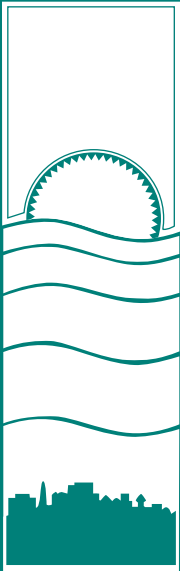




Canadian Council of Ministers  
of the Environment    Le Conseil canadien  
des ministres de l'environnement

# Recommended CCME Standards and guidelines for the Reduction of VOC Emissions from Canadian Automotive Parts Coatings Operations



The Canadian Council of Ministers of the Environment (CCME) is the major intergovernmental forum in Canada for discussion and joint action on environmental issues of national, international and global concern. The 14 member governments work as partners in developing nationally consistent environmental standards, practices and legislation.

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Nox/VOC Phase I Management Plan  
Initiative V307

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# 1.0 Introduction

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## 1.1 Background

This document describes recommended CCME Standards, Guidelines and Codes of Good Practice for the coating operations of both new and existing Automotive Parts manufacturing facilities in Canada. Further background to these recommended Standards may be found in the document, Recommended Standards and Guidelines for Reduction of VOC Emissions from Canadian Automotive Parts Surface Coating Operations. Project number K2218-6-0037. Shapiro & Associates: October 17th, 1997.

The Automotive Parts sector manufactures a large variety of automotive components varying widely in size, complexity and function. The parts can be made of a variety of metals or plastics, the selection being based on function, performance and cost criteria. Examples include bumpers and fascia panels, wheels, decorative trim items and “under-the-hood” components. Many of the manufactured items are coated with a variety of coating products and systems depending on their end use. These finishing systems may range from relatively simple single product coatings to multi-layer coating systems which essentially duplicate the finishing system used on automobile bodies.

The Standards and Guidelines described in this document provide Automotive Parts coatings operations in Canada with two distinct options for achieving the desired VOC emission reductions from this sector, the first option based on Product and Operations Standards, and the second based on Performance Standards.

## 1.2 Principles

The recommendations for Standards, Guidelines and Codes of Good Practice are based on the principles listed below.

1. The implementation of these Standards will achieve reductions in VOC emissions consistent with the targets of the Federal Smog Management Plan for NO<sub>x</sub> and VOCs for commercial/industrial coatings application facilities.
2. The recommended Standards are based on Best Available Technologies Economically Achievable (BATEA).
3. The Standards are expressed in the simplest possible form while remaining effective.
4. The Standards and the determination of compliance are clearly defined.
5. The format of the Standards allows flexibility in the choice of method of achieving compliance.
6. The Standards include the VOCs emitted by all of the designated operations used in the coating facilities in the Automotive Parts sector.
7. The Standards and methodologies will, after an appropriate phase-in period, be uniformly applied to new and existing sources.
8. Implementation of the recommendations is compatible with and supportive of the objectives and concept of pollution prevention.
9. Implementation of the recommendations offers the possibility of minimizing the generation of additional greenhouse gases and other pollutants such as NO<sub>x</sub> and is therefore compatible with government commitments in this regard.
10. The VOC limits are comparable to VOC reduction measures in the U.S.

## 2.0 Abbreviations & Definitions

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### 2.1 Abbreviations

<b>ASTM</b>	American Society for Testing and Materials
<b>BATEA</b>	Best Available Technology Economically Achievable
<b>CAA</b>	US Clean Air Act
<b>CAAA</b>	US Clean Air Act Amendments
<b>CCME</b>	Canadian Council of Ministers of the Environment
<b>CFC</b>	Chlorofluorocarbon
<b>E-Coat</b>	Electrodeposition (primer)
<b>EDP</b>	Electrodeposition (primer)
<b>Elpo</b>	Electrodeposition (primer)
<b>HCFC</b>	Hydrochlorofluorocarbon
<b>MMPP</b>	Miscellaneous Metal Parts and Products
<b>NOS</b>	Not otherwise specified
<b>NOx</b>	Nitrogen oxides
<b>NPRI</b>	National Pollutant Release Inventory
<b>NSPS</b>	New source performance standard
<b>OEM</b>	Original equipment manufacturer
<b>PCTBF</b>	Parachlorobenzotrifluoride
<b>psi</b>	Pounds per square inch
<b>RPP</b>	Regional Remedial Program (CCME, Phase I)
<b>SCFM</b>	Standard cubic feet per minute
<b>TE</b>	Transfer efficiency
<b>U.S.EPA</b>	United States Environmental Protection Agency
<b>VOC</b>	Volatile organic compound

### 2.2 Definitions

**Adhesion promoter:** A coating applied directly to a plastic substrate to provide adhesion of the subsequent coatings. Primarily used on polyolefin plastics.

**Air dried coatings:** The process of curing or drying a coating at ordinary room conditions - a temperature of 15 to 25° F with 40 to 60% relative humidity.

**Applied solids:** Coating solids that remain on the substrate being coated or painted after curing.

**As applied:** The condition of a coating after any dilution by the user just prior to application to the substrate.

**Automobile:** A motor vehicle capable of carrying no more than 7 passengers.

**Automotive OEM sector:** Automobile and light-duty truck assembly plants including coating facilities therein. The following are excluded from the Automotive OEM sector definition: operations used to coat plastic body components or all-plastic automobiles or light-duty truck bodies on separate coating lines; operations used to coat heavy duty trucks, truck-trailers.

**Automotive parts:** Components or sub-assemblies used by the automotive OEM sector in the assembly of motor vehicles. Includes parts intended for the replacement of damaged or defective parts in the automotive after-market.

**Automotive parts sector:** Manufacturers of automotive parts or components which are used in the assembly of automobiles or sold into the after-market. The sector comprises non-OEM assembly operations of automotive OEM manufacturers, independent or subsidiary manufacturers of parts which are used in the assembly of motor vehicles or independent operators of coating facilities which coat automotive parts for other parts manufacturers or the automotive OEM sector.

**Batea:** Best Available Technologies Economically Achievable, for the elimination or capture, control and minimization of organic solvent/VOC emissions. This includes the use of reduced organic solvent/VOC product alternatives in the surface preparation, coating application and cleanup processes.

**Baking coating:** A coating or lining for metal surfaces that is designed to be cured by baking at elevated temperatures, usually above 90°C. The item that is coated must be able to be heated to the required temperature and to withstand this temperature for the required baking period.

**Base coat:** A coating which provides the coloured layer for a composite system consisting of the base coat and a clear coat.

**Base coat/clear coat:** A topcoat system consisting of a relatively thin coloured layer of highly pigmented base coat followed by a layer of a clear or semitransparent coating.

**Chemically curing coating:** A coating in which a cross-linked polymeric film is developed from a chemical reaction between two components, often referred to as the base and curing agent. For example, an epoxy base is reacted with an amine curing agent.

**Clear coat:** A transparent coating, without the pigments that impart color or opacity, normally used to protect or intensify the effect of a color coat beneath.

**Conductive Primer:** A primer having electrical conductive properties which allows subsequent coatings to be applied on non-conductive substrates by electrostatic spray application.

