just the neat solvent themselves. Vanishing oils have VOC contents ranging from 600 g/l to 750 g/l.

Vanishing oils leave a light coating of lubricant on the part during processing and then evaporate shortly thereafter. They need to provide enough lubricity to prevent machinery and parts from seizing but provide very little protection to tooling. They are used because they evaporate and later cleaning operations are not necessary. Vanishing oils should not leave behind tacky or gummy residues. Because the parts are not cleaned afterwards, the vanishing oil must not encourage corrosion and may even provide some small amount of corrosion protection.

Alternatives to high solvent content vanishing oils include water-dilutable MWF and light straight oils. The water-dilutable MWF for use in a vanishing oil applications have sufficient rust preventative compounds to protect parts when the water evaporates. They provide sufficient lubricity but, like traditional vanishing oils, provide little tooling protection. Because they are so dilute, they evaporate leaving a dry, light protective film that is not tacky or gummy. Parts machined in this manner were found to have similar or superior corrosion protection and did not require subsequent cleaning according to an AQMD co-sponsored report, "Assessment, Development and Demonstration of Alternatives to VOC-Emitting Lubricants, Vanishing Oils and Rust Inhibitors". The high water content of the water-dilutable MWF used in these applications makes them less expensive than vanishing oils.

Use of a light straight oil as a vanishing oil alternative could also provide acceptable results in certain situations. There would be little if any evaporation but the residue would not be tacky or gummy and corrosion protection would be excellent. Cleaning would be required however and would increase the cost to the facility.

Rust inhibitors, including rust preventatives and corrosion inhibitors, would also be limited to a VOC content of 25 g/l of material. Some facilities use rust inhibitors that are nearly identical in composition and VOC content to vanishing oils. Metal parts are coated, usually by dipping, with a formulation of solvent like mineral spirits or kerosene that may also contain small amounts of heavier oils and/or wax. The solvent evaporates away leaving behind a small amount of heavier oil, wax or trace amounts of the solvent. The remnant coats the metal surface with a water repellent or protective layer. The heavier oils and wax provide much more protection than the evaporated solvent.

Water-based rust inhibitors have very low VOC content after dilution and are formulated to leave behind a nearly invisible protective coating after the water evaporates. The protective coating is soluble in water but still protects steel, cast iron, and other ferrous parts from in-plant corrosion for up to six months. An added benefit is that the coating can be easily removed using mild aqueous cleaners if required. The water-based rust inhibitors are comparable in price to the solvent-based rust inhibitors.

Alternative lower VOC straight oil rust inhibitors coat the metal surface with an oil that rejects water. Over a long period of time the oil may thicken into a nearly solid protective coating. These products provide excellent long term protection and while higher cost per gallon, are superior in quality to most high VOC products. The straight oil may contain some small amounts of solvents and the VOC content of such products tested range from less than 25 g/l to 191 g/l. Laboratory testing results of rust inhibitors is summarized in Table II.

Table II – VOC Content of Rust Inhibitors

Cleaner/Rust Inhibitor	<25 - 760 g/l
Consumer/General	514 g/l
Rust Inhibitor	<10 - 191 g/l
Rust Inhibitor/Stamping	51* - 125 g/l

*Before dilution

A use and sell-through provision has been included that will allow products manufactured before the effective date of the rule to be sold and used for up to six months after the effective date. This will allow manufacturers, distributors and users to deplete their existing inventories. To facilitate this provision, manufacturers and distributors will be required to display the date or a date code of manufacture on the container beginning July 2009.

The sale of lubricants and rust inhibitors in the AQMD, except those subject to CARB consumer products regulation found in Title 17 of the California Code of Regulations, beginning at Section 94507, is prohibited unless they meet applicable VOC limits. The prohibition would not apply to products sold in this District for shipment outside of this District or for shipment to other manufacturers for repackaging. This provision will redirect the burden of determining the compliance status of products from the machine shops and other users to the manufacturers and distributors who are more familiar with VOC determination. In addition to displaying the date of manufacture on the container, the container must also display the maximum VOC content, as supplied, and after dilution as recommended by the manufacturer. The prohibition of sale will apply to manufacturers and distributors who manufacture for use, sell, offer for sale or distribute directly. Manufacturers that sell products through independent distributors may be able to discharge liability under this provision, provided they forewarned the independent distributors in writing about the compliance status of the product. However, independent distributors will be subject to the prohibition of sale.

