Surface Coating of Plastic Parts: Industry Profile

Revised Draft Report

Prepared for

John L. Sorrels
U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Innovative Strategies and Economics Group (ISEG)
(MD-15)
Research Triangle Park, NC 27711

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Prepared by

Katherine B. Heller
Jui-Chen Yang
Brooks M. Depro
Research Triangle Institute
Health, Social, and Economics Research
Research Triangle Park, NC 27709

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SECTION 1

INTRODUCTION

The U.S. Environmental Protection Agency's (EPA's) proposed National Emission Standards for Hazardous Air Pollutants (NESHAP) will regulate organic hazardous air pollutant (HAP) emissions released during surface coating operations of plastic parts and products. The plastic parts and products surface coating category consists of facilities that apply protective, decorative, or functional coatings and adhesives to plastic substrates through a post-mold coating process only. These goods fall into two major product groups: automotive/transportation and business machines/electronics. In addition to these groups, surface-coated plastic parts are incorporated in a wide range of miscellaneous products, ranging from toys to signs, that are also covered by the NESHAP. Table 1-1 provides a listing of the products produced by affected entities, and the respective six-digit North American Industry Classification System (NAICS) codes of the industries to which those entities belong. This table is not intended to be exhaustive, but rather provides a guide for readers regarding entities likely to be covered by this NESHAP.

Plastic parts surface-coating may be performed by

- captive operators in the same organization as the product manufacturer,
- commercial suppliers that fabricate and coat plastic parts and sell them to the product manufacturer,
- commercial suppliers that surface-coat plastic parts on a toll basis for the product manufacturer, or
- commercial suppliers that coat plastic parts and products as part of refurbishment (EPA, 1994).

The economic effects of the rule are conditional on the technology for producing the plastic parts and their costs of production; the value of the parts to users; and the organization of the industries engaged in plastic parts production, coating, and use. This profile provides background information on these topics organized within a conventional economic framework.

Table 1-1. Industries Manufacturing Surface-Coated Plastic Parts

Includes Manufacturing of:	NAICS Code
Automobile and Truck Parts	
Automobile manufacturing	336111
Light truck and utility vehicle manufacturing	336112
Heavy duty truck manufaturing	336120
Motor vehicle body manufacturing	336211
Motor home manufacturing	336213
Travel trailer and camper manufacturing	336214
Gasoline engine and engine parts manufacturing	336312
Vehicular lighting equipment manufacturing	336321
Other motor vehicle electrical and electronic equipment manufaturing	336322
Motor vehicle steering and suspension component (except spring) manufacturing	336330
Motor vehicle brake system manufacturing	336340
Motor vehicle transmission and power train parts manufacturing	336350
All other motor vehicle parts manufacturing	336399
Motorcycles, bicycles, and parts manufacturing	336991
Military armored vehicle, tank, and tank component manufacturing	336992
All other transportation equipment manufacturing	336999
Business Machine and Computer Equipment Parts	
Office machinery manufacturing	333313
Electronic computer manufacturing	334111
Computer terminal manufacturing	334113
Other computer peripheral equipment manufacturing	334119
Watch, clock, and part manufacturing	334518
Lead pencil and art good manufacturing	339942
Miscellaneous Products	
Plastics pipe and pipe fitting manufacturing	326122
Polystyrene foam product maufacturing	326140
Urethane and other foam product (except polystyrene) manufacturing	326150
All other plastics product manufacturing	326199
Residential electric lighting fixture manufacturing	335121
Current carrying wiring device manufacturing	335931
Laboratory apparatus and furniture manufacturing	339111

(continued)

Table 1-1. Industries Manufacturing Surface-Coated Plastic Parts (continued)

Includes Manufacturing of:	NAICS Code
Miscellaneous Products (continued)	
Costume jewelry and novelty manufacturing	339914
Sporting and athletic goods manufacturing	339920
Doll and stuffed toy manufacturing	339931
Game, toy, children's vehicle manufacturing	339932
Sign manufacturing	339950
Musical instrument manufacturing	339992

Source: U.S. Department of Commerce, Bureau of the Census. 1997 Economic Census: The Bridge Between NAICS and SIC. <http://www.census.gov/epcd/ec97brdg/>. Last updated on June 27, 2000.
Note: The above list is not meant to be an exhaustive list of affected industries, but rather a list to illustrate the types of industries likely to be affected by this proposed rule.

- Section 2 includes a description of surface-coating processes for plastic parts, with discussions of the processes and inputs, types of coated plastic parts, the costs of coating, and the characteristics of coating facilities.
- Section 3 describes the characteristics, uses, and consumers of surface-coated plastic parts and substitution possibilities in consumption.
- Section 4 discusses the industry's organization and provides information on market structure, and companies that own potentially affected plants. Special attention is given to data on small businesses for future use in evaluating the impact on these entities as required by the Small Business Regulatory Enforcement and Fairness Act (SBREFA) and the Regulatory Flexibility Act (RFA).
- Section 5 presents data on trends in the markets for goods for which surface-coated plastic parts are an input. The section includes data on production, consumption, net exports, and prices in industries affected by this NESHAP.

SECTION 2

PRODUCTION, COSTS, AND PRODUCERS

The production of surface-coated plastic parts releases VOC emissions. This section describes the types of coated plastic parts and products, the inputs needed for production of those parts, the production process, and the points at which the process generates these emissions. It describes some of the costs associated with producing surface-coated plastic parts. Finally, it characterizes the producers of plastic parts that will be affected by the NESHAP.

2.1 Surface Coating of Plastic Parts

The production process characterizes the relationship between the inputs to a productive activity and its output(s). Figure 2-1 illustrates the productive activity of surface coating plastic parts. The appropriate quantities of labor services, materials, energy, and capital services are combined according to the relevant rules of production to produce a given quantity of surface-coated parts, where pollutants (VOCs and hazardous air pollutants [HAPs]) are a by-product of that activity. The quantity of pollutants that result from the surface coating process is a direct result of the combination of inputs used in that process. The pollutants may or may not be emitted into the atmosphere depending on the efficiency of pollution abatement activities. This section describes the surface-coating process in terms of the products that result from the surface-coating process, the characteristics of production inputs, and the characteristics of the coating process itself.

2.1.1 Surface-Coated Plastic Products

Surface-coated plastic parts include automobile and light duty truck parts (including other small passenger motor vehicles like motorcycles and golf carts), business machine and computer equipment parts, and some miscellaneous plastic parts ranging from laboratory apparatus to toys.

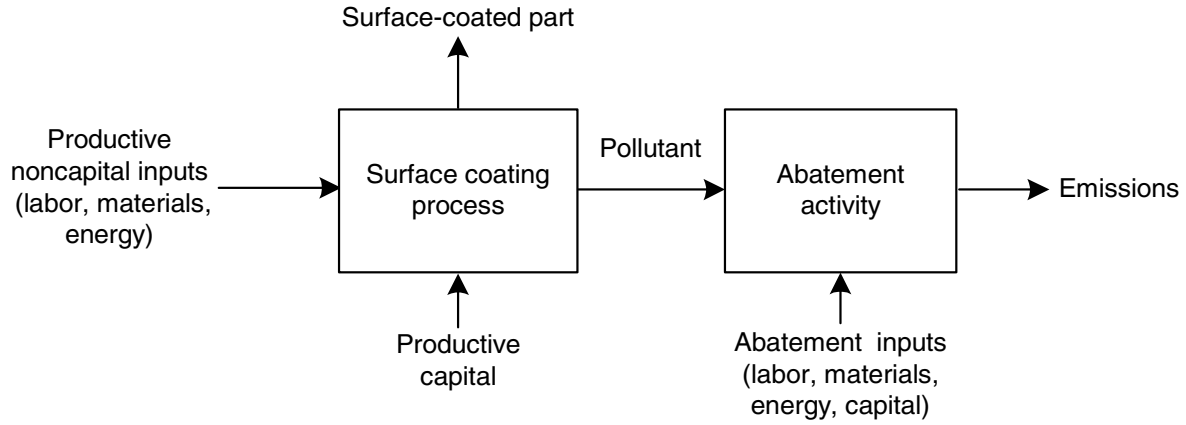

Figure 2-1. The Firm's Production Diagram

2.1.1.1 Automobile and Light Duty Truck Parts

Surface-coated plastic parts are standard components of all passenger vehicles such as cars, light duty trucks, and motorcycles. In 1994, about 8 percent of the average weight of a new passenger car was made of plastic parts (EPA, 1995). The wide variety of automobile and light duty trucks made of plastic or plastic composites includes coated plastic interior parts, exterior body parts, and lighting equipment as well as more functional parts such as gas tanks. In addition, some motorcycle, golf cart, and motor home parts are coated plastic.

Interior Parts. Instrument board assemblies, handles, seat belt parts, air bag covers, dashboards, and door linings are often coated plastic parts.

Exterior Body Parts/Lighting Equipment. Coated plastic parts used on the exterior of automobile bodies include

- body panels, bumpers, grills, fenders, hoods, and wheel covers;
- headlamp and taillight bezels and lamp covers, mirror housings, and windshield frames;
- truck cabs, beds, bodies, and tops; and
- plastic handles, seats and saddles for motorcycles.

Functional Parts. Functional coated plastic vehicle parts include gas tanks, steering assemblies, and suspension parts.

2.1.1.2 Business Machine and Computer Equipment Parts

Computers, calculating and accounting machines, and other office machines are often encased in plastic housings. Handles, buttons, and other external machine parts are also made of plastic.

2.1.1.3 Miscellaneous Parts

There is a wide variety of miscellaneous coated plastic parts and products:

- coated plastic wires and plastic housings for electrical outlets;
- laboratory apparatus and furniture;
- musical keyboard housings, piano and keyboard keys and buttons, and entire musical instruments like recorders;
- dolls and stuffed toys, game parts, toys, and children's vehicles;
- sporting and athletic goods, such as helmets, backboards, balls, bicycles, and kayaks;
- aquarium accessories, boxes, brush handles, drums, siding, hardware, lamp bases, tool handles, life jackets, and shutters;
- costume jewelry; and
- signs and advertising display cases.

2.1.2 Inputs

The surface-coating process requires material inputs as well as labor, capital services, and energy. The primary material inputs into the coating process are plastic parts and coatings. Necessary capital equipment most often includes spray guns, spray booths, conveyor lines, filtration systems, and curing ovens.

2.1.2.1 Material Inputs

Plastic Parts. As an input into the coating process, the important characteristics of plastic parts are the type of resin they are made from and their shape and size. The shape and size of the part affect the coating process in that large parts require larger facilities, spray booths, and curing ovens, and parts with complex shaping may require special handling for

complete and even coating coverage. The resins used to form plastic parts have certain properties that are critical in determining how to prepare the surface for coating, how well the various coatings will adhere to the surface, and what type of curing methods are appropriate.