**Cross-linking:** Method of polymer film formation. Chemical links are set up between molecular chains to form a three-dimensional or network polymer. When cross-linking is extensive, as in most thermosetting resins, it makes one infusible, larger molecule of all the linked chains. Cross-linking generally toughens and stiffens coatings.

**Dip coating:** Application method in which an object is dipped into a container of coating and withdrawn. Excess coating that drains off can be collected and recycled. This method is used in factories to coat small, difficult to paint, or fabricated assemblies.

**Drying:** Process by which coatings change from a liquid to solid state due to evaporation of the solvent, physicochemical reactions of the binding medium, or a combination of these causes.

**Electrodeposition:** Dip coating method that uses an electrical field to promote deposition of the coating material onto the part. The part being painted acts as an electrode, oppositely charged from the particles of paint in the dip tank. The paint particles coat the item and form a continuous, uniform film which is generally baked to achieve cross-linking and insolubility of the binder. Widely used to apply the prime coat to a metal part.

**Electrostatic spray:** A method of applying a spray coating in which an electrical charge is applied to the coating. The atomized coating is attracted to the object by the electrostatic potential between it and the object being coated.

**Existing source:** Any stationary source of air pollution other than a new source.

**Final repair:** The final coating(s) applied on site, after the complete assembly of the motor vehicle to correct damage or imperfections in the finish.

**Flash-off area:** The structure on automotive parts coating lines between the coating application system (dip tank or spray booth) and the bake oven. Used to provide a degree of control of the evaporation rate of solvents from the applied, uncured film.

**Flow coating:** Process of pouring or flowing a coating of paint over an object. This procedure is used to coat the interiors of pipes and small vessels and the exteriors of surfaces (e.g. automotive truck frames) inaccessible by other application methods. Any excess paint drains off and may be reusable.

**Forced drying:** Acceleration of drying by increasing the temperature above ambient, generally above 25° C and below 90° C, by circulating heated air onto or near the coated surface. Also known as low bake curing.

**Guide coat:** See Surfacer

**High Bake Curing:** Curing of the film by subjecting to elevated temperatures above 90° C.

**High solids coating:** A coating with more solids than volatile content. Sixty percent solids sometimes is used as a benchmark measurement, at or beyond which a coating is said to be high solids.

**Low Bake Curing:** See Forced Drying

**Mid-coat:** A coating applied as an intermediate layer between the basecoat and the clearcoat in basecoat/clearcoat systems. The mid-coat is semi-transparent and contributes special colour effects to the system.

**New source:** A coating facility that begins operation on or after January 1, 2002.

**Non-volatile content:** The portion of a coating that does not evaporate during drying or curing under specified conditions, comprising the binder and, if present, the pigment.

**Plastic part:** Any component constructed of synthetic organic material

**Pretreatment:** Chemical treatment, such as phosphating, to prepare a bare metal surface for painting.

**Primer:** The first organic coating, with the exception of adhesion promoter, applied to the cleaned and pre-treated surface of the part.

**Primer surfacer:** See Surfacer

**Prime coat operation:** The prime coat spray booth or dip tank, drain/flash-off area and bake oven(s) used to apply and cure the prime coat.

**Purge:** The coating and associated purging material expelled from the spray system when clearing it. Done when changing colour or to maintain the cleanliness of the spray system.

**Purge capture:** The capture of purge immediately after its use in purging the system to prevent the release of VOC emissions. Includes the disposal of the captured purge material.

**Radiation curing coating:** A coating formulated so that the curing reaction is produced by projecting electromagnetic radiation (ultraviolet, visible, or infrared light) onto the uncured coating after application.

**Solids:** Nonvolatile matter in a coating composition; the ingredients of a coating composition that, after drying, are left behind and form the dry film.

**Solventborne coating:** One which contains 5% or less water as the volatile constituent, the remainder being organic solvent.

**Solvent cleaning operation:** Operations used to remove uncured coating or contaminants such as soil, grease or lubricants from parts, products, tools, machinery, equipment and general work areas.

**Solvent loss:** Includes losses to air, water and land.

**Spray application:** A method of applying coatings by atomizing the coating material and directing the atomized particles toward the part to be coated. Can be used for all coating operations but generally used today for guide coat and topcoat application. Atomization can be caused by air jets (conventional spray), high pressure (airless spray) or by centrifugal force (bells or disks). Electrostatic charges can be used to improve transfer efficiency with all methods but is an integral and essential element for application with centrifugal atomization.

**Spray booth:** A structure housing automatic or manual spray application equipment for coating operations by this method. Includes facilities for the capture and entrapment of particulate overspray.

**Surface coating application:** Any prime coat, guide coat or top coat operation.

**Surfacer:** An intermediate protective coating applied over the primer and under the topcoat. Also called a guide coat or primer surfacer.

**Surfacer operation:** The spray booth, flash-off area and the bake oven used to apply and cure a coating between the prime coat and the topcoat operations.

**Target area:** The surface area of the part which is to be coated.

**Topcoat:** The final coating applied to provide the final colour and/or protective surface. See also Base coat/clear coat.

**Transfer efficiency:** The ratio of the amount of coatings solids transferred to the surface of the body or part to the total amount of coating solids used in the operation.

**Volatile organic compound:** Any organic compound that participates in atmospheric photochemical reactions. This excludes the following compounds due to their negligible photochemical reactivity:

- Acetone
- Methane
- Ethane
- Methyl chloroform
- Methylene chloride
- Parachlorobenzotrifluoride (PCTBF)
- Chlorofluorocarbons (CFCs)
- Fluorocarbons (FCs)
- Hydrochlorofluorocarbons (HCFCs)

**Volume Solids:** The proportion of a volume of coating which is not volatile and constitutes the actual final coating remaining on the surface after application and curing.

**Waterborne coating:** One which, as supplied and applied, contains more than 5% of its volatile fraction as water.

**Water reducible coating:** A coating which, as applied, contains more than 5% of its volatile fraction as water. May contain less than 5% water as supplied.

## 3.0 Automotive Parts Coating Standards & Guidelines

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### 3.1 Applicability

#### 3.1.1 General Applicability of Standards & Guidelines

Provided that the qualifying criteria are met, Automotive Parts coatings facilities may achieve the VOC reduction objectives described in these Standards by using either:

- Product and Operations Standards and Guidelines; or,
- Performance Standards and Guidelines.

This approach allows the maximum flexibility in the operation of Automotive Parts coating facilities while achieving the VOC reduction objectives of this initiative.

Detailed descriptions of the various elements of the Product and Operations Standards and Guidelines may be found in Schedules 1-4. The description of the Performance Standards and Guidelines may be found in Schedule 5. In determination of the compliance of the facilities, any accompanying adhesion promoters, primers, guide coats and purge/cleaning solvents are to be included in the calculation of the emissions.

#### 3.1.2 Qualifying Criteria

The Product and Operations Standards and Guidelines may be used for any Automotive Parts coating facility without limitation.

