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Economic Impact Analysis of the Halogenated Solvent Cleaning NESHAP

DRAFT

This report contains portions of the economic impact analysis report that are related to the industry profile.

1.0 INDUSTRY PROFILE

1.1 Introduction

This industry profile details the various market characteristics of the industries potentially affected by the NESHAP limiting halogenated solvent emissions from organic solvent cleaners (also called degreasers).* The industries include manufacturers of degreasers, manufacturers of halogenated solvents used in degreasing, and industries that use degreasers.

Industries that use degreasers will be directly impacted by the NESHAP because they will incur control costs. Manufacturers of solvents used in degreasing and manufacturers of degreasing equipment will be indirectly impacted by the regulation. For example, demand for solvents and degreasing equipment will decrease if output in the user industries decreases in response to an attempt to recover control costs by increasing prices. The substitution of alternative cleaning systems or nonhalogenated solvents for cleaning methods using halogenated solvents would also affect both halogenated solvent and degreasing equipment manufacturers.

The profile will first examine the manufacture of degreasing equipment and halogenated solvents. Subsequently, there will be an examination of the industries using degreasers.

1.2 Degreasing Equipment

Degreasers are used to remove water-insoluble soils such as grease, waxes, carbon deposits, oils, fluxes, and tars. Among the surfaces cleaned are plastics, metals, fiberglass, and printed circuit boards. Degreasing takes

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*Though the degreasing NESHAP may also limit HAP emissions, it has not yet been determined which HAPs will be regulated. Thus, the profile only addresses halogenated solvents.

place prior to production processes such as painting, plating, inspection, repair, assembly, heat treatment, and machining. To remove the soils, degreasers use a variety of solvents.

Besides varying in size, from bench-top models to industrial-size models, degreasers also vary in technological sophistication, from a simple tank containing solvent to an automated, multi-stage system.[1] However, degreasers are usually categorized into three groups: cold cleaners, open top vapor cleaners (OTVCs), and in-line (conveyorized) cleaners.

Used most often for maintenance cleaning and the routine cleaning of small parts, cold cleaners use room temperature solvent to clean equipment and parts. These solvents are primarily aliphatic petroleum distillates, alochol blends, or napthas.[2] Only a certain type -- the carburetor cleaner -- uses halogenated solvents.[3] Cold cleaners are batch-operated; this means that their operation is discontinuous and on an as-needed basis.

An OTVC cleans parts and equipment by suspending them in the heated vapors of a solvent. OTVCs, like cold cleaners, are batch-operated. Unlike cold cleaners, they are rarely used for maintenance cleaning because cold cleaners are less expensive to operate for this type of work.[4] Exceptions include the maintenance cleaning of electrical components, small equipment parts, and aircraft parts, where the degree of cleanliness provided by an OTVC is necessary. OTVCs are widely used in metalworking operations.[5]

The final type of degreaser is the in-line or conveyorized (vs. batch) cleaner. The five types of in-line cleaners using halogenated solvents are cross-rod, monorail, belt, strip, and printed circuit board processing equipment (including photoresist strippers, flux cleaners, and

developers).[6] In-line cleaners can use either a cold-cleaning process or a vapor-cleaning process; the majority use vapor cleaning.[7] An in-line cleaner is used mainly in manufacturing facilities where there is a constant stream of parts to be cleaned. In these situations the advantages of a conveyorized system outweigh the lower capital cost of a batch-operated OTVC.[8] One of these advantages is that an in-line cleaner greatly reduces manual parts handling associated with cold cleaners and OTVCs. Another advantage is that in-line cleaners are usually tailored to the specific production environment rather than being of a generic design.

The manufacture of degreasers is part of the broad SIC 3559, Special Industry Machinery, Not Elsewhere Classified.[9] There is little published information concerning the manufacturers of degreasers. The most recent data available are from a 1987 survey of producers of cold cleaners and OTVCs by the JACA Corporation of Fort Washington, PA.[10,11] The survey identified about 50 companies that in 1986 supplied cold cleaners to metal cleaning operations. Among these, some of the major producers were Safety-Kleen, Phillips Manufacturing (a wholly-owned subsidiary of Safety-Kleen), Kleer-Flo, Graymills, Build-All, R&D/Kamas (a division of Fountain Industries), and Crest Ultrasonics.

Cold cleaner units ranged in price from $100 to $5,000 in 1986. Between 25,000 and 50,000 cold cleaners were estimated to have been sold in 1986, over half of which were carburetor or immersion cleaners sold to automotive repair shops.

Approximately 75 companies manufactured OTVCs in 1986. Two companies, Detrex and Baron-Blakeslee, accounted for 50 percent of 1986 production. Other major producers included Phillips Manufacturing, Crest Ultrasonics, Delta

Industries, and Cooper Company. Between 1,000 and 2,000 OTVCs were sold in 1986, ranging approximately in price from $1,500 to $340,000.

There are a number of SIC industries which use degreasing equipment. These user industries are discussed in Section 1.4.

The most recent data concerning the number of degreasers using halogenated solvents are from 1987.[12] In that year there were approximately 100,000 cold cleaners, 25,000 to 35,000 OTVCs, 2,000 to 3,000 in-line vapor cleaners, and 500 to 1,000 in-line cold cleaners using halogenated solvents.

Though there are no published forecasts available for the production of halogenated solvent cleaners, it can be assumed that demand will to some extent be influenced by the degree of substitution of alternative cleaning systems.

1.3 Halogenated Solvents Used In Degreasing

There are five halogenated solvents used by degreasers.[13] They are methylene chloride (MC), perchloroethylene (PCE), trichloroethylene (TCE), 1,1,1-trichloroethane (TCA), and trichlorotrifluoroethane (CFC-113). The first four have been designated for regulation by the degreasing NESHAP.

The manufacture of solvents used in degreasing is classified in SIC 2842, Specialty Cleaning, Polishing, and Sanitation Preparations.[14] Table 1 lists the manufacturers of the four solvents. Dow Chemical U.S.A. currently manufactures all four solvents. Both PPG Industries, Inc. and Vulcan Materials Company produce three of the four solvents. TCA has the largest amount of capacity dedicated to its production (477 million kilograms per year) while TCE has the smallest (145 millions kilograms per year).

TABLE 1. U.S. PRODUCERS OF METHYLENE CHLORIDE (MC), PERCHLOROETHYLENE (PCE), 1,1,1-TRICHLOROETHANE (TCA), TRICHLOROETHYLENE (TCE), 1992

Chemical	Company	Capacity (10^6 kg/yr)
MC	Dow Chemical U.S.A.	104
	Occidental Chemical Corp.	50
	Vulcan Materials Company	95
		249
PCE	Dow Chemical U.S.A.	41
	PPG Industries, Inc.	91
	Vulcan Materials Company	91
		223
TCA	Dow Chemical U.S.A.	227
	PPG Industries, Inc.	159
	Vulcan Materials Company	91
		477
TCE	Dow Chemical U.S.A.	54
	PPG Industries, Inc.	91
		145

Sources: Chemical Marketing Reporter, January 20, 1992, January 27, 1992, February 3, 1992, March 2, 1992.

Table 2 presents production data for the four solvents. Production levels in the mid to latter 80s were down from the beginning of the decade for MC, PCE, and TCE. This trend resulted from decreased demand, particularly for metal degreasing applications.[15] In response to rising disposal costs, users of the solvents began recycling them, contributing to this decreased demand.[14,17] The largest drop in production from 1980 to 1990 was the 50 percent decrease in PCE production. TCA experienced increased production from 1987 to 1989; the chemical was being substituted for trichlorotrifluoroethane (CFC-113) and a number of VOC compounds.[18]

The various end uses of the four solvents are listed in Table 3. It is apparent that TCE is the most reliant on degreasing end-uses; 90 percent of 1992 consumption is accounted for by vapor degreasing applications. Degreasing applications (vapor degreasing, cold cleaning, and electronics cleaning) account for the majority, 52 percent, of TCA consumption. Fifteen percent of MC consumption involves degreasing applications. PCE is the least reliant on degreasing applications, which only currently consume 13 percent of output.

Historical data concerning the domestic consumption of the four halogenated solvents in degreasing applications are contained in Table 4A. As shown, PCE, TCE, and TCA were, in recent years, the major commercial solvents, accounting for 90 to 95 percent of the markets for solvents used in metal degreasing.[19] The consumption of all four chemicals edged downward throughout the decade. Demand was stagnant in recent years, particularly from 1984 to 1987. Not until the period of 1987 to 1989 did the consumption of MC, PCE, and TCE recover. In 1991, the consumption for

TABLE 2. U.S. PRODUCTION OF METHYLENE CHLORIDE (MC), PERCHLOROETHYLENE (PCE), 1,1,1-TRICHLOROETHANE (TCA), AND TRICHLOROETHYLENE (TCE), 1980-1990

	Quantity (10^6 kg)			
	MC	PCE	TCA	TCE
1990	213	174	355	76
1989	213	215	352	50
1988	230	227	317	50
1987	233	215	315	88
1986	254	184	294	75
1985	262	225	268	77
1984	250	231	303	88
1983	265	248	266	91
1982	241	265	270	86
1981	269	313	279	117
1980	256	347	314	121

Sources: Facsimile. Risotto, S., Halogenated Solvents Industry Alliance, to Jenkins, A., JACA Corp. March 12, 1992. Information concerning halogenated solvents.

TABLE 3. USES OF METHYLENE CHLORIDE (MC), PERCHLOROETHYLENE (PCE), 1,1,1-TRICHLOROETHANE (TCA), AND TRICHLOROETHYLENE (TCE), 1992

		Percent of Total Consumption
MC:	paint removal/stripping	31%
	plastics	16%
	flexible polyurethane foam	14%
	pharmaceuticals	11%
	metal cleaning/degreasing	11%
	aerosols	8%
	electronics	4%
	miscellaneous	5%
PCE:	dry cleaning/textile processing	50%
	chemical intermediate	27%
	metal cleaning	13%
	miscellaneous	10%
TCA:	vapor degreasing	31%
	cold cleaning	18%
	aerosols	12%
	adhesives	10%
	chemical intermediates	10%
	coatings and inks	7%
	textiles	4%
	electronics	3%
	miscellaneous	5%
TCE:	vapor degreasing	90%
	chemical intermediate and miscellaneous	10%

Sources: Chemical Marketing Reporter, January 20, 1992, January 27, 1992, February 3, 1992, March 2, 1992.