A provision has been included allowing, if the facility so chooses, the use of high VOC lubricants and rust inhibitors where the emissions are vented to a control device which has an capture efficiency of 90 percent or more on a mass basis and a control efficiency of 95 percent or more on a mass basis or to a maximum 5 ppm VOC by volume from the exhaust. While it is very unlikely that any facility will install a control device just to meet the proposed rule, some facilities already have control devices that control emissions from work areas that contain lubricants or rust inhibitors. In those instances, the emissions are already being reduced and further restrictions are unnecessary.

Recordkeeping Requirements

Many of the facilities subject to the provisions of this rule are small businesses with limited interaction with the District. Those small facilities with operations and equipment that do not use paints, coatings, solvents or adhesives and do not require permits with the District are unlikely to have had experience in keeping daily records. Rule 109 – Recordkeeping for Volatile Organic Compound Emissions requires stationary sources using VOC containing materials to keep records to determine rule applicability and rule compliance. Records are usually required on a daily basis but because the material VOC content limits proposed are below 50 g/l, products compliant with the provisions of this proposed regulation would be considered “Super Compliant Materials” and qualify for exemption from recordkeeping at facilities that do not exceed four tons of VOC emissions in any calendar year, determined by annual recordkeeping. Facilities that emit more than four tons of VOC annually may qualify for the monthly recordkeeping option.

Test Methods and Procedures

While there is no formal regulatory requirement to use a particular test method for determining VOC content of MWF, the default method used is U.S. EPA Reference Method 24 (Method 24). Method 24 was designed to determine the VOC content of coatings and inks only. It was not intended to be used for MWF though there is no other U.S. EPA approved test method other than Method 24 for MWF. Method 24 determines the VOC content of a product by measuring the water and the non-volatile fraction. The remainder is considered VOC (less exempt solvents). The non-volatile fraction is determined by placing the sample in a forced air over at 110°C for sixty minutes. Duplicates samples are run to validate the results.

An alternative method is SCAQMD Method 313 – Determination of Volatile Organic Compounds (VOC) by Gas Chromatograph/Mass Spectrometry (GC/MS). The principal of this U.S. EPA approved method is to inject a liquid sample into GC/MS and sum the concentrations of the individual compounds. The oven is initially at 50°C and kept there for five minutes. It is ramped up 15°C per minute until the sample reaches 200°C. It is then held at 200°C for fifteen minutes. The total specified sampling period is 30 minutes, and previous testing has indicated that methyl palmitate elutes at the 30 minute mark. All compounds, besides water and exempt solvents, that elute prior to methyl palmitate are considered to be VOC.

The AQMD has revised the test method to streamline the method, primarily to accommodate equipment changes. The column type (DB624) and length of column (60 meters) have changed subsequently changing the times when various peaks appear. However, the order of the peaks remains unchanged and methyl palmitate will continue to be used as the marker compound defining volatility. The temperature in the GC oven will continue to be raised after the methyl palmitate peak is reached until the entire sample elutes. Only peaks that occur at or before the methyl palmitate peak are considered when determining VOC content by quantifying the peaks using a Flame Ionization Detector (FID). By specifying the column type and length, the flow and temperature may be varied without altering the VOC content results as long as the methyl palmitate marker compound is identified. This would be useful when trying to further resolve peaks especially when water or exempt compounds are present. The revised protocol is referred to as a GC/FID method.

In an effort to evaluate the VOC content, various MWF samples collected were initially tested using Method 24. For high VOC fluids such as vanishing oils and high solvent content rust preventatives with VOC contents well above 50 grams/liter, reproducible results were easily attainable. However, the non-volatile portion of low vapor pressure MWF samples failed repeatability requirements over three separate tests. The results of the Method 24 testing for these samples were not acceptable. The same samples were tested using revised SCAQMD Test Method 313. The results were repeatable and Table III compares the samples that were tested using both test methods. The revised SCAQMD Test Method 313 yielded much lower VOC contents for low volatility lubricants.