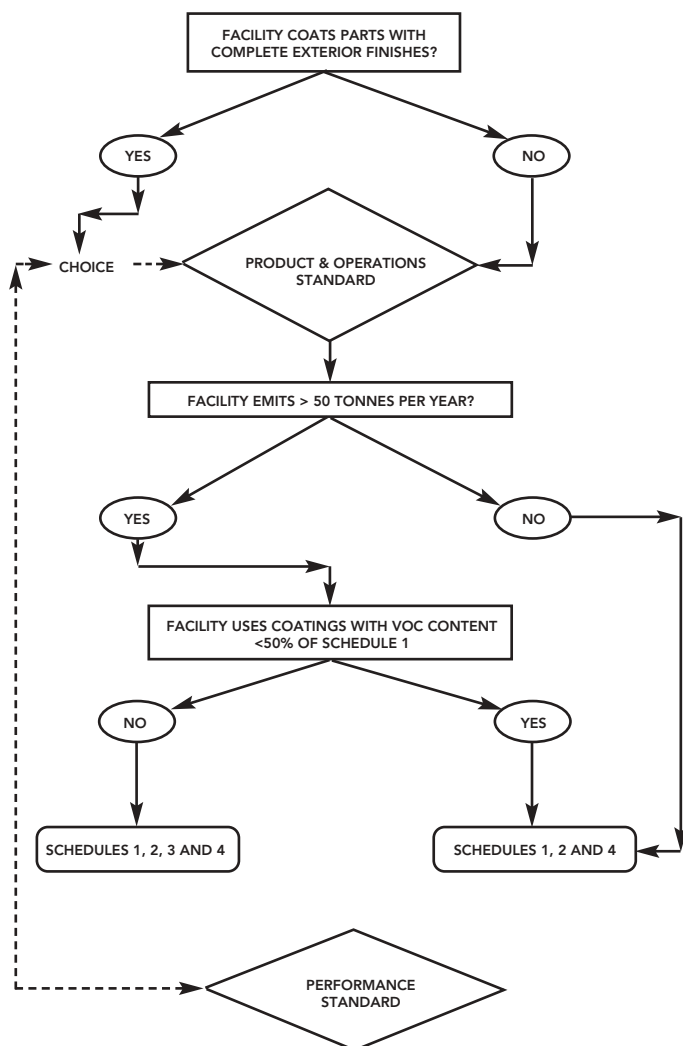
The Performance Standards and Guidelines may only be used for those facilities that coat parts with complete exterior finishes comprising, as a minimum, an automotive topcoat, including basecoat/clearcoat systems and single colour coat exterior finishes equivalent to those used on automobile bodies.

The criteria for determining their applicability of the Product and Operations Standards, and of the Performance Standards, as well as the various applicable Schedules, are presented in Figure 1 on the next page. Note that the criteria apply to individual coating lines within facilities, not to the total use of coatings within a facility.

#### Notes to Figure 1:

1. If the site has more than one coating line applying coatings to the same product as part of different finishing stages for the part, the aggregate of the emissions from these lines are used to determine if the 50 tonne limit is exceeded. If the finishing lines are used for the coating of separate and distinct components, the determination is based on the emissions per finishing line and not on the aggregate of the finishing lines on the site.
2. Compliance for operations using several products, not all of which meet the 50% maximum level, is determined by the weighted average of the products (see Schedule 6).

**Figure 1: Applicability Criteria for VOC Reduction Standards and Schedules**



### 3.1.3 Applicability of Product and Operations Standards

The Product and Operations Standards described in Schedules 1 and 2 apply to facilities that coat Automotive Parts. In some instances, these parts are manufactured by one company and coated under contract by another company (a custom coater). In such instances, the Standards apply to the operation that actually coats the parts.

These Standards are intended to apply to all operations carried out in the application of organic coatings for the protection or decoration of Automobile Parts other than automobile bodies or components mounted on these bodies and painted in the same coating operations. Emission limits for those parts have already been specified in separate Standards and Guidelines (CCME-EPC-109). The Standards and Guidelines for Automotive Parts include the following operations where used by the facility:

<b>Substrate pre-cleaning</b>	Removal of oils and greases by means of solvents, usually by a manual wiping operation.
<b>In-mold coating</b>	Coating applied by spraying or injection into the mold for the part.
<b>Primer or adhesion promoter</b>	The first coating applied to the substrate. Includes primers applied over adhesion promoters for surface enhancement or conductivity.
<b>Anti-chip coating</b>	Usually applied by a spray method.
<b>Surfacer</b>	Also referred to as a guide coat, usually applied by a spray method.
<b>Blackout</b>	Usually applied by a spray method to limited areas of the part.
<b>Topcoat 1</b>	Currently usually a coloured base coat but may also be the first layer of the final colour coat.
<b>Topcoat 2</b>	A clear final coating where base coats are used in step 3. or a second application of the final colour coat.

<b>Mid-coat</b>	An intermediate coating applied in some special cases between topcoat 1 coat and topcoat 2 to achieve a special colour effect.
<b>Purge</b>	Flushing of residual in-line colour or coating with solvent to permit a colour change or periodic equipment cleaning e.g. for clears. May be captured and reclaimed.
<b>Repairs</b>	Coatings applied to rectify defects in the finish, may consist of any or all of the steps in 2., 3., 4., 5. or 6. Above. May be cured in the same way as the original finish, or cured at a lower temperature after assembly of the vehicle. May use different or modified versions of the original coating.
<b>Facility/equipment cleaning</b>	Solvents are used for cleaning of the equipment and cleaning facilities such maintenance as paint circulation lines, spray equipment. Except for waterborne systems, solvents are usually the only effective cleaners available.

Fascias and bumpers, especially those made of plastic, are frequently coated in Automotive Parts finishing facilities, with coating systems analogous to the finish used by the OEM sector on automotive bodies. The comparative uniformity of exterior systems and the substantial emissions from this particular application make this an appropriate segment for the use of Performance Standards. In addition, the use of Performance Standards for the Automotive OEM sector supports the recommendation that a Performance Standard be available for the finishing of parts which effectively duplicate the systems used in the OEM sector.

These Performance Standards are established as a maximum value expressed as a ratio of grams of VOC emitted per square metre of component surface area (i.e., the surface actually coated). The Standard includes the emissions generated by all operations for cleaning, priming, surfacing, finish coating, in-plant repair and equipment cleaning.

The Performance Standard provides for separate VOC emission limits for metal and plastic components. The products and systems used for the two substrate types are different, requiring different VOC emission limits for the two substrates types. The specific limits proposed may be found in Schedule 5.

Research and development programs to lower the VOC emissions of automotive coating operations are actively being pursued in most major automobile manufacturing countries. These programs are directed towards product, process and control technology. As research and development in one or more of these areas may result in an economically viable route to further reduce VOC emissions, *it is recommended that the above limits be reviewed in the year 2005* to incorporate any advances which have been achieved. This is consistent with Phases II and III of the Federal Smog Management Plan.

Excluded from these operations is the application of sealants, undercoating, and sound deadeners, not generally regarded as a coating activity. These operations also are rarely used in the coating of parts.

### 3.1.4 Applicability of Performance Standards

As an alternative option to the Product and Operations Standards described above (and in Schedules 1-4), a facility meeting the qualifying criteria contained in section 3.1.2, may select the Performance Standard as the methodology for achieving compliance with the required VOC emission limits (see Schedule 5).