TABLE 4A: U.S. CONSUMPTION OF METHYLENE CHLORIDE (MC), PERCHLOROETHYLENE (PCE), 1,1,1-TRICHLOROETHANE (TCA), TRICHLOROETHYLENE (TCE) IN DEGREASING APPLICATIONS[a], 1985-1991

	Quantity (10^6 kg)			
	MC	PCE	TCA	TCE
1991	18.8	16.2	123.8[b]	42.0
1989	13.9	31.4	169.5	17.5
1987	22.4	N/A	N/A	56.0
1985	23.4	30.6	163.5	73.3

[a]Include metal cleaning and electronics cleaning by vapor degreasing or cold cleaning.
[b]Estimate.
N/A - Not available

Sources: Chemical Marketing Reporter, Chemical Profiles from: March 2, 1992, February 3, 1992, January 27, 1992, January 20, 1992, January 23, 1989, February 6, 1989, July 1, 1989, July 8, 1989; Halogenated Solvents Industry Alliance, "White Paper -- Perchloroethylene," June 1991, "White Paper -- 1,1,1-Trichloroethane," May 1991; "White Paper -- Methylene Chloride, February 1989, "White Paper - Trichloroethylene," April 1989, "White Paper -- 1,1,1-Trichloroethane," June 1987, "White Paper - Methylene Chloride," May 1987, "White Paper -- Trichloroethylene," November 1986, "White Paper -- Perchloroethylene," August 1987; Facsimile. Risotto, S., Halogenated Solvents Industry Alliance, to Jenkins, A., JACA Corp. March 12, 1992. Information concerning halogenated solvents.

all the solvents fell drastically. The consumption of PCE in metal degreasing dropped 48 percent from 1989 to 1991. Consumption has dropped as there has been more solvent recycling and switching to alternative solvents in response to environmental regulations and sharply rising disposal costs for waste solvents.

Table 4B shows the 1991 consumption of the four solvents in degreasing applications by degreaser type. 40.4 percent (81.2 million kilograms) of total solvent consumption was accounted for by batch vapor cleaners. Batch cold cleaners consumed 37.5 percent (75.4 million kilograms) of the solvents. Overall, batch cleaners (cold cleaning and vapor cleaning) accounted for 77.9 percent of solvent consumption in degreasing applications.

The historical average realized prices of the four halogenated solvents are listed in Table 5. Halogenated solvent prices are influenced by the level of imports, raw material costs, and capacity.[21] The price of MC reached a decade-high of 52 cents per kilogram in 1984, and settled at 46 cents per kilogram by 1990, 6 cents below the 1980 price. The price of PCE fluctuated throughout the period, reaching a decade-high of 49 cents per kilogram in 1989 then falling to 33 cents in 1990. In 1985 the price of TCA was a decade-high of 69 cents per kilogram, and subsequently fell to 59 cents by 1990. In 1988, TCE climbed to its decade-high of 66 cents per kilogram.

Of the four solvents PCE is the most heavily imported (Table 6). MC imports peaked in 1984, and declined through 1991 to 3.2 million kilograms. The peak year for PCE imports occurred in 1986 when 72.2 million kilograms were imported. Imports of PCE subsequently fell to 31.8 million

TABLE 4B. CONSUMPTION OF METHYLENE CHLORIDE (MC), PERCHLOROETHYLENE (PCE), 1,1,1-TRICHLOROETHANE (TCA), AND TRICHLOROETHYLENE (TCE) BY DEGREASER TYPE, 1991

Solvent	1991 Consumption (10^6 Kg)	Consumption in Cold Cleaning (10^6 Kg)				Consumption in Vapor Cleaning (10^6 kg)	
		Batch Cleaners	In-Line Batch Cleaners	Cold Carburetor Cleaners	Photo-resist Stripping	Batch Cleaners	In-Line Cleaners
MC	18.8	6.9	-	1.3	4.4	4.5	1.7
PCE	16.2	4.7	-	-	-	8.4	3.1
TCA	123.8	62.1	8.4	-	-	38.9	14.4
TCE	42.0	1.7	-	-	-	29.4	10.9
Total	200.8	75.4	8.4	1.3	4.4	81.2	30.1
Percent of Total[a]	100%	37.5%	4.2%	.6%	2.2%	40.4%	15.0%

[a]Does not add to 100 due to rounding.

Sources: Chemical Marketing Reporter, January 20, 1992, January 27, 1992, February 3, 1992, March 2, 1992; Facsimile. Sorrels, L., EPA to Holmes C., JACA Corp. March 13, 1992.

TABLE 5. AVERAGE REALIZED PRICE OF METHYLENE CHLORIDE (MC), PERCHLOROETHYLENE (PCE), 1,1,1-TRICHLOROETHANE (TCA), AND TRICHLOROETHYLENE (TCE), 1980-1989

	Price (¢/kg)			
	MC	PCE	TCA	TCE
1990	46	33	59	N/A
1989	47	49	62	N/A
1988	40	44	62	66[a]
1987	N/A	37	70	60[a]
1986	38	36	64	60[a]
1985	N/A	42	68	64[a]
1984	N/A	N/A	N/A	N/A
1983	42	37	55	N/A
1982	N/A	N/A	N/A	N/A
1981	N/A	N/A	N/A	N/A
1980	49	35	53	43

[a]Estimated
N/A - Not available.

Sources: U.S. International Trade Commission. Synthetic Organic Chemicals, 1983, 1986, 1988, 1989, 1990; Mannsville Chemical Products Corporation, "Chemical Products Synopsis -- Perchloroethylene," February, 1989; Mannsville Chemical Products Corporation, "Chemical Products Synopsis-Trichloroethylene," February, 1989, Mannsville Chemical Products Corporation, "Chemical Products Synopsis -- 1,1,1-Trichloroethane," October, 1990.

TABLE 6. U.S. IMPORTS OF METHYLENE CHLORIDE (MC), PERCHLOROETHYLENE (PCE), 1,1,1-TRICHLOROETHANE (TCA), TRICHLOROETHYLENE (TCE), 1980-1989

	Quantity (10^6/kg)			
Year	MC	PCE	TCA	TCE
1990	8.8	24.9	2.8	31.4
1989	7.4	20.5	6.0	26.7
1988	12.4	27.0	7.1	6.0
1987	18.4	24.5	8.8	8.8
1986	16.8	27.5	8.8	17.3
1985	25.6	10.3	5.5	19.8
1984	28.9	13.1	2.0	14.0
1983	19.9	24.7	0.0	15.0
1982	18.0	20.0	0.0	6.2
1981	14.2	35.5	0.0	8.3
1980	11.5	34.0	0.0	3.5

Sources: Facsimile. Risotto, S., Halogenated Solvents Industry Alliance, to Jenkins, A., JACA Corp. March 12, 1992. Information concerning halogenated solvents.

kilograms in 1991. TCA experienced increased imports from 1984 to 1988; imports fell in 1991. After 19.8 million kilograms were imported in 1985, imports of TCE fell to 1.4 million kilograms in 1991.

The growth prospects for halogenated solvents are unfavorable. In June 1991, Chemical Engineering reported that the Freedonia Group, a Cleveland-based market research firm, forecast that over the 1990s the production of halogenated solvents would drop by approximately three percent.[22] There will be technological improvements in vapor degreasers, making more efficient use of solvent.[23] Emission control equipment will also reduce fugitive emissions.[24] The recycling of halogenated solvents will become more prevalent.[25] Finally, alternative solvents may be substituted. These include water or aqueous-based detergents, nonhalogenated solvents (e.g., terpenes, Stoddard solvents, mineral spirits), and newly developed solvents that are partially hydrogenated CFCs or blends of partially hydrogenated CFCs and nonhalogenated solvents.[26]

More recent forecasts by Chemical Marketing Reporter predict negative growth of consumption for MC, TCA, and TCE.[27,28,29] The demand for domestically produced MC will be depressed by increased environmental regulation, including OSHA's revised PEL (permissible exposure level) proposal, and EPA's dry cleaning NESHAP. Growth in consumption is forecast to decline 3 percent per year through 1996. Environmental regulation, specifically the Clean Air Act and Montreal Protocol, are forcing the phase out of TCA production. Consumption is forecast to decline 11.6 percent per year through 1996. TCE consumption is forecast to decline 2.6 percent per year through 1996; it is being regulated because it helps create smog. Only PCE consumption is expected to grow (7% per year through 1996) because of its use in dry cleaning applications.[30]

Consumption of PCE is expected to grow despite increased regulation by OSHA and EPA.

One final point is that all four solvents are regulated by the Hazardous Organics NESHAP (HON) under the Clean Air Act. Thus, besides any control costs imposed by the degreasing NESHAP, there will also be additional control costs due to the HON.

1.4 Industries Using Degreasing Equipment

Degreasing is performed in a variety of industries. Because the process is so widespread, it is not possible to identify the specific establishments and products that would be affected by a degreasing NESHAP. The economic analysis must instead rely on a definition of the industries that use degreasing equipment and any associated data available.

In a 1976 study, Eureka Laboratories identified 38 3-digit and one 2-digit SIC industries that use degreasers.[31] In Table 7, the 39 user industries are listed according to the 1972 SIC classification system used in the Eureka Laboratories. The table also indicates which codes were redefined in the SIC classification system. It should be noted that two other industries perform the same services as SIC 753, Automotive Repair shops. These industries are SIC 551, Motor Vehicle Dealers and SIC 554, Gasoline Service Stations. Because they were not identified by the Eureka Laboratories study, they are discussed only in section 1.5.

Industry Structure

In 1987, the classification system was reorganized. Sixteen industries were affected by this reorganization. However, in four industries the changes were only redistributive within the 3-digit grouping, which does not affect the aggregate data for that industry. These four industries were SICs 336, 349, 353, and 361.

