

JACKFAU-92-444-1



# **Nonroad Mobile Source Sales and Attrition Study: Identification and Evaluation of Available Data Sources**

**Final Report**

**February 1993**

*Submitted to:*

**U.S. Environmental Protection Agency  
Office of Air and Radiation  
2565 Plymouth Road  
Ann Arbor, Michigan 48105**

*Prepared by:*

**Jack Faucett Associates  
(Under Subcontract to Sierra Research Inc.)**



## **JACK FAUCETT ASSOCIATES**

**4550 MONTGOMERY AVENUE • SUITE 300 NORTH**

**BETHESDA, MARYLAND 20814**

**(301) 961-8800**

## **DISCLAIMER**

Although the information described in this report has been funded wholly by the United States Environmental Protection Agency under Contract Number 68-C1-C079 to Sierra Research, it has not been subjected to the Agency's peer and administrative review and is being released for information purposes only. It may not necessarily reflect the views of the Agency and no official endorsement should be inferred.

## TABLE OF CONTENTS

<u>SECTION</u>	<u>Page</u>
DISCLAIMER .....	i
TABLE OF CONTENTS .....	ii
1: INTRODUCTION .....	1-1
2: INDUSTRY DATA .....	2-1
2.1 OVERVIEW .....	2-1
2.2 OUTDOOR POWER EQUIPMENT INSTITUTE (OPEI) .....	2-2
2.3 PORTABLE POWER EQUIPMENT MANUFACTURERS ASSOCIATION (PPEMA) .....	2-18
2.4 INDUSTRIAL TRUCK ASSOCIATION (ITA) .....	2-23
2.5 INTERNATIONAL SNOWMOBILE INDUSTRY ASSOCIATION (ISIA) .....	2-28
2.6 MOTORCYCLE INDUSTRY COUNCIL (MIC) .....	2-33
2.7 EQUIPMENT MANUFACTURERS INSTITUTE (EMI) .....	2-38
2.8 OTHER INDUSTRY ASSOCIATIONS .....	2-42
3: SOURCES OF DATA OTHER THAN INDUSTRY .....	3-1
3.1 OVERVIEW .....	3-1
3.2 CONSULTANTS' REPORTS TO GOVERNMENT .....	3-1
3.3 MACKAY & COMPANY DATA (CONSTRUCTION EQUIPMENT MAGAZINE) .....	3-13
3.4 FIELD SOURCES .....	3-17
3.5 CENSUS DATA .....	3-22
4: POWER SYSTEMS RESEARCH .....	4-1
4.1 OVERVIEW .....	4-1
4.2 ENGINE AND EQUIPMENT SALES ESTIMATES .....	4-3
4.3 EQUIPMENT/ENGINE SCRAPPAGE .....	4-12
4.4 ENGINE REBUILD/REPLACEMENT RATES .....	4-28
4.5 METHODOLOGY FOR GEOGRAPHIC ALLOCATION .....	4-29
4.6 SUMMARY AND RECOMMENDATIONS .....	4-30

## TABLE OF CONTENTS -- (Continued)

<u>Chapters</u>	<u>Page</u>
<b>5: FUTURE WORK: DATA SELECTION AND METHODOLOGY DEVELOPMENT</b> .....	<b>5-1</b>
<b>5.1 OVERVIEW</b> .....	<b>5-1</b>
<b>5.2 NATIONWIDE STATE-LEVEL POPULATIONS</b> .....	<b>5-2</b>
<b>5.3 ENGINE/EQUIPMENT DISTRIBUTION MATRICES</b> .....	<b>5-3</b>
<b>5.4 ANNUAL ENGINE/EQUIPMENT SALES MATRICES</b> .....	<b>5-3</b>
<b>5.5 ENGINE SURVIVAL MATRICES (HISTORICAL)</b> .....	<b>5-4</b>
<b>5.6 ENGINE REBUILD/REPLACEMENT RATE MATRICES (HISTORICAL)</b> .....	<b>5-5</b>
<b>5.7 EQUIPMENT USAGE RATE MATRICES</b> .....	<b>5-5</b>
<b>5.8 TEMPORAL DISTRIBUTION MATRICES</b> .....	<b>5-6</b>
 <b>APPENDIX A: SNOWMOBILE REGISTRATION DATA 1977-1992</b> .....	 <b>A-1</b>
<b>APPENDIX B: MIC STATE POPULATION, ANNUAL USAGE, SEASONAL USAGE ESTIMATES</b> .....	<b>B-1</b>
<b>APPENDIX C: SURVEY METHODOLOGY FOR THE 1987 CENSUS OF AGRICULTURE</b> .....	<b>C-1</b>
<b>APPENDIX D: 1990 CURRENT INDUSTRIAL REPORTS FOR: CONSTRUCTION MACHINERY, FARM MACHINERY, LAWN &amp; GARDEN EQUIPMENT, PUMPS AND COMPRESSORS, AND MOTORS AND GENERATORS</b> ....	<b>D-1</b>
<b>APPENDIX E: LISTING OF EQUIPMENT TYPES INCLUDED IN <i>ENGINDATA</i></b> .....	<b>E-1</b>



## LIST OF TABLES

<u>Tables</u>	<u>Page</u>
2-1 PEI ANNUAL SHIPMENTS FOR SELECTED EQUIPMENT .....	2-5
2-2 WALK-BEHIND ROTARY POWERED MOWERS PERCENTAGE OF ANNUAL UNITS SHIPPED BY HORSEPOWER RANGE .....	2-9
2-3 FRONT ENGINE GARDEN TRACTORS PERCENTAGE OF ANNUAL UNITS SHIPPED BY HORSEPOWER RANGE .....	2-10
2-4 REAR ENGINE RIDING MOWER PERCENTAGE OF ANNUAL UNITS SHIPPED BY HORSEPOWER RANGE .....	2-11
2-5 RIDING GARDEN TRACTORS PERCENTAGE OF ANNUAL UNITS SHIPPED BY HORSEPOWER RANGE .....	2-12
2-6 WALK-BEHIND ROTARY TILLERS PERCENTAGE OF ANNUAL UNITS SHIPPED BY HORSEPOWER RANGE .....	2-13
2-7 PERCENT OF SALES BY OPEI REGION FOR SELECTED EQUIPMENT .....	2-14
2-8 ESTIMATED PRODUCT LIFE SPAN FOR SELECTED EQUIPMENT .....	2-16
2-9 PPEMA's SHIPMENT ESTIMATES OF SELECTED 2-STROKE GASOLINE EQUIPMENT .....	2-19
2-10 ITA'S DECEMBER FORM 2 DATA ORDERS .....	2-25
2-11 ITA ANNUAL SHIPMENT ESTIMATES BY LIFT CAPACITY/ENGINE HORSEPOWER (INTERNAL COMBUSTION ENGINES) .....	2-27

### LIST OF TABLES — (Continued)

<u>Tables</u>	<u>Page</u>
2-12 ESTIMATED NEW RETAIL SALES OF OFF-HIGHWAY MOTORCYCLES AND ATV'S .....	2-35
2-13 FARM WHEEL TRACTOR RETAIL SALES BY STATE, 1985-1989 .....	2-40
2-14 EXAMPLE OF EMI'S PUBLICLY AVAILABLE PERIODIC SALES REPORT .....	2-41
3-1 CALIFORNIA HEAVY CONSTRUCTION EQUIPMENT SURVIVAL AND USE RATES BY VINTAGE .....	3-6
3-2 U.S. SALES OF SELECTED GASOLINE POWERED ENGINES (LESS THAN 25 HP) .....	3-8
3-3 RESIDENTIAL AND COMMERCIAL ATTRITION FACTORS FOR SELECTED LAWN AND GARDEN EQUIPMENT .....	3-10
3-4 2-STROKE VS 4-STROKE SALE SPLITS, HORSEPOWER, LOAD FACTOR, AND USAGE DATA FOR LAWN AND GARDEN EQUIPMENT .....	3-12
3-5 EQUIPMENT TYPES INCLUDED IN MACKAY AND COMPANY'S STUDIES .....	3-16
4-1 ENGINDATA GASOLINE SALES (0 to 1000 HP) .....	4-7
4-2 ENGINDATA DIESEL SALES (0 to 1000 HP) .....	4-8
4-3 COMPARISONS BETWEEN PSR'S SALES DATA AND OPEI, PPEMA SHIPMENT STATISTICS .....	4-9

---

**LIST OF TABLES -- (Continued)**

<b><u>Tables</u></b>	<b><u>Page</u></b>
<b>4-4      HEAVY CONSTRUCTION EQUIPMENT AND          USAGE DATA DEVELOPED BY EEA .....</b>	<b>4-22</b>
<b>4-5      EQUIPMENT ATTRITION AND USAGE DATA DERIVED FROM          PSR'S SCRAPPAGE CURVE .....</b>	<b>4-24</b>
<b>4-6      CALCULATION OF HYPOTHETICAL FLEET-AVERAGE          NO<sub>x</sub> EMISSION RATES .....</b>	<b>4-27</b>

## LIST OF FIGURES

<u>Figures</u>	<u>Page</u>
2-1      VINTAGE ATTRITION RATES FOR ATV'S AND OFF-HIGHWAY MOTORCYCLES .....	2-36
4-1      PSR'S ATTRITION CURVE USED TO ESTIMATE VINTAGE SPECIFIC ATTRITION RATES .....	4-18
4-2      USAGE VS. AGE EEA AND PSR METHODOLOGIES .....	4-25

## SECTION 1: INTRODUCTION

Section 213 of the Clean Air Act, as amended, requires that the U.S. Environmental Protection Agency (EPA) determine the contribution of nonroad engines to the nonattainment of Federal standards for ambient ozone and CO concentrations. In an effort to assess this contribution, EPA conducted its *Nonroad Engine and Vehicle Emission Study* (NEVES) which estimated emissions from 79 types of nonroad equipment for 24 metropolitan areas designated as nonattainment for ozone and/or CO by the Office of Air Quality Planning and Standards (OAQPS).

Results from NEVES are likely to lead to EPA's determination that emissions from nonroad sources are significant. Such a determination would presumably result in emission regulations for at least some categories of nonroad engines. In fact, EPA is currently in the process of developing emission standards for nonroad diesel engines over 50 horsepower. For other types of nonroad engines, EPA is gathering information needed for emission control strategies.

Emission inventories for a given nonattainment area may be determined by the population of nonroad equipment in the area, the typical load factor at which an equipment's engine is operated, the average annual hours of use of the engine, the engine's rated horsepower, and the emission factor attributable to the engine. The product of annual hours of use, the average rated horsepower, and the load factor is referred to by EPA as the 'per-source usage rate. The product of the engine population and the per-source usage rate is referred to as the activity level. Each element is often referred to as an emission parameter.

In estimating the emission parameters described above, EPA's NEVES incorporated data and methodologies developed by EPA, EPA contractors, industry associations, and other parties. However, to support possible control strategies, models estimating historical and future in-use emissions from nonroad engines are needed. Although the NEVES provided an estimate of current year emissions from nonroad equipment and engines, it did not provide a methodology whereby emission inventories could be forecasted, nor did it investigate methods to estimate emission reductions from proposed regulations. Crucial to this latter feature is an understanding of the equipment fleet make-up, including both historical sales and equipment attrition rates.

This report identifies and evaluates data sources maintained by manufacturers, industry associations, consultants, and U.S. and State government agencies describing historical engine/equipment sales, equipment attrition rates (or scrappage), engine rebuild/replacement rates, equipment populations and usage, and other relevant parameters necessary to support an emission inventory forecasting model for nonroad mobile sources. The study focuses on each of the 79 equipment types covered in EPA's NEVES with the exception of engines/equipment used in the Recreational Marine category.

Uncertainty regarding the true emission inventories from nonroad engines is largely fueled by the fact that data on equipment populations and use rates are difficult to obtain because industry is reluctant to publicly reveal historical sales figures or field data on use and scrappage. To the extent that such data is available, Section 2 of this report presents and evaluates industry data on equipment/engine sales, scrappage, and usage. Most of the data evaluated in Section 2 was provided by industry associations during the development of EPA's NEVES.

Section 3 evaluates sales, scrappage, and usage data used by consultants and government in their efforts to estimate emissions from nonroad engines. Consultant reports to ARB and the MacKay & Company studies conducted for *Construction Equipment Magazine* are reviewed, as well as data on engine rebuild/replacement and equipment scrappage rates that are available from "field" contacts, such as equipment rental companies, equipment distributors, service retailers, parts suppliers, and local government agencies (*e.g.*, county park and recreation departments). Finally, Section 3 discusses shipment records for nonroad equipment available from the U.S. Department of Commerce, Bureau of the Census. Information available from the *Current Industrial Reports* for Construction Machinery, Farm Machinery and Lawn and Garden Equipment, and Pumps and Compressors are reviewed and evaluated.

Section 4 presents a comprehensive review of methodologies developed and maintained by Power Systems Research (PSR) to estimate equipment sales, scrappage, and populations. PSR's data on equipment populations and usage was employed in the development of EPA's NEVES and, thus, have been vigorously scrutinized by industry. Section 4 reviews and evaluates PSR's *Engindata* and *Aftermarket* databases and the methodologies that PSR employs to derive engine/equipment sales and attrition rates. PSR's methodology to distribute equipment populations to the State and county levels is also analyzed.

Section 5 provides a discussion of further research that is necessary for the development of data matrices to be used as inputs into an emissions forecasting model.

## **SECTION 2:**

### **INDUSTRY DATA**

#### **2.1 OVERVIEW**

Useful information on sales, scrappage, usage, rebuild/replacement rates, and other relevant parameters have been difficult to obtain from industry associations and engine or equipment manufacturers. To the extent that such data is available, they are often only so at aggregate levels which lessen their value in an emissions analysis. For example, sales by equipment type are usually not broken down by engine/fuel type, horsepower ranges, 2-stroke versus 4-stroke splits, or other levels of disaggregation necessary for the development of a representative in-use emission inventory. Likewise, scrappage estimates are often presented as the number of years of expected useful life for a particular type of equipment, rather than as vintage specific attrition rates which more accurately describe scrappage of in-use fleets. Comprehensive information on engine rebuild/replacement rates are simply not available from industry associations and equipment/engine manufacturers. It appears that industry members do not collect detailed follow-up information on equipment or engines after they have been placed in service.

Nevertheless, publicly available industry data is useful as validation data, or reality checks, for estimates that have been developed through various methodologies. In addition, industry records on shipments and scrappage can be disaggregated to levels necessary for emission inventory development using, for instance, estimates on 2-stroke versus 4-stroke splits or engine/fuel type splits that are available from other sources.



This section presents and evaluates the usefulness of data that have been presented by industry associations and equipment/engine manufacturers. Information provided by the Outdoor Power Equipment Institute (OPEI), Portable Power Equipment Manufacturers Association (PPEMA), Equipment Manufacturers Institute (EMI), Motorcycle Industry Council (MIC), Industrial Truck Association (ITA), and the International Snowmobile Industry Association (ISIA) is reviewed. The Engine Manufacturers Association (EMA) has not submitted any relevant data, and directed requests to EMI. Similarly, manufacturers have not been forthcoming in providing sales or scrappage data, even anecdotally, and have directed requests to their representative associations.

## 2.2 OUTDOOR POWER EQUIPMENT INSTITUTE (OPEI)

OPEI is a national trade association which represents manufacturers of powered lawn and garden equipment, component and attachment suppliers, as well as industry related allied services. Member products include walk-behind lawnmowers, rear engine riding mowers, lawn and garden tractors, walk-behind tillers, walk-behind snow throwers, commercial turf care equipment, shredders and grinders, lawn vacuums, flexible line trimmers, leaf blowers, log splitters, power rakes, thatchers, lawn edgers and trimmers, engines, and equipment components and attachments.

Data available from OPEI include historical product shipments, national and regional usage data, and estimates of equipment life spans. During the course of EPA's NEVES, OPEI presented EPA and its contractor, EEA, with their estimates of national shipments, annual usage (often differentiated by commercial and residential applications), and estimates of product life. To arrive at estimates of annual hours of use and product life span, OPEI surveyed approximately 30 members of OPEI's *Technical Committee* which is comprised of

technical representatives from member companies. Although details of the survey questionnaire were not available from OPEI, conversations with OPEI's technical staff provided some insight about the process that was employed to derive estimates of annual hours of use, product life spans, and residential/commercial splits.

- **Residential vs. Commercial:** OPEI's questionnaire asked technical members to provide sales splits (percentages), annual hours of use, and life span estimates separately for residential and commercial end users. OPEI defines commercial users as those users that are hired lawn maintenance professionals.
- **Annual Hours of Use:** Annual hours of use estimates were provided by members of the *Technical Committee* at the regional level (*i.e.*, at the nonattainment level). OPEI then calculated a straight average of these regional usage estimates to derive national numbers.
- **Product Life Spans:** National product life span estimates were compiled by OPEI from the responses to the questionnaire. OPEI then subjectively weighted each response by sales volume and product quality (*e.g.*, mass merchandiser brand, premium brand, etc.) to derive a weighted average estimate of average life for products used in residential and commercial applications. Details of the weighting scheme were not available from OPEI.

OPEI was unable to locate a copy of the questionnaire that was distributed to the members of the *Technical Committee*. Likewise, a list of the manufacturers and their technical representatives was not available from OPEI. As a result, a detailed evaluation of the methods used by the manufacturers to estimate usage and product life spans was not possible. However,

OPEI stated that estimates most likely reflect a manufacturer's "best guess". If so, high levels of uncertainty may be inherent in the usage and product life span estimates generated from responses to a survey that is not founded on scientific sampling techniques.

In contrast, shipment data were derived from OPEI's *Shipment Program* which calls on detailed shipment records provided by member companies for various types of lawn and garden equipment. Historical shipment estimates were recently provided to JFA that go as far back as 1946, as well as data, previously not submitted to EPA or EEA, on power source splits and historical horsepower distributions. OPEI's shipment estimates reflect actual shipments and thus are likely representative of the market for these products.