Table III - Comparison of Results by Test Method

Type	Application	Results Method 24	Results Method 313
Straight	Vanishing / Stamping	740 g/l	750 g/l
Straight	Machining / Grinding	120 g/l*	<25 g/l
Straight	Machining / Grinding	170 g/l*	<25 g/l

*Failed repeatability requirements

Because of the improved accuracy and repeatability, revised SCAQMD Test Method 313 using the alternative column and GC/FID will be used to determine VOC content for the proposed rule and the final protocol for testing will be released to the public. Test methods to determine the capture and control efficiency of a control device are also included.

Exemptions

Exemptions to the labeling requirements and sales prohibition are included in the proposed rule for consumer products. These products are already subject to Title 17 of the California Code of Regulations, beginning at Section 94507, also known as the California Consumer Product Regulation. The California Consumer Product Regulation includes statewide labeling requirements and a sales prohibition for consumer products and the proposed rule will not add further requirements. However, the use of these products during the manufacture and assembly of products and parts is subject to VOC content limit.

Lubricants and rust inhibitors manufactured or sold for use outside the District will not be subject to the labeling requirements of the proposed rule. The intent of the proposed rule is to regulate only the products being manufactured or sold for use inside the District.

Finally, lubricant and rust inhibitors already subject to VOC limits in Regulation XI would not be subject to the limits, labeling requirements and prohibition of sales proposed in this rule. This would include solid film lubricants, dry lubricative materials and barrier coatings subject to Rule 1124. Paints and coatings intended to completely cure and leave a solid, permanent film to beautify and protect metal surfaces are also exempt. Paints and coatings are subject to other coating rules in Regulation XI.

EMISSION INVENTORY

The overall national inventory of metal working fluids was taken from the International Lubricant Manufacturers Association (2003). It indicates that 117 million gallons were sold nationwide (see Table IV).

Table IV - National Sales

Metalworking Fluid Type	Amount Sold (millions of gallons/year)
Straight	27.3
Soluble	49.3
Semi-Synthetic	21.7
Synthetic	18.9
Total	117.2

EPA estimates 10.2 percent of the fabricated metal industry are located in California in its Fabricated Metal Sector Notebook (1995). According to listings in the California Manufacturers Register, the Basin accounts for approximately 70 percent of the industry in California. This would indicate that 8.3 million gallons of MWF were sold in the Basin (see Table V).

Table V – Ratio of National Sales to South Coast Air Basin Sales

Metalworking Fluid	Amount Sold Nationwide (millions of gallons/year)	Amount Sold in California (millions of gallons/year)	Amount Sold in South Coast (millions of gallons/year)
Straight	27.3	2.8	2.0
Soluble	49.3	5.0	3.5
Semi-Synthetic	21.7	2.2	1.5
Synthetic	18.9	1.9	1.3
Total	117.2	11.9	8.3

To supplement these estimates, in 2006, the AQMD conducted a survey of local MWF manufacturers, distributors and users. The survey data indicated that those local manufacturers and distributors annually sold 4.2 million gallons of MWF and 0.5 million gallons of vanishing oils, rust preventatives and solvents in the Basin (see Table VI). Presumably, the solvents are used as vanishing oils, rust preventatives, for thinning other metal working fluids or cleaning.

Table VI – Volume Surveyed

MWF Type	Volume Surveyed (thousand gallons)
General MWF	3,742.2
Vanishing Oil	64.1
Rust Inhibitors	155.7
Solvent	238.0
Total	4,200.0

Approximately 30 percent or 71,000 gallons of the 238,000 gallons of solvents reported in the survey are used for cleaning applications subject to Rule 1124 and cannot be included in the VOC emission inventory for this rule making activity.

Table VII – Applicable Volume

MWF Type	Applicable Volume Surveyed (thousand gallons)
General MWF	3,742.2
Vanishing Oil	64.1
Rust Inhibitors	155.7
Solvent	167.0
Total	4,129.0

A serious drawback from the survey and national sales data was the lack of VOC information on the metal working fluids. More than eighty percent of the volume surveyed listed the VOC content as “None” or not determined. Therefore, the AQMD sampled a broad range of products from local manufacturers and distributors and performed VOC testing to establish a more accurate emissions inventory.

