4.2.2.4 Other Metal Coating[1-4]

4.2.2.4.1 Process Description

Large appliance, metal furniture, and miscellaneous metal part and product coating lines have many common operations, similar emissions and emission points, and available control technology. Figure 4.2.2.4-1 shows a typical metal furniture coating line.

Large appliances include doors, cases, lids, panels, and interior support parts of washers, dryers, ranges, refrigerators, freezers, water heaters, air conditioners, and associated products. Metal furniture includes both outdoor and indoor pieces manufactured for household, business, or institutional use. "Miscellaneous parts and products" herein denotes large and small farm machinery, small appliances, commercial and industrial machinery, fabricated metal products and other industries that coat metal under Standard Industrial Classification (SIC) codes 33 through 39.

Large Appliances -

The coatings applied to large appliances are usually epoxy, epoxy/acrylic, or polyester enamels for the primer or single coat, and acrylic enamels for the topcoat. Coatings containing alkyd resins are also used. Prime and interior single coats are applied at 25 to 36 volume percent solids. Topcoats and exterior single coats are applied at 30 to 40 volume percent. Lacquers may be used to touch up any scratches that occur during assembly. Coatings contain 2 to 15 solvents, typical of which are esters, ketones, aliphatics, alcohols, aromatics, ethers, and terpenes.

Small parts are generally dip coated, and flow or spray coating is used for larger parts. Dip and flow coating are performed in an enclosed room vented either by a roof fan or by an exhaust system adjoining the drain board or tunnel. Down or side draft booths remove overspray and organic vapors from prime coat spraying. Spray booths are also equipped with dry filters or a water wash to trap overspray.

Parts may be touched up manually with conventional or airless spray equipment. Then they are sent to a flashoff area (either open or tunneled) for about 7 minutes and are baked in a multipass oven for about 20 minutes at 180 to 230°C (350 to 450°F). At that point, large appliance exterior parts go on to the topcoat application area, and single coated interior parts are moved to the assembly area of the plant.

The topcoat, and sometimes primers, are applied by automated electrostatic disc, bell, or other types of spray equipment. Topcoats often are more than 1 color, changed by automatically flushing out the system with solvent. Both the topcoat and touchup spray areas are designed with side- or down-draft exhaust control. The parts go through about a 10-minute flashoff period, followed by baking in a multipass oven for 20 to 30 minutes at 140 to 180°C (270 to 350°F).

Metal Furniture -

Most metal furniture coatings are enamels, although some lacquers are used. The most common coatings are alkyds, epoxies, and acrylics, which contain the same solvents used in large appliance coatings, applied at about 25 to 35 percent solids.