Table 2-1 presents OPEI's historical national shipment records for walk-behind power mowers, front engine lawn tractors/riding mowers, rear-engine lawn tractors/riding mowers, riding garden tractors, rotary tillers, snow throwers, walk-behind fixed blade edgers/trimmers, commercial walk-behind rotary turf mowers, and commercial riding rotary turf mowers.<sup>1</sup> Shipment data for shredders and grinders, lawn vacuums, flexible line trimmers, leaf blowers, log splitters, power rakes, thatchers, and lawn edgers and trimmers are compiled by OPEI and maintained in their *Shipment Program*, but are not released to the public for the following reasons:

- These products are often produced by manufacturers that are not members of OPEI implying that OPEI's shipment statistics for these equipment types may not represent the entire market for these products; and

---

<sup>1</sup>These model year, as opposed to calendar year, figures include estimates of non-member companies and pre-1987 exports. Post 1987 estimates only include domestic shipments.

**Table 2-1**  
**OPEI Annual Shipments for Selected Equipment**

Model Year	Walk Behind Lawnmowers	Front Engine Riding Mowers	Rear Engine Riding Mowers	Riding Garden Tractors	Rotary Tillers	Snow Throwers	Walk Behind Edgers/Trimmers	Walk Behind Turf Mowers	Riding Turf Mowers
1991	5,350,000	840,000	209,000	128,000	296,000	285,000	133,000	93,000	20,000
1990	5,700,000	885,000	247,000	156,000	300,000	355,000	166,000	98,000	23,000
1989	5,300,000	793,000	260,000	139,000	305,000	543,000	167,000	76,000	20,000
1988	5,600,000	812,000	375,000	170,000	285,000	532,000	N/A	N/A	N/A
1987	5,900,000	800,000	375,000	150,000	272,000	526,000	N/A	N/A	N/A
1986	5,400,000	623,000	322,000	149,000	311,000	482,000	N/A	N/A	N/A
1985	5,193,000	548,000	355,000	147,000	362,000	421,000	N/A	N/A	N/A
1984	4,950,000	502,000	354,000	152,000	399,000	348,000	N/A	N/A	N/A
1983	4,400,000	415,000	276,000	129,000	408,000	264,000	N/A	N/A	N/A
1982	4,600,000	393,000	261,000	146,000	497,000	95,000	N/A	N/A	N/A
1981	4,600,000	370,000	250,000	151,000	501,000	344,700	N/A	N/A	N/A
1980	5,700,000	494,000	314,000	220,000	667,000	1,577,000	N/A	N/A	N/A
1979	5,900,000	515,000	343,000	254,000	571,300	1,118,000	N/A	N/A	N/A
1978	5,400,000	477,000	272,900	219,000	571,000	416,000	N/A	N/A	N/A
1977	5,000,000	403,800	266,200	215,000	633,000	267,950	N/A	N/A	N/A
1976	4,900,000	403,800	266,200	210,000	780,000	165,434	N/A	N/A	N/A
1975	4,700,000	374,539	246,910	230,000	1,200,000	156,800	N/A	N/A	N/A
1974	6,000,000	596,922	393,513	325,000	845,000	227,253	N/A	N/A	N/A
1973	6,400,000	538,400	354,933	250,000	575,000	300,000	N/A	N/A	N/A
1972	5,200,000	397,948	262,342	245,500	450,000	315,000	N/A	N/A	N/A
1971	4,800,000	368,687	243,052	275,500	400,000	265,000	N/A	N/A	N/A
1970	4,900,000	394,729	260,220	275,500	400,000	245,000	N/A	N/A	N/A
1969	5,300,000	409,652	270,058	300,000	400,000	265,000	N/A	N/A	N/A
1968	4,900,000	351,130	231,478	325,000	400,000	255,000	N/A	N/A	N/A
1967	4,680,000	321,870	212,188	280,000	400,000	185,000	N/A	N/A	N/A
1966	4,360,000	292,609	192,899	250,000	325,000	185,000	N/A	N/A	N/A
1965	4,130,000	234,087	154,319	175,000	340,000	165,000	N/A	N/A	N/A
1964	4,100,000	N/A	N/A	125,000	400,000	160,000	N/A	N/A	N/A
1963	3,900,000	N/A	N/A	100,000	306,090	200,000	N/A	N/A	N/A
1962	4,000,000	N/A	N/A	90,000	317,264	175,000	N/A	N/A	N/A
1961	3,500,000	N/A	N/A	67,124	277,048	75,000	N/A	N/A	N/A
1960	3,800,000	N/A	N/A	43,486	315,406	40,000	N/A	N/A	N/A
1959	4,200,000	N/A	N/A	27,047	251,778	20,000	N/A	N/A	N/A
1958	3,841,000	N/A	N/A	12,643	173,348	18,000	N/A	N/A	N/A
1957	3,266,000	N/A	N/A	N/A	129,796	12,000	N/A	N/A	N/A
1956	3,200,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1955	2,750,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1954	1,802,000	N/A	N/A	N/A	75,082	N/A	N/A	N/A	N/A
1953	1,275,000	N/A	N/A	N/A	67,922	N/A	N/A	N/A	N/A
1952	1,155,000	N/A	N/A	N/A	41,498	N/A	N/A	N/A	N/A
1951	1,241,000	N/A	N/A	N/A	26,098	N/A	N/A	N/A	N/A
1950	1,080,000	N/A	N/A	N/A	17,211	N/A	N/A	N/A	N/A
1949	529,000	N/A	N/A	N/A	11,006	N/A	N/A	N/A	N/A
1948	397,000	N/A	N/A	N/A	15,176	N/A	N/A	N/A	N/A
1947	362,000	N/A	N/A	N/A	31,051	N/A	N/A	N/A	N/A
1946	139,018	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

1) The model year is September 1 through August 31 for all products listed except snow throwers. The snow thrower model year begins in March and ends in February.

2) For 1976-1965, independent estimates were not available for front and rear engine riding mowers. Shipments were aggregated into lawn tractors/riding mowers. The figures shown for pre-1977 are based on 1977 splits. Front engine mowers were taken as 58% of the total, while rear engine mowers were 38.5% of the total.

- Some of these products are produced by only a few firms (often one or two) so that disclosing shipment records may compromise the market positions of certain manufacturers.

For the purpose of an emissions analysis, however, shipment data for leaf blowers and trimmers and edgers are available from the Portable Power Equipment Manufacturers Association (PPEMA) and are reviewed later in Section 2.

It should be noted that the product shipments shown in Table 2-1 are not synonymous with product sales. The latter more closely reflects the actual number of units placed in service, while the former accounts for units not yet sold that sit in inventory. Estimates are not available from OPEI of inventories maintained at different levels of the distribution system. Furthermore, OPEI's estimates, as shown in Table 2-1, have limited use in the development of an emissions forecasting model or in an investigation of emission reductions from proposed regulations. Such a model requires a disaggregated profile of equipment sales that accounts for the distribution of sales by horsepower, engine cycle, and fuel type. In an effort to meet these requirements, OPEI provided the following power base shipment distributions for selected equipment:

DISTRIBUTION OF SHIPMENTS BY POWER BASE			
	Gasoline	Diesel	Electric
Walk-Behind Lawnmowers	96%	0%	4%
Snowblowers	84%	16%	0%
Riding Mowers	97%	3%	0%
Lawn Tractors	96%	4%	0%
Garden Tractors	84%	16%	0%
String Trimmers	56%	0%	44%

Similar distributions for rotary tillers or the other types of lawn and garden equipment covered by OPEI are not available from OPEI.

Although these data provide useful information, the distributions by power base have surely changed from one model year to the other. As a result, a static representation, as shown above, does not account for likely trends in consumers' preferences between the available power sources. Historical shipment records by power base would better serve the characterization of the in-use fleets of lawn and garden equipment, but these are only available from OPEI for riding mowers, lawn tractors, and garden tractors (back to 1978). However, generating such statistics is resource intensive since OPEI's *Shipment Program* is actually maintained by a contractor to OPEI (Association Research, Inc.). Consequently, additional data on historical sales distributions for these equipment types by fuel type were not provided for this study, but will be provided once EPA begins the development of data matrices necessary for an emissions model.

OPEI was less forthcoming in providing data on 2-stroke versus 4-stroke model year shipment splits. Estimates were submitted only for consumer walk-behind lawnmowers. OPEI estimates that 90 percent of walk-behind lawnmowers designed for consumer applications are actually sold to residential users. Of these, 95 percent employ 4-stroke gasoline engines and 5 percent 2-stroke gasoline engines. According to OPEI, the remaining 10 percent of consumer walk-behind lawnmowers are sold to commercial consumers (*e.g.*, landscaping firms), of which 85 percent use 4-stroke gasoline engines and 15 percent use 2-stroke gasoline engines. Similar splits for other types of lawn and garden equipment would be extremely helpful but are not available from OPEI.

OPEI's estimates on the percentage of annual units shipped by horsepower range for various equipment are presented in Tables 2-2 through 2-6. For each equipment type shown in these tables, a significant sales shift has taken place toward more powerful engines. For example, the percent of lawnmowers sold under 3.9 horsepower has declined from 74 percent in 1986 to 59 percent in 1991, while those sold over 5 horsepower have increased from 1 percent to 24 percent over the same period. According to OPEI, these shifts are not the result of any definitional changes in how manufacturers report horsepower and thus reflect actual trends toward more powerful engines. In order to consider the potential for emission control and the technology required to meet emission standards, similar trends for other engine specifications, such as the penetration of overhead valves, are necessary. Shipment distributions by technology are not maintained nor are they compiled by OPEI, however.

One objective of developing an emission forecasting model is to help States to determine the contribution of nonroad engines to local emission inventories and to help them assess the effectiveness of control programs. As a result, State level sales, scrappage, and usage data are needed. Regional shipment distributions were provided by OPEI for sixteen regions, each

Table 2-2

**WALK-BEHIND ROTARY POWERED MOWERS  
PERCENTAGE OF ANNUAL UNITS SHIPPED BY  
HORSEPOWER RANGE**

YEAR	3.9 HP & UNDER	4.0 - 4.9 HP	5.0 HP & OVER
1986	74%	25%	1%
1987	71%	28%	1%
1988	71%	27%	2%
1989	69%	25%	6%
1990	61%	22%	17%
1991	59%	17%	24%

2-9

Source: OPEI



**Table 2-3**

**FRONT ENGINE GARDEN TRACTORS  
PERCENTAGE OF ANNUAL UNITS SHIPPED BY  
HORSEPOWER RANGE**

<b>YEAR</b>	<b>9.99 HP &amp; UNDER</b>	<b>10.00 - 13.9 HP</b>	<b>14.0 HP &amp; OVER</b>
1981	13%	84%	3%
1982	13%	80%	7%
1983	8%	86%	6%
1984	4%	86%	10%
1985	5%	81%	14%
1986	5%	82%	13%
1987	4%	82%	14%
1988	2%	83%	15%
1989	2%	82%	15%
1990	1%	79%	20%
1991	1%	74%	24%

Source: OPEI

Table 2-4

**REAR ENGINE RIDING MOWER  
PERCENTAGE OF ANNUAL UNITS SHIPPED BY  
HORSEPOWER RANGE**

YEAR	7.99 HP & UNDER	8.00 - 9.99 HP	10.0 HP & OVER
1980	30%	54%	16%
1981	26%	55%	19%
1982	21%	57%	22%
1983	14%	58%	28%
1984	11%	60%	29%
1985	10%	53%	37%
1986	10%	56%	34%
1987	9%	55%	36%
1988	9%	53%	38%
1989	7%	40%	53%
1990	4%	34%	62%
1991	3%	21%	76%

Source: OPEI

Table 2-5

**RIDING GARDEN TRACTORS  
PERCENTAGE OF ANNUAL UNITS SHIPPED BY HORSEPOWER RANGE**

YEAR	13.9 HP & UNDER	14.0 - 15.9 HP	16.0 - 17.9 HP	18.0 - 19.9 HP	20.0 HP & OVER			18.0 HP & OVER
1980	25%	14%	50%					11%
1981	23%	10%	49%					18%
1982	23%	12%	50%					15%
1983	18%	11%	33%	34%	+	4%	=	38%
1984	15%	8%	29%	44%	+	4%	=	48%
1985	18%	9%	24%					49%
1986	20%	9%	20%	47%	+	4%	=	51%
1987	17%	8%	10%	60%	+	5%	=	65%
1988	9%	11%	17%	54%	+	9%	=	63%
1989	11%	8%	16%	54%	+	11%	=	65%
1990	9%	8%	14%	58%	+	11%	=	69%
1991	5%	7%	14%	64%	+	9%	=	73%

Source: OPEI

Table 2-6

**WALK-BEHIND ROTARY TILLERS  
PERCENTAGE OF ANNUAL UNITS SHIPPED BY  
HORSEPOWER RANGE**

YEAR	6.0 HP & UNDER		3.99 HP & UNDER		4.0 - 6.0 HP	OVER 6.00 HP
1980	83%	=	17%	+	66%	17%
1981	87%	=	17%	+	70%	13%
1982	82%	=	17%	+	65%	18%
1983	83%	=	15%	+	68%	17%
1984	82%					18%
1985	86%					14%
1986	88%					12%
1987	88%	=	19%	+	69%	12%
1988	88%	=	18%	+	70%	12%
1989	87%	=	19% %	+	68%	13%
1990	91%	=	13%	+	78%	9%
1991	91%	=	14%	+	77% %	9%

2-13

Source: OPEI

Table 2-7

## PERCENT OF SALES BY OPEI REGION FOR SELECTED EQUIPMENT

REGION	WALK-BEHIND MOWERS	RIDING MOWERS	LAWN TRACTORS	GARDEN TRACTORS	WALK-BEHIND TILLERS
ME,NV,VT	1.5	1.5	2.2	1.4	2.2
MA,RI,CT	3.6	3.6	3.4	2.5	2.4
NY,NJ,PA	12.7	11.5	16.3	13.1	7.8
OH,MI	10.7	7.7	9.2	12.4	5.8
IL,WI,IN	9.9	8.3	8.6	11.7	9.7
MN,AND,SD	2.2	3.0	3.4	2.8	1.5
MO,NE,KA	5.8	4.7	5.3	6.7	8.6
DE,MD,DC,WV	7.2	4.9	6.5	7.8	8.0
NC,SC,GA,FL	12.4	21.5	14.4	15.3	12.1
KT,KE	4.5	8.3	6.5%	5.7	5.8
AL,MS	3.9	6.2	5.4	4.6	5.2
AR,LA	3.2	5.7	5.4	3.6	7.1
OK,TX	8.5	7.7	7.6	60.	7.8
MT,ID,WY,CO	1.9	.9	1.1	.4	3.2
NW,AZ,UT,NV	2.0	.4	.6	1.1	4.1
CA,WA,OR	10.1	4.3	4.0	5.0	8.8

Source: OPEI

comprising two, three, or four States. Table 2-7 shows these 1990 model year distributions for the five equipment types that were available. Similar historical distributions would be extremely useful for the development of an emissions model. Moreover, State rather than regional data are needed, although regional shipment data may still be useful as a starting point for developing a fleet mix model. OPEI, however, does not maintain State specific data of any kind, other than that shown in Table 2-7. Furthermore, distributions like those exhibited in Table 2-7 are not available for any other model years.

Information on scrappage, or attrition rates, from OPEI is limited to that generated from the *Technical Committee* survey. Estimated product life spans were submitted by OPEI during the development of EPA's NEVES and are shown in Table 2-8. These estimates, however, do not accurately describe the rate of attrition across in-use fleets. Attrition rates provide information on the expected survival rate of equipment by vintage, and, thus, are integral in determining the vintage distribution of in-use fleets. Vintage distributions, together with engine profiles by model year, are necessary for an accurate estimate of current and future emission inventories.

Estimated annual hours of use were provided by OPEI for most lawn and garden equipment during the development of NEVES. Where appropriate, distinctions between consumer and commercial use were provided based on results from the *Technical Committee* survey. National and regional estimates on annual usage are presented in EPA's NEVES and are not reiterated in this report. State level estimates on annual usage are not available from OPEI.

JFA inquired about available data on typical engine rebuild/ replacement rates. Unfortunately, such information is not available through OPEI.

**Table 2-8**  
**ESTIMATED PRODUCT LIFE SPAN FOR SELECTED**  
**EQUIPMENT**

**Walk-Behind Mowers**

Consumer Use - 6 Years  
Commercial Use - 3 Years

**Multi-Spindle Walk-Behind Mowers**

Commercial Use - 3 Years

**Riding Mowers (Rear Engine)**

Consumer Use - 6 Years

**Lawn Tractors**

Consumer Use - 6 Years

**Garden Tractors**

Consumer Use - 9 Years

**Walk-Behind Tillers**

Consumer Use - 9 Years  
Commercial Use - 3 Years

**Misc. Lawn and Garden Equipment**

Consumer Use - 10 Years  
Commercial Use - 10 Years

(Category includes walk-behind blower/vacs, edger trimmers,  
snow throwers, etc.)

Although OPEI has been responsive to data requests, further detail is needed for the development of data matrices required to formulate an emissions inventory model. JFA contacted OPEI to determine further data availability. It is evident that OPEI does not compile nor does it maintain detailed information on historical shipments by State, technology, engine cycle, or power base for most of the equipment types that OPEI represents. With the exception of historical shipment distributions by power base for lawn tractors, riding mowers, and garden tractors (which will be submitted by OPEI at a later date), the extent of shipment data availability from OPEI is limited to that presented in this report. Similarly, OPEI is not a source for detailed information on equipment attrition rates, State level annual hours of use estimates, or equipment rebuild/replacement rates.

The reliability of OPEI's data is also questionable. While the shipment estimates are likely representative of actual product shipments, OPEI's data on scrappage, usage, and commercial/residential splits are based on unscientific methods that rely on a relatively small-scale survey. It is unclear how the 30 or so surveyed manufacturers developed the estimates for these variables, but OPEI has suggested that a "best-guess" approach may have been widely used. Although the technical representatives of the various manufacturers surveyed by OPEI may be experts in their respective fields, their responses are likely biased and may reflect testing experiences rather than field data. As a result, OPEI's estimates on scrappage, usage, and commercial/residential splits should be interpreted with caution and probably best serve as comparative data for estimates developed by other sources. Likewise, the lack of detail exhibited by OPEI's shipment data limits their direct use into an emission calculation. However, at the aggregate level, OPEI's shipment estimates are likely representative of actual levels.