TABLE 7. INDUSTRIES USING DEGREASING EQUIPMENT, BY 1972 AND 1987 BASIS

SIC Code, 1972 Basis	Industry Name	SIC Code Redefined in 1987
254	Partitions and Fixtures	
259	Misc. Furniture and Fixtures	
332	Iron and Steel Foundries	
335	Nonferrous Rolling and Drawing	
336	Nonferrous Foundries	***
339	Misc. Primary Metal Products	
342	Cutlery, Handtools, and Hardware	
343	Plumbing and Heating, Except Electric	
344	Fabricated Structural Metal Products	
345	Screw Machine Products, Bolts, Etc.	
346	Metal Forgings and Stampings	
347	Metal Services, n.e.c.	
348	Ordnance and Accessories, n.e.c.	
349	Misc. Fabricated Metal Products	***
351	Engines and Turbines	
352	Farm and Garden Machinery	
353	Construction and Related Machinery	***
354	Metalworking Machinery	***
355	Special Industry Machinery	***
356	General Industrial Machinery	***
357	Office and Computing Machines	***
358	Refrigeration and Service Machinery	
359	Misc. Machinery, Except Electrical	***
361	Electric Distributing Equipment	***
362	Electrical Industrial Apparatus	***
364	Electric Lighting and Wiring Equipment	***
366	Communication Equipment	***
367	Electronic Components and Accessories	***
369	Misc. Electrical Equipment and Supplies	***
371	Motor Vehicles and Equipment	
372	Aircraft and Parts	
376	Guided Missiles, Space Vehicles, Parts	
379	Misc. Transportation Equipment	
381	Engineering and Scientific Instruments	***
382	Measuring and Controlling Devices	***
39	Misc. Manufacturing Industries	
401	Railroads - Maintenance	
458	Air Transport - Maintenance	

TABLE 7. (CONTINUED)

SIC Code, 1972 Basis	Industry Name	SIC Code Redefined in 1987
753	Auto Repair	

Misc. - Miscellaneous.
n.e.c. - Not elsewhere classified.

Sources: U.S. Department of Commerce, Bureau of the Census, 1982 Census of Manufactures, 1987 Census of Manufactures.

Eleven 3-digit industries did change in aggregate terms. These eleven were SICs 354, 355, 356, 357, 359, 362, 364, 366, 369, 381, and 382. For more specific information on how these industries changed refer to Appendix A. There were changes in SIC 367, but it is not known whether they were merely redistributive or affecting the aggregate. Table 8 compares 1987 and 1982 revenues for the user industries. Revenues are reported in nominal dollars. The two years are comparable except for those industries whose redefinition in 1987 resulted in aggregate changes. These include SICs 354, 355, 356, 357, 359, 362, 364, 366, 369, 381 and 382. SIC 371, Motor Vehicles and Equipment, had revenues of $205.9 billion in 1987, the highest among the industries under consideration. It also had the most revenue in 1982. SIC 339, Miscellaneous Primary Metal Products, had the least revenue, $2.9 billion, in 1987.

Table 9 lists the number of establishments, employment, and revenue in 1987 of the industries using degreasing equipment. It is evident from the table that the 114,601 establishments in SIC 753, Auto Repair, were the most in any industry. This total was comparable to the 140,880 establishments of the 36 industries in manufacturing. The second largest industry in terms of total establishments is SIC 359, Industrial Machinery, Not Elsewhere Classified, with 22,348. The fewest number of establishments, 141, were in SIC 376, Guided Missiles, Space Vehicles, Parts.

Employment in the user industries ranged from 31,800 in SIC 339, Miscellaneous Primary Metal Products, to 751,400 in SIC 371. Revenue ranged from $2.9 billion in SIC 339 to the $205.9 billion in SIC 371.

To provide a more detailed picture of the number of establishments and revenue, Table 10 and Table 11

TABLE 8. REVENUES FOR THE INDUSTRIES USING DEGREASING EQUIPMENT, 1987 AND 1982

SIC Code	Industry Name	1987 Revenue (thousands of 1987 $)	1982 Revenue (thousands of 1982 $)	Industries Whose 1987 and 1982 Revenues Aren't Directly Comparable
254	Partitions and Fixtures	$5,537,200	$3,709,900	
259	Misc. Furniture and Fixtures	$3,740,100	$2,390,100	
332	Iron and Steel Foundries	$10,627,700	$9,641,500	
335	Nonferrous Rolling and Drawing	$33,282,200	$25,462,900	
336	Nonferrous Foundries (castings)	$6,315,000	$4,603,200	
339	Misc. Primary Metal Products	$2,907,000	$2,066,300	
342	Cutlery, Handtools, and Hardware	$13,480,600	$10,081,700	
343	Plumbing and Heating, Except Electric	$5,282,700	$4,003,300	
344	Fabricated Structural Metal Products	$40,416,100	$34,904,300	
345	Screw Machine Products, Bolts, Etc.	$7,890,200	$5,834,400	
346	Metal Forgings and Stampings	$28,409,800	$20,057,100	
347	Metal Services, n.e.c.	$7,789,500	$5,124,800	
348	Ordnance and Accessories, n.e.c.	$7,643,600	$4,992,900	
349	Misc. Fabricated Metal Products	$24,339,900	$22,274,100	
351	Engines and Turbines	$14,570,400	$13,039,700	
352	Farm and Garden Machinery	$11,474,300	$13,108,200	
353	Construction and Related Machinery	$24,622,300	$32,037,500	
354	Metalworking Machinery	$22,003,500	$18,149,600	***
355	Special Industry Machinery	$17,096,100	$13,127,800	***
356	General Industrial Machinery	$24,120,500	$24,458,800	***
357	Computer and Office Equipment	$60,626,500	$43,027,500	***
358	Refrigeration and Service Machinery	$23,234,900	$16,449,900	
359	Industrial Machinery, n.e.c.	$19,921,400	$14,496,700	***
361	Electric Distribution Equipment	$8,196,800	$8,108,200	
362	Electrical Industrial Apparatus	$15,266,300	$13,825,100	***
364	Electric Lighting and Wiring Equipment	$18,004,000	$12,047,800	***
366	Communications Equipment	$34,000,600	$46,426,000	***
367	Electronic Components and Accessories	$50,257,700	$34,516,800	***
369	Misc. Electrical Equipment and Supplies	$21,230,300	$12,543,500	***

TABLE 8. (CONTINUED)

SIC Code	Industry Name	1987 Revenue (thousands of 1987 $)	1982 Revenue (thousands of 1982 $)	Industries Whose 1987 and 1982 Revenues Aren't Directly Comparable
371	Motor Vehicles and Equipment	$205,923,100	$112,269,600	
372	Aircraft and Parts	$77,304,100	$52,026,700	
376	Guided Missiles, Space Vehicles, Parts	$26,285,200	$14,398,000	
379	Misc. Transportation Equipment	$6,032,800	$4,527,000	
381	Search and Navigation Equipment	$36,366,800	N/A	***
382	Measuring and Controlling Devices	$26,042,000	$14,632,800	***
39	Misc. Manufacturing Industries	$32,012,000	$26,891,400	
401	Railroads - Maintenance	$4,338,334	N/A	
458	Air Transport - Maintenance	$6,138,218	N/A	
753	Auto Repair	$28,664,181	N/A	

Misc. - Miscellaneous.
N/A - Not available.
n.e.c. - Not elsewhere classified.

Sources: Air Transport Association of America. Air Transport 1989: The Annual Report of the U.S, Scheduled airline Industry; Interstate Commerce Commission, Bureau of Accounts, Transportation Statistics in the United States (for the year ended December 31, 1987); U.S. Department of commerce, Bureau of the Census. 1987 Census of Manufactures, 1982 Census of the Manufactures, 1987 Census of Service Industries.

TABLE 9. NUMBER OF ESTABLISHMENTS, EMPLOYMENT, AND REVENUE FOR THE INDUSTRIES USING DEGREASING EQUIPMENT, 1987

SIC Code	Industry Name	Number of Establish-ments	Employment	Revenue (thousands of $)
254	Partitions and Fixtures	2,459	74,100	$5,537,200
259	Misc. Furniture and Fixtures	2,086	49,900	$3,740,100
	TOTAL	4,545	124,000	$9,277,300
332	Iron and Steel Foundries	1,231	129,800	$10,627,700
335	Nonferrous Rolling and Drawing	1,069	163,000	$33,282,200
336	Nonferrous Foundries (castings)	1,689	79,500	$6,315,000
339	Misc. Primary Metal Products	977	31,800	$2,907,400
	TOTAL	4,966	404,100	$53,132,500
342	Cutlery, Handtools, and Hardware	2,328	145,200	$13,480,600
343	Plumbing and heating, Except Electric	833	45,500	$5,282,700
344	Fabricated Structural Metal Products	12,583	407,200	$40,416,000
345	Screw Machine Products, Bolts, Etc.	2,572	94,700	$7,890,200
346	Metal Forgings and Stampings	4,070	255,300	$28,409,800
347	Metal Services, n.e.c.	5,265	112,600	$7,789,500
348	Ordnance and Accessories, n.e.c.	376	87,600	$7,643,600
349	Misc. Fabricated Metal Products	7,528	261,700	$24,339,900
	TOTAL	35,555	1,409,800	$135,252,400
351	Engines and Turbines	359	86,900	$14,570,400
352	Farm and Garden Machinery	1,799	82,000	$11,474,300
353	Construction and Related Machinery	3,473	188,300	$24,622,300
354	Metalworking Machinery	11,466	267,700	$22,003,500
355	Special Industry Machinery	4,557	169,100	$17,096,100
356	General Industrial Machinery	3,952	240,400	$24,120,500
357	Computer and Office Equipment	2,052	327,700	$60,626,500
358	Refrigeration and Service Machinery	2,105	190,400	$23,234,900
359	Industrial Machinery, n.e.c.	22,348	291,900	$19,921,400
	TOTAL	52,091	1,844,400	$217,669,900
361	Electric Distribution Equipment	760	77,000	$8,196,000
362	Electrical Industrial Apparatus	2,206	165,500	$15,266,300
364	Electric Lighting and Wiring Equipment	1,951	166,600	$1,004,000
366	Communications Equipment	1,506	260,200	$34,000,600
367	Electronic Components and Accessories	5,836	546,400	$50,257,700
369	Misc. Electrical Equipment and Supplies	2,328	188,000	$21,230,300
	TOTAL	14,587	1,403,700	$146,955,700