Plastic parts that are to be coated are first manufactured out of one of two types of resins: thermoplastic or thermoset. Properties important to surface coaters include solvent resistance and the temperature at which the material can be baked. Table 2-1 lists common thermoplastic resins and describes their general properties. The table also includes some information on thermoplastic elastomers, unique resins that combine properties of plastics and rubber. The table indicates the abbreviations generally used to describe the different resins. Table 2-2 presents the same information for thermoset resins.

Coatings. Coatings typically include additives, binders, pigments, and carriers. Powder coatings, however, contain no carriers.

Additives, comprising less than 2 percent of the total weight of the coating, improve properties such as coalescence, flow, and other properties (University of Missouri-Rolla, 1999). Additives may

- affect the rheological properties of coatings (i.e., their ability to flow),
- speed the curing process,
- ensure pigment dispersion,
- reduce the surface tension of the coating to ensure complete coverage of the part,
- serve as defoamers so that the dried coating surface is free of bubbles, and
- serve as fungicides or bactericides ("Surface Coating," *Encyclopedia Britannica*).

Table 2-1. General Properties of Common Thermoplastic and Thermoplastic Elastomer Resins

Resin or Composite	Abbreviation	Maximum Bake Temperature (°F)	Solvent Resistance	Strength	Adhesion	Comments
Acetal		185 to 220				• Resistant to a wide variety of solvents • Pigmented grades can match any translucent color
Acrylic		180	Good	Good	Easy	• Available in a wide range of transparent and translucent colors because the resin is very compatible with dyes and pigments
Cellulosics		220	Good	Good	Difficult	
Ketone-based resins		289 to 347				• Resistant to high temperatures
Nylon		300	Good	Good	Easy	• Very paintable • Heat resistant
Polyarylate						• Heat resistant • Good weatherability • Capability for high-gloss surface metalization of parts
Polybutylene terephthalate	PBT	284	Good			• Resistant to automotive fluids • Temperature resistance • Good resistance to most chemical solutions • At room temperature PBT is unaffected by water, weak acids and weak bases, common organic solvents, greases and oils, and cleaning solutions • Addition of other polymers (like polycarbonates) can improve the surface appearance
Polycarbonate		250	Poor	Excellent	Easy	• Solvent sensitive
Polycarbonate and polybutylene terephthalate (PBT) blend	XENOY	200 to 240	Fair	Excellent	Fairly easy	

(continued)

Table 2-1. General Properties of Common Thermoplastic and Thermoplastic Elastomer Resins (continued)

Resin or Composite	Abbreviation	Maximum Bake Temperature (°F)	Solvent Resistance	Strength	Adhesion	Comments
Polyimide						• Highly heat resistant • Good electrical properties • Resistant to most commonly organic solvents
Polyolefins (blends of polypropylene, polyethylene and its copolymers)	TPO	175 to 250	Good	Fair/ good	Moderately difficult	• Requires adhesion promotor • Easy to process • Thermoplastic elastomer
Polyethylene terephthalate	PET	250				• Fillers and reinforcements applied • Heat resistant
Polypropylene	PP	250				
Polyphenylene oxide (modified)	PPO	180	Fair	Excellent	Fairly easy	• Heat resistant
Polyurethane	TPU	250	Good	Good	Fairly easy	• Very paintable • Thermoplastic elastomer
Polyvinyl chloride	PVC	150 to 210	Good	Variable	Fairly easy	
Styrenic resins						
Acrylic-styrene-acrylonitrite	ASA	180 to 220				
Acrylonitrile butadiene styrene	ABS	165 to 170	Poor	Good	Easy	• Heat and solvent sensitive • Works best with two component urethane coatings
Polystyrene		140	Very poor	Poor	Easy	
Styrene-maleic anhydride	S-Ma	235				• High heat resistance • Usage mainly interior

(continued)

Table 2-1. General Properties of Common Thermoplastic and Thermoplastic Elastomer Resins (continued)

Resin or Composite	Abbreviation	Maximum Bake Temperature (°F)	Solvent Resistance	Strength	Adhesion	Comments
Styrenic resins (continued)						
Styrene-maleic anhydride	S-Ma	235				• High heat resistance • Usage mainly interior
Styrene block copolymer	SBC					• Thermoplastic elastomer
Styrene butadiene-styrene	SBS	Low	Poor			• Type of SBC
Styrene-isoprene-styrene	SIS		Good		Fairly Easy	• Type of SBC
Styrene-ethylene-butylene-styrene	SEBS					• Type of SBC • UV Resistant
Thermoplastic polyester	TPE[a]	220 to 225				• Very paintable

[a] TPE is also used as the abbreviation for the group of resins known as thermoplastic elastomers—a group of specialty rubbers with the processing characteristics of thermoplastics and the elasticity of rubber.

Sources: U.S. Environmental Protection Agency. 1994. *Alternative Control Techniques Document: Surface Coating of Automotive/Transportation and Business Machine Plastic Parts*. EPA 435/R-94-017. Research Triangle Park, NC: U.S. Environmental Protection Agency.

Howlett, Elizabeth. 1998. "Thermoplastic Elastomers in the Auto Industry: Increasing Use and the Potential Implications." *Industry, Trade, and Technology Review* January:28–41.

Table 2-2. General Properties of Thermoset Resins

Resin or Composite	Abbreviation	Maximum Bake Temperature (°F)	Solvent Resistance	Strength	Adhesion	Comments
Epoxy		120 to 140				• Low heat resistance • Rigid • Very porous
Melamines		400		Good		
Phenolic		500	Excellent	Good	Fairly difficult	• Brittle • Heat resistant
Polyurathanes	PU	250	Good			• Flexible • High heat resistance
Thermoset polyester		400	Excellent	Good	Fairly easy	• Very rigid • High heat resistance • Porosity problems

Source: U.S. Environmental Protection Agency. 1994. *Alternative Control Techniques Document: Surface Coating of Automotive/Transportation and Business Machine Plastic Parts*. EPA 435/R-94-017. Research Triangle Park, NC: U.S. Environmental Protection Agency.

Binders form the coating film, which adheres flexibly to the surface of the plastic part. Binders are most often polymers—the same types of organic molecules that make up the resins used to form plastic parts. Sprayed-on surface coatings form films after evaporation of the carriers. The polymer solids, pigments, and additives are dissolved in large amounts of solvent and/or water so that the solids remain separated until applied to the surface of a plastic part. The evaporation of the carriers then leaves only the solids, which join together to form the film.

Pigments are insoluble solids that provide opacity to obscure the surface of a plastic part and add color. Table 2-3 describes the chemical components of commonly used pigments.

Table 2-3. Chemical Components of Common Coating Pigments

Pigment Color	Chemical Components
White	Titanium dioxide, white lead, zinc oxide
Red	Iron oxides, calcium sulfate, cadmium selenide
Orange	Lead chromate-molybdate
Brown	Iron oxides
Yellow	Iron oxides, lead chromate, calcium sulfide
Green	Chromium oxide, copper, phosphotungstic acid, phosphomolybdic acid
Blue	Ferric ferrocyanide, copper
Purple	Manganese phosphate
Black	Black iron oxide
Metallic	Aluminum, bronze, copper, lead, nickel, stainless steel, silver, powdered zinc

Source: *McGraw Hill Encyclopedia of Science and Technology*, 1987, as quoted in EPA's Sector Notebook Project on the Motor Vehicle Assembly Industry, September 1995, page 27.

Carriers are organic solvents, liquid carbon dioxide, or water, which facilitate the transference of the other, often solid, coating components to the plastic part.

2.1.2.2 Capital Inputs

The coating process involves capital inputs including coating equipment such as spray booths, filtration systems, spray guns, conveyor lines, and curing ovens and investment in pollution-abatement equipment.

Coating Equipment. Parts to be coated may enter a partially or totally enclosed spray booth either manually or by way of a conveyor belt. Application of the coating may be accomplished through manual or robotic methods. Figure 2-2 shows a powder coating being

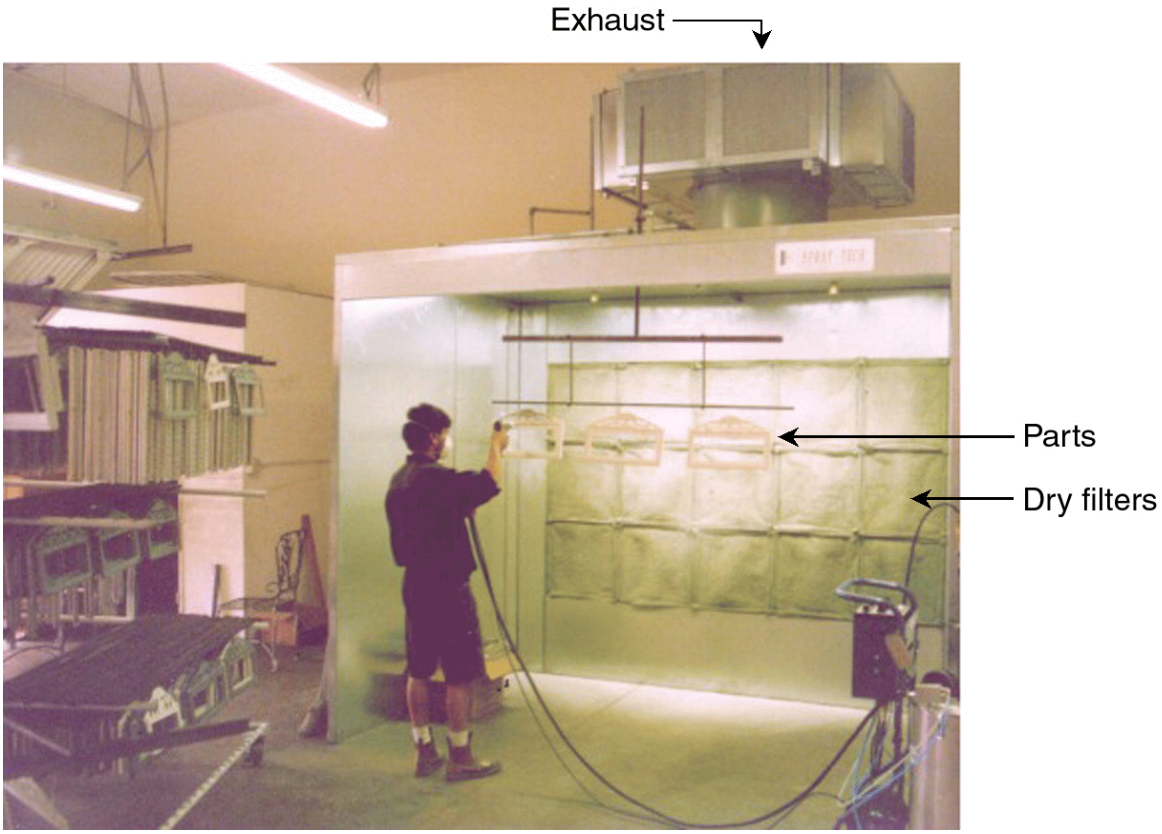

Figure 2-2. Powder Coating Booth

Source: <www.spraytech.com/powder.html>.

applied manually in a partially enclosed spray booth. Figure 2-3 shows a spray booth to

Figure 2-3. A Conveyorized Paint Finishing Booth

Source: OBI Spray Booths and Systems Catalog #201-2. Inside Cover.

which parts are delivered by way of conveyor belt.