### 2.3 PORTABLE POWER EQUIPMENT MANUFACTURERS ASSOCIATION (PPEMA)

PPEMA is the national, not-for-profit trade association representing the manufacturers of small engine powered nonroad equipment such as chainsaws, string trimmers, brush cutters, blowers, hedge trimmers, portable generators, and cut-off saws. Unlike many other nonroad equipment industries, almost all of PPEMA's members manufacture the engines used in the final products that they produce. These engines are predominantly 2-stroke gasoline engines better suited for hand-held applications.

Shipment data for selected equipment were directly provided by PPEMA, while information on product life spans and usage is available from a report to PPEMA by Heiden Associates, Inc. entitled *A 1989 California Baseline Emissions Inventory For Total Hydrocarbon & Carbon Monoxide Emissions From Portable Two-Stroke Power Equipment*, dated July 24, 1990. This report uses PPEMA's data on shipments, average annual hours of use, and product life spans to derive emission inventories from portable 2-stroke equipment operating in California.

PPEMA's national shipment estimates are shown in Table 2-9. Estimates were provided for chainsaws, trimmers/brushcutters, hand-held blowers, back-pack blowers, hedge trimmers, and cut-off saws. The numbers shown in Table 2-9 are for 2-stroke gasoline powered equipment, since diesel or 4-stroke gasoline engines are not used in these applications. Shipments, as defined by PPEMA, include product that "goes-out-the-door" of U.S. plants and includes foreign firms with U.S. subsidiaries that produce equipment inside the U.S. Given this definition, equipment that is eventually exported out of the U.S. are also included in Table 2-9.

**Table 2-9**  
**- PPEMA's Shipment Estimates**  
**of Selected 2-Stroke Gasoline**  
**Equipment**

<b>Calendar Year</b>	<b>Chainsaws</b>	<b>Trimmers/ Brushcutters</b>	<b>Hand-Held Blowers</b>	<b>Back-Pack Blowers</b>	<b>Hedge Trimmers</b>	<b>Cut-Off Saws</b>
1992	1,176,060	3,026,340	764,400	75,920	107,120	27,000
1991	1,153,000	2,967,000	728,000	73,000	104,000	27,000
1990	1,378,000	2,962,000	655,000	87,000	102,950	27,300
1989	1,404,000	2,962,000	668,000	99,000	70,500	26,500
1988	1,377,000	3,022,800	564,000	80,400	N/A	N/A
1987	1,350,000	2,748,000	397,000	67,000	N/A	N/A
1986	1,350,000	2,390,000	336,500	76,200	N/A	N/A
1985	1,527,000	1,920,000	N/A	N/A	N/A	N/A
1984	1,684,000	1,835,000	N/A	N/A	N/A	N/A
1983	1,527,000	1,654,000	N/A	N/A	N/A	N/A
1982	1,400,000	1,250,000	N/A	N/A	N/A	N/A
1981	1,820,000	N/A	N/A	N/A	N/A	N/A
1980	2,646,500	N/A	N/A	N/A	N/A	N/A
1979	2,940,000	N/A	N/A	N/A	N/A	N/A
1978	2,896,000	N/A	N/A	N/A	N/A	N/A

Regional and/or State level shipment estimates have not been provided by PPEMA, although they exist given that PPEMA's estimates of annual industry product shipments to California were used by Heiden Associates to estimate emissions from hand-held portable 2-stroke equipment operating California. Moreover, PPEMA's State level shipment data were employed by Heiden Associates in its report to PPEMA entitled *Estimates of 24 Non-Attainment Area Portable Two-Stroke Power Equipment Populations Based on Actual Industry Shipments Data and Four Alternative Activity Models*, dated October 30, 1991. JFA has contacted both Heiden Associates and PPEMA in an attempt to obtain State level shipment data. Heiden Associates cannot release the data without PPEMA's consent, and PPEMA has not responded to our request. It is likely that State level shipment data will not be publicly released by PPEMA, however. According to Heiden Associates, through State level product shipment data the identity of various manufacturers can be determined. As a result, PPEMA will likely not publicly release State level shipment statistics since the market position of certain manufacturers may be compromised.

PPEMA's estimates of the average annual hours of use and typical product life spans are available from the first Heiden Associates' report that is mentioned above. Estimates appearing in that report on usage and life spans are national estimates rather than California specific. These figures are presented below.

PPEMA's Estimates of Usage and Expected Life				
Equipment Type	Average Use Hours (Prof.)	Average Use Hours (Cons.)	Expected Life Yrs. (Prof.)	Expected Life Yrs. (Cons.)
Trimmers/Brushcutters	170	10	1.50	6.00
Hand Blowers	197	9	2.00	6.67
Back Blowers	293	12	1.83	6.67
Cut-Off Saws	113	0	2.00	—
Hedgetrimmers	75	7	3.00	7.50
Chainsaws	405	7	1.00	8.00

PPEMA's estimated percentage of sales going to professional users and consumers, also appearing in Heiden's report, are provided below for each equipment type:

PPEMA's Sales Breakdown by Type of User		
Equipment Type	% Sales (Prof.)	% Sales (Cons.)
Trimmers/Brushcutters	16%	84%
Hand Blowers	5%	95%
Back Blowers	95%	5%
Cut-Off Saws	100%	0%
Hedgetrimmers	79%	21%
Chainsaws	25%	75%

As mentioned in Heiden's report, PPEMA's life expectancy estimates, annual hours of use estimates, and distributions between professional and residential users (*i.e.*, consumers) are

averages of three individual PPEMA member company estimates. Details regarding the identity of these manufacturers or the processes that were employed by them to derive the estimates were not available from PPEMA or Heiden Associates. Steve McGonegal of Heiden Associates did mention, however, that manufacturers may have developed their estimates from information that was provided by each firm's marketing department. This can be interpreted to mean that the estimates likely reflect field data rather than testing results. Of course, the possibility also exists that the estimates reflect "best guesses" by the marketing people of the three manufacturers. JFA contacted PPEMA for more information, but none has been provided.

Finally, Heiden Associates' Steve McGonegal provided some insight on the process that was employed to determine the usage, life expectancy, and sales distribution differences between professional and residential end users. Differences reflect a model specific process that identifies for each equipment type those models that are oriented toward professional applications versus those that are designed for residential applications. Information at the model level was then presumably used by each manufacturer to calculate usage, life span, and sales by user category. Model level data, however, are not available from PPEMA and it remains unclear whether or not the three manufacturers employed a rigorous model based approach or "best guess" approach to derive the estimates presented above as averages.

The data presented above is particularly useful for validating estimates derived by other sources. PPEMA is one source for data describing the distinction between professional and consumer usage and expected life. However, while their estimated annual usage estimates can be directly incorporated into an emissions forecasting model, more detailed data on scrappage are necessary, as was discussed in Section 2.2. Vintage specific attrition rates, however, are not available from PPEMA. Furthermore, the validity of PPEMA's usage and life span

estimates cannot be assessed without additional information about how each of the three manufacturers calculated the numbers that are imbedded in the averages that are exhibited in this report. PPEMA's shipment data, however, are probably reflective of the market for these products, given that they are based on actual shipment records.

As in the case of OPEI, PPEMA does not maintain data on engine rebuild/replacement rates for the equipment that is produced by their member manufacturers.

## 2.4 INDUSTRIAL TRUCK ASSOCIATION (ITA)

ITA is a national, non-profit trade association of forklift truck manufacturers and their suppliers. According to their estimates, members of ITA collectively produce and sell 90 percent of all industrial forklift trucks in the U.S. These trucks are powered by diesel, gasoline, electric motors, or LPG.

ITA has maintained a *Statistical Program* since 1928 that records information on the number of forklift trucks manufactured by member companies in their U.S. plants, the number of forklift trucks imported into the U.S. from member companies with foreign plants, and the number of forklift trucks manufactured by non-member companies, but marketed by member companies. Shipment data are available for seven classes of industrial trucks: electric motor rider trucks (Class 1); motor narrow aisle trucks (Class 2); electric motor hand trucks (Class 3); internal combustion engine trucks, cushion tire only (Class 4); internal combustion engine trucks, pneumatic tire only (Class 5); industrial tractors (Class 6); and rough terrain forklifts (Class 7).

The program uses data submitted by ITA member companies through what are called **Telegraphic Reports** and **Monthly Detailed Statistical Reports**. **Telegraphic Reports** report the number of factory orders during a given month, and include data on the number of orders from, and shipped to, end users. However, they do not include U.S. government or inter/intra-plant transfers. **Monthly Detailed Statistical Reports** include information on the total gross orders, total net orders (*i.e.*, gross orders minus cancellations), and net shipments. Net factory orders received are detailed according to truck class, market sector, capacity, and engine fuel type. End user level reports detail net order and shipment information by truck class, market sector, and geographic location.

ITA's **Statistical Program** is an excellent source of shipment information for forklifts, industrial tractors, and rough terrain forklifts. Data from the program were submitted to EPA describing forklift sales estimates for the 24 nonattainment areas included in NEVES. ITA has confirmed that similar data are maintained for all truck classes at the national and State levels. An example of the type of sales data that was submitted by ITA during NEVES is provided in Table 2-10, which lists forklift orders by lift truck class for the years 1983 to 1990. According to ITA, these estimates are virtually identical to calendar year shipments, the difference being canceled orders during a given year. A given year's canceled orders, however, usually become next year's shipments so that in the long run the order figures are close to actual shipments. ITA's **Statistical Program** can provide data beyond the detail that is exhibited in Table 2-10, including State level shipments by lift truck class and lift capacity (which can be translated to a rough measure of horsepower as shown in Table 2-11).

Shipment data contained in ITA's database are used by manufacturers to evaluate the performance of their dealers. Shipments are traced by Standard Industrial Classification (SIC) code allowing manufacturers to determine how many and which types of lift trucks are shipped

**Table 2-10**

**DECEMBER FORM 2 DATA  
ORDERS**

ITA TRUCK CLASS	YEAR								
	1983	1984	1985	1986	1987	1988	1989	1990	TOTAL
<b>1 Electric</b>	10,613	13,498	16,165	15,809	17,392	17,895	17,312	16,303	124,987
<b>2 Electric</b>	5,444	6,733	9,197	8,486	10,637	12,732	11,861	10,444	75,534
<b>3 Electric</b>	15,267	17,845	23,114	24,094	24,874	29,053	28,517	25,020	187,784
<b>4 Gasoline</b>	4,627	6,523	7,360	6,924	7,895	9,698	9,518	7,327	59,962
<b>Diesel</b>	592	1,135	942	1,450	1,665	1,510	1,199	808	9,301
<b>LPG</b>	11,450	18,719	19,274	18,227	20,858	18,097	18,043	15,724	140,392
<b>5 Gasoline</b>	4,505	6,650	7,375	7,371	8,744	9,831	8,868	7,251	60,595
<b>Diesel</b>	3,087	4,705	4,854	4,750	5,670	5,197	4,925	4,579	37,767
<b>LPG</b>	3,324	5,478	5,932	6,191	7,636	7,398	7,851	18,955	62,765
<b>6 Electric</b>	389	344	422	414	346	261	515	217	2,908
<b>7 Gasoline</b>	244	244	186	118	95	42	47	50	1,026
<b>Diesel</b>	590	590	900	711	740	684	754	511	5,480

Source: ITA



to a given industry. From that information, manufacturers can develop marketing plans. As a result, the information that is maintained and compiled by ITA through the *Statistical Program* is extremely important to manufacturers, and ITA members spend a considerable amount of resources to develop and maintain the database. Given this expense, ITA has stated that they will not provide additional data to EPA beyond what was submitted during the development of NEVES.

National estimates of average annual hours of use were provided to EPA by ITA for forklifts during the development of NEVES. These estimates can be found in EPA's NEVES and are not repeated in this report. The usage data submitted by ITA, as well as their life expectancy estimate of 8 years, were based on a field survey that was conducted during the 1980's. ITA strongly stands by their estimate of an 8-year average useful life, as this estimate is used, according to ITA, by various government agencies, such as OSHA, in their regulatory analyses. ITA does not maintain nor does it compile vintage specific survival rates or engine rebuild/replacement data.

ITA's *Statistical Program* is potentially an excellent source of detailed information on lift truck shipment statistics. However, it is apparent that no further information will be provided by ITA, thus limiting the use of ITA's shipment information to that which has already been submitted to EPA. Similarly, ITA has not provided detailed information about the field survey from which usage and life expectancy estimates were derived. As a result, the validity of these data cannot be evaluated. ITA's data on usage, life expectancy, and lift truck shipments best serve for comparative purposes, rather than as direct inputs into an emissions model.

**Table 2-11**

**ITA ANNUAL UNITS BY LIFT CAPACITY/ENGINE HORSEPOWER  
(Internal Combustion Engines)**

<b>Lift Capacity (lbs.)</b>	<b>Engine Power (BHP)</b>	<b>Annual Units (5 Year Average)</b>	<b>(%)</b>
THRU 6,000	THRU 60	42,500	(80%)
7,000 THRU 15,000	61 THRU 90	9,700	(18%)
16,000 THRU 40,000	91 THRU 125	900	(2%)
ABOVE 40,000	126 THRU 260	50	(NIL)

Source: ITA

## **2.5 INTERNATIONAL SNOWMOBILE INDUSTRY ASSOCIATION (ISIA)**

Four manufacturers currently produce snowmobiles for the U.S. market. These are Arctco, Inc., Bombardier, Inc., Polaris Industries L.P., and Yamaha Motor Company, Ltd.. Of these all but Polaris are active members of ISIA, the trade organization for manufacturers of snowmobiles.

All engines used in current and recent model year snowmobiles are of a 2-stroke design and are exclusively fueled by gasoline. Such an engine design is optimal for snowmobiles because of the requirement for high performance, or a high horsepower to weight ratio. While some snowmobiles employ one or three cylinder engines, most have two cylinders.

ISIA provided aggregate historical sales estimates for snowmobiles sold in the U.S. These estimates are provided below:

<b>Estimated Snowmobile Retail Sales In The United States</b>	
<b>Model Year</b>	<b>Estimated Sales</b>
1991	75,000
1990	80,000
1989	78,000
1988	65,000
1987	61,000
1986	58,000
1985	51,000
1984	59,000
1983	49,000

These estimates are based upon information reported to ISIA by its members, extended to 100 percent of the industry operating in the North American market.<sup>2</sup> The estimate for model year 1991 included sales as of February 28, 1991. The model year ends on March 31 of every year. The sales estimates shown above were derived from member company retail sales figures,

<sup>2</sup>Note that the sum of estimated sales presented here is 576,000. Yet in a submittal to the California Air Resources Board (dated June 1, 1991) ISIA states that an estimated one million snowmobiles are in operation in the United States. ISIA estimates the average life span of snowmobiles to be approximately 10 years. However, the sum of sales for the 1982 to 1991 ten year period will unlikely total one million given that the 1983 to 1991 sum is only 576,000. Roy Muth, ISIA's President and Chief Executive Officer, provided some insight about the cause of the apparent discrepancy. He stated that the one million population estimate was derived from information about the expected size of the snowmobile market, rather than through a methodology that is based on sales or shipment records. Clearly, ISIA's sales and life expectancy estimates do not support this population estimate, unless snowmobile sales in 1982 totaled about 424,000 units -- an unlikely case given the relatively low yearly sales estimates presented above.

rather than shipment records. Since snowmobile manufacturers are highly vertically integrated, they are able to track retail sales from their retail distribution networks. Polaris' retail sales have been estimated through a methodology that relies on ISIA's market knowledge. ISIA stated that while Polaris' sales estimates may not be totally accurate, they are consistent with what ISIA anticipates to be the overall snowmobile market in the United States.

ISIA does not compile retail sales by State. However, most States require the registration of snowmobiles operating on public land. These registration figures, provided by ISIA and presented in **Appendix A**, can be compared against population estimates derived from other sources (such as PSR) to assess the validity of the other source's estimates. Moreover, State registration distributions can be used as a proxy of sales by State, if one assumes that the majority of snowmobiles bought in a particular State are used and registered in that State. Conceptually, registration data can also be used to derive an implied attrition curve. However, such a derivation requires vintage distributions for both sales and registrations. Although such a distribution is available for the sales data, ISIA does not maintain registration data by vintage. Vintage specific registrations may, however, be available from the States directly, but gathering the information will be resource intensive. Moreover, the issue of unregistered snowmobiles presents a problem for such an approach to the derivation of snowmobile attrition curves.

The number of days, or hours per year, that a snowmobile is operated greatly depends on snow cover and, thus, fluctuates from year to year. A survey of snowmobile owners conducted by ISIA during the 1986-1987 season provided the following annual usage data:

---

< 10 days	11%
11-20 days	29%
21-30 days	24%
> 30 days	36%.

The usage data shown above was constructed from both Canadian and U.S. survey responses. Details of the 1986-1987 season ownership and use survey were not available from ISIA. Since then, however, ISIA conducted another survey during the spring of 1992 entitled *U.S. Snowmobile Ownership Survey*. ISIA provided the following discussion about the survey procedure and responses:

Given that ISIA estimates that over one million people constitute the population of snowmobile owners throughout the U.S., to survey this population at a 95 percent confidence level, 386 usable surveys were needed by ISIA. In an attempt to achieve this number of responses, 3000 survey/questionnaires were mailed out for the spring 1992 survey.

Returns numbered 625, a 20.8 percent response rate. Data used to describe snowmobile usage in the U.S. were derived from 385 survey responses. The number used closely approximated the necessary 386 surveys needed to attain a 95 percent confidence level, plus or minus five percent.

According to ISIA, the spring 1992 ownership survey showed that sixty-one and three tenths percent of the respondents indicated that one or two people operate snowmobiles in their households. Thirty-eight and seven tenths of the respondents reported three or more operators (n=380). The majority of respondents (66.2 percent) indicated less than 30 days of usage per year whereas 23.3 percent indicated more than 30 days of use per year (n=382). Fifty-nine and two tenths percent rode over 500 miles annually (n=382). Seventy and nine tenths percent of the respondents indicated that more than half of all mileage traveled was accounted for on the weekend (n=378). Seventy-seven percent of the respondents reported that over 50 percent of the mileage traveled takes place during daylight hours (n=379). The mileage traveled while carrying a passenger was less than 51 percent according to 93.9 percent of the respondents (n=380).