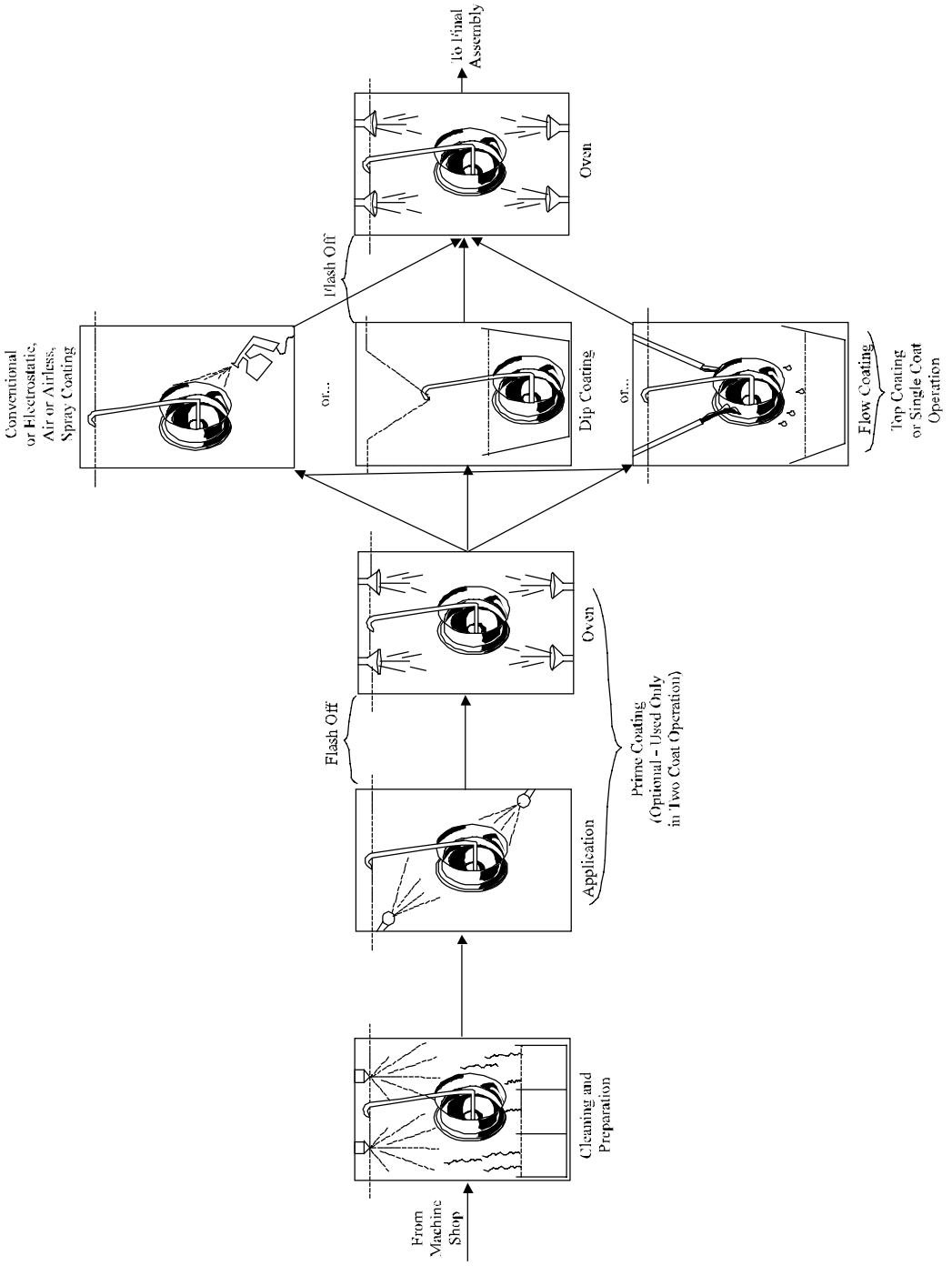

Figure 4.2.2.4-1. Metal product coating line emission points.

On a typical metal furniture coating line (see Figure 4.2.2.4-1), the prime coat can be applied with the same methods used for large appliances, but it may be cured at slightly lower temperatures, 150 to 200°C (300 to 400°F). The topcoat, usually the only coat, is applied with electrostatic spray or with conventional airless or air spray. Most spray coating is manual, in contrast to large appliance operations. Flow coating or dip coating is done, if the plant generally uses only 1 or 2 colors on a line.

The coated furniture is usually baked, but in some cases it is air dried. If it is to be baked, it passes through a flashoff area into a multizone oven at temperatures ranging from 150 to 230°C (300 to 450°F).

Miscellaneous Metal Parts And Products -

Both enamels (30 to 40 volume percent solids) and lacquers (10 to 20 volume percent solids) are used to coat miscellaneous metal parts and products, although enamels are more common. Coatings often are purchased at higher volume percent solids but are thinned before application (frequently with aromatic solvent blends). Alkyds are popular with industrial and farm machinery manufacturers. Most of the coatings contain several (up to 10) different solvents, including ketones, esters, alcohols, aliphatics, ethers, aromatics, and terpenes.