TABLE 9. (CONTINUED)

SIC Code	Industry Name	Number of Establish-ments	Employment	Revenue (thousands of $)
371	Motor Vehicles and Equipment	4,438	751,400	$205,923,100
372	Aircraft and Parts	1,622	596,000	$77,304,100
376	Guided Missiles, Space Vehicles, Parts	141	213,700	$26,285,200
379	Misc. Transportation Equipment	1,118	49,400	$6,032,800
	TOTAL	7,319	1,610,500	$315,545,200
382	Search and Navigation Equipment	1,064	369,400	$36,26,800
382	Measuring and Controlling Devices	4,168	264,700	$26,042,000
	TOTAL	2,252	654,100	$62,308,800
39	Misc. Manufacturing Industries	16,573	3374,300	$32,012,000
	TOTAL MANUFACTURING	140,888	7,834,900	$972,153,800
401	Railroads - Maintenance	N/A	N/A	$4,338,334
458	Air Transport - Maintenance	N/A	51,233	$6,138,218
753	Auto Repair	114,601	485,566	$20,664,181
	GRAND TOTAL*	255,489	8,361,699	$1,011,295,533

*-Excludes establishment data for SICs 401 and 458 as well as employment data for SIC 401.
Misc. - Miscellaneous.
N/A - Not available.
n.e.c. - Not elsewhere classified.

Sources: Air Transport Association of America. Air Transport 1989; The Annual Report of the U.S. Scheduled Airline Industry; Interstate Commerce Commission, Bureau of Accounts, Transportation Statistics in the United States (for the year ended December 31, 1987); U.S. Department of Commerce, Bureau of the Census. 1987 Census of Manufactures, 1987 Census of the Service Industries.

disaggregate these two statistics by the employment-size class of the establishments in each user industry. In Table 10 the distribution of establishments is addressed. The auto repair industry, SIC 753, had the greatest percentage (98%) of establishments employing zero to 19 employees. In contrast, only 23 percent of the establishments in SIC 376 had 19 or fewer employees. For establishments with 20 to 99 employees, SIC 332, Iron and Steel Foundries, had the highest concentration (39%); only two percent of the establishments in SIC 753 had that number of employees. Finally, 51 percent of the establishments in SIC 376 employed more than 100 people. In SIC 753, no establishments existed which fell into this category.

Table 11 details the distribution of revenue in the user industries by employment-size class. Some data were not disclosed, or were unavailable. In many cases, the user industries had the greatest percentage of revenue being generated by the establishments with the most employees. A marked example of this phenomenon is SIC 372, Aircraft and Parts; 97 percent of this industry's revenue was earned by establishments employing more than 100 people. Exceptions include SICs 347 and 359; establishments with 20 to 99 employees had the most revenue for these two industries.

Table 12 lists the capacity utilization rates for the industries from 1985 to 1988. These utilization rates are practical rates, derived by dividing actual output by the engineering capacity. The trends in each industry vary both by percentage of capacity utilized and in which year the highest utilization rate occurred. SIC 379, Miscellaneous Transportation Equipment, typically had the lowest utilization rates over the four-year period. The highest utilization rates on average were achieved by SIC 342, Cutlery, Handtools, and Hardware.

TABLE 10. DISTRIBUTION OF ESTABLISHMENTS BY EMPLOYMENT-CLASS SIZE FOR THE INDUSTRIES USING DEGREASING EQUIPMENT, 1986

SIC Code	Industry Name	Total Establish-ments	Distribution of Establishments by Employment-Size Class			Percent of Total Establishments		
			1-19	20-99	100+	1-19	20-99	100+
254	Partitions and Fixtures	2,458	1,602	691	165	65%	28%	7%
259	Misc. Furniture and Fixtures	2,086	1,582	392	102	76%	19%	5%
332	Iron and Steel Foundries	1,231	448	480	303	36%	39%	25%
335	Nonferrous Rolling and Drawing	1,069	311	336	422	29%	31%	39%
336	Nonferrous Foundries (castings)	1,689	899	580	210	53%	34%	12%
339	Misc. Primary Metal Products	977	584	352	41	60%	36%	4%
342	Cutlery, Handtools, and Hardware	2,330	1,369	629	332	59%	27%	14%
343	Plumbing and heating, Except Electric	833	511	194	128	61%	23%	15%
344	Fabricated Structural Metal Products	12,585	7,828	3,936	821	62%	31%	7%
345	Screw Machine Products, Bolts, Etc.	2,572	1,466	909	197	57%	35%	8%
346	Metal Forgings and Stampings	4,070	2,129	1,426	515	52%	35%	13%
347	Metal Services, n.e.c.	5,265	3,606	1,502	157	68%	29%	3%
348	Ordnance and Accessories, n.e.c.	376	217	57	102	58%	15%	27%
349	Misc. Fabricated Metal Products	7,530	4,902	2,025	603	65%	27%	8%
351	Engines and Turbines	359	167	92	100	47%	26%	28%
352	Farm and Garden Machinery	1799	1,254	398	147	70%	22%	8%
353	Construction and Related Machinery	3,474	2,057	1,001	416	59%	29%	12%
354	Metalworking Machinery	11,445	8,548	2,465	432	75%	22%	4%
355	Special Industry Machinery	4,557	2,931	1,269	357	64%	28%	8%
356	General Industrial Machinery	3,952	2,047	1,312	593	52%	33%	15%
357	Computer and Office Equipment	2,052	1,113	521	418	54%	25%	20%
358	Refrigeration and Service Machinery	2,104	1,142	552	410	54%	26%	19%
359	Industrial Machinery, n.e.c.	22,346	18,983	3,074	289	85%	14%	1%

TABLE 10. (CONTINUED)

SIC Code	Industry Name	Total Establish-ments	Distribution of Establishments by Employment-Size Class			Percent of Total Establishments		
			1-19	20-99	100+	1-19	20-99	100+
361	Electric Distribution Equipment	760	350	214	196	46%	28%	26%
362	Electrical Industrial Apparatus	2,206	1,295	534	377	59%	24%	17%
364	Electric Lighting and Wiring Equipment	1,951	969	594	388	50%	30%	20%
366	Communications Equipment	1,506	592	509	405	39%	34%	27%
367	Electronic Components and Accessories	5,836	2,955	1,806	1,075	51%	31%	18%
369	Misc. Electrical Equipment and Supplies	2,327	1,374	566	387	59%	24%	17%
371	Motor Vehicles and Equipment	4,438	2,353	1,190	895	53%	27%	20%
372	Aircraft and Parts	1,621	780	459	382	48%	28%	24%
376	Guided Missiles, Space Vehicles, Parts	141	32	37	72	23%	26%	51%
379	Misc. Transportation Equipment	1,118	754	263	101	67%	24%	9%
382	Search and Navigation Equipment	1,064	576	263	245	53%	24%	23%
382	Measuring and Controlling Devices	4,170	2,486	1,096	588	60%	26%	14%
39	Misc. Manufacturing Industries	16,573	12,899	2,961	713	78%	18%	4%
401	Railroads - Maintenance	N/A	N/A	N/A	N/A	N/A	N/A	N/A
458	Air Transport - Maintenance	N/A	N/A	N/A	N/A	N/A	N/A	N/A
753	Auto Repair*	98,930	96,947	1,960	23	96%	2%	0%

* - The establishment data for SIC 753 applies only to establishments that operated the entire year; 15,671 establishments did not operate the entire year.
Misc. - Miscellaneous.
N/A - Not available.
n.e.c. - Not elsewhere classified.

NOTE: The total number of establishments for certain 3-digit SICs may differ from what was reported in Table 9-9 due to rounding errors in the source.

Sources: U.S. Department of Commerce, Bureau of the Census. 1987 Census of Manufactures, 1987 Census of Service Industries.

TABLE 11. DISTRIBUTION OF REVENUE BY EMPLOYMENT-CLASS SIZE FOR THE INDUSTRIES USING DEGREASING EQUIPMENT, 1986

SIC Code	Industry Name	Total Establish-ments	Distribution of Establishments by Employment-Size Class			Percent of Total Revenue (thousands of $)		
			1-19	20-99	100+	1-19	20-99	100+
254	Partitions and Fixtures	$5,536,200	$713,400	$2,076,500	$2,746,400	13%	38%	50%
259	Misc. Furniture and Fixtures	$3,740,100	$513,000	$1,0986,900	$2,131,000	14%	29%	57%
332	Iron and Steel Foundries	$10,627,700	$209,900	ND	ND	2%	ND	ND
335	Nonferrous Rolling and Drawing	$33,282,200	ND	ND	ND	ND	29%	ND
336	Nonferrous Foundries (castings)	$6,315,200	$455,000	$1,825,000	$4,034,400	7%	42%	64%
339	Misc. Primary Metal Products	$2,907,400	$384,100	$1,228,700	$1,294,600	13%		45%
342	Cutlery, Handtools, and Hardware	$13,517,100	$690,300	$2,247,900	$10,578,000	5%	17%	78%
343	Plumbing and heating, Except Electric	$5,282,700	$291,500	$965,900	$4,025,300	6%	18%	76%
344	Fabricated Structural Metal Products	$40,390,600	$4,973,100	$16,348,400	$19,069,100	12%	40%	47%
345	Screw Machine Products, Bolts, Etc.	$7,890,000	$766,600	$3,127,900	$3,995,700	10%	40%	51%
346	Metal Forgings and Stampings	$28,409,800	$1,230,900	$5,893,600	$21,285,300	4%	21%	75%
347	Metal Services, n.e.c.	$7,789,500	$1,367,000	$3,773,500	$2,649,000	18%	48%	34%
348	Ordnance and Accessories, n.e.c.	$7,643,600	ND	$167,800	ND	ND	2%	ND
349	Misc. Fabricated Metal Products	$24,401,100	$2,457,000	$7,658,700	$14,285,400	10%	31%	59%
351	Engines and Turbines	$14,570,400	$109,700	$473,600	$13,987,100	1%	3%	96%
352	Farm and Garden Machinery	$11,474,300	$693,700	$1,434,400	$9,346,200	6%	13%	81%
353	Construction and Related Machinery	$24,627,300	$1,422,500	$4,692,500	$18,512,300	6%	19%	75%
354	Metalworking Machinery	$22,019,300	$3,404,900	$7,761,700	$10,852,700	15%	35%	49%
355	Special Industry Machinery	$17,096,600	$1,547,300	$5,161,700	$10,387,600	9%	30%	61%
356	General Industrial Machinery	$24,120,500	$1,310,000	$5,711,000	$17,099,500	5%	24%	71%
357	Computer and Office Equipment	$60,569,800	ND	$3,254,900	ND	ND	5%	ND
358	Refrigeration and Service Machinery	$23,227,600	$692,500	$2,766,700	$19,768,400	3%	12%	85%
359	Industrial Machinery, n.e.c.	$19,913,600	$5,646,100	$7,254,400	$7,013,100	28%	36%	35%