Activities for which snowmobiles were used included trail riding/touring (93.8 percent), followed by family outings and play area riding (38.4 percent each), pleasure racing (27.5 percent), and ice fishing/hunting (18.4 percent) -- multiple answers were allowed.

For the snowmobile most often ridden by the respondents, 25.5 percent got over 15 miles per gallon of gasoline whereas 50.5 percent reported getting 10-15 miles per gallon (n=380). Fuel consumption was important to 63.8 percent of the respondents whereas 36.2 percent reported that it was not an important factor in their riding decisions (n=381). Thirty-six and seven tenths percent of the respondents indicated the use of between 26 and 100 gallons of gas per year for the most often used snowmobile while 24.3 percent of the respondents did not know annual fuel consumption figures (n=379). For all snowmobiles in a household, 49.3 percent of the respondents reported using less than 150 gallons of gasoline per year, while 25.6 percent reported that they did not know the amount of gasoline consumed (n=375).

When respondents were asked if they take overnight trips, 22.1 percent reported taking 1 to 2 overnight trips in the past 12 months. Another 23.4 percent took 3 to 5 trips. Thirty-seven percent reported taking none (n=384). Of those taking overnight trips, 51.8 percent stayed no more than 2 nights away from home. On a one-day trip or less, 26.4 percent of the respondents reported traveling less than 25 miles one way while 58.5 percent reported traveling less than 51 miles one way (n=371). On overnight trips, 18.2 percent of the respondents reported that they travel less than 51 miles one way while 55.1 percent reported traveling over 100 miles one way.

In order to transport their snowmobiles to where respondents ride most often, 19.8 percent rode the snowmobile, 73.2 percent used a trailer and 7.0 percent used a pickup truck (n=384).

In addition to the discussion presented above, ISIA also stated that neither survey (*i.e.*, the 1986-1987 or the 1992 survey) directly provide usage information at the regional level. ISIA has not investigated this issue. Moreover, a copy of the questionnaire was requested but not provide by ISIA.

ISIA has also conducted consumer surveys over the last 5 years from which useful life estimates were derived. At first, manufacturers and ISIA believed the average expected life span of snowmobiles to be 7 years. But survey data showed that a significant number of older snowmobiles remained in service. As a result, ISIA has revised their life expectancy estimate to 10 years, although some snowmobiles have been found to last as long as 15 years.

As with most other nonroad equipment associations, vintage specific attrition rates and rebuild/replacement rates were not available from ISIA or from member manufacturers.

## 2.6 MOTORCYCLE INDUSTRY COUNCIL (MIC)

MIC is a non-profit national trade organization representing manufacturers and distributors of motorcycles, motorcycle parts and accessories, and members of allied trades. Products represented by this association include on-highway motorcycles, scooters, all terrain vehicles (ATV's), and off-highway motorcycles. Of these, ATV's and off-highway motorcycles are considered to be nonroad vehicles and, thus, apply to this study.

Extensive information is available from MIC's *1991 Motorcycle Statistical Annual* on ATV's and off-highway motorcycles. This publication is the single most complete public source of data for these nonroad vehicles. Estimates are available on model year retail sales by engine size (which give some indication of horsepower ranges) and major brands. In addition, current in-use populations by State are provided, as well as vintage specific attrition rates, historical registrations, imports by country and engine displacement, and average annual mileage estimates.

MIC has developed a rigorous, scientific approach to estimate off-highway motorcycle and ATV sales, usage, and attrition. The underlying sources for these estimates include manufacturer wholesale shipment records, retail outlet audits, and results from an extensive survey conducted every five years by Burke Marketing Research. MIC recently submitted the following detailed description of the processes that are employed to estimate vehicle sales and vintage specific attrition rates.

Data published by MIC regarding retail sales estimates of vehicles used off-highway are based on three sources:



- 1) **The MIC Retail Sales Report** which is based on warranty registration data provided by Honda, Yamaha, Kawasaki, Suzuki and Harley Davidson (which account for over 90 percent of total retail sales). The MIC also conducts a physical audit of a sample of dealers throughout the U.S. to determine the ratio of warranty registrations to retail sales about every two years.
- 2) **R.L. Polk Registrations** - New motorcycle registration statistics are purchased from R.L. Polk & Company. These are useful for estimating sales of brands not included in the MIC Retail Sales Reporting System.
- 3) **MIC Manufacturers Wholesale Sales** reports and other miscellaneous data are used to verify that sales estimates are in line.

Vehicles in use are estimated from sales data each year and adjusted using an operability, survival probability rate. The operability rate is updated every five years from results of the *Survey of Motorcycle Ownership and Usage* conducted by Burke. Operability rates by model type are based on the percent of the vehicle population by age of vehicle compared to the number of vehicles sold new each year. A separate analysis of the operability rate was done in 1980 and has been updated for 1985 and 1990.

Burke's survey results are employed to determine national and State level off-highway and ATV populations and usage, as well as vintage specific survival probability rates (as mentioned above). MIC's State level population, annual usage, and seasonal usage estimates derived from Burke's survey are provided in **Appendix B**, as well as a detailed description of the surveying methodology that was employed by Burke Marketing Research. In sum, a total of 1,896 telephone interviews of motorcycle<sup>3</sup> owners and 1,204 interviews of households not currently owning a motorcycle were conducted during 1990 using the Super Survey Sampling National Probability Sample (NPS).

Table 2-12 and Figure 2-1 summarize sales and attrition data from the *1991 Motorcycle Statistical Annual*. JFA recommends that MIC data be used as the basis for developing the

---

<sup>3</sup>Includes on-highway and off-highway motorcycles and ATVs.

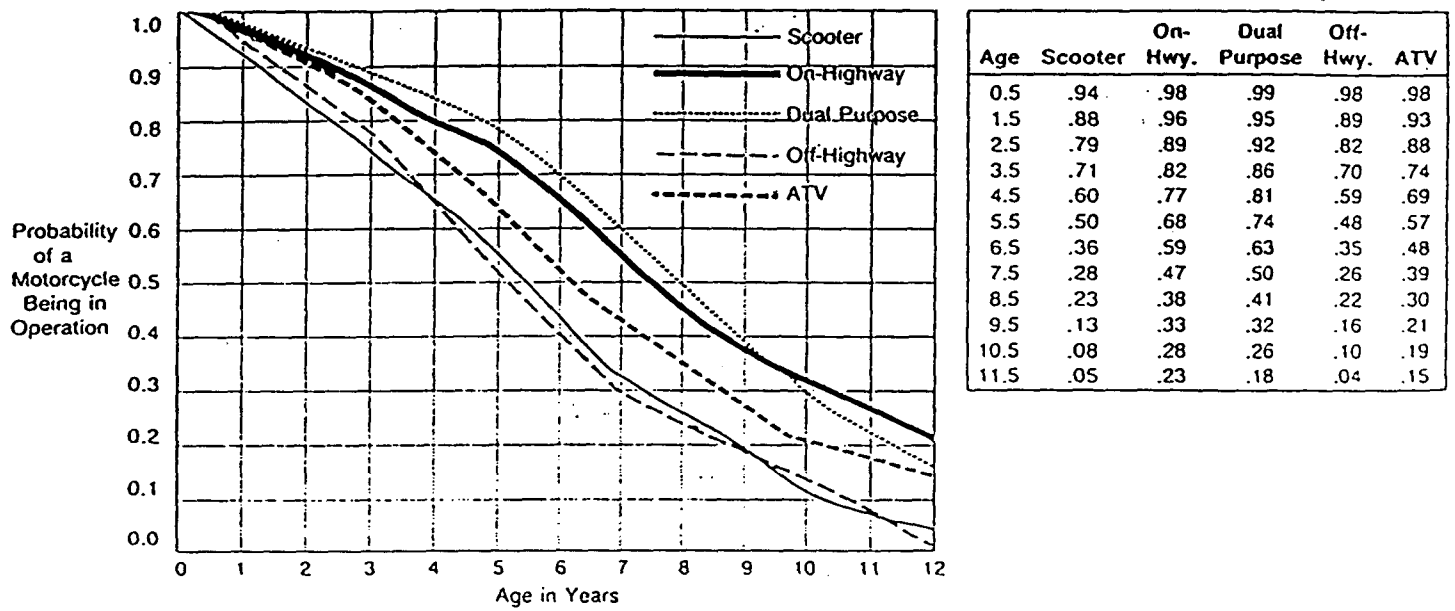
**TABLE 2-12****ESTIMATED NEW RETAIL SALES OF  
OFF-HIGHWAY MOTORCYCLES AND ATVs**

<b>YEAR</b>	<b>OFF-HIGHWAY MOTORCYCLES</b>	<b>ATVs</b>
1970	199,000*	N/A
1971	226,000*	N/A
1972	233,000*	N/A
1973	292,000*	N/A
1974	244,000*	N/A
1975	247,000*	N/A
1976	260,000*	N/A
1977	283,000*	N/A
1978	326,000*	N/A
1979	332,000*	N/A
1980	313,000*	N/A
1981	370,000*	N/A
1982	165,000	250,000
1983	155,000	425,000
1984	150,000	550,000
1985	145,000	550,000
1986	125,000	480,000
1987	100,000	405,000
1988	85,000	290,000
1989	70,000	200,000
1990	84,000	145,000

\* Sales estimates include both off-highway motorcycles and ATVs units.

Source: Motorcycle Industry Council

**FIGURE 2-1  
VINTAGE ATTRITION RATES FOR ATVs  
AND OFF-HIGHWAY MOTORCYCLES**



Source: Motorcycle Industry Council

data matrices needed for emission estimates and forecasts of off-highway motorcycles and ATVs, since sales, usage, and scrappage data on these equipment types are not readily available from other sources.

Detailed sales breakdown by engine type (*i.e.*, two or four stroke) are unavailable. However, information compiled in 1990 by MIC for California indicated that 28.92 percent of the in-use California population was 2-stroke powered, while the remaining 71.08 percent of the in-use fleet was powered by 4-stroke engines. These estimates included only recreational off-highway populations and ATVs, and excluded closed course, competition (motocross) motorcycles, which are virtually all powered by 2-stroke engines. MIC's statistical annual also provides some generalized data on 2-stroke versus 4-stroke sales splits. However, the splits presented in that publication do not distinguish between motorcycle types (*i.e.*, on-highway, off-highway, dual purpose, or ATV's).

MIC estimates off-highway motorcycle usage in the U.S. to be an average of 313 miles per year. ATV usage is estimated to average 263 miles per year. These estimates were derived from Burke Marketing Research's *1990 Survey of Motorcycle Usage and Ownership* conducted for MIC in 1991. The survey results were recently provided to JFA and further indicate that the riding season for ATV's is year-round, whereas off-highway motorcycle usage follows a warm weather pattern. In addition, an estimated 66.5 percent of off-highway motorcycle usage and 65.9 percent of ATV usage occurs on weekends. Days ridden annually average 51.2 for off-highway motorcycles and 81.1 for ATV's, according to Burke's survey.

Data on engine rebuild/replacement rates are not available from MIC or from their member manufacturers. However, it is known that many enthusiasts routinely refresh (replace rings

and/or pistons) the top end of their 2-stroke motorcycles between riding seasons. On the other hand, many others, notably 4-strokes, see little or no major maintenance during their life spans.

## 2.7 EQUIPMENT MANUFACTURERS INSTITUTE (EMI)

EMI has been extensively involved in EPA's process of characterizing emissions from nonroad sources. EMI is the principal association in the U.S. representing manufacturers of agricultural, construction, forestry, material handling, and utility equipment. A total of 160 equipment manufacturers and 140 associates and suppliers are members of EMI. Their input was essential in deriving EPA's NEVES inventory B estimates, as they provided population estimates on construction, agricultural, and light commercial equipment, and estimates on average hours of annual use.

EMI's estimates of equipment populations do not, however, rely on a detailed profile of equipment sales, scrappage, and engine rebuild/replacement rates. For example, agricultural equipment population estimates submitted to EPA for NEVES were taken from the *1987 Agricultural Census* conducted by the U.S. Department of Commerce, Bureau of the Census, which collects survey data for motor trucks, farm tractors, combines, cotton pickers/cotton strippers, mower conditioners, and pick-up balers. Of these, only tractors, combines, and cotton pickers/cotton strippers are considered as nonroad vehicles. A detailed description of the survey methodology employed by the Bureau of the Census for the *1987 Census of Agriculture* is presented in **Appendix C**. Estimated equipment populations are available from this source at the national, State, and county levels.

Similarly, EMI's estimates of construction equipment populations used publicly available data from a 1987 MacKay & Company's study for Construction Equipment Magazine, which

reported the estimated total national population by machine type. EMI states in their letter to John German (EPA) dated July 30, 1991 the following observation which indicates their rationale for employing this data source. "This source [MacKay & Company's data] was the only one available to our knowledge. Estimating machine populations would be very difficult because of the lack of a continuous time series of retail sales over a long period of years. The industry has collected such data only since 1980, a period of time too short for making population estimates."

Original sales data available from EMI are generally limited to the type shown in Table 2-13 for farm wheel tractors. These sales estimates were compiled from EMI's public reports, a summary example of which is provided in Table 2-14. These reports summarize manufacturer specific sales that are submitted to EMI and can be used to compile information similar to that shown in Table 2-13. However, much effort will need to be expended to develop State level historical sales by horsepower ranges for farm wheel tractors and historical State level sales for the other types of agricultural equipment included in EMI's public reports. Moreover, JFA has only received detailed State sales records for 1987 and 1988 from EMI, although similar records should be available for other years.

EMI's statement regarding the availability of sales data for construction equipment implies that such information is maintained by manufacturers, but is not likely to be provided to EPA or its contractors. EMI has stated that sales information beyond that available from their public reports will not be provided because of proprietary reasons. Similarly, data on scrappage and engine rebuild/replacement rates are not available directly from EMI or from its member manufacturers. Information provided by EMI on annual usage is included in EPA's NEVES, so it is not reviewed in this report. However, it should be noted that usage data provided by EMI were also directly derived from usage information found in MacKay & Company's study.

# Table 2-13

## Farm Wheel Tractor Retail Sales By State, 1985-1989

State	1985			1986			1987			1988			1989		
	2-wheel Drive	4-wheel Drive	Total Tractors	2-wheel Drive	4-wheel Drive	Total Tractors	2-wheel Drive	4-wheel Drive	Total Tractors	2-wheel Drive	4-wheel Drive	Total Tractors	2-wheel Drive	4-wheel Drive	Total Tractors
Alabama	2,872	2	2,874	3,041	—	3,041	2,943	1	2,944	2,959	2	2,961	4	2,874	2,878
Alaska	39	—	39	22	—	22	20	—	20	12	—	12	—	18	18
Arizona	1,240	29	1,269	657	16	673	638	2	640	677	8	685	20	805	825
Arkansas	3,683	70	3,753	3,154	55	3,209	3,083	31	3,114	3,145	105	3,250	178	3,442	3,620
California	4,931	74	5,005	5,138	73	5,211	4,970	49	5,019	5,963	87	6,050	235	5,971	6,207
Colorado	983	89	1,072	711	50	761	682	59	741	750	98	848	109	795	904
Connecticut	715	1	716	937	—	937	1,091	1	1,092	1,065	—	1,065	—	674	674
Delaware	286	7	293	351	6	357	320	4	324	369	12	381	17	409	426
Florida	4,543	30	4,573	4,732	31	4,763	4,375	55	4,430	4,615	68	4,683	98	4,235	4,333
Georgia	5,242	5	5,247	5,077	6	5,083	5,173	3	5,176	4,644	5	4,649	11	4,491	4,502
Hawaii	126	9	135	142	4	146	149	4	153	194	2	196	4	206	210
Idaho	786	83	869	483	35	518	497	17	514	490	23	513	71	805	876
Illinois	3,327	252	3,579	3,182	155	3,337	3,204	116	3,320	3,070	173	3,243	322	3,364	3,686
Indiana	2,789	113	2,902	2,784	68	2,852	2,712	46	2,758	2,348	100	2,448	195	2,694	2,889
Iowa	1,894	68	1,962	2,022	69	2,091	2,433	64	2,497	2,516	111	2,627	161	2,489	2,650
Kansas	1,739	248	1,987	1,585	134	1,719	1,591	132	1,723	1,778	268	2,046	293	1,767	2,060
Kentucky	3,044	23	3,067	2,643	11	2,654	2,519	8	2,527	2,506	14	2,520	34	2,923	2,957
Louisiana	3,419	66	3,485	2,802	15	2,817	2,430	23	2,453	2,112	66	2,278	79	2,297	2,375
Maine	625	—	625	806	—	806	824	—	824	903	—	903	1	695	696
Maryland	2,139	3	2,142	2,081	1	2,082	2,279	2	2,281	2,022	3	2,025	8	1,869	1,877
Massachusetts	783	—	783	999	—	999	1,188	—	1,188	1,043	2	1,045	—	650	650
Michigan	2,975	74	3,049	3,051	51	3,102	2,624	34	2,658	2,782	56	2,838	104	2,713	2,817
Minnesota	1,714	202	1,916	1,651	183	1,834	1,816	153	1,969	1,777	227	2,004	311	1,965	2,276
Mississippi	3,172	20	3,192	2,516	7	2,523	2,317	16	2,333	2,351	21	2,372	31	2,471	2,502
Missouri	3,159	35	3,194	3,290	38	3,328	3,266	43	3,309	3,268	97	3,365	119	3,056	3,175
Montana	602	122	724	323	103	426	340	76	416	347	79	426	147	443	590
Nebraska	963	63	1,026	1,258	66	1,324	1,314	64	1,378	1,585	90	1,675	146	1,614	1,760
Nevada	113	4	117	102	2	104	99	1	100	87	1	88	3	111	114
New Hampshire	946	—	946	1,139	—	1,139	1,293	—	1,293	1,117	1	1,118	1	725	725
New Jersey	1,062	1	1,063	1,275	—	1,275	1,337	—	1,337	1,395	1	1,396	4	1,068	1,068
New Mexico	529	18	547	418	9	427	444	5	449	456	6	462	9	455	455
New York	3,717	21	3,738	4,065	24	4,089	4,074	6	4,080	3,937	16	3,953	37	3,410	3,410
North Carolina	4,478	9	4,487	4,511	7	4,518	5,334	3	5,337	5,218	4	5,222	27	4,955	4,982
North Dakota	917	351	1,268	892	292	1,184	1,092	223	1,315	623	285	908	397	805	1,202
Ohio	4,537	56	4,593	4,364	67	4,431	4,276	25	4,301	3,758	33	3,791	85	3,783	3,868
Oklahoma	2,203	167	2,370	1,899	82	1,981	1,857	81	1,938	1,729	164	1,893	208	1,682	1,890
Oregon	1,606	36	1,642	1,699	24	1,723	1,579	11	1,590	1,612	28	1,640	60	1,720	1,780
Pennsylvania	4,095	16	4,111	4,524	15	4,539	4,640	9	4,649	4,462	11	4,473	18	4,007	4,025
Rhode Island	97	—	97	117	—	117	119	—	119	115	—	115	—	83	83
South Carolina	2,171	5	2,176	2,033	1	2,034	2,127	2	2,129	2,646	5	2,651	8	2,465	2,473
South Dakota	809	158	967	934	149	1,083	1,130	118	1,248	837	179	1,016	223	1,023	1,246
Tennessee	4,522	16	4,538	4,207	13	4,220	4,472	6	4,478	4,015	15	4,030	34	3,814	3,848
Texas	13,252	192	13,444	9,849	77	9,926	8,183	95	8,278	6,839	150	6,989	146	6,718	6,864
Utah	625	6	631	480	4	484	308	1	309	283	5	288	8	342	350
Vermont	600	2	602	625	—	625	639	—	639	612	—	612	1	580	581
Virginia	3,253	5	3,258	3,309	6	3,315	3,704	1	3,705	3,722	2	3,724	3	3,579	3,582
Washington	1,652	83	1,735	1,450	39	1,489	1,433	30	1,463	1,325	53	1,378	87	1,672	1,714
West Virginia	685	—	685	925	1	926	850	—	850	685	—	685	1	631	632
Wisconsin	2,615	60	2,675	2,225	41	2,266	1,900	23	1,923	1,844	40	1,884	59	2,373	2,432
Wyoming	168	18	186	149	7	156	131	8	139	105	12	117	25	165	190
U.S. Govt.	13	—	13	29	—	29	183	2	185	368	1	369	1	54	55
Miscellaneous	306	—	306	250	—	250	529	—	529	835	—	835	5	509	515
<b>TOTAL</b>	<b>112,761</b>	<b>2,912</b>	<b>115,673</b>	<b>106,758</b>	<b>2,037</b>	<b>108,795</b>	<b>106,531</b>	<b>1,653</b>	<b>108,184</b>	<b>104,017</b>	<b>2,729</b>	<b>105,746</b>	<b>4,151</b>	<b>102,419</b>	<b>106,570</b>