SCAQMD Test Method 313 was applied to 35 samples including consumer product multipurpose lubricants, synthetic water-dilutable coolants, and bio-based machining oils. Table VIII summarizes the VOC results for these various products. The complete test results are included in Appendix A - Lubricant and Rust Inhibitor VOC Content Test Results. All four

general lubricants tested had VOC contents below 25 g/l. All three coolants had VOC contents below 25 g/l after recommended dilution. Twelve of fourteen lubricants with specified applications also had VOC contents below 25 g/l after recommended dilution. One milling product had a VOC content of 70 g/l and one stamping (vanishing oil) product had a VOC content of 750 g/l. Rust preventatives showed the most variability ranging from less than 10 g/l to over 760 g/l. Soluble and vegetable based rust preventatives had the lowest VOC content with two results still pending. The traditionally formulated rust preventatives had significantly higher VOC contents with one result still pending. Results from the pending samples are expected by October 2008.

Table VIII - Test Results Using SCAQMD Method 313

Type	VOC Results Method 313	# of Samples
Coolants	28* - 210* g/l	3
General Lubricants	<10 - 19* g/l	4
Rust Preventatives		
Cleaner/Rust Preventative	<25 - 760 g/l	2
Consumer/General	514 g/l	1
Rust Preventative	<10 - 191 g/l	2 (2 pending)
Rust Preventative/Stamping	51* - 125 g/l	2
Cutting/Grinding Lubricants		
Cold heading	2 g/l	1
Cutting	<10 - 13 g/l	2
Grinding	<10 - 146* g/l	3
Machining	<25 - 162* g/l	5
Metal Removal	12 g/l	1
Milling	70 g/l	1
Stamping (Vanishing)	750 g/l	1 (2 pending)
Others Pending	Pending	3

*Before dilution

While some results are still pending, the completed test results indicate that most MWFs have a low VOC content. Excluding rust preventatives, only two of 21 products sampled had VOC contents greater than 25 g/l. Only one product, a vanishing oil used for stamping applications, had a VOC content greater than 100 g/l. The VOC content of rust preventatives ranged from <25 g/l to 760 g/l.

After analyzing the sample results, the survey information and national sales data provide a clearer picture of the emission inventory from lubricants and rust inhibitors. Using the sales weighted average from the survey information collected and the sample test results, general MWFs have a sales weighted average VOC content of 25 g/l or less. Because EPA method 24 results were repeatable and confirmed using SCAQMD Test Method 313 for high VOC products, the sales weighted average VOC content was used directly from the survey information for vanishing oils, rust inhibitors and solvent. Vanishing oils reported in the survey had a sales weighted average VOC content of 710 g/l. Solvent-based rust inhibitors had a sales weighted average VOC content of 660 g/l. Straight solvents used in lubricant and rust inhibition operations had a sales weighted average VOC content of 790 g/l. Using this methodology, the

VOC emission inventory for the proposed rule is estimated to be 4.3 tons per day and is summarized in Table IX.

Table IX – Surveyed Emission Inventory

MWF Type	Volume Surveyed (thousand gallons)	Sales Weighted Average VOC Content (g/l)	Total VOC Emission (tons per day)
General MWF	3,742.2	25	1.07
Vanishing Oil	64.1	710	0.52
Rust Inhibitors	155.7	660	1.17
Solvent	167.0	790	1.50
Total	4,129.0	N/A	4.30

The AQMD survey captured just over half of the metal working fluid sales predicted and could be extended to regional and national manufacturers and distributors if necessary. Extrapolating from national sales figures, the overall VOC emission inventory can be as high as 8.8 tons per day as seen in Table X.

Table X – Emission Inventory from National Sales

MWF Type	Volume Surveyed (thousand gallons)	Sales Weighted Average VOC Content (g/l)	Total VOC Emission (tons per day)
General MWF	7,637	25	2.18
Vanishing Oil	131	710	1.06
Rust Inhibitors	318	660	2.39
Solvent	341	790	3.06
Total	8,427	N/A	8.78

EMISSION REDUCTIONS

The proposed rule will establish a VOC content limit of 25 g/l for lubricants and rust inhibitors. For approximately 90 percent of fluids subjects to the rule, the proposed limit will have no impact as most general MWF already have VOC contents that are less than 25 g/l. These low VOC fluids account for only about 25 percent of the VOC emissions.