TABLE 11. (CONTINUED)

SIC Code	Industry Name	Total Establish-ments	Distribution of Establishments by Employment-Size Class			Percent of Total Revenue (thousands of $)		
			1-19	20-99	100+	1-19	20-99	100+
361	Electric Distribution Equipment	$8,196,800	$225,500	$930,000	$7,041,300	3%	11%	86%
362	Electrical Industrial Apparatus	$15,266,300	$635,400	$2,077,900	$12,553,000	4%	14%	82%
364	Electric Lighting and Wiring Equipment	$18,004,000	ND	$2,903,900	ND	ND	16%	ND
366	Communications Equipment	$34,000,700	$354,100	$2,168,000	$31,478,600	1%	6%	93%
367	Electronic Components and Accessories	$50,257,600	$1,296,000	$5,445,900	$43,515,700	3%	11%	87%
369	Misc. Electrical Equipment and Supplies	$21,213,600	ND	$2,154,700	ND	ND	10%	ND
371	Motor Vehicles and Equipment	$205,861,900	$1,690,300	$5,849,700	$198,321,900	1%	3%	ND
372	Aircraft and Parts	$77,278,200	$400,900	$1,760,800	$75,116,300	1%	2%	97%
376	Guided Missiles, Space Vehicles, Parts	$28,265,100	ND	ND	ND	ND	ND	ND
379	Misc. Transportation Equipment	$6,032,700	$383,400	$1,069,600	$4,579,700	6%	18%	76%
382	Search and Navigation Equipment	$36,266,800	$261,700	$856,100	$35,149,000	1%	2%	97%
382	Measuring and Controlling Devices	$26,042,700	$1,283,000	$4236,600	$20,523,100	5%	16%	79%
39	Misc. Manufacturing Industries	$32,012,000	ND	ND	ND	ND	ND	ND
401	Railroads - Maintenance	N/A	N/A	N/A	N/A	N/A	N/A	N/A
458	Air Transport - Maintenance	N/A	N/A	N/A	N/A	N/A	N/A	N/A
753	Auto Repair*	$27,308,159	$23,750,770	$3,358,444	$198,945	87%	12%	1%

* - The revenue establishment data for SIC 753 applies only to establishments that operated the entire year; 15,671 establishments that did not operate year-round generated revenue of $1,356,022,000.

Misc. - Miscellaneous.
N/A - Not available.
ND - Not disclosed (in order to avoid reporting data for individual companies).
n.e.c. - Not elsewhere classified.

NOTE: The revenue figures may differ from those in Table 9-9 because certain revenue data was not disclosed, thus not included for certain SICs.

Sources: U.S. Department of Commerce, Bureau of the Census. 1987 Census of Manufactures, 1987 Census of Service Industries.

TABLE 12. CAPACITY UTILIZATION RATES FOR THE INDUSTRIES USING DEGREASING EQUIPMENT, 1985-1988 (FROM THE FOURTH QUARTER OF EACH YEAR)

SIC Code	Industry Name	1988	1987	1986	1985
254	Partitions and Fixtures	65%	63%	62%	57%
259	Misc. Furniture and Fixtures	78%	78%	74%	66%
332	Iron and Steel Foundries	83%	765	685	66%
335	Nonferrous Rolling and Drawing	77%	76%	69%	66%
336	Nonferrous Foundries (castings)	74%	54%	68%	64%
339	Misc. Primary Metal Products	82%	77%	60%	65%
342	Cutlery, Handtools, and Hardware	77%	75%	80%	77%
343	Plumbing and Heating, Except Electric	78%	77%	74%	71%
344	Fabricated Structural Metal Products	66%	65%	62%	64%
345	Screw Machine Products, Bolts, Etc.	73%	74%	69%	73%
346	Metal Forgings and Stampings	45%	73%	48%	70%
347	Metal Services, n.e.c.	61%	45%	54%	51%
348	Ordnance and Accessories, n.e.c.	66%	57%	59%	52%
349	Misc. Fabricated Metal Products		65%		60%
351	Engines and Turbines	60%	56%	53%	57%
352	Farm and Garden Machinery	56%	51%	30%	42%
353	Construction and Related Machinery	58%	56%	41%	51%
354	Metalworking Machinery	76%	65%	63%	68%
355	Special Industry Machinery	71%	61%	56%	50%
356	General Industrial Machinery	68%	60%	56%	56%
357	Computer and Office Equipment	67%	65%	62%	66%
358	Refrigeration and Service Machinery	67%	68%	65%	66%
359	Industrial Machinery, n.e.c.	70%	73%	65%	64%
361	Electric Distribution Equipment	77%	70%	69%	67%
362	Electrical Industrial Apparatus	61%	55%	55%	57%
364	Electric Lighting and Wiring Equipment	64%	66%	64%	65%
366	Communications Equipment	68%	68%	73%	71%
367	Electronic Components and Accessories	72%	69%	63%	62%
369	Misc. Electrical Equipment and Supplies	65%	69%	69%	69%

TABLE 12. (CONTINUED)

SIC Code	Industry Name	1988	1987	1986	1985
371	Motor Vehicles and Equipment	81%	77%	74%	76%
372	Aircraft and Parts	63%	66%	70%	63%
376	Guided Missiles, Space Vehicles, Parts	60%	64%	64%	60%
379	Misc. Transportation Equipment	38%	25%	48%	N/A
381	Search and Navigation Equipment	N/A	N/A	N/A	N/A
382	Measuring and Controlling Devices	59%	57%	59%	61%
39	Misc. Manufacturing Industries	61%	58%	59%	63%
401	Railroads - Maintenance	N/A	N/A	N/A	N/A
458	Air Transport - Maintenance	N/A	N/A	N/A	N/A
753	Auto Repair	N/A	N/A	N/A	N/A

Misc. - Miscellaneous.
N/A - Not available.
n.e.c. - Not elsewhere classified.

Sources: U.S. Department of Commerce, Bureau of the Census. Current Industrial Reports, 1988.

Exports, imports, and the balance of trade for each user industry are listed in Table 13. SIC 371, Motor Vehicles and Equipment, had a trade deficit of -$47.5 billion, the largest of any of the 39 industries. The largest trade surplus was $25.3 billion in SIC 372, Aircraft and Parts.

This industry's exports as a percentage of revenue, 42 percent, is the highest among the user industries (Table 14). At the other extreme, less than one percent of SIC 376's revenue came from exports.

Profitability data are not available at the 3-digit SIC level. Therefore, Table 15 lists the average after-tax income of the two-digit categories in which the user industries in manufacturing are contained. SIC industries 401, 458, and 753 are the only exceptions. The profitability data are survey data taken from Dun and Bradstreet's Industry Norms and Key Business Ratios as well as the Bureau of the Census' Quarterly Financial Report. For SICs 33 through 38 the average income after taxes is the average of the sum of quarterly ratios for 1990. The average income after taxes for each four-digit industry comprising SICs 25 and 753 were averaged to come up with a ratio for the two industries. The profitability ratios ranged from 6.6 percent in SIC 38, Instruments and Related Products, to 1.3 percent in SIC 37, Transportation Equipment.

Output forecasts for industries using degreasing equipment are presented in Table 16.[32] Average annual rates between 1992 and 1997 range from 0.39 percent in SIC 348, Ordnance and Accessories, n.e.c. to 9.64 percent in SIC 357, Computer and Office Equipment.

The growth rates in output underscore the diversity of industries engaged in degreasing operations. For

TABLE 13. EXPORT AND IMPORT DATA FOR THE INDUSTRIES USING DEGREASING EQUIPMENT, 1990

SIC Code	Industry Name	Exports (thousands of $)	Imports (thousands of $)	Balance of Trade (thousands of $)
254	Partitions and Fixtures	N/A	N/A	N/A
259	Misc. Furniture and Fixtures	$1,555,277	$5,198,877	($3,643,600)
332	Iron and Steel Foundries	$127,326	$66,436	$60,890
335	Nonferrous Rolling and Drawing	$4,882,688	$5,363,098	($480,410)
336	Nonferrous Foundries (castings)	$38,619	$33,258	$5,361
339	Misc. Primary Metal Products	N/A	$179,323	N/A
342	Cutlery, Handtools, and Hardware	$1,592,208	$2,402,174	($809,966)
343	Plumbing and Heating, Except Electric	$293,092	$268,264	$24,828
344	Fabricated Structural Metal Products	$1,163,891	$623,214	$540,677
345	Screw Machine Products, Bolts, Etc.	$624,009	$1,214,411	($590,402)
346	Metal Forgings and Stampings	$1,666,065	$907,372	$758,693
347	Metal Services, n.e.c.	N/A	N/A	N/A
348	Ordnance and Accessories, n.e.c.	$2,334,571	$455,962	$1,878,609
349	Misc. Fabricated Metal Products	$3,239,537	$5,575,075	$2,335,538)
351	Engines and Turbines	$3,608,607	$2,190,853	$1,417,754
352	Farm and Garden Machinery	$4,076,108	$2,742,288	$1,333,820
353	Construction and Related Machinery	$8,675,280	$5,083,557	$3,591,733
354	Metalworking Machinery	$4,057,410	$5,525,119	($1,467,709)
355	Special Industry Machinery	$5,230,157	$5,938,599	($708,442)
356	General Industrial Machinery	$6,847,222	$6,103,753	$743,469
357	Computer and Office Equipment	$23,007,309	$23,619,036	($611,727)
358	Refrigeration and Service Machinery	$3,838,240	$2,067,201	$1,771,039
359	Industrial Machinery, n.e.c.	$1,888,477	$1,742,022	$146,455