Source: Equipment Manufacturers Institute (formerly Farm & Industrial Equipment Institute) Figures do not include garden tractors, motor tillers or contractors' off-highway equipment

**Table 2-14**  
**EXAMPLE OF EMI'S PUBLICLY AVAILABLE**  
**PERIODIC SALES REPORT**

EQUIPMENT	December			January - December		
	1989	1988	Percentage Change	1989	1988	Percentage Change
<b>Farm Wheel Tractors:</b>						
<b>2-Wheel Drive</b>						
Under 40 HP	2,401	3264	-26.44%	46,926	54,741	-14.28%
40 & Under 100 HP	2,633	2455	7.25%	34,910	33,160	5.28%
100 & Under 140 HP	609	465	30.97%	5,214	4,320	20.69%
140 HP & Over	<u>1,834</u>	<u>1332</u>	37.69%	<u>15,369</u>	<u>11,802</u>	30.22%
<b>Total 2-Wheel Drive</b>	7,477	7,516	-0.52%	102,419	104,023	-1.54%
<b>4-Wheel Drive</b>						
Under 200 HP	69	123	-43.90%	1,125	998	12.73%
200 HP & Over	<u>316</u>	<u>171</u>	84.80%	<u>3,026</u>	<u>1,731</u>	74.81%
<b>Total 4-Wheel Drive</b>	385	294	30.95%	4,151	2,729	52.11%
<b>TOTAL FARM WHEEL TRACTORS</b>	<u>7,862</u>	<u>7,810</u>	0.67%	<u>106,570</u>	<u>106,752</u>	-0.17%
<b>Combines (Self-Propelled)</b>	1,012	505	100.40%	9,110	5,995	51.96%
<b>Rectangular Balers</b>	203	154	31.82%	7,123	5,735	24.20%
<b>Forage Harvesters</b>	116	70	65.71%	2,801	2,405	16.47%
<b>(Shear Bar Type)</b>						
<b>Windrowers (Pull Canvas &amp; Power Units)</b>	107	83	28.92%	2,121	1,606	32.07%
<b>Mower Conditioners</b>	339	401	-15.46%	13,152	11,043	19.10%
<b>Combination Grinder-Mixers</b>	365	326	11.96%	2,485	2,656	-6.44%



MacKay's study is reviewed in Section 3 of this report.

The potential usefulness of EMI's original sales data for various agricultural equipment is potentially great. Once EMI's public reports have been thoroughly reviewed and summarized into State level sales by equipment type and horsepower ranges (at least for farm wheel tractors), EMI's sales information can be employed as validation data or as baseline data from which gasoline and diesel, as well as 2-stroke and 4-stroke, sales estimates can be derived. However, in order to develop population estimates from these sales estimates, vintage specific attrition rates are necessary. Moreover, the feasibility or cost-effectiveness of undertaking such a resource intensive task needs to be further evaluated.

## **2.8 OTHER INDUSTRY ASSOCIATIONS**

JFA also contacted additional industry associations to request data on sales, scrappage, and engine rebuild/replacement rates. Those contacted include the Engine Manufacturers Association (EMA), the Construction Industry Manufacturers Association (CIMA), the Outdoor Power Equipment Aftermarket Association (OPEAA), the National Equipment Servicing Dealers Association (NESDA), the Engine Service Association (ESA), the Associated Equipment Distributors (AED), and the North American Equipment Dealers Association (NAEDA). The latter two were suggested as possible sources by EMI.

EMA and CIMA were, and continue to be, involved in the process of estimating emissions from nonroad sources. However, each has provided limited data on the parameters that are needed for an emissions model. EMA's input has concentrated on: helpful qualitative descriptions of the nonroad engine industry; characterizations of nonroad engine duty cycles; recommendations on the selection of representative test procedures, baseline emission factors.

and actual measured emissions; regulatory approaches; and descriptions of possible emission control technologies. CIMA, on the other hand, submitted construction equipment populations estimates by horsepower ranges. However, the estimates that were provided were directly taken from the 1987 MacKay & Company study. Letters were sent to both of these associations asking for detailed data on scrappage, sales, and engine rebuild/replacement rates. But, their answers confirmed our expectations that they maintain no data on these issues.

The other associations that were contacted by telephone provided no useful data on any of the parameters that are needed. OPEAA, NESDA, and ESA were targeted with the hope that they would at the very least provide anecdotal data on scrappage and/or engine rebuild/replacement rates. Unfortunately, they referred data requests to the other associations reviewed in Sections 2.1 through 2.7.

### **SECTION 3:**

#### **SOURCES OF DATA OTHER THAN INDUSTRY**

##### **3.1 OVERVIEW**

Since useful information on equipment sales, usage, attrition, and engine rebuild/replacement rates is not fully exhaustive from industry sources, other possible sources of relevant information were researched. These alternative sources include reports prepared by contractors and other investigative parties for government, data available from MacKay & Company, anecdotal information on scrappage and engine maintenance available from "field" sources (such as equipment rental firms, service dealers, etc.), and equipment shipment data available from the Bureau of the Census for construction, farm, and lawn and garden equipment. Estimates on the relevant parameters that are available through these sources can be used as benchmarks against which industry data and information compiled by Power Systems Research (PSR) can be compared. This section reviews these alternative sources of information.

##### **3.2 CONSULTANTS' REPORTS TO GOVERNMENT**

With the goal of expanding the number of possible data sources on nonroad equipment sales, attrition, usage, populations, emissions, and other relevant factors, JFA conducted a literature search to identify reports on nonroad emissions. This search identified various nonroad studies that were conducted by consultants in recent years. The following were found to have useful information and are reviewed in this study: 1) *Inventory of Emissions from Non-Automotive Vehicular Sources*, prepared by KVB, Inc. for the California Air Resources Board (ARB), dated February 1980; 2) *Status Report: Emissions Inventory on Non-Farm (MS-1), Farm (MS-2), and Lawn and Garden (Utility) (MS-3) Equipment*, prepared by ARB, dated July

1983; 3) *Feasibility and Cost-Effectiveness of Controlling Emissions from Diesel Engines in Rail, Marine, Construction, Farm, and Other Mobile Off-Highway Equipment*, prepared by Radian Corporation for the U.S. EPA on February 1988; 4) *Feasibility of Controlling Emissions from Off-Road, Heavy-Duty Construction Equipment*, prepared by Energy and Environmental Analysis, Inc. (EEA) for ARB, dated December 1988; and 5) *Technical Support Document for California Exhaust Emission Standards and Test Procedures for 1994 and Subsequent Model Year Utility and Lawn and Garden Equipment Engines*, prepared by Booz, Allen, & Hamilton (BAH) for ARB during 1990. Reports submitted by consultants during the development of NEVES were not reviewed for this study.

#### **KVB's 1980 Report to ARB**

The purpose of this study was to develop methodologies by which emission inventories from construction vehicles, agricultural vehicles, industrial vehicles, and marine vessels could be estimated for California and/or the South Coast Air Basin (SCAB). Separate methodologies were developed for each of the equipment categories described above. However, none of these relied on population estimates developed from sales and scrappage data. As a result, the only relevant information available from this study are out-dated California specific usage rates and fuel consumption rates for selected construction, agricultural, and industrial equipment.

#### **ARB's 1983 Report**

This ARB report estimates emission inventories for construction, agricultural, and lawn and garden equipment. The methodologies to calculate these inventories rely on equipment populations, load factor, annual hours of use, average horsepower, and emission factor

estimates. Useful information is available on load factors, usage, average horsepowers, and scrappage.

For construction equipment, population estimates were derived from U.S. Census data on construction Machinery (Form MQ-35D). Shipment data was compiled for 1969 through 1979, and a ten year life span was used to calculate the active populations of 24 types of construction equipment. This ten year life span estimate reflected manufacturer comments provided to ARB during that study. ARB staff also consulted with several construction firms to verify manufacturer lifetime estimates. At that time, those firms claimed that given two to three engine overhauls in a ten year span, a ten year useful life span was representative.

Farm equipment population estimates were derived using EMI's (then FIEI) sales data for various types of equipment. These sales estimates were combined with anecdotal estimates of scrappage rates. The useful life expectancy for 2-wheel and 4-wheel drive tractors were given as 16 and 10 years, respectively. While that of combines, windrowers, and forage harvesters, were estimated at 16 years, 13 years, and 11 years, respectively. These estimates were based on individual manufacturers' estimates, associations' estimates, and ARB staff communications with equipment dealers.

Lawn and garden equipment populations were estimated using a combination of Census shipment data for internal combustion engines, shipment data for individual types of lawn and garden equipment, estimated sales splits to commercial and residential users derived from information supplied by manufacturers, associations, and estimates of equipment useful lives and attrition. Three sources of information were used to derive the attrition rates employed by ARB in that report: 1) uncited Trendex reports concerning walk-behind lawnmowers and riding mowers/lawn tractors, 2) an uncited Kearney report concerning chainsaws, and 3) attrition

factors supplied by an unidentified major manufacturer of small utility gasoline-powered engines. The attrition factors used by ARB are shown later in this section in Table 3-3.

The information available in this ARB report on attrition, usage, and other emission parameters is extremely useful. Although somewhat outdated, ARB's estimates can be used as baseline data or validation data for estimates derived from other sources.

### **Radian's 1988 Report to EPA**

This report provides some useful information on diesel engines employed in agricultural, construction, and industrial applications. For this study, agricultural equipment populations were supplied by EMI (formerly FIEI), while estimates on average horsepower and hours of usage per year are based on a study conducted by Environmental Research and Technology, Inc. (ERT) entitled *Feasibility, Cost, and Air Quality Impact of Potential Emission Control Requirements on Farm, Construction, and Industrial Equipment in California* (1982). JFA has been unable to obtain a copy of this ERT report, but we anticipate that useful information may be available from it since Radian uses their usage and horsepower estimates for construction and industrial equipment as well. On the other hand, MacKay & Company's population estimates were used by Radian for construction and industrial equipment.

Radian's report provides no information on sales, scrappage, or engine rebuild/replacement rates. However, their population, usage, load factor, and horsepower estimates can be used to compare similar data available from other sources.

**EEA's 1988 Report to ARB**

EEA's report on emissions from heavy-duty construction equipment operating in California is a good source of independently derived estimates of vintage specific attrition rates and annual hours of use for the heavy-duty construction category (*i.e.*, equipment with engines above 50 horsepower). During the course of that study, EEA conducted a small survey of major construction contractors, State and local agencies, and equipment rental agencies operating in California to determine the number of construction vehicles by horsepower ranges owned by these entities, estimates of typical useful life, and average annual usage data. Between 50 and 60 survey questionnaires were mailed, of which 20 to 25 responses were received by EEA. Results from the responses indicated the average life of a backhoe/loader to be 10 years, while that of a roller/compactor to be 9 years. While many contractors reported the average life of their equipment to be 15-20 years, others reported average equipment lives of 5, 7, or 10 years. These lower estimates may reflect duration of ownership, rather than useful life, since many contractors resell their equipment. County and city governments were found to keep their equipment for much longer periods of time. Based on the information from the survey, EEA estimated the average life of construction equipment, as an aggregate, to be 13 to 15 years.

EEA also constructed vintage specific attrition and usage rates for this ARB report. Scrappage rates were based on anecdotal information, and are reproduced (along with usage rates) in Table 3-1. EEA's scrappage curve shows a mean life of 15 years. EEA's vintage specific usage rates were also derived from anecdotal information. Construction companies interviewed by EEA indicated new equipment usage to be extensive in the first 8 to 10 years of its life, while EEA's survey indicated that equipment older than 20 years was used 700/800 hours per year, about one-half of the EEA's estimated new equipment usage of 1400 hours per year.

**Table 3-1****CALIFORNIA HEAVY CONSTRUCTION EQUIPMENT  
SURVIVAL AND USE RATES BY VINTAGE**

<b>EQUIPMENT VINTAGE</b>	<b>EQUIPMENT SURVIVAL RATE</b>	<b>EQUIPMENT USE HOURS/YEAR</b>
1	1.00	1400
2	0.98	1400
3	0.96	1400
4	0.94	1400
5	0.92	1400
6	0.90	1400
7	0.88	1400
8	0.86	1300
9	0.84	1200
10	0.80	1100
11	0.75	1000
12	0.70	1000
13	0.65	1000
14	0.60	1000
15	0.55	1000
16	0.50	1000
17	0.45	950
18	0.40	900
19	0.35	850
20	0.30	800
21	0.27	750
22	0.24	700
23	0.21	700
24	0.18	700
25	0.15	700
26	0.12	700
27	0.09	700
28	0.06	700
29	0.04	700
30	0.02	700

Source: Energy and Environmental Analysis, Inc. (EEA)



**BAH's 1990 Report to ARB**

The technical support document prepared by BAH for ARB's utility and lawn and garden equipment engines emissions study provides detailed information on national shipment data, residential versus commercial sales splits, attrition factors, annual hours of usage, and average horsepower derived by various sources for the most common types of lawn and garden equipment. Unfortunately, data on engine rebuild/replacement rates are not available from BAH's report.

BAH's report provides historical (1981 to 1989) national shipment data for 14 types of lawn and garden equipment. OPEI's shipment data for walk-behind mowers, front engine riding mowers, rear engine riding mowers, garden tractors, tillers, and snow throwers were used in BAH's analysis. Sales estimates for general utility equipment were compiled under the assumption that general utility engine sales average between 6 percent and 8 percent of the total lawn and garden sales (*i.e.*, shipments) provided by OPEI. Finally, national sales estimates for shredders/grinders, specialized turf care equipment, blowers/vacuums, edgers/trimmers, and chainsaws were developed from a combination of Census' *Current Industrial Reports* -- Farm Machinery and Lawn and Garden Equipment -- and data obtained from OPEI's *Utility Equipment Market Survey*, which reiterates data already presented in Section 2.2 of this report. Table 3-2 provides BAH's national sales estimates for those equipment types not presented in Table 2-1.

BAH's report also provides useful information about the breakdown of sales by commercial and residential (or consumer) end users. BAH analyzed data provided by Briggs & Stratton, OPEI, ARB, and Heiden Associates to arrive at their estimates. As a summary, consumer/commercial splits available from various sources are provided below.

Table 3-2

**U.S. SALES OF SELECTED GASOLINE POWERED ENGINES  
LESS THAN 25 HORSEPOWER, 1981-1989**

PRODUCT CATEGORY	YEARS								
	1981	1982	1983	1984	1985	1986	1987	1988	1989
GENERAL UTILITY	640,083	621,696	610,184	689,620	727,678	754,936	827,070	806,910	765,074
SHREDDERS/GRINDERS	19,443	16,330	23,239	34,229	55,770	67,211	59,454	72,330	77,405
SPECIALIZED TURF CARE	10,620	14,168	12,688	14,277	24,952	49,015	24,359	38,046	31,108
4-CYC BLOWERS/VACUUMS	9,776	10,103	3,996	8,598	5,742	9,630	10,285	14,323	16,342
4-CYC EDGERS/TRIMMERS	143,986	184,363	169,916	141,100	164,313	136,500	153,600	170,400	185,888
2-CYC EDGERS/TRIMMERS	308,595	568,131	717,279	828,000	1,713,000	1,847,000	2,102,000	2,314,000	2,542,000
2-CYC BLOWERS/VACUUMS	285,682	525,948	664,022	766,522	1,124,579	951,472	991,854	1,393,710	950,868
CHAIN SAWS	1,323,800	1,560,249	1,261,545	1,121,000	1,252,000	1,152,000	1,193,000	1,155,000	1,294,000

SOURCE: BAH

Estimates of Consumer Sales as a Percentage of Total Sales					
Product Category	Briggs	OPEI	ARB	Heiden	BAH
Walk-Behind Mowers	90%	90%	90%	N/A	88%
Riding Mowers	75%	100%	75%	N/A	95%
Tillers	60%	60%	50%	N/A	60%
General Utility	50%	0%	50%	N/A	25%
Chainsaws	N/A	N/A	90%	75%	75%
Misc. L & G Equip.	50%	60%	90%	N/A	60%
Misc. 2-Stroke	N/A	N/A	N/A	85%	85%

The attrition factors used by BAH to estimate equipment populations and emissions were taken directly from ARB's 1983 report entitled *Status Report: Emissions Inventory on Non-Farm (MS-1), Farm (MS-2), and Lawn and Garden (Utility) (MS-3) Equipment* and are shown in Table 3-3. In addition, some useful comparisons between various estimates of average lifespans are made in the BAH report.