Pollution-Abatement Equipment. To manage HAP emissions resulting from the coating process, additional equipment may be used at some plastic parts surface coating sources. Spray booth filtration systems may be connected to scrubbing towers or carbon absorption filters to extract the emissions from the filtered air. The extracted solvents then are incinerated to keep them from escaping into the atmosphere. The capital equipment associated with managing the solvents released in the coating process requires other inputs such as fuel, energy, and chemicals.

2.1.3 The Surface Coating Process

The surface coating of plastic parts includes the following steps:

- preparation of the coating (i.e., mixing with thinners or other additives),
- surface preparation,
- coating application and flash-off,
- drying and/or curing, and
- cleaning of equipment used in surface coating.

2.1.3.1 Surface Preparation

Once a part is formed, it may require surface preparation to correct flaws, clean residue from the surface, and/or to prepare the surface to receive the coating. Correcting surface flaws is necessary to provide an even surface for the coating, to achieve an aesthetically pleasing final product, and, in some cases, to improve the eventual performance of functioning parts. Correcting surface flaws may involve sanding, puttying, and gassing out plastic parts. Cleaning may include wipe-down (dry or solvent), multistage washing cycles, or deionized water rinses. Finally, masking may be used to prevent unwanted surface coating on specific areas of the part or product.

2.1.3.2 Coating

Coating application methods for plastic parts include brush, dip, flow, spray, vacuum metallizing, and others. Immediately following application plastic parts are usually introduced to a flash-off zone. The flash-off zone is an area where the coating completes its flowing or leveling prior to curing. Figure 1-4 shows an example coating line for a three-coat system.

2.1.3.3 Drying and/or curing

The drying and/or curing processes for plastic parts includes ambient, elevated temperature, forced-air, radiation-cure, and ultraviolet light. The proper curing conditions for each coating, including temperature, residence time in an oven or under a lamp, and humidity depend on the type of coating used and the characteristics of the substrate coated. After curing at elevated temperatures, coated parts enter a cool-down zone where they remain until cool enough for further handling (EPA, 1998).

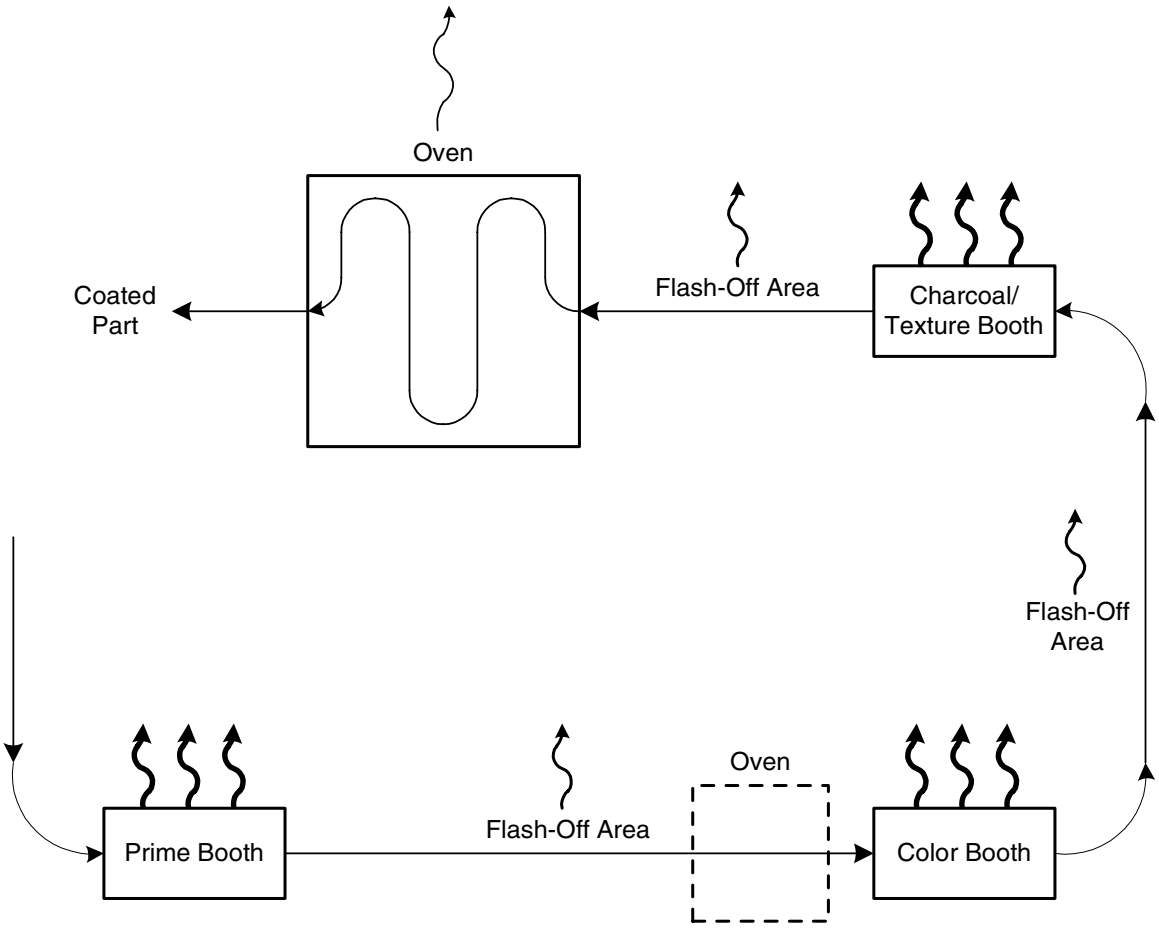

Figure 2-4. Example Coating Line for Three-Coat Systems

Source: U.S. Environmental Protection Agency. 1994. *Alternative Control Techniques Document: Surface Coating of Automotive/Transportation and Business Machine Plastic Parts*. EPA 435/R-94-017. Research Triangle Park, NC: U.S. Environmental Protection Agency.

2.1.3.4 Equipment Cleaning

Cleaning is performed on the equipment for a variety of reasons to include flushing of the paint lines and application equipment for color changes, housekeeping, etc. The specific solvent used to clean the equipment will vary depending on the type of material (i.e., waterborne, solventborne, etc.) being applied with the equipment. Commonly used cleaning materials include water, butyl acetate, acetone, xylene, and water-based peel-off cleaner.

2.1.4 Emissions

Solvents used to clean and prepare the surfaces of parts contain VOCs and HAPs that may evaporate into the atmosphere. In this rule, EPA is addressing these emissions and others caused by using adhesives to bond parts before they are coated. More critical are the solvents in the coatings themselves. EPA assumes that 100 percent of the VOCs and HAPs used as carriers in a coating are emitted into the atmosphere. Much of the solvents never reach the part surface because they are part of the coating overspray. The solvents in the overspray evaporate into the air in the booth and would become dangerously concentrated if they were not either released into the environment or captured and incinerated by control systems.

2.2 Costs of Surface Coating

The (opportunity) costs of production depend on whether the productive activity is characterized by the existence of a fixed factor such as plant and equipment whose quantity cannot be varied over the time frame of analysis or whether the activity is in the planning stage. In the former short-run case, there is no cost to using the fixed input and for any output rate, the (minimum) total costs of production are simply

$$C_x = P_n Q_{nx}^{*} + P_m Q_{mx}^{*} + P_g Q_{gx}^{*}, \qquad (2.1)$$

assuming that the fixed factor is capital. However, although the cost of the fixed factor is not included in the costs of production, the cost is conditional on the quantity of the fixed input available since it influences the productivity of the other inputs. The * denotes that these are the minimum cost quantities of the inputs for a given output rate. The abatement costs for existing controls are similarly calculated.

In the planning long-run case, all costs are variable and the cost of the fixed factor (e.g., capital services) must be included: PkQkx*. In the intermediate-run case when there is the opportunity to use the fixed input in another application, this foregone opportunity is also part of the cost of production.

The cost function describes the relationship between the minimum costs of production and alternative output rates. Figure 2-5 shows a typical textbook characterization of a short-run unit cost function.

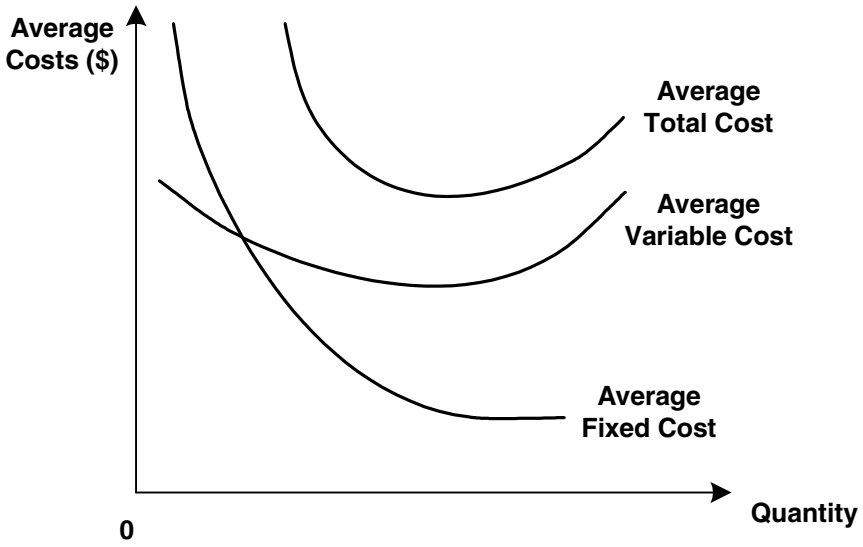

Figure 2-5. Short-Run Unit Cost Function

For existing suppliers of surface-coating services, the primary fixed input is the capital equipment used. This includes washing systems, spray booths and/or plating vats, conveyor lines and hoists, spray guns and pumping systems, filtration systems, reclaim systems, curing ovens and incinerators, and other pollution abatement equipment.