However, there would be substantial VOC emission reductions from vanishing oils, rust inhibitors and solvents used to dilute lubricants or used directly as vanishing oils or rust inhibitors. Using the sales weighted average VOC content from surveyed products, establishing a VOC content limit of 25 g/l would reduce emissions by over 95% for the affected categories and reduce 3.08 tons per day of VOC emissions.

Table XI – Emission Reductions

MWF Type	Volume Surveyed (thousand gallons)	Ave VOC Content (g/l)	Proposed VOC Content	Percent Reduction	Total VOC Emission Inventory (tons per day)	Total VOC Emission Reduction (tons per day)
General MWF	3,742.2	25	25	0%	1.07	0.00
Vanishing Oil	64.1	710	25	96%	0.52	0.50
Rust Inhibitors	155.7	660	25	96%	1.17	1.13
Solvent	167.0	790	25	97%	1.50	1.45
Total	4,129.0				4.26	3.08

Again, extrapolating from national sales figures, the potential emission reduction double to 6.29 tons of VOC emissions reduced.

Table XII – Emission Reductions from National Sales

MWF Type	Volume Surveyed (thousand gallons)	Ave VOC Content (g/l)	Proposed VOC Content	Percent Reduction	Total VOC Emission Inventory (tons per day)	Total VOC Emission Reduction (tons per day)
General MWF	7637.1	25	25	0%	2.18	0.00
Vanishing Oil	130.8	710	25	96%	1.06	1.02
Rust Inhibitors	317.7	660	25	96%	2.39	2.30
Solvent	340.8	790	25	97%	3.06	2.96
Total	8426.5				8.78	6.29

Multiple low-VOC commercially available products have been identified in numerous applications. In many applications, the only products in use are low-VOC products already in compliance with the proposed limits. Cold heading, drawing, grinding, honing machining and metal removal fluids as well as coolants and general lubricants were all found to have low VOC content products in widespread use. For the two applications where high VOC products were identified, stamping (vanishing oil) and rust inhibitors, aqueous- and petroleum-based technologies were identified and demonstrated in field testing. Those alternatives were analyzed and found to have VOC contents that would meet the proposed limits.

The transition to low-VOC content lubricants and rust inhibitors is not expected to increase criteria pollutants or global warming gases. The substitution of one type of fluid with another will not have an impact on other criteria pollutants. The increased use of control equipment is considered very unlikely and therefore not expected to be a source of increased pollutants. There may be some negligible decrease in global warming gases from shipping MWF concentrates instead of ready-to-use products. Water is added onsite to the concentrates and thus weigh less during transit reducing fuel consumption.

COST AND COST-EFFECTIVENESS

The use of low-VOC alternatives to vanishing oils and rust inhibitors is expected to have increased costs for machinery including skimmers, decanters, mixers, sump cleaners and possibly cleaning equipment. In addition, there would be an overall increase in the cost of fluids. On an individual facility basis, the costs may be significant, insignificant or even a cost savings.

For alternatives to vanishing oils, companies would ideally use a water soluble MWF that would not require cleaning. The soluble lubricants are heavily diluted with water and would likely cost less than a vanishing oil potentially resulting in a cost savings. They would have rust preventative compounds to prevent corrosion and evaporate leaving behind a light, corrosion protective film.

However, the worst case scenario for shops using vanishing oils would be to use an oil that would require cleaning of the product afterwards. The shops would need to purchase cleaning equipment, automated handling equipment, cleaning chemistry, and pay for added electricity.

For a typical shop using 500 gallons of vanishing oil annually, the shop would face an estimated annualized capital cost of $9,700, $5,040 in cleaning chemistry and disposal costs and $7,900 in increased electrical costs. The lubricant cost would decrease by $2,600 annually. The total maximum annual cost per typical facility would be $44,300.