The BAH report also provides useful information on 2-stroke versus 4-stroke splits, annual use, load factors, and average horsepower for the equipment types included in their study. BAH's estimates are based on data available from OPEI, CIC Research, ARB, and Heiden Associates. Table 3-4 summarizes BAH's estimates of these parameters.

Table 3-3

**RESIDENTIAL AND COMMERCIAL ATTRITION FACTORS  
FOR SELECTED LAWN AND GARDEN EQUIPMENT  
RESIDENTIAL USE ATTRITION FACTORS**

PRODUCT CATEGORY	YEARS									IMPLIED AVERAGE LIFESPAN
	1981	1982	1983	1984	1985	1986	1987	1988	1989	
WALK BEHIND MOWERS	0.32	0.40	0.48	0.58	0.69	0.79	0.89	0.96	1.00	7.04
RIDING MOWER (FRT ENG)	0.32	0.40	0.48	0.58	0.69	0.79	0.89	0.96	1.00	7.04
RIDING MOWER (REAR ENG)	0.32	0.40	0.48	0.58	0.69	0.79	0.89	0.96	1.00	7.04
GARDEN TRACTOR	0.32	0.40	0.48	0.58	0.69	0.79	0.89	0.96	1.00	7.04
TILLERS	0.32	0.40	0.48	0.58	0.69	0.79	0.89	0.96	1.00	7.04
SNOWTHOWERS	0.14	0.23	0.32	0.42	0.54	0.69	0.83	0.94	1.00	5.41
GENERAL UTILITY	0.32	0.40	0.48	0.58	0.69	0.79	0.89	0.96	1.00	7.04
SHREDDERS/GRINDERS	0.32	0.40	0.48	0.58	0.69	0.79	0.89	0.96	1.00	7.04
4-CYC BLOWERS/VACUUMS	0.32	0.40	0.48	0.58	0.69	0.79	0.89	0.96	1.00	7.04
4CYC EDGERS/TRIMMERS	0.32	0.40	0.48	0.58	0.69	0.79	0.89	0.96	1.00	7.04
2-CYC EDGERS/TRIMMERS	0.07	0.16	0.24	0.37	0.59	0.83	0.94	0.98	1.00	5.21
2CYC-BLOWERS/VACUUMS	0.07	0.16	0.24	0.37	0.59	0.83	0.94	0.98	1.00	5.21
CHAIN SAWS	0.07	0.16	0.24	0.37	0.59	0.83	0.94	0.98	1.00	5.21

Table 3-3, cont.

## COMMERCIAL USE ATTRITION FACTORS

PRODUCT CATEGORY	YEARS									IMPLIED AVERAGE
	1981	1982	1983	1984	1985	1986	1987	1988	1989	LIFESPAN
WALK BEHIND MOWERS				0.07	0.10	0.24	0.48	0.79	1.00	2.68
RIDING MOWER (FRT ENG)	0.04	0.08	0.10	0.18	0.32	0.48	0.69	0.89	1.00	3.78
RIDING MOWER (REAR ENG)	0.04	0.08	0.10	0.18	0.32	0.48	0.69	0.89	1.00	3.78
GARDEN TRACTOR	0.04	0.08	0.10	0.18	0.32	0.48	0.69	0.89	1.00	3.78
TILLERS	0.14	0.23	0.32	0.42	0.54	0.69	0.83	0.94	1.00	5.41
SNOWTHOWERS	0.14	0.23	0.32	0.42	0.54	0.69	0.83	0.94	1.00	5.41
GENERAL UTILITY				0.01	0.07	0.24	0.59	0.94	1.00	2.85
SHREDDERS/GRINDERS	0.14	0.23	0.32	0.42	0.54	0.69	0.83	0.94	1.00	5.41
SPECIALIZED TURF CARE	0.04	0.08	0.10	0.18	0.32	0.48	0.69	0.89	1.00	3.78
4-CYC BLOWERS/VACUUMS				0.07	0.10	0.24	0.48	0.79	1.00	2.68
4CYC EDGERS/TRIMMERS				0.07	0.10	0.24	0.48	0.79	1.00	2.68
2-CYC EDGERS/TRIMMERS				0.01	0.07	0.24	0.59	0.94	1.00	2.85
2CYC-BLOWERS/VACUUMS				0.01	0.07	0.24	0.59	0.79	1.00	2.85
CHAIN SAWS				0.00	0.00	0.00	0.00	0.33	1.00	1.33

NOTE:ATTRITION RATES FOR ALL EQUIPMENT ARE TAKEN FROM ARB'S 1983 OFF-ROAD EMISSION INVENTORY REPORT.  
ATTRITION RATES FOR COMMERCIAL CHAINSAWS HOWEVER ARE BASED ON INTERVIEWS WITH EQUIPMENT MANUFACTURERS.

SOURCE: BAH

Table 3-4

**2-STROKE vs. 4-STROKE SALE SPLITS, HORSEPOWER,  
LOAD FACTOR AND USAGE DATA FOR  
LAWN AND GARDEN EQUIPMENT**

PRODUCT CATEGORY	RESIDENTIAL					COMMERCIAL				
	PERCENT 4 CYCLE	PERCENT 2 CYCLE	AVG. HP	LOAD FACTOR	ANNUAL HRS USE PER YEAR	PERCENT 4 CYCLE	PERCENT 2 CYCLE	AVG. HP	LOAD FACTOR	ANNUAL HRS USE PER YEAR
WALK BEHIND MOWERS	93%	7%	3.5	36%	20.0	85%	15%	4	36%	320
RIDING MOWERS (FRT ENG)	100%	0%	13.0	42%	38.0	100%	0%	14	42%	380
RIDING MOWERS (REAR ENG)	100%	0%	10.0	38%	38.0	100%	0%	11	38%	380
GARDEN TRACTORS	100%	0%	15.0	60%	56.0	100%	0%	17	60%	180
TILLERS	100%	0%	5.0	40%	18.0	100%	0%	6	40%	72
SNOWTHROWERS	95%	5%	4.5	35%	10.0	95%	5%	6	35%	60
GENERAL UTILITY	95%	5%	4.0	50%	5.0	95%	5%	10	50%	96
SHREDDERS/GRINDERS	95%	5%	4.0	36%	16.5	95%	5%	12	36%	190
SPECIALIZED TURF CARE						90%	10%	12	50%	800
4-CYC BLOWERS/VACUUMS	100%	0%	3.5	36%	10.0	100%	0%	8	36%	190
4-CYC EDGERS/TRIMMERS	100%	0%	3.5	36%	10.0	100%	0%	5	36%	190
2-CYC BLOWERS/TRIMMERS	0%	100%	0.8	50%	10.0	0%	100%	2	50%	170
2-CYC BLOWERS/VACUUMS	0%	100%	0.8	50%	10.0	0%	100%	3	50%	275
CHAIN SAWS	0%	100%	1.5	50%	7.0	0%	100%	4	50%	405

Source: BAH

### 3.3 MACKAY & COMPANY DATA (CONSTRUCTION EQUIPMENT MAGAZINE)

One of the most referred to sources for information on construction equipment populations, usage, and scrappage is *Construction Equipment* magazine's report on the *Universe of Construction Equipment*. The data appearing in this report was compiled by MacKay & Company through a four step process designed to determine the operating universe for 37 categories of construction equipment operating in the U.S., as well as average age, annual hourly usage, and ownership patterns.

The first step was to determine the number of firms in the operating universe by SIC code. The primary reference was the U.S. Census of Construction and Census of Mines. In addition to Census data, MacKay & Company relied on input from trade associations about the number and types of firms that operate construction equipment.

The second step was a detailed review of government and industry data on production, exports, and imports of specific equipment types, thereby allowing MacKay & Company to estimate the number of units placed in service in the U.S.

Third, MacKay & Company conducted a relatively extensive mail survey. Questionnaires were sent to the magazine's subscribers identified to be equipment users, to residential and light commercial builders who receive *Professional Builder* magazine, and to rental dealers and distributors. Responses allowed MacKay & Company to determine equipment acquisition patterns, type of ownership (*i.e.*, own, lease, or rent), purchases of new versus used equipment, life expectancies that are applied to their estimates of units placed in service, and machine usage by type of application and fleet size as measured by the replacement value of a firm's

construction equipment. A total of 16,750 questionnaires were mailed out for the latest version of this study on October 3, 1990. Overall, more than 5,000 responses were received, equivalent to a 32.9 percent response rate. Six questionnaires were developed and sent out. Three of the six were targeted at equipment end-users identified through *Construction Equipment* magazine subscribers. One questionnaire was targeted at residential and commercial builders identified from *Professional Builder* magazine. Two other questionnaires were sent to rental dealers and distributors to assure that rental equipment are not double counted in the sampling process. In effect, each questionnaire was different in content and can be regarded as an independent survey from the others, although together they account for MacKay & Company's sample universe of construction equipment operators. A detailed distribution of the total respondents by audience is provided below:

Questionnaire	Audience	Respondents	Response Rate
1	End-users	872	38.1%
2	End-users	860	38.9%
3	End-users	2,702	33.7%
4	Builders	248	9.9%
5	Distributors	405	46.2%
6	Rental Dealers	434	49.6%
Total		5,521	32.9%

The fourth and final step included the development of machine profiles by vocation and fleet size for each equipment type. By comparing MacKay & Company's study results with *Construction Equipment's* supplemental firm audit conducted by Business Publications Audit.



a profile of machines operated by *Construction Equipment* reader firms was developed. It should be noted, however, that MacKay & Company's sample universe by definition does not account for all companies that own or use all types of construction equipment. As EMI has argued, for instance, backhoe loaders and skid steer loaders are often employed in agricultural applications. But since the survey process accounts for all units in rental fleets, then if firms outside the sample universe rent construction equipment, then that firm's equipment are included in MacKay & Company's estimates.

Table 3-5 shows the equipment types included in the 1987 and 1991 MacKay studies. Both studies cover virtually the same equipment types, although the 1991 study added Aerial Work Platforms and All Terrain Cranes. The 1987 study used a three-step rather than a four step methodology. However, the same issues were basically investigated and the same survey process was employed as in the 1991 study -- the 1991 study was an update to the 1987 study. The methodology of the 1987 study was as follows:

- **Phase 1:** Detailed analysis of machine production and import/export data for the past two decades.
- **Phase 2:** Identification of the distribution of each type of machine according to user-fleet size and vocation.
- **Phase 3:** Performance of accuracy checks comparing data and assumptions with those of major equipment marketers.

MacKay & Company's study is only available through *Construction Equipment* magazine, the owner of the actual study. The non-advertiser price for the latest *1991 Universe Study* is

**Table 3-5**  
**EQUIPMENT TYPES INCLUDED IN**  
**MACKAY AND COMPANY'S STUDIES**

1991 STUDY		1987 STUDY	
<b>EARTHMOVING</b>	<b>LIFTING</b>	<b>EARTHMOVING</b>	<b>LIFTING AND HOISTING EQUIPMENT</b>
Backhoe Loaders	Aerial Work Platforms	Tractor Backhoe-Loaders	Lattice-Boom Crawler Cranes
Crawler Dozers	All-Terrain Cranes	Crawler Dozers	Lattice-Boom Truck Cranes
Crawler Loaders	Hydraulic Truck Cranes	Loaders	Hydraulic Truck Cranes
Hydraulic Excavators	Knuckleboom Cranes, Truck-Mounted	Skid-Steer	Self-Propelled Rough-Terrain Cranes
Crawler-Mounted	Lattice-Boom Crawler Cranes	Crawler-Type	Tower Cranes
Wheel-Mounted	Lattice-Boom Truck-Mounted Cranes	Wheel-Type	Truck-Mounted Knuckle-Boom Cranes
Truck-Mounted Telescopic	Rough-Terrain Cranes	Excavators	Truck-Mounted Telescopic Cranes
Motor Graders	Rough-Terrain Forklifts	Wheel-Type	Rough-Terrain Forklifts
Articulated	Telescopic	Crawler-Type	Vertical Mast
Rigid Frame	Vertical Mast	Truck-Mounted/Telescoping	Telescopic Boom
Off-Highway Haulers	Telescopic Cranes, Truck-Mounted	Graders	
Articulated Dumps	Tower Cranes	Rigid-Frame	<b>PAVING AND MATERIAL PRODUCTION</b>
Straight Dumps		Articulated	Concrete Pumps
Tractor-Trailer Rear/Side Dumps	<b>PAVING</b>	Compactors	Truck-Mounted
Scrapers	Asphalt Pavers	Vibrating	Trailer-Mounted
Conventional/Open Bowl	Concrete Pavers	Non-Vibrating	Skid-Mounted
Elevating	Slab	Scrapers	Rollers
Skid-Steer Loaders	Slipform	Conventional	Single-Drum
Trenchers	Combination	Elevating	Double-Drum
Chain Type	Concrete Pumps	Trenchers	Rubber-Tired
Wheel-Type	Trailer-or Skid-Mounted	Chain-Type	Asphalt Pavers
Wheel Loaders	Truck-Mounted	Wheel-Type	Crawler
	Planers & Profilers	Off-Road Haulers	Rubber-Tired
	Crawler-Mounted	Rigid-Frame, Rear-Dump	Towed
	Wheel-Mounted	Articulated, Rear-Dump	Concrete Pavers and Slipformers
	Rollers & Compactors	Bottom/Side-Dump Tractor Trailers	Slab Pavers
			Curb/Gutter Median Slipform Pavers
			Combination Slab and Slipform Pavers
			Planer/Profilers
			Crawler-Mounted
			Rubber-Tired
			Crushing Plants
			Screening Plants

\$6,000. According to *Construction Equipment* magazine, this price includes copies of the questionnaires and a 24 page brochure summarizing the results of the study (the brochure can be purchased separately for \$300). In order to conduct a detailed examination of the data presented in MacKay & Company's study, the full study would have to be purchased. Such an evaluation would help to validate other data sources and would assure industry that all considerations were given to the data that they seem to support.

### 3.4 FIELD SOURCES

Given the scarcity of information on engine rebuild/replacement rates and scrappage from conventional sources, JFA contacted equipment rental firms, parts distributors, equipment retailers, equipment service and repair firms, lawn maintenance companies, contractors, and local government agencies to determine whether or not these organizations have conducted studies or surveys on nonroad equipment usage, attrition, and/or maintenance. These so called "field" sources of data can provide valuable anecdotal information which can be used to validate statistics derived from estimation methodologies.

None of the field sources that were contacted by JFA had performed studies or surveys on those issues relevant to the parameters needed for an emissions model. However, some interesting anecdotal information was obtained that highlights the types of data that are available from these sources.

- **Equipment Rental Firms:** The extent of information that is available from these organizations is limited to anecdotal accounts of usage and life expectancy. Information on engine rebuild/replacement is less available given that rental firms often resell their equipment before major overhauls or engine replacements

are performed. However, these firms often maintain detailed records of their equipment describing age and usage. For example, Mr. Pratt of Walter S. Pratt and Sons stated that their pumps and compressors see between 400 and 1000 annual hours of use, while Wayne Stabaugh of Rental Tools & Equipment Co. noted that estimates on life expectancy could be generated for the firms inventory of equipment. In general, rental firms suggested that, as expected, life expectancy depends on maintenance practices. The types of equipment that are represented by rental firms cover a large portion of the spectrum of nonroad equipment and vehicles including chainsaws, commercial lawnmowers, air compressors, pumps, generators, welders, tractors, and other types of construction, industrial, and agricultural equipment.

- **Parts Distributors:** JFA contacted parts distributors in an effort to obtain information on engine rebuild/replacement rates. These firms only maintain an inventory of parts and do not generate data on any of the parameters relevant to this study.
- **Equipment Retailers:** Although major equipment retailers conduct product testing, life of the engine or chassis is not a variable that they analyze. As with parts distributors, this field source is not a source of relevant information.
- **Equipment Service and Repair Firms:** Service and repair firms provided helpful insights about the factors that affect engine life. For example, a contact at Honda Engine Sales and Repair noted that the life expectancy of an engine depends on various factors such as engine size, fuel type, use environment, and maintenance. Scott Johns of Mower Medic noted that commercial mowers

commonly accumulate about 500 hours of use between services, while residential type mowers accumulate 300 hours of use before service is performed. The difference may reflect differences in design characteristics, as commercial mowers typically are built for more rugged applications and employ larger engines. On a similar note, Honda Engine Sales and Repair suggested that large diesel engines (such as those found in heavy-duty construction or agricultural equipment) often exhibit a useful life of 10,000 to 12,000 hours, while smaller gasoline (or diesel) engines are designed to only last for approximately 2,000 hours.

The information available from this type of field source is limited to anecdotal data that varies from one firm to another depending on experience and the brand of products that are serviced. While equipment service and repair firms can provide useful anecdotal information on usage and expected life spans, it is unlikely, from our contacts, that any firm has conducted a formal, scientific study or survey on usage, scrappage, or engine rebuild/replacement.

- **Lawn Maintenance Companies:** Field information about the usage characteristics of lawn and garden equipment can be obtained through discussions with lawn maintenance companies. However, information from this source is anecdotal rather than based on scientific studies or surveys. For instance, a representative from Chemlawn suggested that their lawnmowers are operated on average between 40 and 50 hours per week. At this rate, if the engine lasts for three years then the company's best expectations have been met with respect to life expectancy. Chemlawn purchases new equipment and scraps equipment at the end of their useful lives.