## 4.0 List of Schedules

### Schedule 1

#### Product VOC Content Limits

##### S-1.1 Temporary Exemptions

Manufacturers and importers of coatings for finishing Automotive Parts shall limit the VOC content, as applied, of each coating manufactured or imported for use in Canada as shown in the following tables. Temporary exemptions from these standards, for specific products, may be granted providing the following criteria are met:

- The manufacturer shall provide satisfactory evidence of the need for a temporary exemption from the standard for specific products;
- The manufacturer shall submit a written plan, providing including, but not limited to, the following information;
- the product category;
- the exemption period requested;
- the annual sales volume in the past year;
- the expected sales volume per year for the requested exemption period;
- the actions planned to remove the need for the exemption; and,
- the anticipated VOC content, as used, of the replacement product.

The granting of the exemption shall be at the discretion of the responsible jurisdiction.

##### S-1.2 Coatings for Metal Parts

This Standard provides maximum VOC contents for categories of coating products as applied to metal parts. The methodology and formulas to be used in determining the VOC contents are also included.

Coating Type	VOC Content (g/L as applied)
Primers	
Electrodeposition/ autophoretic coatings	30
Anti-corrosion	420
Zinc rich	480
Glass adhesive	600
Basecoats/midcoats	360
Extreme performance	420
Clearcoats	520
All other coatings	360

##### S-1.3 Plastic parts

This Standard provides maximum VOC contents for categories of coating products, as applied, which are used on plastic parts.

Coating Type	VOC Content (g/L as applied)
High Bake Coatings	
Adhesion primer	780
Flexible substrate primer	540
Rigid substrate primer	420
Basecoat	516
Clearcoat	480
All other topcoats	516
<b>Air Dry Or Force Dry Coatings</b>	
Adhesion primer	780
Primers	576
Basecoat	600
Clearcoat	540
All other topcoats	600

### S-1.4 Calculation of VOC emissions

The coating products subject to VOC content limits are defined “as applied.” In many instances this is not necessarily “as supplied.” The primary product may be adjusted for viscosity, by the addition of VOC-containing reducers to render it suitable for application, or for cure or performance, by the addition of a second component or cross-linker, or both.

To determine compliance, the VOC content of the product is calculated after all reducers and components are incorporated into the product according to the coating product manufacturer’s specifications.

The VOC content of the coatings is determined by any of the following methods, there being no significant differences between them for the purposes of these standards.

1. ASTM Standard Practice D-3960-92
2. US EPA Reference Method 24 (CFR Title 40, Part 60, Appendix A).
3. The theoretical total solvent content of the product or component derived from the manufacturer’s theoretical product or component formula.

### S-1.5 Primary products or components containing water and/or exempt volatile organic compounds

The VOC content of primary products or components containing water and/or exempt volatile organic compounds as applied for automotive parts shall be calculated according to Equation 1.

#### Equation 1

$$VOC_{PROD} = \frac{W_{VOL} - W_{EX} - W_W}{1 - V_{EX} - V_W}$$

where:

$VOC_{PROD}$  is the VOC content of the product or component, in g/L.

$W_{VOL}$  is the total weight of volatile material per litre of product or component, in grams.

$W_{EX}$  is the weight of exempt volatiles per litre of primary product or component, in grams.

$W_W$  is the weight of water per litre of primary product or component, in grams.

$V_{EX}$  is the volume of exempt material(s) per litre of primary product or component, in litres.

$V_W$  is the volume of water per litre of primary product or component, in litres.

### S-1.6 Reducers or thinners

Reducers do not normally have a non-volatile constituent. Where these products do not have a non-volatile constituent, the VOC content is calculated using Equation 2. If the reducers have a non-volatile constituent, the VOC content is calculated using Equation 1.

#### Equation 2

$$VOC_{RED} = W_{VOC} - W_{EX} - W_W$$

where:

$VOC_{RED}$  is the VOC content of the reducer or thinner, in g/L.

$W_{VOC}$  is the total weight of volatile material per litre of reducer or thinner, in grams.

$W_{EX}$  is the weight of exempt volatiles per litre of reducer or thinner, in grams.

$W_W$  is the weight of water per litre of reducer or thinner, in grams.

### S-1.7 Single stage systems

VOC content of a single stage coating, including primers, in-mold coatings, surfacers or guide coats, single stage topcoats and specialty coatings, shall be calculated using Equation 3.

#### Equation 3

$$VOC_{Cg} = A\% \times VOC_A + B\% \times VOC_B + C\% \times VOC_{RED} + etc.$$

where:

$VOC_{Cg}$	is the VOC content of the coating as applied, in g/L.
$VOC_A$	is the VOC content of the primary product A, in g/L.
$VOC_B$	is the VOC content of additional component, if used, in g/L.
$VOC_{RED}$	is the VOC content of the reducer/thinner in g/L.
A%	is the % volume of primary product A in the mixture as applied.
B%	is the % volume of additional components in the mixture as applied.
C%	is the volume of the added reducer/thinner in the mixture as applied.

If the mixture as used has additional components or additives these would be included in the calculation as Component D, E, etc. and treated as the other constituents in the mixture

### S-1.8 Basecoat/clearcoat systems

#### Equation 4

$$VOC_{BC/CC} = \frac{VOC_{BC} + 2VOC_{CC}}{3}$$

where:

$VOC_{BC/CC}$	is the VOC content of the basecoat/clearcoat system as applied, in g/L.
$VOC_{BC}$	is the VOC content of the basecoat as used and calculated for a single stage product in Equation 1.
$VOC_{CC}$	is the VOC content of the clearcoat as used and calculated for a single stage product in Equation 1.

### S-1.9 Multi-stage Coatings (3 or more coatings)

#### Equation 5

$$VOC_{MS} = \frac{VOC_{BC} + VOC_{MC1} + VOC_{MC2} + 2VOC_{CC}}{M + 3}$$

where:

$VOC_{MS}$	is the VOC content of the multi-stage coating system as applied, in g/L.
$VOC_{BC}$	is the VOC content of basecoat as applied, in g/L. calculated using Equation 1.
$VOC_{MC1}$	is the VOC content of the first mid-coat as applied, in g/L. calculated using Equation 1.
$VOC_{MC2}$	is the VOC content of the second mid-coat as applied, in g/L. calculated using Equation 1.
$VOC_{CC}$	is the VOC content of the clearcoat as applied, in g/L. calculated using Equation 1.
M	is the number of mid-coats.

Additional mid-coats are incorporated in the equation in the same way as mid-coats 1 and 2.

### S-1.10 Cleaners

Cleaners do not normally have a non-volatile constituent. Where these products have a non-volatile constituent, the VOC content is calculated using Equation 1. Where these products do not have a non-volatile constituent, the VOC content is calculated using Equation 6.