TABLE 13. (CONTINUED)

SIC Code	Industry Name	Exports (thousands of $)	Imports (thousands of $)	Balance of Trade (thousands of $)
361	Electric Distribution Equipment	$504,698	$790,454	($285,756)
362	Electrical Industrial Apparatus	$2,507,330	$3,238,628	($731,298)
364	Electric Lighting and Wiring Equipment	$3,928,489	$4,709,896	($781,407)
366	Communications Equipment	$5,115,295	$8,561,495	($3,446,200)
367	Electronic Components and Accessories	N/A	$19,805,200	N/A
369	Misc. Electrical Equipment and Supplies	$4,657,088	$4,325,838	$331,250
371	Motor Vehicles and Equipment	$28,503,900	$75,988,723	($47,484,823)
372	Aircraft and Parts	$36,479,978	$11,227,386	$25,252,592
376	Guided Missiles, Space Vehicles, Parts	$50,047	$4,984	$45,063
379	Misc. Transportation Equipment	$973,225	$249,621	$723,604
381	Search and Navigation Equipment	$2,062,258	$830,122	$1,232,136
382	Measuring and Controlling Devices	$7,725,884	$4,239,526	$3,486,358
39	Misc. Manufacturing Industries	$4,295,835	$20,090,473	($15,794,638)
401	Railroads - Maintenance	N/A	N/A	N/A
458	Air Transport - Maintenance	N/A	N/A	N/A
753	Auto Repair	N/A	N/A	N/A

Misc. - Miscellaneous.
N/A - Not available.
n.e.c. - Not elsewhere classified.

Sources: U.S. Department of Commerce, Bureau of the Census, Foreign Trade Division. Reports EM 575 and IM 175, 1990.

TABLE 14. EXPORTS AS A PERCENTAGE OF REVENUE FOR THE INDUSTRIES USING DEGREASING EQUIPMENT, 1990

SIC Code	Industry Name	Exports (thousands of $)	Revenue (thousands of 1990 $)	Exports As a Percentage of Revenue
254	Partitions and Fixtures	N/A	$6,201,664	N/A
259	Misc. Furniture and Fixtures	$1,555,277	$4,188,912	37%
332	Iron and Steel Foundries	$127,326	$11,903,024	1%
335	Nonferrous Rolling and Drawing	$4,882,688	$37,276,064	13%
336	Nonferrous Foundries (castings)	$38,619	$7,073,024	1%
339	Misc. Primary Metal Products	N/A	$3,256,288	N/A
342	Cutlery, Handtools, and Hardware	$1,592,208	$15,098,272	11%
343	Plumbing and Heating, Except Electric	$293,092	$5,916,624	5%
344	Fabricated Structural Metal Products	$1,163,891	$45,266,032	3%
345	Screw Machine Products, Bolts, Etc.	$624,009	$8,837,024	7%
346	Metal Forgings and Stampings	$1,666,065	$31,818,976	5%
347	Metal Services, n.e.c.	N/A	$8,724,240	N/A
348	Ordnance and Accessories, n.e.c.	$2,334,571	$8,560,832	27%
349	Misc. Fabricated Metal Products	$3,239,537	$27,260,688	12%
351	Engines and Turbines	$3,608,607	$16,318,848	22%
352	Farm and Garden Machinery	$4,076,108	$12,851,216	32%
353	Construction and Related Machinery	$8,675,290	$27,576,976	31%
354	Metalworking Machinery	$4,057,410	$24,643,920	16%
355	Special Industry Machinery	$5,230,157	$19,147,632	27%
356	General Industrial Machinery	$6,847,222	$27,014,960	25%
357	Computer and Office Equipment	$23,007,309	$67,901,680	34%
358	Refrigeration and Service Machinery	$3,838,240	$26,023,088	15%
359	Industrial Machinery, n.e.c.	$1,888,477	$22,311,968	8%
361	Electric Distribution Equipment	$504,698	$9,180,416	5%
362	Electrical Industrial Apparatus	$2,507,330	$17,098,256	15%
364	Electric Lighting and Wiring Equipment	$3,928,489	$20,164,480	19%
366	Communications Equipment	$5,115,295	$38,080,672	13%
367	Electronic Components and Accessories	N/A	$56,288,624	N/A
369	Misc. Electrical Equipment and Supplies	$4,657,088	$23,777,936	20%

TABLE 14. (CONTINUED)

SIC Code	Industry Name	Exports (thousands of $)	Revenue (thousands of 1990 $)	Exports As a Percentage of Revenue
371	Motor Vehicles and Equipment	$28,503,900	$230,633,872	12%
372	Aircraft and Parts	$36,479,978	$86,580,592	42%
376	Guided Missiles, Space Vehicles, Parts	$50,047	$29,439,424	0%
379	Misc. Transportation Equipment	$973,225	$6,756,736	14%
381	Search and Navigation Equipment	$2,062,258	$40,618,816	5%
382	Measuring and Controlling Devices	$7,725,884	$29,167,040	26%
39	Misc. Manufacturing Industries	$4,295,835	$35,853,440	12%
401	Railroads - Maintenance	N/A	$4,858,934	N/A
458	Air Transport - Maintenance	N/A	$6,874,804	N/A
753	Auto Repair	N/A	$32,103,883	N/A

Misc. - Miscellaneous.
N/A - Not available.
n.e.c. - Not elsewhere classified.

Sources: Air Transport Association of America. Air Transport 1989: The Annual Report of the U.S. Scheduled Airline Industry; Interstate Commerce Commission, Bureau of Accounts, Transportation Statistics in the United States (for the year ended December 31, 1987); U.S. Department of Commerce, Bureau of the Census. 1987 Census of Manufactures, 1987 Census of the Service Industries.

TABLE 15. AVERAGE AFTER-TAX PROFIT MARGIN IN THE INDUSTRIES USING DEGREASING EQUIPMENT: 1990

SIC Code	Industry Name	Average After-Tax Profit Margin
25	Furniture and Fixtures	4.8%
33	Primary Metals Industries	2.6%
34	Fabricated Metal Products	3.4%
35	Industrial Machinery and Equipment	4.4%
36	Electronic and Other Electric Equipment	3.0%
37	Transportation Equipment	1.3%
38	Instruments and Related Products	6.6%
39	Misc. Manufacturing Industries	N.A
401	Railroads - Maintenance	N/A
458	Air Transport - Maintenance	N/A
753	Auto Repair	6.0%

Misc. - Miscellaneous.
N/A - Not available.

Sources: Dun and Bradstreet Information Services. Industry Norms & Key Business Ratios 1990-1991; U.S. Department of Commerce, Bureau of the Census. Quarterly Financial Report, First Quarter 1991.

TABLE 16. OUTPUT FORECASTS OF INDUSTRIES USING DEGREASING EQUIPMENT

SIC Code	Industry Name	Percent Change From Previous Year								Average Annual Growth 1992-1997
		1990*	1991	1992	1993	1994	1995	1996	1997	
254	Partitions and Fixtures	0.98	-5.50	9.31	5.58	5.23	3.90	2.91	3.29	4.18
259	Misc. Furniture and Fixtures	0.98	-5.50	9.31	5.58	5.23	3.90	2.91	3.29	4.18
332	Iron and Steel Foundries	-9.00	-8.79	3.72	2.00	0.08	0.70	0.52	1.43	0.94
335	Nonferrous Rolling and Drawing	-4.14	-2.77	11.89	4.14	4.31	2.34	2.22	2.81	3.16
336	Nonferrous Foundries (castings)	3.17	-2.77	11.89	4.14	4.31	2.34	2.22	2.18	3.16
339	Misc. Primary Metal Products	-0.87	-6.69	3.60	3.81	4.20	2.33	2.24	2.73	3.06
342	Cutlery, Handtools, and Hardware	3.71	-5.27	9.07	3.88	4.36	2.76	1.52	2.29	2.96
343	Plumbing and Heating, Except Electric	0.35	-2.42	6.09	3.08	3.88	2.36	1.74	1.99	2.61
344	Fabricated Structural Metal Products	-3.49	-5.98	2.91	1.66	3.26	3.79	3.64	3.44	3.15
345	Screw Machine Products, Bolts, Etc.	-1.99	-6.10	9.60	4.36	4.07	1.90	1.29	1.60	2.64
346	Metal Forgings and Stampings	-1.99	-6.10	9.60	4.36	4.07	1.90	1.29	1.60	2.64
347	Metal Services, n.e.c.	-1.99	-6.10	9.60	4.36	4.07	1.90	1.29	1.60	2.64
348	Ordnance and Accessories, n.e.c.	-4.63	-4.72	-0.35	-0.41	1.25	0.06	0.40	0.68	0.39
349	Misc. Fabricated Metal Products	0.35	-2.42	6.09	3.08	3.88	2.36	1.74	1.99	2.61
351	Engines and Turbines	3.02	-3.12	2.93	4.91	4.15	2.94	2.47	2.05	3.30
352	Farm and Garden Machinery	7.99	-1.94	5.97	3.95	4.00	2.75	2.02	2.16	2.97
353	Construction and Related Machinery	-1.48	-3.49	6.19	6.06	5.76	4.60	3.46	3.40	4.65
354	Metalworking Machinery	1.90	-1.32	11.04	6.98	6.51	5.36	4.16	4.66	5.53
355	Special Industry Machinery	2.51	-7.76	7.23	7.11	7.21	4.95	3.87	3.48	5.31
356	General Industrial Machinery	3.21	-6.53	5.35	5.76	5.42	4.40	4.27	3.72	4.71
357	Computer and Office Equipment	9.12	4.22	10.59	12.45	11.78	8.92	7.44	7.71	9.64
358	Refrigeration and Service Machinery	-2.77	-3.04	7.42	5.95	4.49	3.19	3.37	3.03	4.00
359	Industrial Machinery, n.e.c.	3.60	-5.29	3.41	3.27	4.75	4.16	4.08	3.08	3.87