Local country clubs also provided anecdotal information on lawn maintenance practices and equipment. The superintendent at the Kenwood Golf and Country Club noted, for example, that the club's lawn maintenance equipment is often resold after four years of use, although riding mowers see 6 to 10 years of use before major rebuild and resale.

- **Contractors:** The field source that most directly represents the types of equipment used in construction applications is contractors. As with other field sources, however, contractors only provide anecdotal accounts of equipment usage and useful life. For example, Driggs Corporation, a large construction contractor in the Washington, D.C. area, noted that on average their engines operate from 8 to 10 thousand hours before repairs are performed, while some machines see 17 to 22 thousand hours of use in their lifetime (accounting for periodic maintenance). Driggs' equipment are usually resold after 4 to 6 years of service. Finally, Driggs noted that the firm maintains detailed records for each equipment type from which maintenance data can be constructed. According to Driggs, *Fleet Owners Magazine* lists 500 contractors who own approximately 20 million dollars worth of equipment and likely maintain detailed records on each piece of machinery. Contractors are, therefore, potentially a good field source of maintenance data on construction equipment. But, none of the contractors that were contacted by JFA have compiled or documented their data into a format that is publicly available or readily applicable to an emissions analysis.
- **Government Agencies/Departments:** Local and Federal government agencies, such as the National Park Service, often own, use and maintain various types of

nonroad equipment. JFA contacted a number of local government agencies -- including the Maryland Department of Transportation (road construction equipment), the Virginia Department of Transportation (road construction equipment), and the California Parks Equipment Management division (light commercial/industrial, lawn and garden, and recreational equipment) -- and various Federal agencies to determine the types of relevant data that are available on usage, scrappage, and rebuild/replacement rates. In general, local or State governments maintain detailed inventories of equipment from which vintage and maintenance profiles can be constructed. However, equipment are often resold rather than scrapped so that expected life spans are difficult to develop from these inventories or records.

Federal agencies also maintained detailed equipment inventories. Unlike local or State governments, however, many federal agencies use equipment until the equipment's useful life has been fully expended. So, life expectancy estimates can be derived from their records. In fact, the National Park Service has developed a manual (of which a copy was not available) on the recommended retirement stages for self-propelled vehicles. However, most of these vehicles are registered for on-highway use.

Although field sources are a source for anecdotal information on nonroad equipment usage, scrappage, and maintenance practices, it is unlikely that any of the field sources outlined above have developed scientific or survey based estimates on emission parameters that are representative of nationwide or regional in-use nonroad equipment fleets. Furthermore, anecdotal information often varies substantially from one specific contact to another signifying the uncertainty of estimates derived from this approach. However, ranges can be formulated

from anecdotal information on usage, scrappage, and rebuild practices that can be used as reality checks on data provided by other sources.

### 3.5 CENSUS DATA

Product specific shipment data are available from the Bureau of Census' *Current Industrial Reports* for Construction Machinery (Form MA35D), Farm Machinery and Lawn and Garden Equipment (Form MA35A), Pumps and Compressors (Form MA35P), Motors and Generators (Form MA36H), and Internal Combustion Engines (Form MA35L). No other *Current Industrial Reports* (CIR's) relevant to nonroad equipment and engines are developed or maintained by Census.

Generally, CIR's are constructed from Census surveys covering all firms engaged in the manufacturing of the products in question. For example, the survey from which the CIR for Farm and Lawn and Garden Equipment is derived covers firms engaged in the manufacture of farm machinery and lawn and garden equipment. Only very small firms (generally less than 5 employees) are excluded.

The figures presented in CIR's on quantity and value of shipments represent physical shipments of all products sold, transferred to other establishments of the same company, or shipped on consignment, whether for domestic or export sale. Shipment data are available for many product codes specifying well defined equipment types. For instance, some of the products included in the CIR for Construction Machinery are:

**Product Code 35311 00:** off-highway wheel tractors including wheel tractors for use as towing units, rubber tired dozers, and self-propelled wheeled log skidders



**Product Code 35316 00:** mixers pavers, and related equipment including concrete mixers, pavement reclaimers/planers, asphalt plants, and other types of equipment

**Product Code 35318 00:** scrapers, graders, rollers, and off-highway trucks. Shipments are broken down by horsepower range, and specific data is provided for export shipments.

Similarly, the CIR for Farm Machinery and Lawn and Garden Equipment includes detailed shipment data for lawnmowers, lawn tractors and riding mowers, garden tractors, turf tractors, combines, windrowers or swathers, wheel tractors (farm type), and many other types of related equipment.

A complete and thorough compilation of historical shipment statistics available from the relevant CIR's requires extensive resources. No such compilations were derived for this study, and JFA knows of no studies that have undertaken this task. However, *Current Industrial Reports* (CIR's), published annually by the Bureau of the Census, have extensive, publicly available data on product shipments which can be used as a benchmark figure for comparison purposes with other shipment or sales estimates. In addition, the reports contain export/import information, although not at a disaggregate level (*e.g.*, by horsepower range). According to the U.S. Department of Commerce, these reports "present timely data on the production, inventories, and orders of approximately 4,400 products, which represent 30 percent of all U.S. manufacturing".

For CIR's relevant to this study, data is collected from mail surveys of firms operating within an industry. Approximately 1,200 companies were surveyed for the CIR covering Farm Machinery and Lawn and Garden Equipment, while this figure was 270 for Construction Machinery CIR, 350 for the Pumps and Compressors CIR, and 250 for the Motors and Generators CIR.

As mentioned above, within each CIR, data on quantity and value of shipments are broken down according to product codes. These specific figures, which measure shipments of all goods sold, transferred, or shipped, do not differentiate between goods exported or sold domestically. CIR's also include data on the number of companies that manufacture a given product and, in some cases, these products are listed by horsepower range. In addition, data on engine type are also included, although these data are sometimes grouped with other engine types (*e.g.*, shipments for electric nonriding mowers are grouped with rotary gas nonriding mowers). Product information based on engine cycle (*e.g.*, two stroke vs. four stroke) is not given. As a result, data can be obtained based on both the engine type and horsepower of a product, although availability of this data varies considerably.

Errors in the estimates provided in CIR's could exist as a result of factors such as response errors, definitional problems, and data entering. To correct for nonrespondents and late reporters, estimates are made for missing data based on respondents' annual movements in shipments. This estimation process is limited for most data cells to 10 percent total shipments. If more than 10 percent of shipments are estimated in this manner, then Census suggests that the estimate should be interpreted with caution. In certain cases, data indicating production figures for individual companies are withheld, while data on quantity of shipments that are inconsistent with value of shipment figures are not included. Although such errors appear to cast doubt on the accuracy of the data in the CIR's, the Bureau of the Census notes that such nonsampling errors are common in most survey procedures.

CIR's are available at a minimal cost (about \$1 per copy), and can be obtained for years as far back as the 1970's. **Appendix D** provides copies of the most recent (*i.e.*, 1991) CIR's for construction, farm machinery and lawn and garden equipment, pumps and compressors, and motors and generators.

As shown by the CIR's appearing in Appendix D, information is also available on both the value and quantity of exports and imports for different products. These data are not organized based on product codes but on the Harmonized System (HS). As a result, export/import information does not have the same level of detail as shipment information. For example, no trade data is given for snowthrowers or leafblowers. Breakdowns based on horsepower range and, in most cases, engine type, are generally not included in trade data, however. The data has additional limitations; trade data on lawn and garden products such as lawn mowers and garden tractors are not given for 1989 or 1990. For 1990, no table is given comparing product codes with product descriptions for the CIR covering Farm Machinery and Lawn and Garden Equipment.

The deficiencies with the shipment estimates that are available in CIR's are minimal. CIR's are an inexpensive, publicly available source of detailed shipment estimates that should be used as benchmarks against which estimates derived by independent sources can be compared. Therefore, JFA recommends that future effort be expended to organize CIR shipment data in a manner that can be easily applied to an emission analysis.

## **SECTION 4:**

### **POWER SYSTEMS RESEARCH**

#### **4.1 OVERVIEW**

Power Systems Research, Inc. (PSR) is a global market research and consulting company which provides information to organizations in the power equipment industry including engine and component manufacturers, original equipment manufacturers, government agencies, and financial institutions. PSR compiles data for approximately 80 types of mobile nonroad equipment and engines used in lawn and gardening, agricultural, construction, industrial, and other applications.

PSR's data were the basis for emission inventory estimates developed under EPA's NEVES (specifically, Inventory A emission estimates). For that study, national population estimates by fuel type and 2-stroke versus 4-stroke splits were purchased from PSR for 79 types of nonroad equipment. PSR's data on national and regional average annual hours of use, load factors, and average horsepower by fuel type were also employed to determine NEVES' Inventory A emission estimates. PSR's State-level equipment populations were used by EEA to distribute equipment to the various nonattainment areas included in EPA's study. Not surprisingly, PSR's data have been, and continue to be, vigorously scrutinized by nonroad engine and equipment industry members.

Nevertheless, PSR is the only known source of comprehensive and detailed data on nonroad engines and equipment. Through over 15 years of research, PSR has developed various databases that provide detailed historical information on engine sales and specifications, equipment populations, and part consumption profiles. Databases maintained by PSR that

contain information which can be used to develop the data matrices on emission parameters necessary for a nonroad emissions inventory forecasting model include *Engindata* and *Aftermarket*.

- *Engindata* contains annual shipments of engines with power ratings up to 1,000 horsepower. Engine shipments are available by calendar year, manufacturer, engine model, and market application (*i.e.*, equipment type) for every domestic and imported engine marketed in the United States and Canada.
- *Aftermarket* contains current population statistics for all 1 to 1,000 horsepower gasoline, diesel, natural gas, and LPG engines by State, county, engine manufacturer and model, and market application sold in North America. This database is constructed from historical sales data contained in *Engindata*. To arrive at current-year equipment population estimates, a scrappage function is applied to the historical sales data. PSR has also developed a scheme used in *Aftermarket* that distributes national equipment populations to the State and county levels. This scheme is based on activity indices derived from Census data.

This section provides a review and evaluation of the statistics that are available from these PSR databases. PSR's methodologies to compile engine/equipment sales data, attrition rates, equipment populations, parts consumption profiles, and geographic equipment distributions are reviewed and evaluated. In addition, insights are provided on the feasibility of using PSR data as the basis for the matrices required for an emission forecasting model.

## 4.2 ENGINE AND EQUIPMENT SALES ESTIMATES

PSR's methodology to estimate equipment populations begins with a detailed profile of engine sales and engine installations. Sales, or shipment, statistics are gathered from dealers, product literature, annual reports of engine and equipment manufacturers, industry publications providing periodic equipment or engine shipments, U.S. Commerce data such as those found in CIR's, and continuous contact with original equipment manufacturers (OEM's) who provide PSR with annual engine installations. From product literature, PSR identifies which engines go in which equipment types, and hence estimate annual engine/equipment sales at the national level.

A detailed, step-by-step description of PSR's engine sales and installations estimation methodology, by equipment type, was not available from PSR. However, discussions and meetings with PSR have provided some insight on the specifics of the process that is used to derive sales estimates.

First, for equipment types used in construction, agriculture, industrial, and commercial applications (*i.e.*, medium-duty and heavy-duty equipment), PSR mostly relies on information that is obtained from their industry contacts and information that available publicly from manufacturers or industry associations. The detail of information on engine sales, installations, and equipment sales provided to PSR by engine manufacturers and OEM's is highly variable. Some manufacturers and OEM's are very forthcoming with information, while others provide little or no data. However, PSR maintains, for example, that manufacturers are generally very cooperative, or open, when discussing a competitor's sales volume and market share. So it is possible to arrive at sales numbers for a particular manufacturer through information provided

by a competitor. Clearly, this approach is anecdotal in nature and can lead to estimation errors. Note, however, that this is only one approach in the process that is employed by PSR.

Second, PSR's relationship with lawn and garden equipment/engines manufacturers and OEM's is not as well developed as for other types of equipment. As a result, PSR heavily relies on publicly available sales information from industry associations, product literature, U.S. Commerce, and other public sources to derive engine sales statistics and engine installations/equipment type relationships for the lawn and garden market.

Third, once all available sources of information have been investigated, PSR fills data holes through analysis and relies on their experience and extensive knowledge of engine and equipment markets.

Finally, after independent estimates of engine sales and installations by equipment type have been generated by PSR, the estimates are compared to publicly available *benchmark* figures. This sales data validation technique involves comparisons of PSR derived estimates with shipment data available from other sources, such as industry associations, *Current Industrial Reports*, and other Commerce data. According to PSR, a *benchmark* figure for each equipment type is derived from an analysis of shipment data available through alternative sources. PSR then compares this *benchmark* to the estimate produced through the process described above. PSR's estimates are adjusted to reflect a difference of plus or minus 5 percent from the *benchmark* figure. According to PSR, however, for cases in which there is a large discrepancy between the estimate and the *benchmark*, PSR further investigates the issue through additional contact with manufacturers and the Commerce Department. Although Commerce cannot reveal information about specific manufacturers, it apparently will indicate if PSR is missing data from manufacturers of specific equipment types. These *benchmark* numbers have not been

provided by PSR, but preliminary analysis of *Engindata* sales estimates suggests that for some equipment types -- such as rear engine riding mowers, snow throwers, and chainsaws (see Table 4-3) -- PSR's sales are off by more than 20 percent when compared to shipment statistics provided by industry associations, such as OPEI and PPEMA. Unfortunately, PSR will not provide their *benchmark* data for any of the equipment types that they track. Concerns about the ease in which a competitor could obtain the *benchmark* information preclude PSR from doing so.

PSR's methodology to estimate engine sales and the distribution of engine installations by equipment type results with independent estimates by equipment type, engine manufacturer, and engine model. These estimates are maintained in *Engindata*, which includes historical sales data for calendar years dating back to 1973, although PSR has suggested that they attach a lower degree of confidence to their pre-1978 estimates.

In *Engindata*, the term "sales" refers to: the delivery of North American produced or imported loose engines to an OEM, either through a distributor or factory direct channels; the delivery of a piece of equipment containing a North American produced captive engine to the distributor; or the delivery of a packaged or retrofitted engine by a North American distributor to the user. Note that this definition of sales includes exports of North American produced loose engines, but excludes imports of equipment with installed engines. The exclusion of imports with installed engines presents an obstacle to the derivation of an accurate and complete compendium of engines and equipment consumed in North America or the United States. For example, all off-highway motorcycles consumed in the U.S. are imported from other countries (notably Japan) with installed engines. Therefore, sales estimates for this recreational equipment type are equal to zero in *Engindata*.



PSR refers to imports of engines already installed in equipment as *captive imports*. Although details on how the absence of captive imports influences the estimates contained within *Engindata* have not been provided by PSR, discussions with PSR's staff have proven helpful. While captive engines are not accounted for in *Engindata*, PSR has developed a database on *captive import* sales from data available through Commerce on U.S. exports/imports of relevant products. This *captive import* database is used by PSR along with sales data contained in *Engindata* to develop equipment population estimates for PSR's *Aftermarket* database (*Aftermarket* is discussed later in this section). Details on the types of equipment profiled by PSR's *captive import* database, or other relevant information, were not available from PSR. Nevertheless, the fact remains that sales estimates in *Engindata* do not fully reflect the total consumption of engines in the North American market.

Another issue which has not been fully or adequately resolved by PSR concerns *Engindata's* inclusion of engine sales to the Canadian market. As with *captive imports*, the importance of Canadian sales for each application has not been addressed by PSR. Although PSR has suggested that the Canadian share of engine sales for most equipment types is negligible, from an emissions modeling perspective only U.S. engine consumption is relevant. As a result, it is imperative that the Canadian sales share be determined for each equipment type in *Engindata*. However, PSR has not provided any data for this purpose, and will likely not do so in the immediate future. With these caveats in mind, Tables 4-1 and 4-2 present PSR's sales estimates for gasoline powered equipment and diesel powered equipment for 1985 through 1992.