#### Equation 6

$$VOC_{Clean} = W_{VOL} - W_{EX} - W_W$$

where:

$VOC_{Clean}$	is the VOC content of the cleaner, in g/L
$W_{VOL}$	is the total weight of volatile material per litre of cleaner, in grams
$W_{EX}$	is the weight of exempt material per litre of cleaner, in grams
$W_W$	is the weight of water per litre of cleaner, in grams

### Schedule 2 Operations Standards and Guidelines

Compliance with Schedule 2 requires the use of approved coating application technology. The following application technologies meet the equipment requirements of this standard:

#### S-2.1 Spray equipment

- Electrostatic air-atomized spray guns
- Electrostatic airless spray guns
- Electrostatic disc application
- Electrostatic bell application
- Electrostatic CO<sub>2</sub> application process
- Electrostatic HVLP spray guns

#### S-2.2 Immersion application equipment

- Electrodeposition
- Autophoretic deposition

#### S-2.3 Alternative equipment

##### S-2.3.1 Spray equipment

While electrostatic application methods are the preferred spray application technologies, it is recognized that these methods are not viable for the coating of all shapes of Automotive Parts. It is recommended that the following spray technologies be accepted as in compliance subject to presentation of evidence that electrostatic methods are not suitable for reasons of object shape or lack of suitable products from a performance standpoint.

- CO<sub>2</sub> application process
- HVLP spray application
- Airless spray process

##### S-2.3.2 Immersion application equipment

While electrodeposition or autophoretic deposition are the immersion application methods of choice, there may be instances in which they are unsuitable. In these instances, the following immersion methods may be approved for use subject to presentation of evidence that the preferred methods are not suitable.

- Flow coating
- Dipping

#### S-2.4 Exemptions

Conventional air atomized application equipment is permitted for touch-up or other special uses provided the quantity of coating applied in this manner does not exceed, in total, more than 5% of the total coating used in the facility.

### **Schedule 3 Emission Control Equipment**

This emission control schedule has two parts:

1. a minimum of 50% of the total VOC emissions from the coating operations of the facility must be captured and treated; and,
2. a minimum of 95% of the captured VOCs must be destroyed.

### **Schedule 4 Codes of Good Practice**

Previous studies have shown that good operating practices can provide significant reductions in VOC emissions<sup>1</sup>. In addition to the reduction of VOC emissions, the practices can also result in material and waste disposal cost savings for the coating.

#### **S-4.1 Elements of the Code of Good Practice**

The Code of Good Practice is comprised of four distinct elements:

1. Solvent Management;
2. Training;
3. Materials Handling; and
4. Equipment Operation, Maintenance and Cleaning.

Each of these four elements is an important and integral part of the Code of Good Practice and an effective program to minimize fugitive VOC emissions cannot be achieved if any one is ignored.

#### **S-4.1.1 Solvent Management**

The application of well thought-out health, safety and environmental management systems is an integral part of a program to achieve VOC reduction objectives in an effective and efficient way. These management systems should have a specified scope and be capable of demonstrating that:

- the system is understood, effective and implemented;
- the performance criteria satisfy all applicable legal requirements as well as the health and environmental policies of the organization;
- the system is based primarily on prevention rather than correction after an incident; and
- the system is flexible and capable of modification and evolutionary change.

Certain characteristics of any management system should be in place to ensure that the program is carried out efficiently and effectively. The following characteristics are sufficiently generic so as to apply to systems for managing virtually any technical activity and in particular to solvent management systems:

1. Planning
  - a) Explicit goals and objectives
  - b) Well-defined scope
  - c) Well defined inputs and resource requirements
  - d) Identification of needed tools and training
2. Organization
  - a) Clear lines of authority and explicit assignment of roles, responsibilities
  - b) Variance procedures and audit mechanisms
  - c) Corrective action mechanisms
  - d) Formal procedures

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<sup>1</sup> See Environment Canada reports K2036-3-7091 Recommended Guidelines for the Reduction of VOC Emissions from Canadian Automotive OEM Coating Facilities and K2335-5-0169 Recommended Guidelines and Standards for the Reduction of VOCs from Canadian Automotive Refinish Operations. K2036-3-7091 is the study most directly applicable to the current study and contains the most detailed industry data. It shows an average value ~18% and a range of <1% to ~43% of total VOC emissions, clearly identifying the significance and opportunities for substantial reductions.

3. Implementation
  - a) Detailed work plans
  - b) Specific milestones for accomplishments
  - c) Initiating mechanisms
4. Control
  - a) Performance standards and measurement methods
  - b) Performance measurement and reporting
  - c) Checks and balances
  - d) Internal reviews

Not all features or characteristics may be needed in every specific situation. Exceptions and departures based on local circumstances are acceptable and suggested changes and additions based on actual experience are to be encouraged.

#### **S-4.1.2 Training**

The VOC emissions generated outside of the primary coating operations are comparatively small. Further, they arise from a variety of sources and operations, some of which may not be recognized for their contribution to the VOC emission pool. It is important, therefore, that all personnel involved in these operations is made aware of this contribution and the need to reduce or eliminate it wherever possible. This can best be accomplished by comprehensive and effective training of supervisory and operating personnel. Training should therefore be provided in the following areas commensurate with their specific responsibilities:

1. The theory, characteristics and value of solvent management systems;
2. Applicable health, safety and environmental laws and regulations including those governing labeling, spills, emergencies and reporting and waste handling and disposal;
3. All applicable aspects of this Code of Good Practice including:
  - a) Equipment and operating standards,
  - b) Solvent storage and handling,
  - c) Waste handling and disposal,
  - d) Record keeping,
  - e) Test methods;

4. All applicable operating procedures and standards including:
  - a) Normal operations including daily check lists,
  - b) Routine maintenance,
  - c) Solvent conservation and maintenance,
  - d) Cleaning and maintaining equipment including safety,
  - e) Procedures and entry requirements,
  - f) Containment and recovery of spills,
  - g) Handling and disposal of wastes,
  - h) Equipment start-up, shut down and emergency responses;
  - i) Test methods and procedures;
  - j) Use of personal protective and monitoring equipment; and
  - k) Intent and benefits of following this Code of Good Practice.

#### **S-4.1.3 Materials Handling**

##### **S-4.1.3.1 Returnable Containers**

###### *Totes*

Totes, during transportation and while in storage, should be completely sealed to avoid the possibility of fugitive emissions of Volatile Organic Compounds (VOCs) into the atmosphere.

During the transfer of the materials in totes to the circulation system tanks or into later storage vessels, a small ventilation opening may be utilized to prevent the creation of a vacuum in the container. Failure to do so could result in only partial emptying of the container and result in unexpected large spillage when the transferring operation is thought to be complete and the tote is disconnected. As a precaution against this eventuality and to avoid even small losses in this way, the tote valve should be secured in the closed position before disconnection. Immediately after this has been done, the lids and vents on the tote should be tightly closed to prevent any subsequent escape of VOCs from the container.

Lids, vents and other openings should be designed to eliminate the possibility of leaking during the return transportation. Totes should be shipped back to the materials supplier or to a qualified processor

of such empty containers for cleaning and re-use. By prior agreement a small amount of solvent (or de-ionized water as appropriate) may be added to the totes before their return for cleaning. This step will ensure that only a minimum quantity of cleaner (probably also a VOC) is required for the cleaning operation by preventing the drying of paint to the inside walls, valves and other fittings. Care must be taken to control the amount of solvent added for this purpose to ensure that the classification of the container as “Empty” is not affected.

### ***Drums***

All paint drums arriving at the plant should be returnable and re-usable where feasible and appropriate to the manufacturer's handling requirements. During transfer operations analogous to those described above for totes, the ventilation bung may be removed but should be securely replaced immediately thereafter.