Variable inputs include labor used for both production and pollution abatement, coatings and other chemical solutions, uncoated plastic parts and products, fuels, and purchased electricity. Total costs of the variable inputs used by industries that produce, coat, and use plastic parts and products are provided in Table 2-4. Plastic parts and products prices are not included because they are usually produced in-house or delivered to the coater for coating on a toll basis, so the price for the parts is not readily available. Note that the table provides industry data on costs rather than costs only for firms that coat plastic parts and products. The costs reported are much larger than the actual costs of surface coating.

For any existing supplier of plastic parts surface-coating services, the costs of production depend on the supplier's purchase of variable inputs and the opportunity cost of owning capital equipment. EPA regulations result in changing a facility's minimum cost quantities of some inputs, often both variable inputs and capital equipment.

2.3 Suppliers of Plastics Parts Coating Services

EPA has identified 202 existing facilities that coat plastic parts and products, which would be directly affected by the rule. Of these 202 facilities, EPA had sufficient data to allow costs to be estimated for 185 facilities. These 185 facilities are the facilities covered by this study. Table 2-5 shows the location of the facilities by state.

These suppliers of plastic parts coating services are as varied as the parts themselves. They range from small single-facility firms with annual revenues in the hundreds of thousands of dollars to facilities owned by large automobile manufacturers with total revenues in the hundreds of billions of dollars.

The organization of a production process varies according to the benefits of team production[1] and the costs of monitoring shirking amongst team members. Firms that produce products comprising surface-coated plastic parts use team production to perform the actual coating process. However, only some of the firms find it efficient to combine surface-coating services with the actual manufacture of plastic parts or with the assembly process of coated parts and other inputs used as components in another downstream good. Three types of production organization are used in surface coating:

[1]Team production occurs when several types of resources are used together to produce a product which is not a sum of separable outputs of each cooperating resource and where resources do not all belong to one person. Team production is beneficial when a "team" can produce goods and services which an individual could never produce alone or when the marginal product of a team is greater than the sum of individual marginal products of team members.

Table 2-4. Production Costs of Industries Producing Coated Plastic Parts: 1997

Industry	NAICS Code	Labor		Cost of Materials (10^3)	Total Capital Expenditures (10^3)
		Total Employment	Total Payroll (10^3)		
Automobile and Truck Parts					
Automobile manufacturing	336111	114,060	6,411,952	66,546,225	3,355,800
Light truck and utility vehicle manufacturing	336112	94,033	5,361,980	70,927,268	1,769,649
Heavy duty truck manufacturing	336120	28,214	1,190,164	10,306,435	120,735
Motor vehicle body manufacturing[a]	336211	1,722	54,000	200,324	8,086
Motor home manufacturing	336213	17,936	503,294	2,679,768	49,753
Travel trailer and camper manufacturing	336214	32,036	770,504	2,724,961	62,502
Gasoline engine and engine parts manufacturing	336312	81,160	3,550,770	17,847,864	1,750,675
Vehicular lighting equipment manufacturing	336321	16,506	628,534	1,686,309	169,235
Other motor vehicle electrical and electronic equipment manufacturing[b]	336322	30,489	1,048,438	4,096,932	239,147
Motor vehicle steering and suspension component (except spring) manufacturing	336330	48,625	2,323,579	5,473,746	552,144
Motor vehicle brake system manufacturing	336340	43,147	1,486,119	6,407,923	473,867
Motor vehicle transmission and power train parts manufacturing	336350	111,955	5,516,801	19,567,915	1,902,483
All other motor vehicle parts manufacturing[c]	336399	173,229	5,442,190	18,656,740	1,600,988
Motorcycles, bicycles, and parts manufacturing	336991	17,074	567,520	1,797,470	103,730
Military armored vehicle, tank, and tank component manufacturing[d]	336992	5,982	238,241	495,679	17,819
All other transportation equipment manufacturing	336999	19,290	504,886	2,875,923	98,858

(continued)

Table 2-4. Production Costs of Industries Producing Coated Plastic Parts: 1997 (continued)

Industry	NAICS Code	Labor		Cost of Materials (10^3)	Total Capital Expenditures (10^3)
		Total Employment	Total Payroll (10^3)		
Business Machine and Computer Equipment Parts					
Office machinery manufacturing	333313	10,492	327,913	1,180,516	97,724
Electronic computer manufacturing	334111	105,383	4,251,722	40,239,744	1,053,379
Computer terminal manufacturing	334113	5,764	253,087	941,879	34,716
Other computer peripheral equipment manufacturing	334119	93,130	4,563,858	16,981,173	980,417
Watch, clock, and part manufacturing[e]	334518	6,332	178,481	380,468	26,214
Lead pencil and art good manufacturing[f]	339942	1,210	29,408	82,640	8,821
Miscellaneous Products					
Plastics pipe and pipe fitting manufacturing[g]	326122	4,058	100,969	261,268	39,467
Polystyrene foam product manufacturing	326140	26,983	756,131	2,447,473	318,445
Urethane and other foam product (except polystyrene) manufacturing	326150	37,129	1,002,055	3,851,626	216,477
All other plastics product manufacturing[h]	326199	523,192	13,989,931	30,344,499	3,449,409
Residential electric lighting fixture manufacturing[i]	335121	74	1,973	2,405	173
Current carrying wiring device manufacturing	335931	44,907	1,293,583	2,326,114	219,293
Laboratory apparatus and furniture manufacturing	339111	16,833	616,819	909,818	58,880
Costume jewelry and novelty manufacturing [j]	339914	13,975	314,581	448,479	19,325
Sporting and athletic goods manufacturing	339920	68,920	1,799,871	4,679,110	345,602

(continued)

Table 2-4. Production Costs of Industries Producing Coated Plastic Parts: 1997 (continued)

Industry	NAICS Code	Labor		Cost of Materials (10^3)	Total Capital Expenditures (10^3)
		Total Employment	Total Payroll (10^3)		
Miscellaneous Products (continued)					
Doll and stuffed toy manufacturing	339931	3,392	63,722	104,698	3,939
Game, toy, children's vehicle manufacturing	339932	29,375	767,211	1,870,746	136,243
Sign manufacturing	339950	82,246	2,367,259	3,314,770	234,572
Musical instrument manufacturing	339992	13,286	359,101	493,019	36,262

[a] Excludes 707 firms classified under the truck and bus bodies (SIC 3713).

[b] Excludes 252 firms classified under the electronic components, n.e.c. (SIC 3679), and 570 firms classified under the engine electrical equipment (SIC 3694).

[c] Excludes 6 firms classified under the internal combustion engines, n.e.c. (SIC code 3519) and 1 firm under the all other manufacturing industries (SIC code 9994).

[d] Includes 38 firms classified under the tanks and tank components (SIC 3795).

[e] Includes 2 firms classified under the wire springs (SIC 3495), and 128 firms under the watches, clocks, and watch cases (SIC 3873).

[f] Excludes 17 firms classified under the public building and related furniture (SIC 2531), and 143 firms under the lead pencils and art goods (SIC 3952).

[g] Excludes 349 firms classified under the plastics pipe (SIC 3084).

[h] Excludes 140 firms classified under the manufacturing industries, n.e.c. (SIC code 3999).

[i] Excludes 497 firms classified under the residential lighting fixtures (SIC 3645), and 53 firms under the manufacturing industries, n.e.c. (SIC 3999).

[j] Excludes 17 firms classified under the metal coating and allied services (SIC code 3479) and 80 firms under the fabricated metal products, n.e.c. (SIC code 3499).

Source: U.S. Department of Commerce, Bureau of the Census. 1999aa-1999nn. *Manufacturing—Industry Series, 1997 Economic Census.* Washington, DC.

Table 2-5. Surface Coaters of Plastic Parts and Products, by State

State	Number of Facilities
Arkansas	2
California	3
Connecticut	2
Florida	1
Georgia	1
Iowa	2
Illinois	5
Indiana	11
Kansas	3
Kentucky	2
Louisiana	1
Massachusetts	2
Michigan	54
Minnesota	3
Missouri	5
North Carolina	3
North Dakota	1
New Hampshire	1
New Mexico	1
New York	1
Ohio	31
Oklahoma	1
Pennsylvania	4
South Carolina	3
South Dakota	1
Tennessee	6
Texas	1
Virginia	3
Wisconsin	9
NA	22
Total	185

Source: U.S. Environmental Protection Agency (EPA). 2001. ICR Survey Responses. Washington, DC: U.S. Environmental Protection Agency.

- captive facilities in the same organization as the product manufacturer,

- commercial suppliers that fabricate and coat plastic parts and sell them to the product manufacturer,
- commercial suppliers that surface-coat plastic parts on a toll basis for the product manufacturer, or
- commercial suppliers that coat plastic parts and products as part of refurbishment (EPA, 1994).

SECTION 3

CONSUMPTION, VALUE, AND CONSUMERS

Surface-coating is a value-adding process demanded for its ability to increase a plastic part's or product's aesthetic value, conductivity, and durability. Surface-coated plastic parts and products are most often intermediate goods incorporated into final products ranging from automobiles to toys, although they may be final products themselves. The demand for surface-coated plastic parts and products is based on their value to consumers as part of a final good. The demand for surface-coating services is directly related to the demand for those parts and products.

This section characterizes the demand side of the market for surface-coated plastic parts. It describes the characteristics of the various types of coated plastic parts and the value to consumers of each of four different types of final consumer goods: automobiles and light duty truck parts, heavy duty truck parts, business machine and computer equipment parts, and miscellaneous parts and products. The behavioral response of consumers to a change in the price of plastic parts, quantified in economics as the elasticity of demand, is also discussed.

3.1 Characteristics of Plastic Parts and Products

The demand for a commodity is not simply for the good itself but instead for a set of characteristics and properties that is satisfied by a particular commodity. Commodities can thus be described as bundles of attributes that provide services (Lancaster, 1966). The production processes of surface-coated plastic parts allow room to vary the characteristics of the final product. Frequently, gains in one particular characteristic demand sacrifices of another or increased materials and/or processing costs. Also, users of different types of plastic parts do not all require the same set of attributes. For example, electronic and office equipment manufacturers coat plastics with metallic substances to make them conductive and protect them from electromagnetic/radio frequency interference signals. However, children playing with plastic toys and dolls are interested in the appearance of the toy; the parents may value its safety and durability. Some of the various characteristics of surface-coated plastic parts are

- flammability,
- recyclability,
- expected lifetime (i.e., durability, susceptibility to UV rays),
- environmental attributes (i.e., safety of disposal and end of life),
- weight,
- safety (i.e., protection provided in an automobile accident),
- aesthetics,
- thermal properties (i.e., heat tolerance),
- flexibility/rigidity, and
- conductivity.