Table XIII - Maximum Increased Cost per Facility

	Annual Cost
Capital (annualized)	
Cleaning Equipment	$5,400
Automated Handling	$4,300
Cleaning Chemistry	$3,800
Disposal	$1,900
Electricity	$7,900
Lubricant	<$2,600>
Total	$20,700

Using the most conservative assumption for all vanishing oil usage (64,100 gallons), the maximum overall annual cost would be $2.6 million.

Total Volume of Vanishing Oil	Typical facility usage	Number of Facilities
64,100 gallons	500 gallons	128

Number of Facilities	Cost per facility	Total Annual Cost
128	$20,700	$2.6 million

The conversion from high VOC rust inhibitors to low VOC rust inhibitors would only involve the alteration of the chemistry. The equipment (tanks) would remain the same and there would be no added electrical costs. The alternative chemistry has a higher cost but many of the rust inhibitors are diluted with water making the cost much more comparable to the high VOC rust inhibitors.

Again, the worst case scenario is evaluated and it is assumed that non-dilutable rust inhibitors are used. The cost of mineral spirits used as a rust inhibitor is approximately $3.60 per gallon. The alternative bio-based rust inhibitor sells for $8.30 per gallon, a $4.70 increase per gallon. The alternative rust inhibitor would be used in the same volume as the mineral spirits. The cost increase over 155,700 thousand gallons would be $0.5 million dollars annually.

Total Volume of Rust Inhibitor	Increased cost per gallon	Total Annual Cost
155,700 gallons	$4.70	$0.5 million

Solvent is used as both a vanishing oil and rust inhibitor. When determining costs, the solvent usage is split evenly between the vanishing oil and rust inhibitors. Thus 83,500 gallons are attributed towards vanishing and 83,500 gallons of solvent are used as rust inhibitors. The same worst-case methodology is used for vanishing oil and rust inhibitors to determine the cost of replacing the solvent. The total cost for solvent replacement would be $3.9 million.

Total Volume of Solvent Used as Vanishing Oil	Typical facility usage	Number of Facilities
83,500 gallons	500 gallons	167

Number of Facilities	Cost per facility	Total Annual Cost
167	$20,700	$3.5 million

Likewise,

Total Volume of Solvent Used as Rust Inhibitor	Increased cost per gallon	Total Annual Cost
83,500 gallons	$4.70	$0.4 million

Some shops may be required to do additional record keeping demonstrating that their annual emissions remain below four tons. Four tons of emissions from lubricants and rust inhibitors at 25 g/l (0.2 pounds per gallon) would be equivalent to over 38,000 gallons used per year. Of 115 machine shops surveyed, less than eight percent used lubricants and rust inhibitors in sufficient quantities to remotely approach the four ton annual limit. Of the 7,282 affected facilities, an estimated 570 would require a more thorough review of annual records. It is estimated that the process of gathering the year's purchase records would require about eight hours of labor per facility from discussions and experience with facilities conducting record keeping. At $20 per hour, the annual increase in record keeping costs would be $20/hour * 8 hours/facility * 570 facilities = $0.1 million. The remaining facilities would require a negligible effort to demonstrate that their annual usage was below the four ton annual limit.

Manufacturers and distributors would also be required to determine the VOC content of the products and label the containers with the VOC content and a date of manufacture or date code. Laboratory testing using a modified version of SCAQMD Test Method 313 costs between $200 and $500 per sample according to several analytic laboratories that perform the testing. Manufacturers and distributors offer hundreds of products each. Many of those are similar with slight variations on the additives incorporated in the product. Manufacturers and distributors may be able to test some subset of products and be able to calculate the VOC content of their remaining products. Others will insist on testing every product for liability concerns. Conservatively assuming that there are 10,000 applicable products and every product would be laboratory tested at $350, there would be a one time cost of $3.5 million. Annualized over ten

years, the additional annual cost to manufacturers and distributors would be $0.4 million. Most containers use computerized labels which can be altered by simple reprogramming. The cost to alter those labels is considered negligible.

As proposed, the rule would reduce emissions by 3.08 tons per day with an estimated cost of $7.5 million dollars. The maximum overall cost-effectiveness of the proposed amendment would be $6,671 per ton of VOC emissions reduced on a conservative basis. However, case studies conducted on the use of compliant rust inhibitors and lubricants actually showed an overall reduction in costs, yielding a cost savings to the facility.