If it is necessary, because of system design, to remove the lid for access to the material, e.g. for viscosity adjustment or pumping, the open drum should be covered with a flexible covering in such a way as to minimize VOC losses to the atmosphere. The lids should be carefully stored in the interim to ensure that they are not inadvertently damaged during this period and that they are used to reseal the container when empty. Steps should be taken to make certain that the empty drums are tightly closed, and all bungs replaced to avoid possible fugitive emissions during the return to the supplier or drum cleaner.

#### **S-4.1.3.2 Non-Returnable Containers**

All full and part full non-returnable containers should be shipped and stored with lids and other openings sealed air tight. Handling during transfer operations to mixing or circulating tanks should be done, as closely as possible, in the same way as returnable containers. If any thinning is required, at least a portion of the required solvent should be added to the just emptied container to assist in minimizing any residual material. The solvent/paint mixture should then be added to the material just removed. After emptying, the non-returnable

container should immediately be processed by approved methods as waste or hazardous waste as appropriate to the residues, if any, remaining in the container. The use of non-returnable containers should be reduced or, if possible, be discontinued, to the extent feasible and appropriate to the materials handling procedures in use at the coating facility.

### ***Mix Tanks***

In paint mix rooms, all mixing tanks should be kept tightly closed except when required for additions or sampling. Sampling tubes should be fitted if possible to minimize the need to open the vessel. All tank lid gaskets should be on a regular inspection schedule to ensure proper sealing. Defective or damaged seals should be replaced promptly.

Tanks should be vented through a flame arrestor/conservation vent combination. At installations where vent pipes are interconnected between mix tanks, tanks not in use should be kept with lids and other openings securely closed.

### ***Bulk-Storage Tanks***

Bulk-storage tanks containing paint, solvents, purge materials and holding tanks for wastes should be totally enclosed systems. Ventilation should be through flame arrestor/conservation vents. Vent pipes from each tank should be independent of those from other tanks. Interconnection between tanks is not recommended. Fill lines should enter tanks from the top only to prevent accidental leakage and spills. Transfer pumps, filters, metering devices, valves, etc. should be periodically inspected under regularly scheduled maintenance. Any devices found to be defective or suspect should be repaired immediately.

### ***Application Equipment***

The operation of application equipment should include:

- Written procedures for the proper operation of the equipment,
- Training of employees in the operation and monitoring of the equipment used for the application of the coatings,

- All necessary test equipment required for setting and monitoring the proper operation of the equipment,
- Record keeping procedures, and
- Monitoring of the operation of the equipment and of the records kept.
- Periodic retraining and review of procedures.

### ***Baking Equipment***

The operation of baking or force dry equipment should include:

- Written procedures for the proper operation of the equipment,
- Training of employees in the operation and monitoring of the ovens used for the curing of the coatings,
- All necessary test equipment required for setting and monitoring the proper operation of the equipment,
- Record keeping procedures, and
- Monitoring of the operation of the equipment and of the records kept.
- Periodic retraining and review of procedures.

### ***Abatement Equipment***

The operation of abatement equipment such as booth controls, ovens afterburners should include:

- Written procedures for the proper operation of the equipment,
- Training of employees in the operation and monitoring of the abatement equipment
- All necessary test equipment required for setting and monitoring the proper operation of the equipment,
- Record keeping procedures, and
- Monitoring of the operation of the equipment and of the records kept.
- Periodic retraining and review of procedures.

## **S-4.1.4 Equipment Cleaning**

### **S-4.1.4.1 Paint System Flushing**

Paint circulating systems must, of necessity, be cleaned periodically. The frequency of cleaning, a costly operation which can generate significant quantities of solvent to be recycled, can be reduced by keeping the system well balanced. A well-balanced system keeps paint settling to a minimum and thus reduces the creation of dirt, a major quality problem for paint finishes.

When system flushing does become necessary, cleaning agents should be carefully selected for minimum VOC content, lowest photochemical reactivity while still remaining effective. The coatings supplier should recommend the cleaning solution composition keeping all of the above three factors in mind.

As an initial step, as much old paint as possible from the circulating lines should be blown back using compressed air and if necessary solvent. The returned paint should be blown back into totes, tankers or waste storage tanks.

Transfer of flushing solvents into mix tanks, and paint circulating systems should be done through completely sealed piping and/or hose arrangements to avoid fugitive VOC emissions.

All tank lids and other openings in the system except flame arrestor/conservation vents should be closed during the circulation of solvents. Used flushed paint and paint/flushing solvent mixtures should be pumped into transportable sealable containers and sent for reclamation and reuse. Although the circulating system itself is a totally enclosed system, VOCs can be released during the blowback operation. As a preventative measure, therefore, it is recommended that the mix tanks or paint lines be emptied at the same rate as paint or solvents are returned from the circulating system.

### ***Mix Tanks***

Paint deposits can build up on the insides of mix tanks above the usual liquid level. Heavy paint deposits on inside tank walls should be manually removed by scraping with non-sparking tools. Alternatively, they may be removed by blasting with high pressure water streams. Collected waste material should be transferred to transportable containers having sealable lids. Wherever possible, VOC generating solvent washes should be avoided and VOC-free cleaning agents used if available.

When necessary to use solvents for tank cleaning, managed amounts of strippers should be applied with brushes or wipers. Used brushes, wipers and other equipment used for this purpose should be stored for disposal, in approved, sealable containers. If subject to spontaneous combustion, the storage container should contain sufficient water to cover the waste. As far as possible, residual solvents in tanks should be removed by pumping or draining into sealed containers and sent for recycling.

Air supply breathing apparatus should be supplied along with good ventilation.

#### **S-4.1.4.2 Paint Transfer and Spray Equipment**

Paint transfer and application equipment such as pumps, filters, regulators, valves, metering devices, spray guns, bells, etc. should be cleaned using measured amounts of VOC-creating solvents. Parts should be manually scrubbed, applying small amounts of strippers. When soaking is required, containers with air tight lids should be used. Used solvents should be returned to sealed containers of a waste collection system for recycling and reuse.

### ***Filters***

Filter vessels should be emptied before cleaning or changing filter media by blowing out with compressed air. Used filter bags should be immediately transferred into containers equipped with sealable lids for storage and transportation.

### ***Spray Booths***

The cleaning of spray booths is a difficult job, costly in both labour materials and potential interruption of production. Effective spray booth cleaning procedures can therefore prove both cost and VOC reduction effective. This can best be accomplished with plant-specific written procedures for the cleaning crews. In down draft spray booths, air supply and exhaust volumes should be maintained at optimum design parameters. Overspray, the main element requiring removal, should be kept at minimum levels for conventional or electrostatic air atomized spray guns by fine tuning spray patterns and reducing paint fluid and air atomizing pressures.

Carefully planned cleaning schedules will also contribute to fewer cleaning cycles without sacrificing quality. Wherever possible grates should be cleaned with high pressure hot water. Spray booth walls may be coated with strippable compounds, preferably low VOC types which can be readily removed by hot, high pressure water streams. Flat surfaces may be cleaned by scraping.

Windows and walls not suitable for coating with strippable compounds may be cleaned with measured amounts of VOC-containing strippers applied manually by brush. Complex equipment shapes may be cleaned with wipers moistened with small amounts of solvents. Cleaning of automatic application zones should be limited and disposable shrouds used where possible. Booth cleaning equipment, including solvents should be stored in closed cabinets, preferably with limited access.