TABLE 16. (CONTINUED)

SIC Code	Industry Name	Percent Change From Previous Year								Average Annual Growth 1992-1997
		1990*	1991	1992	1993	1994	1995	1996	1997	
361	Electric Distribution Equipment	-0.92	-7.70	6.48	5.14	5.42	3.74	2.51	2.17	3.79
362	Electrical Industrial Apparatus	-0.92	-7.70	6.48	5.14	5.42	3.74	2.51	2.17	3.79
364	Electric Lighting and Wiring Equipment	1.05	-4.38	8.82	3.68	3.72	2.11	1.59	1.46	2.50
366	Communications Equipment	3.20	3.11	6.75	8.76	6.50	4.31	4.16	4.19	5.57
367	Electronic Components and Accessories	4.80	2.16	10.63	10.31	12.00	7.96	5.78	6.33	8.45
369	Misc. Electrical Equipment and Supplies	-3.28	-4.14	9.28	4.31	4.24	3.40	3.23	2.83	3.60
371	Motor Vehicles and Equipment	-7.46	-5.04	15.07	5.01	4.97	1.51	1.63	0.50	2.71
372	Aircraft and Parts	3.93	-4.21	2.71	2.31	1.31	2.36	2.96	3.65	2.48
376	Guided Missiles, Space Vehicles, Parts	2.81	-3.04	5.50	1.81	1.21	3.20	3.26	2.64	2.42
379	Misc. Transportation Equipment	2.81	-3.04	5.50	1.81	1.21	3.20	3.26	2.64	2.42
381	Search and Navigation Equipment	2.20	0.47	5.62	5.29	5.65	4.44	4.29	4.27	4.78
382	Measuring and Controlling Devices	2.20	0.47	5.62	5.29	5.65	4.44	4.29	4.27	4.78
39	Misc. Manufacturing Industries	4.20	-1.19	4.37	2.16	3.13	3.74	3.88	3.91	3.36
401	Railroads - Maintenance	0.42	-1.99	5.26	3.80	2.89	3.12	2.34	2.13	2.85
458	Air Transport - Maintenance	2.99	0.74	3.91	4.56	4.77	4.73	4.29	4.26	4.52
753	Auto Repair	3.89	2.21	2.96	2.65	2.78	2.87	2.82	2.75	2.77

*Actual

Notes on Forecasts
(a) Forecasts for SIC 254 and SIC 259 are combined.
(b) Forecasts for SIC 335 and SIC 336 are combined.
(c) Forecasts for SIC 339 are grouped with forecasts for SIC 334 (Secondary Smelting and Refining of Nonferrous Metals).
(d) Forecasts for SIC 343 and SIC 349 are combined.
(e) Forecasts for SIC 345, SIC 346 and SIC 347 are combined.
(f) Forecasts for SIC 361 and SIC 362 are combined.
(g) Forecasts for SIC 376 and SIC 379 are combined, and are grouped with Forecasts for SIC 375 (Motorcycles, Bicycles, and Parts).
(h) Forecasts for SIC 381 and SIC 382 are combined.
(i) This is a combined forecast for the major group SIC 40 (Railroad Transportation), SIC 474 (Rental of Railroad Cars) and SIC 4789 (Transportation Services, n.e.c.).

Misc. - Miscellaneous.
n.e.c. - Not elsewhere classified.
Source: Forecasts provided by Wharton Econometric Forecasting Associates, Bala Cynwyd, PA.

example, the range of annual averages in SIC 33, (Primary Metals Industry, SIC 34, Fabricated Metal Products, except Machinery and Transportation Equipment), and SIC 35 (Industrial and Commercial Machinery and Computer Equipment), is 0.94 percent to 3.16 percent, 0.39 percent to 3.15 percent, and 2.97 percent to 9.64 percent.

Industries with exceptionally high average growth rates are SIC 357 Electronic Components and Accessories, with a rate of 9.64 percent, and SIC 367, with a rate of 8.45 percent. Those with very low growth rates are SIC 332 Iron and Steel Foundries, with a rate of 0.94 percent, and SIC 348, Ordnance and Accessories, n.e.c., with a rate of 0.39 percent.

1.5 Automotive Repair Industry

Almost 50 percent of the establishments identified as users of degreasing equipment is accounted for by SIC 753, Automotive Repair Shops. The industry ranks fifth-highest in terms of employment. For these two reasons and the fact that auto repair shops are labor-intensive, low-margin operations, it may be that firms in this industry will experience disproportionate economic impacts. Thus, it necessary to profile the industry in order to assess the magnitude of the impacts resulting from the NESHAP.

SIC 753 is a heterogenous industry consisting of seven four-digit SIC industries. These industries are Top, Body, and Upholstery Repair Shops and Paint Shop (SIC 7532), Automotive Exhaust System Repair Shops (SIC 7533), Tire Retreading and Repair Shops (SIC 7534), Automotive Glass Replacement Shops (SIC 7536), Automotive Transmission Repair Shops (SIC 7537), General Automotive Repair Shops (SIC 7538), and Automotive Repair Shops, Not Elsewhere Classified (SIC 7539). Statistics concerning all seven four-digit industries are presented in Tables 17 through 20.

TABLE 18. LEGAL FORMS OF FIRMS IN SIC 753, 1987

SIC Code	Industry Name	Total Number of Firms	Corporations[a]	Individual Proprietorships[b]	Partnerships[c]	Other
7532	Top, Body, and Upholstery Repair Shops and Paint Shops	32,233	13,380	16,595	2,234	24
7533	Automotive Exhaust System Repair Shops	3,654	2,185	1,230	235	4
7534	Tire Retreading and Repair Shops	1,763	1,083	578	101	1
7536	Automotive Glass and Replacement Shops	2,510	1,333	996	180	1
7537	Automotive Transmission Repair Shops	6,131	3,156	2,578	395	2
7538	General Automotive Repair Shops	54,419	21,225	29,094	4,056	44

TABLE 18. (CONTINUED)

SIC Code	Industry Name	Total Number of Firms	Corporations[a]	Individual Proprietorships[b]	Partnerships[c]	Other
7539	Automotive Repair Shops, Not Elsewhere Classified	9,229	4,303	4,271	655	0
753	Automotive Repair Shops	109,939	46,665	55,342	7,856	76

[a]Corporations are business firms that have the legal status of a fictional individual, which is owned by stockholders, and run by a set of elected officers and a board of directors.
[b]Proprietorships are business firms owned by a single person.
[c]Partnerships are business firms whose ownership is shared by a fixed number of proprietors.

Source: U.S. Department of Commerce, Bureau of the Census. 1987 Census of Service Industries.

TABLE 19. DISTRIBUTION OF EMPLOYMENT IN SIC 753 BY FOUR-DIGIT INDUSTRIES, 1987

SIC Code	Industry Name	Employment (10^3)	Average Number of Employees Per Establishment[a]
7532	Top, Body, and Upholstery Repair Shops and Paint Shops	162.8	5
7533	Automotive Exhaust System Repair Shops	21.7	4
7534	Tire Retreading and Repair Shops	13.8	7
7536	Automotive Glass Replacement Shops	18.1	5
7537	Automotive Transmission Repair Shops	26.3	4
7538	General Automotive Repair Shops	202.6	4
7539	Automotive Repair Shops, Not Elsewhere Classified	40.3	4
753	Automotive Repair Shops	485.6	4

[a]Approximation.

Sources: Gale Research, Inc. Service Industries USA. Detroit, MI, 1992; U.S. Department of Commerce, Bureau of the Census. 1987 Census of Service Industries.

TABLE 20. DISTRIBUTION OF REVENUE IN SIC 753 BY FOUR-DIGIT INDUSTRIES, 1987

SIC Code	Industry Name	Revenue ($10^6$$)	Average Revenue Per Establishment ($)
7532	Top, Body, and Upholstery Repair Shops and Paint Shops	9,312.3	282,611
7533	Automotive Exhaust System Repair Shops	1,466.8	298,737
7534	Tire Retreading and Repair Shops	1,104.0	572,021
7536	Automotive Glass Replacement Shops	1,278.0	361,630
7537	Automotive Transmission Repair Shops	1,394.0	220,047
7538	General Automotive Repair Shops	11,872.5	214,506
7539	Automotive Repair Shops, Not Elsewhere Classified	2,236.7	233,160
753	Automotive Repair Shops	28,664.2	250,122

Sources: Gale Research Inc. Service Industry Analysis. Detroit, MI, 1992; U.S. Department of Commerce, Bureau of the Census. 1987 Census of Service Industries.

automotive aftermarket. The aftermarket consists of part-producing firms and outlets that service and repair the more than 180 million vehicles in the U.S. in 1992.[33] Data for all three industries are presented in Tables 21 through 9-24.

In Table 21, the number of establishments and firms in each industry is shown. The 114,601 automotive repair shops accounted for 58.9 percent of all establishments in the three industries in 1987. These establishments were owned by 109,939 firms. SIC 551 accounted for 14.6 percent of all establishments and SIC 554 26.5 percent.

The various legal forms of firms in the three industries are listed in Table 22. The majority of gasoline service stations and automotive repair shops were individual proprietorships. Eighty-eight percent of motor vehicle dealers were corporations. For SICs 554 and 753, corporations accounted for 33.7 percent and 42.4 percent of all firms.

As can be seen in Table 23, SIC 551 employed, approximately 1.9 times more personnel than SIC 753 in 1987; it employed 3.1 times more than SIC 554. These differences in part account for the larger average number of employees in SIC 551 in comparison to the other two industries.

Motor vehicle dealers also had much higher revenues in 1987 than the other two automotive service sectors (Table 24). In that year, revenue for SIC 551 was $280,529.2 million. It is important to note, however, that much of this revenue is attributable to motor vehicle sales. It is not known what percentage was accounted for by service operations. The same is true of gasoline service stations which derive income from gasoline sales.