Table XIV – Maximum Cost-Effectiveness

MWF Type	Volume Surveyed (thousand gallons)	Total VOC Emission Inventory (tons per day)	Total VOC Emission Reduction (tons per day)	Maximum Cost (millions)
General MWF	3,742.20	1.07	0	0.0
Vanishing Oil	64.1	0.52	0.5	2.6
Rust Inhibitors	155.7	1.17	1.13	0.5
Solvent	167	1.5	1.45	3.9
Record keeping	N/A	N/A	N/A	0.1
Laboratory Testing	N/A	N/A	N/A	0.4
Total	4,129.00	4.26	3.08	7.5

INCREMENTAL COST-EFFECTIVENESS

Under Health and Safety Code Section 40920.6, the AQMD is required to perform an incremental cost analysis when adopting a Best Available Retrofit Control Technology (BARCT) rule or feasible measure required by the California Clean Air Act. To perform this analysis, the AQMD must (1) identify one or more control options achieving the emission reduction objectives for the proposed rule, (2) determine the cost effectiveness for each option, and (3) calculate the incremental cost effectiveness for each option. To determine incremental costs, the AQMD must "calculate the difference in the dollar costs divided by the difference in the emission reduction potentials between each progressively more stringent potential control option as compared to the next less expensive control option."

Proposed Rule 1144 implements Control Measure CTS-01 from the 2007 Air Quality Management Plan. Because Control Measure CTS-01 is intended to meet feasible measure requirements under the California Clean Air Act, an incremental cost analysis is required and will be presented at a future public meeting.

COMPARATIVE ANALYSIS

Health and Safety Code Section 40727.2 requires a written analysis comparing the proposed rule with existing federal and AQMD regulations. Federal regulations do not regulate VOC emissions from lubricant and rust inhibitor operations. Most lubricants and rust inhibitors are categorized by the AQMD under miscellaneous solvent operations.

They are currently subject to Rule 442 - Usage of Solvents which reduces VOC emissions from VOC-containing materials that are not subject to VOC limits in any Regulation XI rule. Material or equipment subject to Rule 442, such as lubricants and rust inhibitors, are allowed to emit up to 833 pounds per month (five tons per year) of VOC emissions per facility without restriction. Solid film lubricants, dry lubricative materials and barrier coatings are subject to Rule 1124 - Aerospace Assembly and Component Manufacturing Operations and are not subject to this proposed rule. Similarly, paint and coating intended to completely cure and leave a solid, permanent film to beautify and protect metal surfaces are subject to other coating rules in Regulation XI and are not subject to this rule. Examples include aerospace, architectural, auto body, and metal paints and coatings with applicable VOC limits in Rules 1113 – Architectural Coatings, Rule 1124, Rule 1151 - Motor Vehicle and Mobile Equipment Non-Assembly Line Coating Operations, and Rule 1107 – Coating of Metal Parts and Products respectively.

SOCIOECONOMIC ASSESSMENT

A socioeconomic analysis of Proposed Rule 1144 will be performed. A draft report will be released no later than 30 days prior to the AQMD Governing Board hearing.

CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA)

Pursuant to the California Environmental Quality Act (CEQA) and AQMD Rule 110, appropriate documentation will be prepared to analyze any potential adverse environmental impacts associated with the Proposed Rule 1144. Comments received at the public workshop and CEQA scoping meeting will be considered when preparing the CEQA document.

DRAFT FINDINGS UNDER THE CALIFORNIA HEALTH AND SAFETY CODE

Health and Safety Code Section 40727 requires that prior to adopting, amending or repealing a rule or regulation, the AQMD Governing Board shall make findings of necessity, authority, clarity, consistency, non-duplication, and reference based on relevant information presented at the hearing. The draft findings are as follows:

Necessity – State and federal health-based ambient air quality standards for ozone are regularly and significantly exceeded in the AQMD. The reduction of VOC from Proposed Rule 1144 is part of a comprehensive strategy to meet federal and State air quality standards.