Solvents used in cleaning operations should be closely monitored with volumes and access controlled. The use of non-VOC strippers and/or hot high pressure water should be used as the preferred option wherever feasible. Used cleaning equipment should be stored and sent for disposal in tightly sealed containers.

## S-4.2 Check List For Good Practices

### Solvent Management

Practice	Currently Done (Y/N)	Plans, Actions, Timing
Effective solvent management plan in place.		
Plan assessed for safety, health, legal, and environmental policy requirements.		
Emphasis of plan on prevention rather than correction.		
Plan designed for modification and change.		
Audit mechanism in place.		
Formal procedures in place.		
Corrective action mechanisms.		
Roles and responsibilities clearly assigned.		

### Training has been provided in the following areas:

Practice	Currently Done (Y/N)	Plans, Actions, Timing
Solvent management plan principles and objectives.		
Applicable health, safety and environmental regulations.		
Solvent conservation.		
Solvent recovery and recycling.		
Equipment and operating standards and procedures.		
Use of personal protective and monitoring equipment.		
Solvent storage and handling.		
Spill prevention.		
Containment and recovery of spills and leaks.		
Cleaning and maintenance of equipment.		
Waste handling and disposal.		
Record keeping.		
Test methods.		

## Materials Handling

### Returnable Containers

Practice	Currently Done (Y/N)	Plans, Actions, Timing
Totes and drums completely sealed during transportation and storage.		
Small ventilation opening during transfer to circulating system.		
Tote valves secured in closed position after emptying and before disconnecting.		
Ensure lids and vents are tightly closed after emptying container.		
Lids, vents and other openings designed to prevent leaking during return transportation.		
Any solvent/water added after emptying is by prior agreement with supplier.		
Above additions controlled to avoid excessive use and reclassification of container as empty.		
All drums arriving at the facility are returnable and reusable.		
Drums covered with flexible covering if lids removed for pumping, viscosity adjustment, etc.		
Removed lids safely stored to prevent damage to seal.		
Lids removed during use promptly replaced and container tightly resealed.		

### Non-Returnable Containers

Practice	Currently Done (Y/N)	Plans, Actions, Timing
Use of non-returnable containers reduced to minimum possible.		
Containers shipped with lids and openings tightly sealed.		
Handling as for returnable containers to minimize losses.		
Portion of thinner, if any added to emptied container to minimize residual material.		
Empty containers to be promptly processed as hazardous waste.		

### Mix Tanks

Practice	Currently Done (Y/N)	Plans, Actions, Timing
All mix tanks are kept tightly closed except for additions.		
Procedures for additions designed to minimize fugitive emissions.		
Sampling tubes fitted.		
Lid gaskets regularly inspected and replaced if defective.		
Tanks vented through flame arrestor/conservation vent.		
Tanks not in use have vents and lids sealed.		
Pumps, filters, valves, metering devices and vents inspected under regularly scheduled maintenance.		
Repairs promptly made.		

### Bulk-Storage Tanks

Practice	Currently Done (Y/N)	Plans, Actions, Timing
All bulk storage tanks are totally enclosed systems.		
Ventilation of tanks is through flame arrestor/conservation vents.		
Each tank has independent vent system. Tank vents are not inter-connected.		
Fill lines enter tank from the top to prevent spills.		
Pumps, filters, valves, metering devices and vents inspected under regularly scheduled maintenance.		
Repairs promptly made.		

## Equipment Operation

### Application Equipment

Practice	Currently Done (Y/N)	Plans, Actions, Timing
Written procedures provided.		
Operators trained in the operation of the equipment.		
Monitoring procedures for equipment operations in place.		
Scheduled maintenance program.		
Record keeping procedures defined.		
Operation and record keeping monitored.		
Scheduled periodic retraining program.		

### Curing Equipment

Practice	Currently Done (Y/N)	Plans, Actions, Timing
Written procedures provided.		
Operators trained in the operation of the equipment.		
Monitoring procedures for equipment operations in place.		
Scheduled maintenance program.		
Record keeping procedures defined.		
Operation and record keeping monitored.		
Scheduled periodic retraining program.		

### Abatement Equipment

Practice	Currently Done (Y/N)	Plans, Actions, Timing
Written procedures provided.		
Operators trained in the operation of the equipment.		
Monitoring procedures for equipment operations in place.		
Scheduled maintenance program.		
Record keeping procedures defined.		
Operation and record keeping monitored.		
Scheduled periodic retraining program.		

## Equipment Cleaning

### Paint System Flushing

Practice	Currently Done (Y/N)	Plans, Actions, Timing
Paint system kept well balanced to minimize need for cleaning.		
Cleaning solutions selected for minimum possible VOC content.		
Paint in system blown back before cleaning solution added.		
Recovered paint kept in sealed containers for reclamation, if possible or disposal.		
Transfer of cleaning solution into system done through sealed piping.		
All lids and openings except flame arrestor/conservation vents kept sealed during cleaning.		
Spent paint/cleaning solution pumped into transportable sealable containers.		
Recovered paint, paint/cleaning solution sent for reclamation if possible.		
Paint mix tanks and lines emptied at same rate as returned from circulating system.		

### Mix Tank Cleaning

Practice	Currently Done (Y/N)	Plans, Actions, Timing
Initial cleaning done by non-VOC methods.		
Collected waste stored in transportable, sealed containers.		
Use non-VOC cleaners.		
Tanks cleaned using brushes or wipers where possible.		
Cleaning brushes, wipers stored in approved, sealable containers.		
Residual solvents removed by pumping where possible.		
Safety equipment includes air breathing apparatus.		

## Filters

Practice	Currently Done (Y/N)	Plans, Actions, Timing
Filter vessels emptied before cleaning or changing by blowing out with compressed air.		
Used filters immediately transferred to transportable, sealed containers.		

## Spray Booth Cleaning

Practice	Currently Done (Y/N)	Plans, Actions, Timing
Specific written cleaning procedures.		
Regular inspection and maintenance of air supply and exhaust performance.		
Application equipment maintained for minimum overspray.		
Planned cleaning schedules to minimize cleaning cycles.		
Grates cleaned by high pressure water where possible.		
Spray booth walls coated with film or low VOC compounds compatible with high pressure water cleaning.		
Other areas cleaned by low VOC methods (brushes, wipers, etc.).		
Automated application zones protected with disposable shrouds.		
VOC-containing cleaning equipment and materials in controlled access cabinets.		
Solvents used for cleaning have controlled access with closely monitored usage.		
Non-VOC strippers and cleaners used where feasible.		
Used cleaning equipment and fluids stored and sent for disposal in sealed containers.		

## Schedule 5 Performance Standards and Guidelines

### S-5.1 VOC Limits

The specific limits proposed are:

Metal substrates:

110 grams of VOC per square metre

Plastic substrates:

280 grams of VOC per square metre

Note that these limits are expressed in grams of VOC per square metre of actually coated surfaces, not the entire surface area (including the back) of the part<sup>2</sup>.

### S-5.2 Effective Dates

#### S-5.2.1 New Sources

It is recommended that these limits be placed on all new and renovated facilities as defined below, which begin operation on or after January 1st, 2003.