Single or double coatings are applied in conveyored or batch operations. Spraying is usually employed for single coats. Flow and dip coating may be used when only 1 or 2 colors are applied. For 2-coat operations, primers are usually applied by flow or dip coating, and topcoats are almost always applied by spraying. Electrostatic spraying is common. Spray booths and areas are kept at a slight negative pressure to capture overspray.

A manual 2-coat operation may be used for large items like industrial and farm machinery. The coatings on large products are often air dried rather than oven baked, because the machinery, when completely assembled, includes heat sensitive materials and may be too large to be cured in an oven. Miscellaneous parts and products can be baked in single or multipass ovens at 150 to 230°C (300 to 450°F).

4.2.2.4.2 Emissions And Controls

Volatile organic compounds (VOC) are emitted from application and flashoff areas and the ovens of metal coating lines (see Figure 4.2.2.4-1). The composition of emissions varies among coating lines according to physical construction, coating method, and type of coating applied, but distribution of emissions among individual operations has been assumed to be fairly constant, regardless of the type of coating line or the specific product coated, as Table 4.2.2.4-1 indicates. All solvent used can be considered potential emissions. Emissions can be calculated from the factors in Table 4.2.2.1-1 if coatings use is known, or from the factors in Table 4.2.2.4-1 if only a general description of the plant is available. For emissions from the cleansing and pretreatment area, see Section 4.6, Solvent Degreasing.

When powder coatings, which contain almost no VOC, are applied to some metal products as a coating modification, emissions are greatly reduced. Powder coatings are applied as single coats on some large appliance interior parts and as topcoat for kitchen ranges. They are also used on metal bed and chair frames, shelving, and stadium seating, and they have been applied as single coats on small appliances, small farm machinery, fabricated metal product parts, and industrial machinery components. The usual application methods are manual or automatic electrostatic spray.

Table 4.2.2.4-1 (Metric And English Units). EMISSION FACTORS FOR TYPICAL METAL COATING PLANTS[a]

EMISSION FACTOR RATING: B

Type Of Plant	Production Rate	Emissions		Estimated Emissions (%)	
		Mg/yr	ton/yr	Application And Flashoff	Ovens
Large appliances					
Prime and topcoat spray	768,000 units/yr	315	347	80	20
Metal furniture[b]					
Single spray[c]	48 x 10^6 ft^2/yr	500	550	65 - 80	20 - 35
Single dip[d]	23 x 10^6 ft^2/yr	160	176	50 - 60	40 - 50
Miscellaneous metal[b]					
Conveyor single flow[d]	16 x 10^6 ft^2/yr	111	122	50 - 60	40 - 50
Conveyor dip	16 x 10^6 ft^2/yr	111	122	40 - 50	50 - 60
Conveyor single spray[e]	16 x 10^6 ft^2/yr	200	220	70 - 80	20 - 30
Conveyor two coat, flow and spray	16 x 10^6 ft^2/yr	311	342	60 - 70	30 - 40
Conveyor two coat, dip and spray	16 x 10^6 ft^2/yr	311	342	60 - 70	30 - 40
Conveyor two coat, spray	16 x 10^6 ft^2/yr	400	440	70 - 80	20 - 30
Manual two coat, spray and air dry	8.5 x 10^6 ft^2/yr	212	223	100	0

[a] References 1-4.

[b] Estimated from area coated, assumed dry coating thickness of 1 mil, coating of 75% solvent by volume and 25% solids by volume, appropriate transfer efficiency (TE), and solvent density of 0.88 kg/liter (7.36 lb/gal). The equation to be used is:

$$E\ (tons/yr) = 2.29 \times 10^{-6} \text{ area coated } (ft^2) \times \frac{V}{100 - V} \times \frac{1}{TE}$$

or

$$E\ (Mg/yr) = 2.09 \times 10^{-6} \text{ area coated } (ft^2) \times \frac{V}{100 - V} \times \frac{1}{TE}$$

where V = VOC as volume %.

[c] Transfer efficiency assumed to be 60%, presuming the coater uses manual electrostatic equipment.