While many of the above characteristics of plastic parts and products will be determined primarily by the composition of the uncoated part itself, coatings influence almost all of the above characteristics to some degree, though mostly indirectly. Primary characteristics that can be directly affected by the coating part are

- durability (scratch and chemical resistance);
- aesthetics (the color and texture of the part);
- conductivity (of electromagnetic/radio frequency interference signals); and
- and the presence of some functional capabilities, such as reflective properties.

3.2 Uses of Plastic Parts and Products

As described in Section 2, surface-coated plastic parts are vital components of a wide range of products, including transportation equipment, business machines and computers, and a multitude of miscellaneous products. The uses of parts and characteristics of interest to their consumers vary across those product groups. Because coated plastic parts are an intermediate good used in the production of a final good such as a complete automobile or a complete copier machine, the use of plastic parts is often dictated by a manufacturer's interpretations of consumer preferences rather than directly by the consumer himself.

3.2.1 Automotive and Truck Parts

Plastics are used increasingly to produce transportation equipment parts.[1] By 1993, manufacturers were using over 250 pounds of plastic in the average vehicle (SPI, 1999). Car interiors alone represent a value of about $1,200 per vehicle, of which $500 is due to the value of plastic components (*Modern Plastics Encyclopedia*, 1999a). Automobile and other transportation equipment purchasers are concerned with the performance, safety, appearance, and longevity of transportation products. Accordingly, auto makers are especially concerned with the durability, corrosion resistance, and resiliency of plastic parts, which affect the expected lifetime of the product. They often choose the coating of a part based on the eventual location of the part on the vehicle. For example, the lower a part is on a car, the more resistant it must be to damage from particles that might fly up from the road. The UV resistance of interiors is becoming increasingly important to automakers as they find consumers demanding longer warranties on the color retention and other properties of auto interiors at the same time that interior exposure to UV is increasing along with an increase in window areas (*Modern Plastics Encyclopedia*, 1999a). Auto makers also consider the aesthetic properties of the part—its color and texture—since the appearance of a vehicle affects its value to consumers. Plastics may be easily molded into new and exciting aerodynamic shapes. The light weight of plastic parts contributes to fuel efficiency and is a factor often considered in making decisions to substitute plastic parts for those made of glass or metal. Plastics have another important advantage over metal parts—the ease of processing them into unique shapes. This characteristic has been important to makers of gas tanks. For example, Plastic Omnium, a South Carolina-based plastic automotive parts maker, claims that their plastic tanks are safer than metal tanks because they will not explode. In addition, plastic tanks can be more easily molded to fit space requirements than metal tanks. As an example, Plastics Omnium engineers used plastic to mold two small fuel tanks to provide enough fuel storage for the space-limited Corvette. The tanks are layers of plastic bound by adhesives (Miller, 1998).

3.2.2 Computers and Business Equipment

Like the consumers of automotive and truck parts, consumers of computers and business equipment value performance, safety, appearance, and longevity. Coatings affect

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[1] It is uncertain whether facilities that apply coatings to gas tanks will be affected by this proposed rule. The example of gas tanks is provided merely as an illustration of one advantage plastic parts have over metal parts.

the safety, appearance, and longevity of products. Although the range of aesthetic characteristics seems narrower for products in this segment than those in the automotive segment, consumers of computers and business equipment do place a value on appearance. Manufacturers are aware of the aesthetic value consumers place on computer and business machine housings and often make their production choices accordingly. For example, Sun Microsystems invested many resources in finding an exciting design for the housing of their Starfire server. Sun's Kathleen McLaurin observed: "It was especially important that the product appeal visually to the design-sensitive commercial users we were targeting" (Fox, 1998). The same sentiment guided Macintosh in its design of the i-Mac. No matter how the performance of the computer is evaluated, no one denies its eye-catching appearance. Even less innovative manufacturers find it necessary to at least color-match plastic parts to coated metal parts and use molded-in texture to find a market for their product. In addition, coatings serve the purpose of hiding any flaws in a part's substrate (EPA, 1994).

Business equipment users are also interested in the safety of the equipment. Manufacturers can increase the safety of machines by using selected resins that do not easily ignite and/or that are capable of self-extinguishing. In some cases, fire-retardant chemicals may be added to the resins to increase safety, although some European regulations preclude the use of many of these chemicals, thus limiting the choices of exporting manufacturers (*Modern Plastics Encyclopedia,* 1999b). EMI/RFI (Electromagnetic Interference/Radio Frequency Interference) shielding is necessary to prevent a machine or computer from interfering with other electronic equipment and to prevent airwaves from outside the equipment from interfering with its performance. Shielding is best accomplished with grounded, high-conductivity coatings containing nickel or copper.

3.2.3 Miscellaneous Products

Like consumers of the other two categories of products described above, consumers of miscellaneous products are concerned with the appearance, safety, and longevity of plastic parts, all of which can be improved with the application of coatings. Consumers of construction materials desire plastic parts that can withstand the elements and that be coated to match numerous architectural coatings. Consumers of plastic laboratory apparatus and furniture desire durable products that will not degenerate when cleaned with cleaning solvents. Consumers of sports equipment want durable plastic products that can withstand impacts and have aesthetic appeal. Consumers of toys desire products that are attractive, safe (i.e., nontoxic), and durable.

3.3 Substitutes

In most of the products described above, coated plastic parts have often replaced glass or metal parts, because they are lightweight, cheaper to produce than similar metal or glass parts, and sometimes safer to use than metal or glass substitutes. Currently, depending on the part in question, glass or metal are the only viable substitutes for coated plastic automobile parts. Table 3-1 lists auto parts that may be made out of coated plastic parts and indicates whether the part could also be made of glass and/or metal. Because plastic parts are much cheaper and lighter than glass or metal, it is unlikely that vehicle manufacturers will switch from plastic parts back to metal parts.

3.4 Elasticity

The elasticity of demand for coated plastic parts and products is a measure of the responsiveness of the quantity of coated products demanded to a change in the price of those products. The responsiveness of quantity demanded to price increases with the availability of substitutes, the time frame of adjustment, the price proximity of substitutes, and the price of a good in relation to a consumer's budget. The more inelastic the demand, the more easily firms will be able to pass the costs of regulation on to consumers. The demand for coated plastic parts may be relatively inelastic because plastic parts are generally much cheaper than metal and glass substitutes.

Table 3-1. Auto Parts Made of Plastic

Type of Part	Possible Materials for Use in Constructing Part
Interior Parts:	
Instrument panel	Plastic, steel
Console	Plastic
Heater/AC controls	Plastic, steel, aluminum
Speaker grille	Plastic, metal
Dome light	Plastic, glass
Ash tray	Plastic, metal
Van/utility vehicle rear	Plastic, metal
Airbag cover	Plastic
Exterior Parts:	
Grille	Plastic, metal
Wheel cover	Plastic, metal
Lighting	Plastic, glass
Headlamp or taillamp reflector	Plastic, glass
Headlamp lense	Plastic, glass
Facia cladding	Plastic
Window encapsulation cladding	Plastic
Body sides, fenders	Plastic, steel, aluminum
Bumper	Plastic, steel, aluminum
Functional Parts:	
Engine fan	Plastic, steel
Fuel tank	Plastic, steel
Housings	Plastic, metals

Sources: U.S. Environmental Protection Agency, Office of Compliance, Office of Enforcement and Compliance Assurance. 1995. *EPA Office of Compliance Sector Notebook Project—Profile of the Motor Vehicle Industry*. EPA/310-R-95-009. Washington, DC: U.S. Environmental Protection Agency.

Fettis, Gordon. 1995. *Automotive Paints and Coatings*. Weinheim, Germany: Verlagsgesellschaft mbH.

SECTION 4

FIRM CHARACTERISTICS

The economic impacts regulating surface-coating facilities are related to the ownership structure of those facilities. The market power, size, and integration of firms affect their ability to pass the costs of regulation on to consumers and/or absorb those costs without significant harm to their financial position. The 185 surface coating facilities included in this analysis are owned by 130 firms. Firms owning facilities that coat motor vehicle or business machine parts appear to have somewhat more market power than those that coat miscellaneous parts. The relatively larger degree of concentration might not be so obvious if it were possible to further specify the product markets for miscellaneous parts and products. However, it is intuitively obvious that specific requirements that original equipment manufacturers (OEMs) impose on their suppliers of plastic vehicle and business machine parts would make it more likely that coating facilities would have close relationships with their customers and hence more market power than the facilities that coat miscellaneous plastic parts and products.

This section describes the ownership structure of surface-coating facilities, including the overall concentration levels in industries affected by the Plastic Parts and Products NESHAP, the number and size of firms owning affected surface-coating facilities, the vertical and horizontal integration of those firms, and the current number of small businesses affected by the NESHAP. The terms facility and establishment are used synonymously in this analysis and refer to the physical location where products are coated. Likewise, the terms company and firm are used synonymously and refer to the legal business entities that own facilities.

4.1 Market Power of Firms

The ownership concentration of surface-coating facilities is important because it affects the firms' ability to influence the price of surface-coating services or the price of inputs they purchase. If an industry is perfectly competitive, then individual producers are not able to influence the price of the output they sell or the inputs they purchase. This condition is most likely to hold if the industry has a large number of firms, the products sold are undifferentiated, and entry and exit of firms are unrestricted. Product differentiation can

occur both from differences in product attributes and quality and from brand name recognition of products. Entry and exit of firms are unrestricted for most industries except, for example, in cases when government regulates who is able to produce, when one firm holds a patent on a product, when one firm owns the entire stock of a critical input, or when a single firm is able to supply the entire market.

When compared across industries, firms in industries with fewer firms, more product differentiation, and restricted entry are more likely to be able to influence the price they receive for a product by reducing output below perfectly competitive levels. This ability to influence price is referred to as exerting market power. At the extreme, a single monopolistic firm may supply the entire market and hence set the price of the output. On the input market side, firms may be able to influence the price they pay for an input if there are few firms, both within and outside the industry, that use that input. At the extreme, a single monopsonist firm may purchase the entire supply of the input and hence set the price of the input.

Surface coating is a competitive industry in that surface coating is not a differentiated product but rather a process that is extremely similar across a wide range of products. In addition, surface-coating facilities are owned by a large number of firms, and the cost of surface coating equipment is low enough that entry into the market is not extremely difficult.