More recent data concerning the average repair and service dollar volume earned in 1990 by selected parts of

TABLE 21. NUMBER OF ESTABLISHMENTS AND FIRMS IN SICS 551, 554, AND 753, 1987

SIC Code	Industry Name	Establishments	Firms
551	Motor Vehicle Dealers (New and Used)	28,320	26,997
554	Gasoline Service Stations	51,682[a]	N/A
753	Automotive Repair Shops	114,601	109,939
	Total	194,603	N/A

[a]Includes only those establishments with automotive service bays. These establishments account for approximately 45 percent of the total number of gasoline service stations (114,748).

N/A - Not available.

Sources: U.S. Department of Commerce, Bureau of the Census. 1987 Census of Retail Trade, 1987 Census of Service Industries.

TABLE 22. LEGAL FORMS OF FIRMS IN SICS 551, 554, AND 753, 1987

SIC Code	Industry Name	Total Number of Firms	Corporations[a]	Individual Proprietorships[b]	Partnerships[c]	Other
551	Motor Vehicle Dealers (New and Used)	26,997	23,626	2,365	660	346
554	Gasoline Service Stations	76,041*	25,632*	44,141*	5,570*	698*
753	Automotive Repair Shops	109,939	46,665	55,342	7,856	76
	Total	212,977	95,923	101,848	14,086	1,120

*These figures apply to all establishments in SIC 554, regardless of whether or not they have an automotive service bay.

[a]Corporations are business firms that have the legal status of a fictional individual, which is owned by stockholders, and run by a set of elected officers and a board of directors.

[b]Proprietorships are business firms owned by a single person.

[c]Partnerships are business firms whose owenrship is shared by a fixed number of proprietors.

Sources: U.S. Department of Commerce, Bureau of the Census. 1987 Census of Retail Trade, 1987 Census of Service Industries.

TABLE 23. EMPLOYMENT STATISTICS FOR SICS 551, 554 and 753, 1987

SIC Code	Industry Name	Employment (10^3)	Average Number of Employees Per Establishment[a]
551	Motor Vehicle Dealers (New and Used)	939.9	33
554	Gasoline Service Stations	307.2[a]	6[a]
753	Auto Repair Shops	485.6	4
	Total	2,172.2	

[a]These figures apply only to those gasoline service stations with automotive service bays.

Sources: U.S. Department of Commerce, Bureau of the Census. 1987 Census of Retail Trade, 1987 Census of Service Industries.

TABLE 24. REVENUE STATISTICS FOR SICS 551, 554 and 753, 1987

SIC Code	Industry Name	Revenue (10^6)	Average Revenue Per Establishment ($)
551	Motor Vehicle Dealers (New and Used)	280,529.2[a]	9,905,692[a]
554	Gasoline Service Stations	37,939.1[a,b]	734,087[a,b]
753	Auto Repair Shops	28,664.2	250,122

[a]Not all revenue is attributable to motor vehicle servicing.
[b]These figures apply only to those gasoline service stations with automotive service bays.

Sources: U.S. Department of Commerce, Bureau of the Census. 1987 Census of Retail Trade, 1987 Census of Service Industries.

TABLE 25. AVERAGE ANNUAL REPAIR AND SERVICE DOLLAR VOLUME AND AVERAGE NUMBER OF BAYS FOR SELECTED AUTOMOTIVE SERVICE INDUSTRIES

Industry	Average Annual Repair and Service Dollar Volume, 1990	Average Number of Bays, 1990
Repair Shops	300,000	5.2
Service Stations	151,000	2.8
Body Shops	359,000	8.8
Car/Truck Dealerships	1,640,000	17.2
Tire Dealers	195,000	3.9

Source: Service Station Management. October 1990, pp. 1-TAP - 34-TAP.

the service industry are contained in Table 9-25. Car/Truck Dealerships earned more than four times the service revenue of the second ranked industry, Body Shops. They almost had twice as many service bays on average as body shops. Repair shops, tire dealers, and service stations were ranked third, fourth, and fifth, respectively.

These statistics, however, do not address the market share controlled by each automotive service industry. The market share controlled by each industry is a function of both average revenue per establishment and the number of establishments in an industry. It should also be noted that some consumers do their own maintenance work. Standard and Poor's Corporation reported total service market shares for 1990 using a slightly different format for describing the industries. General and Specialty Repair Shops controlled 28 percent of the market, Service Stations 27 percent, New Car Dealers 21 percent, Auto Discount and Department Stores, 16 percent, and Tire Stores 8 percent.[34] So while the Car/Truck Dealership industry earns much more service revenue on average, it ranks only third in market share because it has less establishments than the other industries.

The automotive repair industry's output growth has historically followed the trend for the overall economy.[35] Factors influencing the industry's output include changes in disposable income, the number of miles driven, and the quality and durability of vehicles and their parts. Conventional wisdom holds that fewer vehicle sales result in increased aftermarket sales because consumers spend more on repair instead of new cars.[36] However, as the economy contracts, disposable income declines. Thus, consumers tend to delay scheduled and discretionary maintenance. This lengthening of the "repair cycle" has the effect of reducing the total number of service establishments.[37]

The aforementioned factors caused the growth in aftermarket sales to fall in 1991.[38] Many people delayed maintenance work due to the economic downturn. At the same time, there was a decline in the growth rate of the number of miles driven in 1991. However, the aftermarket is expected to return to its average annual growth rate of about two percent; the demand for scheduled repairs and maintenance is expected to improve.[39]

Beyond these business cycle effects, average annual growth in the aftermarket has slowed since 1980.[40] Three factors have contributed to this decline:

- A greater number of new vehicles are on the road, as the number of vehicles scrapped annually has been increasing.
- Original parts are increasingly well-designed and engineered, and are lasting longer.
- Specific diagnostic technologies more accurate;u identify parts that are likely to fail, reducing the practice of routine parts replacement.

Thus, average annual growth is not expected to exceed two percent in the 1990s.

The single largest growth potential for the aftermarket products and services is the "untapped" aftermarket according to the Motor and Equipment Manufacturers Association (MEMA).[41] The "untapped" market represents unperformed maintenance. Currently, it is estimated that $47.4 billion is the size of this market. Making consumers aware of the need for preventive vehicle maintenance should help open the market. However, this phenomonon has existed for decades, and cannot be expected to significantly alter growth rates in the industry.[42]

4.0 REFERENCES

1. U.S. Environmental Protection Agency. Alternative Control Technology Document-Halogenated Solvent Cleaners, Research Triangle Park, NC, August 1989, p. 2-1.

2. Reference 1, p. 3-23.

3. Reference 1, p. 3-23.

4. Reference 1, p. 3-3.

5. Reference 4.

6. Reference 1, p. 3-13.

7. Reference 6.

8. Reference 6.

9. Executive Office of the President, Office of Management and Budget. Standard Industrial Classification Manual, 1987, p. 211.

10. U.S. Environmental Protection Agency. "Profile for the Degreasing NSPS and NESHAP," EPA 68-02-4320, Number 22, April 13, 1987, pp. 9-36 - 9-37.

11. Reference 4.

12. Reference 1, p. 3-1.

13. Reference 9, p. 140.

14. Chemical Marketing Reporter, Chemical Profiles from: January 23, 1989, February 6, 1989, July 1, 1989, July 8, 1989.

15. Mannsville Chemical Products Corporation, "Chemical Products Synopsis-Trichloroethylene," February, 1989.

16. "Chemical Profile -- Trichloroethylene." Chemical Marketing Reporter, July 1, 1989.

17. "U.S. Regs Catalyze Changes in Solvents." Chemical Marketing Reporter, January 21, 1991, p. 5.

18. Reference 16.

19. Reference 17.

20. "The Recycling Loop Closes For Solvents." Chemical Engineering, June 1991, p. 43.

21. Reference 18.

22. Reference 18.

23. Reference 18.

24. Reference 1, p. 4-66.

25. Chemical Marketing Reporter, January 27, 1992.

26. Chemical Marketing Reporter, February 3, 1992.

27. Chemical Marketing Reporter, March 2, 1992.

28. Chemical Marketing Reporter, January 20, 1992.

29. U.S. Environmental Protection Agency. Organic Solvent Cleaners-Background Information for Proposed Standards, Research Triangle Park, NC, October 1979.

30. "U.S. Industrial Analysis Service," Wharton Econometric Forecasting Associates. Growth rate data are in the form of indices of industrial output. The average annual growth rate is compounded. These forecasts were revised in mid-September, 1991.

31. U.S. Department of Commerce, International Trade Administration. U.S. Industrial Outlook 1992, Washington, D.C. p. 36-17.

32. Standard and Poor's Corp. Industry Surveys "Auto-Auto Parts -- Basic Analysis." New York, NY, January 30, 1992, p. A95.

33. Monthly Labor Review. "Productivity in Automotive Repair Shops". March 1988 p. 23.

34. Reference 33.

35. Reference 33.

36. Reference 33.

37. Reference 33, p. 36-19.

38. Reference 33.

39. Reference 33.

40. Telecon. Holmes, C., JACA Corp., with Reiss, D., Motor and Equipment Manufacturers Association. April 20, 1992. Discussion of the aftermarket industry.

41. Suprenant, K.S. and D.W. Richards, Dow Chemical Company. Study to Support New Source Performance Standards for Solvent Metal Cleaning Operations. Prepared for U.S. Environmental Protection Agency. Research Triangle Park, NC. Contract No. 68-02-1329, Task Order No. 9. June 1976.

42. Reference 43.

43. Confidential report on chlorinated solvents. Prepared for U.S. Environmental Protection Agency. Washington, DC. Contract No. 68-02-4235. March 13, 1987.

44. Telecon. Donato, S.A., JACA Corp., with representatives of eight manufacturers of solvents and three manufacturers of degreasing equipment. November 11-18, 1987. Telephone survey.

45. National Screw Machine Products Association, Chlorinated Solvent Emissions Survey, Summary Letter, May 28, 1993, p. 2.