[d] Flow and dip coat transfer efficiencies assumed to be 90%.

[e] Transfer efficiency assumed to be 50%, presuming the coater uses electrostatic equipment but coats a wide range of product sizes and configurations.

Improving transfer efficiency is a method of reducing emissions. One such technique is the electrostatic application of the coating, and another is dip coating with waterborne paint. For example, many makers of large appliances are now using electrodeposition to apply prime coats to exterior parts and single coats to interiors, because this technique increases corrosion protection and resistance to detergents. Electrodeposition of these waterborne coatings is also being used at several metal furniture coating plants and at some farm, commercial machinery, and fabricated metal products facilities.

Automated electrostatic spraying is most efficient, but manual and conventional methods can be used, also. Roll coating is another option on some miscellaneous parts. Use of higher solids coatings is a practiced technique for reduction of VOC emissions.

Carbon adsorption is technically feasible for collecting emissions from prime, top, and single-coat applications and flashoff areas. However, the entrained sticky paint particles are a filtration problem, and adsorbers are not commonly used.

Incineration is used to reduce organic vapor emissions from baking ovens for large appliances, metal furniture, and miscellaneous products, and it is an option for control of emissions from application and flashoff areas.

Table 4.2.2.4-1 gives emission factors for large appliance, metal furniture, and miscellaneous metal parts coating lines, and Table 4.2.2.4-2 gives their estimated control efficiencies.

Table 4.2.2.4-2. ESTIMATED CONTROL EFFICIENCIES FOR METAL COATING LINES[a]

Control Technology	Application			Organic Emissions Reduction (%)		
	Large Appliances	Metal Furniture	Miscellaneous	Large Appliances	Metal Furniture	Miscellaneous
Powder	Top, exterior or interior single coat	Top or single coat	Oven-baked single coat or topcoat	95 - 99[b]	95 - 99[b]	95 - 98[c]
Waterborne (spray, dip, flowcoat)	All applications	Prime, top or single coat	Oven-baked single coat, primer and topcoat; air dried primer and topcoat	70 - 90[b]	60 - 90[b]	60 - 90[c]
Waterborne (electrodeposition)	Prime or interior single coat	Prime or single coat	Oven-baked single coat and primer	90 - 95[b]	90 - 95[b]	90 - 95[c]
Higher solids (spray)	Top or exterior single coat and sound deadener	Top or single coat	Oven-baked single coat and topcoat; air dried primer and topcoat	60 - 80[b]	50 - 80[b]	50 - 80[c]
Carbon absorption	Prime, single or topcoat application and flashoff areas	Prime, top or single coat application and flashoff areas	Oven-baked single coat, primer and topcoat application and flashoff areas; air dried primer and topcoat application and drying areas	90[d]	90[d]	90[d]
Incineration	Prime, top or single coat ovens	Ovens	Ovens	90[d]	90[d]	90+[d]

[a] References 1-3.

[b] The base case against which these % reductions were calculated is a high organic solvent coating that contains 25 volume % solids and 75 volume % organic solvents. Transfer efficiencies for liquid coatings are assumed to be about 80% for spray and 90% for dip or flowcoat, for powders about 93%, and for electrodeposition, 99%.

[c] Figures reflect the range of reduction possible. Actual reduction achieved depends on compositions of the conventional coating originally used and replacement low organic solvent coating, on transfer efficiency, and on relative film thicknesses of the two coatings.

[d] Reduction is only across the control device and does not account for capture efficiency.

References For Section 4.2.2.4

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3. *Control Of Volatile Organic Emissions From Existing Stationary Sources, Volume V: Surface Coating Of Miscellaneous Metal Parts And Products*, EPA-450/2-78-015, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1978.

4. G. T. Helms, "Appropriate Transfer Efficiencies For Metal Furniture And Large Appliance Coating", Memorandum, Office Of Air Quality Planning And Standards, U. S. Environmental Protection Agency, Research Triangle Park, NC, November 28, 1980.