Authority - The AQMD Governing Board obtains its authority to adopt, amend, or repeal rules and regulations from Health and Safety Code Sections 39002, 40000, 40001, 40440, 40441, 40702 and 41508.

Clarity - The AQMD Governing Board has determined that Proposed Rule 1144 – Lubricants and Rust Inhibitors, is written and displayed so that the meaning can be easily understood by persons directly affected by them.

Consistency - The AQMD Governing Board has determined that Proposed Rule 1144 – Lubricants and Rust Inhibitors, is in harmony with, and not in conflict with or contradictory to, existing statutes, court decisions, federal or state regulations.

Non-Duplication - The AQMD Governing Board has determined that Proposed Rule 1144 – Lubricants and Rust Inhibitors, does not impose the same requirement as any existing state or federal regulation, and the proposed amendments are necessary and proper to execute the powers and duties granted to, and imposed upon, the AQMD.

Reference - In adopting this regulation, the AQMD Governing Board references the following statutes which the AQMD hereby implements, interprets or makes specific: California Health and Safety Code sections 40001, 40440, and 40702.

REFERENCES

"Comments of the Independent Lubricant Manufacturers Association (ILMA) on 'Metalworking Fluids: Summary of Nomination for Review: NTP 12th Report on Carcinogens, September 2003 Submitted by Report on Carcinogens Group, NIEHS'", [Online] Available at www.**ilma.org**/about/ntp_comments.pdf (Accessed July 29, 2008).

U.S. Environmental Protection Agency, Office of Enforcement and Compliance Assurance, Office of Compliance (September 1995). *Sector Notebook Project: Profile of the Fabricated Metal Products Industry* [Online] Available at http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/fabmetsn.pdf (Accessed July 29, 2008).

California Manufacturers Register. Twinsburg: Harris Infosource, 2006.

Method 24 – Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings. U.S. Environmental Protection Agency, February 2000.

"Assessment, Development and Demonstration of Alternatives to VOC-Emitting Lubricants, Vanishing Oils and Rust Inhibitors", August 2006. Prepared by the Institute for Research and Technical Assistance for South Coast Air Quality Management District Under Contract No. 05058 and the United States Environmental Protection Agency Region IX.

Appendix A – Lubricant and Rust Inhibitor VOC Content Test Results

Type	Application	Results Method 313
General Lubricants		
Straight	General Lubricant	<10 g/l
Straight	General Lubricant	<10 g/l
Soluble	Soluble Oil	19 g/l*
Straight	Hydraulic Oil	10.5 g/l
Coolants		
Synthetic	Coolant/Grinding	210 g/l*
Soluble	Coolant/Grinding	28 g/l*
Soluble	Coolant	38 g/l*
Cutting/Grinding Lubricants		
Polymer	Cold heading	2 g/l
Straight	Cutting	<10 g/l
Straight	Cutting	12.5 g/l
Synthetic	Cutting/Grinding	146 g/l*
Synthetic	Cutting/Grinding	118 g/l*
Straight	Cutting/Grinding	<10 g/l
Soluble	Machining/Grinding	33 g/l*
Semi-Synthetic	Machining/Grinding	162 g/l*
Straight	Machining/Grinding	<25 g/l
Straight	Machining/Grinding	<25 g/l
Straight	Machining/Grinding	<25 g/l
Straight	Metal Removal	12 g/l
Unknown	Milling	70 g/l
Straight	Stamping	Pending
Straight	Stamping	Pending
Straight	Stamping (Vanishing)	750
Other		
Unknown	Electrical Discharge Machining	Pending
Unknown	Electrical Discharge Machining	Pending
Soluble	Penetrant	Pending
Rust Preventatives		
Straight	Cleaner/Rust Preventative	<25 g/l
Straight	Cleaner/Rust Preventative	760 g/l
Straight	Consumer/General	514 g/l
Synthetic	Corrosion Preventive	NR
Straight	Rust Preventative	Pending
Straight	Rust Preventative	<10 g/l
Straight	Rust Preventative	190.5 g/l
Soluble	Rust Preventative/Stamping	51 g/l*
Straight	Rust Preventative/Stamping	125 g/l

* Before dilution