##### S-5.2.1.1 Definition of New Sources

A new source is defined as a facility used for coating automobile components and which meets any one of the following criteria:

- The facility was constructed in a location where such a facility did not exist prior to January 1st, 2002.
- A modified (renovated, replaced or added) facility on the site of a facility constructed prior to January 1st, 2003, where the modification or the addition to existing facilities becomes operational on or after January 1st, 2003, and where it will result in an increase of 25 tonnes, on a total annual VOC emissions basis, over the previous total annual permitted emissions of the facility being modified.

#### S-5.2.2 Existing Sources

It is recommended that the limits take effect on January 1st, 2005.

##### S-5.2.2.1 Definition of Existing Sources

Existing sources are defined as any sources which are in operation prior to January 1st, 2002 and which are not otherwise defined as new sources.

### S-5.3 Definitions And Methodology

#### S-5.3.1 Calculation of VOC Emissions

The calculation of VOCs emitted by the coating facilities is based on the determination of the total quantity of solvents used in the coating related operations. Solvents captured and sent for processing externally are deducted from the total quantity of solvent used. VOCs that are captured and incinerated by acceptable control technologies are also deducted from the total quantity of solvent use.

#### S-5.3.2 Reporting

It is recommended that the manufacturing location maintain monthly records of total VOCs released to the atmosphere for all of the specified operations and of the surface areas coated and that the annual results based on these values will be used to determine compliance with the stated limits. It is recommended that reporting be done annually and harmonized with the annual reporting period of the NPRI data.

#### S-5.3.3 Surface Area Definition

In calculating the grams of VOC emitted per square metre it is necessary to determine the target surface area of the part to be used. An automotive part may have a complex shape, and in some instances, the manufacturer may not be able to measure the target area. In these instances, in the interest of simplicity the use of the total surface area, i.e., all interior and exterior surfaces whether finish coated or not, may be used to determine the target area by means of the following equation:

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<sup>2</sup> To avoid confusion, it should also be noted that the limit was originally expressed (in a draft version of this document) in terms of grams of VOC per square metre of entire surface area, including area not actually coated. The limit, therefore was 55 g/m<sup>2</sup>, instead of 110 g/m<sup>2</sup>. It should be clear that these limits are in fact equivalent, and that there has been no effective change, except in how the limit is expressed.

$$\text{Target area} = \frac{\text{Total surface area}}{2}$$

This use of target area is consistent with practices within the automotive industry.

It is recommended that the determination may be made by one of the following methods at the manufacturer's option:

1. By calculation from the weight of the part prior to any of the finishing operations using the following formula:

$$TA = \frac{2}{10} \times \frac{Wc}{dc \times tc} \times P$$

where:

TA = Target area of the component (square metres)

Wc = Weight of the component (kilograms)

dc = density of the component (grams per cubic centimetre)

tc = thickness of component (centimetres)

P = percent of total surface to be painted

This method of determining target area is best suited for components manufactured from sheet materials of known or determinable thickness.

2. By weighing the component before coating with electrodeposition primer and after curing that primer. The target area may then be calculated according to the formula:

$$TA = (Wp - Wu) (10 \times dp \times tp) \times P$$

where:

TA = Target area in square metres

Wp = Weight of the primed component in kg.

Wu = Weight of the unprimed component in kg.

dp = Density of the primer solids in g/cc.

tp = cured primer film thickness in cm.

P = percent of total surface to be painted

Note: This method of determining surface area is primarily suited for use with metal components although it may be used for other conductive substrates where an equivalent primer deposition is possible.

3. The surface area of the component may be derived from the calculations made during the design of the component by means of computer assisted design (CAD) programs. Then:

$$TA = S_{CAD} \times P$$

Where:

TA = Target area in square metres

S<sub>CAD</sub> = Total surface area as determined by CAD, in square metres

P = percent of total surface to be painted

4. The target area may be determined by actual physical measurement of the component.

Note: The above methods are not intended to exclude other methods of determining the target area of the component. The governing principle as to the measurement of the target area should be the demonstrated accuracy and reliability of the end result. Provided these criteria are met, all proposed methods should be given serious consideration.

#### S-5.3.4 Calculation of VOCs Emitted

The calculation of the VOCs emitted per square metre of target area are calculated as follows:

$$VE = \frac{1000 [ VC1 \times VOC1 + VC2 \times VOC2 .. + Solv 1 + Solv 2 ..- (RSA + RSB...)]}{B \times S}$$

where:

VE = average VOC emitted in grams per square metre of target area, per month.

VC1 = Volume in litres, of Coating 1 (e.g. adhesion promoter or conductive primer) used per month.

VOC1 = VOC content of Coating 1 in kgs. per litre<sup>3</sup>.

VC2 = Volume in litres, of Coating 2 (e.g. basecoat) used per month.

VOC2 = VOC content of Coating 2 in kgs. per litre.

Solv 1 = Weight of solvent 1 (e.g. surfacer thinner) minus water, in kgs. used per month.

Solv 2 = Weight of solvent 2 (e.g. purge solvent) minus water, in kgs. used per month.

RSA = Sum of solvents recaptured in the vapour phase and recycled or destroyed by incineration (e.g solvents emitted during the application of the coating) per month.

RSB = Sum of solvents recaptured and recycled in the liquid phase (e.g. purge solvents or solvents used to clean circulating lines), recovered and recycled or incinerated by an approved method, per month. The sum used shall be net of any solids content as measured by the method used to determine the VOC content of coatings referred to above.

B = Number of components painted for the reporting month.

S = Total target area per component in square metres.

### Schedule 6 Weighted Average Calculation for % VOC

$$\% \text{ VOC Content Ratio} = \frac{(\text{Vol.1} \times \frac{\text{VOC1}}{\text{VOCL1}} + \text{Vol.2} \times \frac{\text{VOC2}}{\text{VOCL2}} + \dots + \text{Vol.n} \times \frac{\text{VOCn}}{\text{VOCLn}})}{(\text{Vol.1} + \text{Vol.2} + \dots + \text{Vol.n})}$$

where:

Vol.1 is the annual volume of Product Category 1 (as used) in litres

VOC1 is the VOC content of Product Category 1 (as used) in g/l.

Vol.2 is the annual volume of Product Category 2 (as used) in litres

VOC2 is the VOC content of Product Category 2 (as used) in g/l.

Vol.n is the annual volume of Product Category n (as used) in litres

VOCn is the VOC content of Product Category n (as used) in g/l.

VOCL1 is the VOC content limit from Schedule 1 for Product Category 1

VOCL2 is the VOC content limit from Schedule 1 for Product Category 2

VOCLn is the VOC content limit from Schedule 1 for Product Category n

<sup>3</sup> May be determined by either of the following methods (there is no significant difference in the accuracy of these two methods):  
 1. ASTM Standard Practice D-3960-92  
 2. The theoretical VOC content based on the total solvent content of the product derived from the theoretical product formula. This methodology is applicable to all coating types.

## 5.0 Technical Working Group Members

*[Note: All of the following were involved in the consultations as either participating or corresponding members, and their contribution is gratefully acknowledged. Not all were involved in the discussions leading to the development of the recommended Standards; some were involved in the earlier initiatives to develop management options.]*

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