Although surface coaters make up small portions of the industries in which they are classified, the differing levels of concentration in those industries may indicate the relative degrees of market power among surface coaters in different industries. Table 4-1 presents several different measures of concentrations in industries that coat plastic parts and products, including four-firm concentration ratios and Herfindahl index numbers for each industry. A four-firm concentration ratio greater than 50 percent is often considered high. The Department of Justice's Horizontal Merger Guidelines claim that a Herfindahl index number less than 1,000 indicates an unconcentrated industry while a Herfindahl index number between 1,000 and 1,800 indicates a moderately concentrated industry and an index number above 1,800 indicates a highly concentrated industry. As Table 4-1 shows, industries that produce motor vehicles and business machines do appear to be more concentrated than those producing miscellaneous plastic parts.

Table 4-1. Measurements of Concentration of Industries Manufacturing Coated Plastic Parts: 1997

Industry	NAICS Code	Number of Companies	Value of Shipments (10^6)	Percentage of the Value of Shipments Accounted for by x Largest Companies				Herfindahl-Hirschmann Index
				x=4	x=8	x=20	x=50	
Automobile and Truck Parts								
Automobile manufacturing	336111	173	95,366	79.5	96.3	99.5	99.9	2,349.7
Light truck and utility vehicle manufacturing	336112	84	110,178	99.3	99.9	99.9	99.9	NA
Heavy duty truck manufaturing	336120	75	14,509	74.4	90.3	98.5	99.8	1,597.1
Motor vehicle body manufacturing[a]	336211	747	9,009	34.4	43.9	59.4	74.9	694.7
Motor home manufacturing	336213	75	3,894	52.2	75.4	94.5	99.7	980.2
Travel trailer and camper manufacturing	336214	761	4,601	26.0	35.3	49.8	67.1	262.2
Gasoline engine and engine parts manufacturing	336312	810	25,787	67.5	75.5	84.8	92.8	1,425.1
Vehicular lighting equipment manufacturing	336321	99	3,336	58.3	76.5	92.7	99.1	1,164.4
Other motor vehicle electrical and electronic equipment manufacturing[b]	336322	890	18,297	53.4	64.2	75.9	87.1	1,615.3
Motor vehicle steering and suspension component (except spring) manufacturing	336330	183	10,633	60.1	72.3	85.6	97.1	1,415.6
Motor vehicle brake system manufacturing	336340	203	10,981	59.2	77.2	89.2	96.5	1,101.0
Motor vehicle transmission and power train parts manufacturing	336350	427	30,106	60.0	79.1	90.9	96.2	1,056.6
All other motor vehicle parts manufacturing[c]	336399	1,271	35,511	27.2	38.3	54.8	70.6	266.4
Motorcycles, bicycles, and parts manufacturing	336991	373	3,383	67.5	76.7	85.9	92.3	2,036.5
Military armored vehicle, tank, and tank component manufacturing[d]	336992	37	1,064	85.0	92.4	99.0	100.0	NA
All other transportation equipment manufacturing	336999	349	4,437	50.7	75.3	83.0	90.6	885.2

(continued)

Table 4-1. Measurements of Concentration of Industries Manufacturing Coated Plastic Parts: 1997 (continued)

Industry	NAICS Code	Number of Companies	Value of Shipments (10^6)	Percentage of the Value of Shipments Accounted for by x Largest Companies				Herfindahl-Hirschmann Index
				x=4	x=8	x=20	x=50	
Business Machine and Computer Equipment Parts								
Office machinery manufacturing	333313	158	3,163	53.0	68.2	81.2	93.5	1,208.3
Electronic computer manufacturing	334111	531	66,302	45.4	68.5	91.4	97.2	727.9
Computer terminal manufacturing	334113	141	1,487	39.4	64.5	87.2	96.5	645.4
Other computer peripheral equipment manufacturing	334119	1,015	26,911	45.3	60.2	73.0	85.4	659.7
Watch, clock, and part manufacturing[e]	334518	145	922	48.1	62.7	86.9	96.9	750.2
Lead pencil and art good manufacturing[f]	339942	171	1,279	52.4	65.6	83.7	94.6	1,047.9
Miscellaneous Products								
Plastics pipe and pipe fitting manufacturing[g]	326122	317	4,792	23.9	37.4	59.8	78.8	260.2
Polystyrene foam product manufacturing	326140	379	4,899	41.4	50.0	65.5	82.7	665.4
Urethane and other foam product (except polystyrene) manufacturing	326150	447	6,665	32.3	43.5	62.9	78.8	403.1
All other plastics product manufacturing[h]	326199	7,522	65,632	5.0	8.1	13.7	23.3	14.9
Residential electric lighting fixture manufacturing[i]	335121	543	2,255	24.5	36.5	55.8	73.6	266.3
Current carrying wiring device manufacturing	335931	446	5,878	21.2	35.0	59.1	80.3	232.0
Laboratory apparatus and furniture manufacturing	339111	371	2,221	19.0	33.3	55.1	74.4	202.5
Costume jewelry and novelty manufacturing[j]	339914	917	1,288	25.2	41.2	55.3	69.0	256.3
Sporting and athletic goods manufacturing	339920	2,477	10,634	21.4	29.2	43.6	59.7	161.1

(continued)

Table 4-1. Measurements of Concentration of Industries Manufacturing Coated Plastic Parts: 1997 (continued)

Industry	NAICS Code	Number of Companies	Value of Shipments (10^6)	Percentage of the Value of Shipments Accounted for by x Largest Companies				
				x=4	x=8	x=20	x=50	Herfindahl-Hirschmann Index
Miscellaneous Products (continued)								
Doll and stuffed toy manufacturing	339931	239	301	31.1	51.1	72.2	89.6	403.9
Game, toy, children's vehicle manufacturing	339932	756	4,463	42.7	53.1	66.0	80.1	564.0
Sign manufacturing	339950	5,580	7,998	7.9	12.2	19.5	30.9	34.5
Musical instrument manufacturing	339992	552	1,325	32.6	45.5	68.1	83.3	420.8

[a] Includes 707 firms classified under the truck and bus bodies (SIC 3713).
[b] Includes 252 firms classified under the electronic components, n.e.c. (SIC 3679), and 570 firms classified under the engine electrical equipment (SIC 3694).
[c] Includes 6 firms classified under the internal combusion engines, n.e.c. (SIC 3519) and 1 firm under the all other manufacturing industries (SIC 9994).
[d] Includes 38 firms classified under the tanks and tank components (SIC 3795).
[e] Includes 2 firms classified under the wire springs (SIC 3495), and 128 firms under the watches, clocks, and watchcases (SIC 3873).
[f] Includes 17 firms classified under the public building and related furniture (SIC 2531), and 143 firms under the lead pencils and art goods (SIC 3952).
[g] Includes 349 firms classified under the plastics pipe (SIC 3084).
[h] Includes 140 firms classified under the manufacturing industries, n.e.c. (SIC 3999).
[i] Includes 497 firms classified under the residential lighting fixtures (SIC 3645), and 53 firms under the manufacturing industries, n.e.c. (SIC 3999).
[j] Includes 17 firms classified under the metal coating and allied services (SIC 3479) and 80 firms under the fabricated metal products, n.e.c. (SIC 3499).

Source: U.S. Department of Commerce, Bureau of the Census. 1999. *Manufacturing—Industry Series, 1997 Economic Census.* Washington, DC.
U.S. Department of Commerce, Bureau of the Census. 2001a. *Economic Census—Concentration Ratios.*
<http://www.census.gov/prod/ec97/m31s-cr.pdf>

4.2 Firm Size by Employment and Revenue

It is likely that large firms will be better able to absorb the financial impacts of the regulation. Hence, firm size is a factor in the distribution of the regulation's economic impacts. The 130 firms owning the 185 surface-coating facilities have yearly revenues as low as $1.3 million and as high as $180 billion. Employment at the firms ranges from 15 employees to 386,000. Tables 4-2 and 4-3 illustrate the distribution of employment and revenues across firms owning surface-coating facilities. Table 4-2 shows that 39 percent of firms employ fewer than 500 people, and 37 percent of firms are relatively large and employ over 1,000 people. Table 4-3 shows that many firms are large based on employment criteria, but the majority (70 percent) have annual revenues less than $500 million.

4.3 Vertical and Horizontal Integration

Vertical integration is a potentially important dimension in analyzing firm-level impacts because the regulation could affect a vertically integrated firm on more than one level. For example, the regulation may affect companies for whom surface coating of plastic parts is only one of several processes in which the firm is involved. A company that coats plastic parts, for example, may also be involved in manufacturing automobiles, aircraft, sporting goods, and appliances. This firm would be considered vertically integrated because it is involved in more than one level of production including surface coating. A regulation that increases the cost of coating plastic parts and products will also affect the cost of producing the final products that use coated plastic parts and products in the production process. Firms that manufacture and coat plastic parts and then use those parts as components in other goods, such as automobiles, are vertically integrated. Firms comprising facilities that coat and manufacture plastic parts are somewhat vertically integrated. Firms with a single coating facility are not vertically integrated.

Horizontal integration is also a potentially important dimension in firm-level impact analysis because a diversified firm may own facilities in unaffected industries, giving them resources to spend on complying with this regulation—if they so choose. The 130 potentially affected firms described in Section 4.2 demonstrate little diversification. Most of the larger firms are oriented in a single industry, usually motor vehicle manufacturing. Many independent single-facility firms may produce a wide variety of products. However, because the Plastic Parts and Products NESHAP is regulating a production process used for all those products, those firms will find almost all products are affected by the regulation.

Table 4-2. Distribution of Potentially Affected Firms by Employment: 2000

Employment Range	Number of Firms	Share of Total
0–500	50	38%
500–1,000	22	17%
>1,000	49	38%
NA	9	7%
Total	130	100%

Source: Dialog Corporation. 2001. U.S. Company Profiles. <www.profound.com>. As obtained August 29, 2001.
Dun and Bradstreet. 2001. D & B Million Dollar Directory: America's Leading Public and Private Companies. Bethlehem, PA: Dun & Bradstreet.
Hoover's Online. 2001. Company Capsules. <http://www.hoovers.com>. As obtained June 25, 2001.
Infausta Incorporated. 2001. References [computer file]. Omaha, NE: Infausta, Inc.
U.S. Bureau of the Census. 2001b. Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations. First Quarter, 2001, Series QF/01-Q1. Washington, DC: U.S. Government Printing Office.

Table 4-3. Distribution of Potentially Affected Firms by 2000 Sales

Company Sales	Number of Firms	Share of Total
Less than $5 million	8	6%
$5 million to $50 million	38	29%
$50 million to $500 million	45	35%
$500 million to $1,000 million	8	6%
$1 billion or greater	22	17%
NA	9	7%
Total	130	100%

Source: Dialog Corporation. 2001. U.S. Company Profiles. <www.profound.com>. As obtained August 29, 2001.
Dun and Bradstreet. 2001. D & B Million Dollar Directory: America's Leading Public and Private Companies. Bethlehem, PA: Dun & Bradstreet.
Hoover's Online. 2001. Company Capsules. <http://www.hoovers.com>. As obtained June 25, 2001.
Infausta Incorporated. 2001. References [computer file]. Omaha, NE: Infausta, Inc.
U.S. Bureau of the Census. 2001b. Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations. First Quarter, 2001, Series QF/01-Q1. Washington, DC: U.S. Government Printing Office.

4.4 Small Businesses

Although the proposed rule affects firms of all sizes, small businesses may have special problems with compliance. The Regulatory Flexibility Act (R.A.) of 1980, as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA), requires that special consideration be given to these entities. The Agency classified 67 potentially affected companies as small using the approach outlined below:

- Standard Industrial Classification (SIC) code data were available for 105 companies (81 percent). These codes were mapped to NAICS industries to determine the appropriate size standard. In cases where mapping resulted in two or more NAICS codes, we used the highest size standard.
- Of the remaining 25 companies, 16 companies either had employment greater than 1,500 employees (therefore large under any manufacturing size standard) or had employment less than 500 employees (small under any manufacturing size standard).
- We assumed firms without employment data (9 firms) are small in this analysis. This assumption may potentially overstate the number of small firms in the analysis.

SECTION 5

MARKETS AND TRENDS

Because plastic parts are used in such widely varied products as automobiles, computers, and toys, surface-coated plastic parts and products are found in many markets. The demand for surface-coating services is driven by all of these markets. This section describes some of the major trends in these markets, including domestic production and consumption, changes in net exports, and price trends.

5.1 Production

Parts coated for use in computer equipment are likely to have experienced the largest increase in production in the past years, since the computer and peripheral equipment industry has been expanding rapidly, as shown in Table 5-1. Table 5-1 also illustrates that the automobile and light duty truck industries have been growing and that the miscellaneous product industries have been decreasing production fairly steadily.

5.2 Consumption

Tables 5-2 through 5-4 indicate how much the above increases and decreases in production can be accounted for by changes in domestic and foreign consumption. Most notably, net exports of goods decreased for all industries described. At least some of this decrease is due primarily to the rapid growth of the U.S. economy (and domestic demand for goods) relative to other economies rather than to an increase in the total share of foreign producers in the market. Apparent domestic consumption increased for every industry shown except for costume jewelry.

5.3 Pricing Trends

Prices for products manufactured by the transportation industries and miscellaneous manufacturing industries have risen while prices for office, computing, and accounting machines have dropped 37.6 percent. This fact, along with the tremendous increase in the value of domestic

Table 5-1. Value of Domestic Product[a] Shipments in Some Industries Using Surface Coated Plastic Parts (10^6 $1997)

	1995	1996	1997[b]	1998[b]	1999[c]	Change from 1995 to 1999 (%)
Automobile and Light Duty Truck Parts						
Automotive Parts and Accessories (NAICS 336370, 336311, 336321, 335911, 336322, 336312, 336330, 336340, 336350, 336399)	$145,926.6	$148,090.6	$167,600.0	$258,228.0	$196,015.3	34%
Motor Vehicles and Bodies (NAICS 336111, 336112, 336120, 336211, 336992)	$208,599.5	$205,776.5	$215,359.0	$306,998.6	$224,644.9	8%
Motorcycles and Parts (NAICS 334111)	$1,442.0	$1,623.2	$1,658.7	$1,770.5	$1,924.3	33%
Business Machine and Computer Equipment Parts						
Computers and Peripherals (NAICS 334111, 334112, 334113, 334119)	$60,533.8	$68,334.7	$84,300.0	$106,301.6	$123,742.3	104%
Miscellaneous Products						
Dolls, Toys, and Games (NAICS 339931, 336991, 339932)	$4,605.7	$4,193.0	$4,261.0	$4,195.2	$4,175.9	–9%
Sporting and Athletic Goods (NAICS 339920)	$9,018.7	$9,289.4	$9,510.0	$9,299.5	$9,256.7	3%
Bicycles and Bicycle Parts (NAICS 334111)	$1,024.6	$969.5	$975.0	$859.2	$694.9	–32%
Costume Jewelry and Novelties (NAICS 339914)	$278,893.6	$2,052.6	$71,611.5	$11,842.9	$10,167.3	–35%

[a] Product shipments include all specific products classified within the industries listed regardless of whether the establishments producing those products fall within the industry classification.
[b] Estimate
[c] Forecast

Sources: U.S. Department of Commerce, International Trade Administration. 2000. *U.S. Industry & Trade Outlook 2000.* New York: The McGraw-Hill Companies.

Prices adjusted using data from the U.S. Bureau of Labor Statistics, Producer Price Index Revision—Current Series, Series pcu37__#, pcu357_#, pcu39__#, pcu3751#1, and pcu3751#2. <http://www.bls.gov>. As obtained on July 12, 2000.

Table 5-2a. Production and Apparent Consumption of Automotive Parts and Accessories (NAICS 336370, 336311, 336321, 335911, 336322, 336312, 336330, 336340, 336350, 336399 [SICs 3465, 3592, 3647, 3691, 3694, 3714]) (10^6 $1997)

Year	Domestic Production	Apparent Domestic Consumption	Net Exports
1995	$145,926.6	$144,381.7	$1,544.9
1996	$148,090.6	$147,572.0	$518.6
1997	$148,201.0	$147,682.0	$519.0
1998	$258,228.0	$256,981.7	$1,246.4
1999	$196,015.3	$197,012.3	–$997.0
Change from 1995 to 1999 (%)	34%	36%	–165%

Sources: U.S. Department of Commerce, International Trade Administration. 2000. *U.S. Industry & Trade Outlook 2000*. New York: The McGraw-Hill Companies.

Prices adjusted using data from the U.S. Bureau of Labor Statistics, Producer Price Index Revision—Current Series, Series pcu37__#. <http://www.bls.gov>. As obtained on July 12, 2000.

Table 5-2c. Production and Apparent Consumption of Motorcycles and Parts (NAICS 334111 [SIC 37512]) (10^6 $1997)

Year	Domestic Production	Apparent Domestic Consumption	Net Exports
1995	$1,442.0	$2,033.5	–$591.5
1996	$1,623.2	$2,134.3	–$511.0
1997	$1,658.7	$2,102.7	–$444.1
1998	$1,770.5	$2,428.3	–$657.9
1999	$1,924.3	$2,869.4	–$945.1
Change from 1995 to 1999 (%)	33%	41%	–60%

Sources: U.S. Department of Commerce, International Trade Administration. 2000. *U.S. Industry & Trade Outlook 2000*. New York: The McGraw-Hill Companies.

Prices adjusted using data from the U.S. Bureau of Labor Statistics, Producer Price Index Revision—Current Series, Series pcu37__#, and pcu3751#2. <http://www.bls.gov>. As obtained on July 12, 2000.

Table 5-2b. Production and Apparent Consumption of Motor Vehicles and Bodies (NAICS 336111, 336112, 336120, 336211, 336992 [SICs 3711, 3713]) (10^6 $1997)

Year	Domestic Production	Apparent Domestic Consumption	Net Exports
1995	$208,599.5	$272,191.6	–$63,592.0
1996	$205,776.5	$269,973.7	–$64,197.1
1997	$215,359.0	$283,891.0	–$68,532.0
1998	$306,998.6	$416,267.3	–$109,268.7
1999	$224,644.9	$310,041.2	–$85,396.3
Change from 1995 to 1999 (%)	8%	14%	–34%

Sources: U.S. Department of Commerce, International Trade Administration. 2000. *U.S. Industry & Trade Outlook 2000*. New York: The McGraw-Hill Companies.

Prices adjusted using data from the U.S. Bureau of Labor Statistics, Producer Price Index Revision—Current Series, Series pcu37. <http://www.bls.gov>. As obtained on July 12, 2000.

Table 5-3. Production and Apparent Consumption of Computers and Peripheral Equipment (NAICS 334111, 334112, 334113, 334119 [SICs 3571, 3572, 3575, 3577]) (10^6 $1997)

Year	Domestic Production	Apparent Domestic Consumption	Net Exports
1995	$60,533.8	$71,611.5	–$11,077.7
1996	$68,334.7	$84,088.1	–$15,753.4
1997	$84,300.0	$106,100.0	–$21,800.0
1998	$106,301.6	$132,433.7	–$26,132.1
1999	$123,742.3	$156,812.2	–$33,069.9
Change from 1995 to 1999 (%)	104%	119%	–199%

Sources: U.S. Department of Commerce, International Trade Administration. 2000. *U.S. Industry & Trade Outlook 2000*. New York: The McGraw-Hill Companies.

Prices adjusted using data from the U.S. Bureau of Labor Statistics, Producer Price Index Revision—Current Series, Series pcu357_#. <http://www.bls.gov>. As obtained on July 12, 2000.

Table 5-4a. Production and Apparent Consumption of Dolls, Toys, and Games (NAICS 339931, 336991, 339932 [SICs 3942, 3944]) (10^6 $1997)

Year	Domestic Production	Apparent Domestic Consumption	Net Exports
1995	$4,605.7	$11,907.1	–$7,301.5
1996	$4,193.0	$12,899.0	–$8,706.0
1997	$4,261.0	$15,351.0	–$11,090.0
1998	$4,195.2	$16,170.3	–$11,975.0
1999	$4,139.3	$16,548.2	–$12,408.9
Change from 1995 to 1999 (%)	–10%	39%	–70%

Sources: U.S. Department of Commerce, International Trade Administration. 2000. *U.S. Industry & Trade Outlook 2000*. New York: The McGraw-Hill Companies.

Prices adjusted using data from the U.S. Bureau of Labor Statistics, Producer Price Index Revision—Current Series, Series pcu39__#. <http://www.bls.gov>. As obtained on July 12, 2000.

Table 5-4b. Production and Apparent Consumption of Sporting and Athletic Goods (NAICS 339920 [SIC 3949]) (10^6 $1997)

Year	Domestic Production	Apparent Domestic Consumption	Net Exports
1995	$9,018.7	$10,269.8	–$1,251.1
1996	$9,289.4	$10,459.3	–$1,169.9
1997	$9,510.0	$10,675.0	–$1,165.0
1998	$9,299.5	$10,854.1	–$1,554.6
1999	$9,415.1	$10,981.3	–$1,566.2
Change from 1995 to 1999 (%)	4%	7%	–25%

Sources: U.S. Department of Commerce, International Trade Administration. 2000. *U.S. Industry & Trade Outlook 2000*. New York: The McGraw-Hill Companies.

Prices adjusted using data from the U.S. Bureau of Labor Statistics, Producer Price Index Revision—Current Series, Series pcu39__#. <http://www.bls.gov>. As obtained on July 12, 2000.

Table 5-4c. Production and Apparent Consumption of Bicycles and Bicycle Parts (NAICS 334111 [SIC 37511]) (10^6 $1997)

Year	Domestic Production	Apparent Domestic Consumption	Net Exports
1995	$1,024.6	$1,719.8	–$695.1
1996	$969.5	$1,563.2	–$593.7
1997	$975.0	$1,644.0	–$669.0
1998	$859.2	$1,681.5	–$822.2
1999	$694.9	$1,722.4	–$1,027.5
Change from 1995 to 1999 (%)	–32%	0%	–48%

Sources: U.S. Department of Commerce, International Trade Administration. 2000. *U.S. Industry & Trade Outlook 2000*. New York: The McGraw-Hill Companies.

Prices adjusted using data from the U.S. Bureau of Labor Statistics, Producer Price Index Revision—Current Series, Series pcu3751#1. Available at www.bls.gov. Obtained on July 12, 2000.

Table 5-4d. Production and Apparent Consumption of Costume Jewelry and Novelties (NAICS 339914 [SIC 3961]) (10^6 $1997)

Year	Domestic Production	Apparent Domestic Consumption	Net Exports
1995	$1,813.6	$2,195.8	–$382.2
1996	$1,681.6	$2,041.0	–$359.3
1997	$1,229.0	$1,552.0	–$323.0
1998	$1,195.5	$1,569.5	–$374.0
1999	$1,170.2	$1,571.2	–$401.0
Change from 1995 to 1999 (%)	–35%	–28%	–5%

Sources: U.S. Department of Commerce, International Trade Administration. 2000. *U.S. Industry & Trade Outlook 2000*. New York: The McGraw-Hill Companies.

Prices adjusted using data from the U.S. Bureau of Labor Statistics, Producer Price Index Revision—Current Series, Series pcu39__#. <http://www.bls.gov>. As obtained on July 12, 2000.

product shipments in the computer industry, suggests that the volume of plastic parts used as inputs into business machines and computers has increased dramatically over the past 5 years, even more so than indicated solely by the data on value of shipments. Table 5-5 shows price changes for all three industry groups that produce a large number of surface-coated plastic parts.

Table 5-5. Price Indices in Industries that Produce Surface-Coated Plastic Parts

Year	Transportation Equipment (NAICS [SIC 37])	Office, Computing, and Accounting Machines (NAICS 333, 334, 339 [SIC 357])	Miscellaneous Manufacturing Industries (NAICS 339 [SIC 39])
1990	115.6	na	114.9
1991	119.8	na	117.5
1992	123.0	na	119.6
1993	126.3	na	121.5
1994	130.1	na	123.3
1995	132.2	70.5	125.9
1996	134.2	63.4	127.8
1997	134.1	55.9	129.0
1998	133.6	48.8	129.7
1999	134.5	44.0	130.3
Change in price from 1990 to 1999 (%)	16.3%	–37.6%[a]	13.4%

na = not available

[a] This is the percentage change from 1995 to 1999.

Source: U.S. Bureau of Labor Statistics, Producer Price Index Revision—Current Series, Series pcu37__#, pcu357_#, and pcu39__#. <http://www.bls.gov>. As obtained on July 12, 2000.

REFERENCES

Dialog Corporation. 2001. U.S. Company Profiles. <www.profound.com>. As obtained August 29, 2001.

Dun and Bradstreet. 2001. D & B Million Dollar Directory: America's Leading Public and Private Companies. Bethlehem, PA: Dun & Bradstreet.

Fettis, Gordon. 1995. *Automotive Paints and Coatings*. Weinheim, Germany: Verlagsgesellschaft mbH.

Fox, Patrick. 1998. "Thermoformed Panels Help Set Starfire Server Ablaze." *PLASTICS Machining & Fabricating*, May/June. <http://www.plasticsmachining.com/199806/furon.html>.

General Business File International (formerly Business ASAP). 1999. Gale Group Collections. As obtained from Infotrac website.

Hoover's Online. 2001. Company Capsules. <http://www.hoovers.com>. As obtained June 25, 2001.

Howlett, Elizabeth. 1998. "Thermoplastic Elastomers in the Auto Industry: Increasing Use and the Potential Implications." *Industry, Trade, and Technology Review* January:28–41.

InfoUSA Incorporated. 2001. ReferenceUSA [computer file]. Omaha, NE: InfoUSA, Inc.

Kent, Gary. "Preparing Plastics for Painting." PFOnline. <http://www.pfonline.com/articles/pfd0003.html>. As obtained on February 11, 2000.

Lancaster, Kelvin J. 1966. "A New Approach to Consumer Theory." *Journal of Political Economy* 74:132-157.

McGraw Hill Encyclopedia of Science and Technology, 1987, as quoted in EPA's Sector Notebook Project on the Motor Vehicle Assembly Industry, September 1995, page 27.

Miller, Hannah. 1998. "Plastic Omnium Fuels Automotive Industry with Molded Parts." *PLASTICS Machining & Fabricating*, May/June. <http://www.plasticsmachining.com/199806/omnium.html>.

Modern Plastics Encyclopedia. 1999a. "Automotive." <http://www.modplas.com/encyclopedia/articles/articles_industry_auto.html>. As obtained on November 30, 1999.

Modern Plastics Encyclopedia. 1999b. "Electronics." <http://www.modplas.com/encyclopedia/articles/articles_industry_electron.html>. As obtained on November 30, 1999.

OBI Spray Booths and Systems Catalog #201-2. Inside Cover.

Society of the Plastics Industry (SPI). 1999. "Plastics in Transportation." Document #2118. <http://www.plasticsindustry.org/industry/2118.html>. As obtained on November 30, 1999.

Spraytech. <www.spraytech.com/powder.html>.

"Surface Coating." Encyclopedia Britannica. <www.britannica.com>.

University of Missouri-Rolla. "Sixth Floor—Coatings." <http://www.umr.edu/-wlf/Coatings/index.html>. As obtained on December 1, 1999.

U.S. Bureau of Labor Statistics, Producer Price Index Revision—Current Series, Series pcu37__#, pcu357_#, pcu39__#, pcu3751#1, and pcu3751#2. <http://www.bls.gov>. As obtained on July 12, 2000.

U.S. Department of Commerce, Bureau of the Census. 1999a. "All Other Motor Vehicle Parts Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3363k.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999b. "All Other Plastics Product Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3261l.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999c. "All Other Transportation Equipment Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3369c.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999d. "Automatic Vending Machine Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3333a.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999e. "Automobile Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3361a.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999f. "Computer Terminal Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3341c.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999g. *Concentration Ratios in Manufacturing*. MC92-S-2. <http://www.census.gov:80/mcd/mancen/download/mc92cr.sum>. As obtained on December 7, 1999.

U.S. Department of Commerce, Bureau of the Census. 1999h. "Costume Jewelry and Novelty Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3399d.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999i. "Current Carrying Wiring Device Manufacturing."*Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3359e.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999j. "Doll and Stuffed Toy Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3391a.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999k. "Electronic Computer Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3341a.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999l. "Game, Toy, and Children's Vehicle Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3399f.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999m. "Gasoline Engine and Engine Parts Manufacturing."*Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3363b.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999n. "Industrial Truck, Tractor, Trailer, and Stacker Machinery Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3339g.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999o. "Laboratory Apparatus and Furniture Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3391a.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999p. "Light Truck and Utility Vehicle Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3361b.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999q. "Magnetic Optical Recording Media Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3346c.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999r. "Military Armored Vehicle, Tank, and Tank Component Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3369b.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999s. "Motor Home Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3362c.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999t. "Motor Vehicle Body Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3362a.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999u. "Motor Vehicle Brake System Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3363f.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999v. "Motor Vehicle Steering and Suspension Components Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3363c.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999w. "Motor Vehicle Transmission and Power Train Parts Manufacturing."*Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3363g.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999x. "Motorcycle, Bicycle, and Parts Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3369a.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999y. "Musical Instrument Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3399n.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999z. "Office Machinery Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3333c.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999aa. "Other Computer Peripheral Equipment Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3341d.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999bb. "Other Metal Container Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3324d.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999cc. "Other Motor Vehicle Electrical and Electronic Equipment Manufacturing."*Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3363d.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999dd. "Plastics Pipe and Pipe Fitting Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3261e.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999ee. "Polystyrene Foam Product Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3261i.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999ff. "Printed Circuit Assemble (Electronic Assembly) Manufacturing."*Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3344h.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999gg. "Showcase, Partition, Shelving, and Locker Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3372d.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999hh. "Sign Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3399l.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999ii. "Sporting and Athletic Good Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3399e.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999jj. "Travel Trailer and Camper Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3362d.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999kk. "Truck Trailer Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3362b.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999ll. "Unsupported Plastics Profile Shape Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3261d.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999mm. "Urethane and Other Foam Product Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3261h.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1999nn. "Vehicular Lighting Equipment Manufacturing." *Manufacturing—Industry Series, 1997 Economic Census*. <http://www.census.gov/prod/ec97/97m3363c.pdf>. As obtained December 1999.

U.S. Department of Commerce, Bureau of the Census. 1997 Economic Census: The Bridge Betwen NAICS and SIC. <http://www.census.gov/epcd/ec97brdg/>. Last updated on June 27, 2000.

U.S. Department of Commerce, Bureau of the Census. 2001a. *Economic Census—Concentration Ratios*. <http://www.census.gov/prod/ec97/m31s-cr.pdf>

U.S. Bureau of the Census. 2001b. Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations. First Quarter, 2001, Series QFR/01-Q1. Washington, DC: U.S. Government Printing Office.

U.S. Department of Commerce, International Trade Administration. 2000. *U.S. Industry & Trade Outlook 2000*. New York: The McGraw-Hill Companies.

U.S. Environmental Protection Agency. 1994. *Alternative Control Techniques Document: Surface Coating of Automotive/Transportation and Business Machine Plastic Parts*. EPA 435/R-94-017. Research Triangle Park, NC: U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency, Office of Compliance, Office of Enforcement and Compliance Assurance. 1995. *EPA Office of Compliance Sector Notebook Project—Profile of the Motor Vehicle Industry*. EPA/310-R-95-009. Washington, DC: U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency, OAQPS, Coatings and Consumer Products Group. 1998. "Preliminary Industry Characterization: Surface Coating of Plastic Parts and Products." Research Triangle Park, NC: U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency (EPA). 2001. ICR Survey Responses. Washington, DC: U.S. Environmental Protection Agency.