Table 4-3 provides comparisons of PSR's sales estimates and OPEI's and PPEMA's shipment estimates for selected lawn and garden equipment. Some of the differences shown in the table between PSR and industry may reflect differences in definition. For example, it is unclear

**Table 4-1**  
**ENGINE DATA GASOLINE SALES**  
**(0 to 1000 HP)**

EQUIPMENT TYPE	CALENDAR YEAR SALES							
	1985	1986	1987	1988	1989	1990	1991	1992
2-WHEEL TRACTORS	3,787	3,393	2,827	2,030	1,766	2,078	2,145	2,253
AERIAL LIFTS	2,742	3,737	5,335	6,623	6,115	4,824	4,439	4,262
AG MOWERS	1,279	1,262	1,190	1,022	625	670	644	633
AG TRACTOR	63	0	0	0	0	0	0	0
AIR COMPRESSORS	48,803	48,752	49,484	47,446	46,788	43,109	37,937	40,217
AIRCRAFT SUPPORT	869	943	1,024	946	954	824	859	874
ALL-TERRAIN VEHICLES	72,206	59,812	55,705	57,604	58,687	79,137	91,831	99,178
BALERS	202	71	60	67	62	58	52	44
BORE/DRILL RIGS	647	737	721	642	623	635	623	654
CEM/MTR MIXERS	12,779	14,906	20,271	20,030	20,091	18,556	18,183	17,887
CHAINSAWS	1,079,143	915,343	813,062	954,232	818,236	823,892	844,849	861,746
CHIPPERS/GRINDERS	6,033	6,315	6,503	6,702	6,762	6,915	6,484	6,548
COMBINES	20	6	0	0	0	0	0	0
COMM TURF	117,392	133,111	148,981	184,682	203,188	219,932	208,698	221,213
CONCRETE/IND SAWS	11,281	11,588	13,667	15,340	13,777	13,377	11,907	12,622
CRANES	389	370	346	352	350	309	273	260
CRUSH/PROC EQUIP	90	93	87	146	296	288	253	261
DUMPERS/TENDERS	1,314	1,333	1,359	1,416	1,480	1,624	1,663	1,648
EXCAVATORS	0	0	0	0	0	0	0	0
FOREST EQUIP	0	0	0	0	0	0	0	0
FORKLIFTS	8,486	7,266	7,400	6,322	9,897	9,961	9,251	8,605
FRONT MOWERS	0	0	1,401	34,398	49,655	60,149	72,179	77,953
GENTR SETS	260,536	281,457	327,712	381,323	469,871	455,464	445,699	449,372
GOLF CARTS	30,250	31,928	33,609	44,248	53,216	54,504	58,494	60,250
GRADERS	0	0	0	0	0	0	0	0
HYD POWER UNIT	2,848	3,351	3,780	4,233	4,453	4,616	4,708	4,897
LEAF BLOW/VACS	226,390	188,282	287,138	307,271	250,860	247,128	222,950	229,638
LN MOWERS	5,331,562	5,488,945	5,900,094	5,672,242	5,275,067	5,850,999	5,444,874	5,224,666
LN/GDN TRACTORS	577,848	787,953	971,584	996,047	951,978	1,069,084	1,011,708	1,007,316
LT PLANTS/SIGNAL BDS	551	382	386	408	458	436	422	457
MINI-BIKES	0	0	0	0	0	0	0	0
OTH AG/EQ	300	154	131	340	380	411	371	386
OTH CONST	224	228	221	232	225	218	192	200
OTH GEN INDUST	6,346	6,583	6,835	6,734	7,630	7,561	6,805	6,668
OTH LN GDN	34,651	34,899	35,682	33,898	32,203	30,594	29,065	29,936
OTH MAT HD	127	109	113	110	113	73	69	68
PAVERS	594	570	614	644	642	611	426	520
PAVING EQ	23,454	24,259	24,903	24,184	23,538	22,080	19,464	21,794
PLATE COMPACTORS	6,047	6,445	6,781	7,332	7,370	7,098	6,446	6,575
PRES WASHERS	25,677	36,397	48,081	57,131	61,258	70,953	73,193	75,634
PUMPS	118,602	128,493	137,039	150,120	152,804	154,254	146,203	153,156
R/T LOADER	629	666	690	696	662	544	479	479
REAR ENG RIDER	280,974	348,703	452,244	423,018	319,713	333,347	361,221	375,525
ROLLERS	3,120	2,543	2,538	2,791	3,034	2,859	2,571	2,829
ROUGH TRN FORKLFTS	599	623	603	562	505	290	203	172
S/S LOADER	5,908	4,664	5,429	5,323	4,881	4,410	3,458	3,704
SCRUB/SWPR	5,159	5,276	5,725	6,243	5,836	5,975	5,737	5,870
SHREDDERS	11,446	12,956	18,983	28,598	42,623	43,226	47,247	51,971
SNOWBLOWER	546,420	603,286	628,620	646,217	683,930	543,877	532,996	575,636
SNOWMOBILE	68,403	69,241	81,010	100,625	111,594	120,152	114,143	120,991
SPEC VEH/CARTS	16,018	18,976	20,073	19,310	17,614	16,958	16,623	16,127
SPRAYERS	14,962	14,237	14,445	17,661	15,308	14,407	13,047	13,309
SURFACING EQUIP	10,281	10,247	10,685	10,487	10,405	9,382	8,258	8,506
SWATHERS	1,882	940	638	348	360	363	327	332
TAMPERS/RAMMERS	2,122	2,689	3,218	3,265	3,070	2,865	2,616	2,773
TERMINAL TRACTORS	899	1,004	1,068	1,141	1,273	1,571	1,485	1,456
TILLERS	336,578	322,252	302,109	322,472	347,559	356,505	335,114	341,818
TRAC/LDR/BCKHOE	18	0	0	0	0	0	0	0
TRENCHERS	5,878	4,976	5,574	5,513	5,273	5,090	4,479	4,075
TRIM/EDGE/CUTTER	2,224,827	2,762,680	3,019,024	2,999,288	3,182,348	3,116,601	3,069,770	3,039,656
WELDERS	32,644	34,973	40,401	45,916	49,131	45,558	41,951	39,567
WOOD SPLTR	44,120	29,065	13,413	10,258	8,941	10,227	10,474	10,409

**Table 4-2**  
**ENGINDATA DIESEL SALES**  
**(0 to 1000 HP)**

EQUIPMENT TYPE	CALENDAR YEAR SALES							
	1985	1986	1987	1988	1989	1990	1991	1992
AERIAL LIFTS	839	1,010	1,030	1,251	1,670	1,660	1,790	1,622
AG MOWERS	74	75	67	67	58	54	52	52
AG TRACTOR*	33,703	22,444	24,528	33,993	45,281	45,826	33,630	28,758
AIR COMPRESSORS	14,301	13,162	14,798	16,218	17,284	16,181	13,989	14,639
AIRCRAFT SUPPORT	1,594	1,694	1,800	1,922	2,010	1,838	1,843	1,773
BALERS	160	205	195	255	230	240	222	211
BORE/DRILL RIGS	748	834	836	815	772	786	781	765
CEM/MTR MIXERS	241	267	314	316	324	304	284	272
CHIPPERS/GRINDERS	1,814	2,038	2,452	2,869	3,699	3,660	3,481	3,476
COMBINES	10,273	8,938	13,245	8,786	12,643	15,197	12,370	11,059
COMM TURF	8,027	11,721	17,702	19,299	21,550	23,452	24,508	25,242
CONCRETE/IND SAWS	13	18	24	35	27	37	32	32
CRANES	3,782	3,739	4,030	4,303	5,534	4,952	4,040	3,843
CRUSH/PROC EQUIP	567	647	706	894	832	793	714	757
CRWLR DOZERS	10,677	8,468	11,589	12,433	9,956	9,219	6,471	5,182
DUMPERS/TENDERS	38	21	21	22	23	24	25	25
EXCAVATORS	2,674	2,792	2,971	3,138	3,176	3,854	3,511	3,629
FOREST EQUIP	4,440	4,849	5,560	4,935	4,593	4,120	3,684	3,755
FORKLIFTS	3,654	3,261	2,878	3,778	4,747	5,022	4,509	4,147
GENTR SETS	25,935	27,960	33,035	38,529	45,331	38,184	35,676	36,302
GRADERS	4,942	4,664	3,702	3,874	4,277	4,061	3,652	3,836
HYD POWER UNIT	269	307	367	424	448	476	501	521
LN/GDN TRACTORS	6,149	8,869	7,141	8,042	6,396	5,743	5,386	5,548
LT PLANTS/SIGNAL BDS	3,434	3,798	4,079	4,477	4,468	4,287	3,153	3,166
OFF-HWY TRACTORS	3,763	2,936	2,341	2,710	2,519	2,447	2,215	2,280
OFF-HWY TRUCK	1,910	1,571	1,917	2,113	2,283	3,175	2,999	3,149
OTH AG/EQ	818	547	549	604	647	721	673	692
OTH CONST	854	909	859	782	802	774	700	731
OTH GEN INDUST	1,973	1,651	1,361	1,273	1,272	1,193	1,058	1,032
OTH LN GDN	0	0	26	54	54	63	60	62
OTH MAT HD	296	273	267	247	253	251	240	234
PAVERS	2,030	2,242	2,386	2,563	2,619	2,465	1,632	1,864
PAVING EQ	1,662	1,511	1,525	1,474	1,340	1,274	1,150	1,283
PLATE COMPACTORS	129	155	177	198	252	258	237	244
PRES WASHERS	427	449	679	875	923	939	948	956
PUMPS	12,236	12,212	10,613	10,787	10,241	9,765	9,045	9,426
R/T DOZER	218	230	230	242	222	208	187	193
R/T LOADER	9,898	8,563	9,020	8,803	8,061	8,626	8,024	6,494
REAR ENG RIDER	0	875	972	1,080	1,200	1,298	1,493	1,493
ROLLERS	7,445	5,544	5,124	5,288	5,325	4,964	4,551	5,032
ROUGH TRN FORKLFTS	6,179	7,003	7,515	7,838	7,798	5,700	3,691	3,326
S/S LOADER	13,783	16,481	21,715	25,325	27,977	27,433	26,715	28,856
SCRAPERS	4,864	3,726	2,898	3,347	3,227	3,003	2,704	2,828
SCRUB/SWPR	3,415	3,806	4,150	4,441	4,724	4,571	3,713	3,255
SNOWBLOWER	120	104	103	102	90	102	98	95
SPEC VEH/CARTS	431	470	473	498	514	512	488	430
SPRAYERS	537	523	476	519	535	548	502	506
SWATHERS	3,478	3,471	4,318	2,867	2,751	2,861	2,661	2,582
TERMINAL TRACTORS	2,614	2,695	2,586	2,994	3,154	3,503	3,442	3,074
TILLERS	0	0	0	0	0	0	0	0
TRAC/LDR/BCKHOE	20,431	25,638	29,305	25,514	22,966	23,248	17,424	15,676
TRENCHERS	3,964	4,154	4,074	4,418	4,994	5,188	4,069	4,295
WELDERS	8,033	11,301	10,345	10,499	11,446	11,103	10,338	10,854
WOOD SPLTR	18	12	5	4	3	2	2	0

\*Note that PSR's sales estimates for agricultural tractors are considerably lower than those provided by EMI in Table 2-13. The cause of the discrepancy has not been resolved by PSR.

**Table 4-3**

**COMPARISONS BETWEEN PSR's SALES DATA AND  
OPEI, PPEMA SHIPMENT STATISTICS**

EQUIPMENT TYPE	OPEI/PPEM 1985	PSR 1985	% DIF	OPEI/PPEM 1986	PSR 1986	% DIF	OPEI/PPEM 1988	PSR 1988	% DIF	OPEI/PPEM 1991	PSR 1991	% DIF
Walk-Behind Mowers	5,193,000	5,331,562	2.67%	5,400,000	5,488,945	1.65%	5,600,000	5,672,242	1.29%	5,350,000	5,439,758	1.68%
Rear Engine Riding Mowers	355,000	280,974	-20.85%	322,000	349,578	8.56%	375,000	420,716	12.19%	209,000	355,478	70.09%
Lawn and Garden Tractors	695,000	583,997	-15.97%	772,000	796,822	3.22%	932,000	992,825	6.53%	968,000	1,018,515	5.22%
Rotary Tillers	362,000	336,578	-7.02%	311,000	322,252	3.62%	285,000	322,472	13.15%	296,000	335,114	13.21%
Snow Throwers	421,000	546,540	29.82%	482,000	603,390	25.18%	543,000	646,319	19.03%	285,000	533,099	87.05%
Chainsaws	1,527,000	1,079,143	-29.33%	1,350,000	915,343	-32.20%	1,377,000	954,232	-30.70%	1,153,000	844,849	-26.73%

exactly what defines a lawn tractor in OPEI's shipment data. Differences may also be the result of calendar versus model year peculiarities. According to PSR, sales available from *Engindata* are based on calendar year data. While this is true for chainsaws, OPEI's data reflect model year shipments. It is further expected that a major cause of differences between *Engindata* sales statistics and those from other sources will be the fact that PSR excludes sales of imported equipment with installed engines. The reader should be advised that comparisons made in Table 4-3 are preliminary. As of yet, no detailed and comprehensive analysis of discrepancies between all the various sources of shipment, or sales, data has been performed. As a result, an understanding of the sources of discrepancies has not been formulated. JFA recommends that such an undertaking be performed in order to account for possible differences between data sources. Clearly, much input from all parties, including PSR, will be required to explain the origins of discrepancies.

In addition to application specific sales reports, such as those shown in Tables 4-1 and 4-2, *Engindata* allows for retrieval of model specific engine sales data by engine manufacturer, market segment (*e.g.*, lawn and garden, construction, etc.), horsepower, equipment type, or a combination of engine model specifications and model sales. Detailed profiles of each engine model are compiled by PSR from the sources described above. These profiles include the following specifications: 1) the year that a specific engine model was introduced into the market and the year that it was discontinued, 2) the fuel type (diesel, gasoline, LPG, natural gas, or heavy diesel), 3) the intermittent horsepower rating per SAE J245 (gasoline) and DIN6270-B (diesel), 4) the continuous horsepower rating per DIN6270-A (diesel), 5) the engine crankshaft speed at which the intermittent horsepower rating is measured (HP RPM), 6) the number of combustion cylinders per engine, 7) the cylinder arrangement (*i.e.*, in-line, angular, or horizontal configurations), 8) the crankshaft plane, either vertical or horizontal, 9) the number of piston strokes in the engine combustion cycle (2-stroke versus 4-stroke), 10) the

delineation between air, water, or oil engine cooling, 11) the engine's displacement in liters, 12) the type of aspiration (turbocharged or naturally aspirated), 13) the type of intercooling describing the treatment of turbocharger air (water-air cooling, air-air cooling, or none), 14) the fuel delivery method (direct-injection, indirect or swirl, carbureted, fuel injection, or pressurized gas), 15) the valve/cam configuration designating the basic design of the engine intake and exhaust valve system (double overhead cam, overhead cam, overhead valve, side valve, or reed valve), 16) the maximum rated torque per SAE J245 (gasoline) and SAE J270 (diesel) expressed as foot/pounds, 17) the engine speed at which torque is measured, or torque RPM, 18) the cylinder bore measured in millimeters, 19) the piston stroke measured in millimeters, and 20) the length, width, height, and weight of the engine.

Although PSR's engine sales and installation estimates have some limitations that have not been addressed by PSR for inclusion into this report, *Engindata* is nevertheless the most complete source of sales statistics that has been identified by JFA for engines produced in North America or the United States and marketed in this region by foreign manufacturers. However, various important issues and methodological details have not been resolved by PSR. JFA has gone through great lengths to obtain further explanations about PSR's estimation process, but no additional data is expected to be forthcoming in the near future.

Yet, PSR's *Engindata* database is an excellent starting point for detailed sales statistics necessary for a nonroad emissions forecasting model. Sales of engines are organized in the database into 99 distinct equipment types. These equipment types are listed in **Appendix E**, and those relevant to this study are identified with an asterisk. In all, data on over 2,050 engine models produced by more than 120 manufacturers located in over 20 countries are contained in *Engindata*. Finally, data comparisons or other data analysis can be readily

conducted, since EPA has already purchased *Engindata* for use in a related JFA analysis under a separate contract with EPA.<sup>4</sup>

### 4.3 EQUIPMENT/ENGINE SCRAPPAGE

In order to arrive at in-use equipment populations, PSR has derived a methodology to calculate attrition rates specific to each engine model and equipment type combination. The attrition methodology derived by PSR utilizes an attrition curve (normal distribution about half life), data on the number of engines/equipment placed into service each year (from *Engindata*), the mean lifetime expectancy (B-50 life) of the engine expressed in Bhp-hrs, the average annual hours of use, the horsepower rating of the equipment's engine, and the typical load factor at which the engine is operated.<sup>5</sup> The discussion presented below focuses on the strengths and limitations of PSR's methodology and the underlying sources that are used to derive necessary data, rather than on its detailed description.

Equipment in-use populations, parts consumption profiles, and geographic distributions of equipment are available from PSR's *Aftermarket* database. This database directly employs sales information from *Engindata* and imbeds PSR's attrition methodology to derive in-use equipment populations by engine model. For those cases where sales estimates are not available from *Engindata*, such as off-road motorcycles, PSR uses aggregate shipment

---

<sup>4</sup>EPA has access to *Engindata* until August 1993. The original price of the database was \$13,650, which includes a one year licensing agreement.

<sup>5</sup>For a description of PSR's attrition methodology the reader is referred to EEA's Final Report to EPA entitled *Methodology to Estimate Nonroad Equipment Populations by Nonattainment Areas*, written for EPA's NEVES on September 30, 1990.

estimates available from industry or the Commerce Department. Details about their approach to solving this data hole have not been provided by PSR, as mentioned in Section 4.2.

Likewise, PSR has not submitted their estimated vintage attrition rates for any equipment type shown in Tables 4-1 or 4-2, so comparisons between PSR's attrition rate estimates and those from other sources cannot be performed. However, several conceptual observations can be made regarding PSR's methodology.

#### **4.3.1 B-50 Lives By Engine Model (Bhp-hrs)**

The attrition, or survival, rates that are derived by PSR will reflect the data and sources that are used in their calculation. Although an engine will have a predictable laboratory survival rate, most manufacturers do not test significant numbers of engines to establish a reliable mean failure rate. As a result, PSR mostly relies on information from actual owner experiences to derive their mean lifetime expectancies (or B-50 lives) for each engine model found in *Aftermarket*, although information from manufacturer reports of mean failure design lives and from statistically valid reports of actual engine failures are also used according to PSR.<sup>6</sup> Over the past 15 years, PSR has surveyed over 200,000 owners and operators from which lifetime and survival statistics on more than 1.5 million individual pieces of equipment have been gathered. By combining average annual hourly usage (also compiled from survey data), engine age, and percent of engines remaining in the fleet, PSR is able to estimate the median age (in Bhp-hrs) at which half of the engines originally placed in service remain in service and half have been placed out of service. This median age is known as the engine's B-50 life. According to PSR, for an engine model originally placed in service in a given year, plotting

---

<sup>6</sup>These sources (reports) were not provided or referenced by PSR.



the percent of units placed out of service versus engine age through time results in a bell-shaped curve. The apex of this curve is considered to be the median age, or B-50 life. In estimating B-50 life for each engine model, PSR attempts to obtain 96 survey responses per year per model until sufficient are acquired to trace out the bell-shaped curve and corresponding median life in Bhp-hrs. This process is rigorously followed for high production volume models, while low production models receive less attention in the survey process. Yet, PSR's notion is that if representative survey data on average life can be acquired and compiled for 50 percent of the engine models in *Aftermarket* (i.e., the high volume models), then the B-50 lives for the remaining models can be estimated.

Once PSR establishes for a particular engine model the B-50 life it is generally not updated. PSR does, however, compare their estimated B-50 lives to available data from manufacturers. PSR's clients (mostly engine manufacturers like Perkins, Cummins, or other producers of medium to heavy-duty engines) often provide PSR with feedback about the comparability of PSR's B-50 life estimates to those developed by the manufacturers themselves. If discrepancies are found between PSR's estimates and manufacturers' estimates that cause significant inaccuracies in total equipment population estimates, then PSR re-examines survey results and takes appropriate action to correct for the differences -- this may include additional survey work. This feedback mechanism is likely not available for small nonroad engines, since Briggs & Stratton or Tecumseh do not purchase *Aftermarket*.

Details specific to the surveying process that is employed by PSR (i.e., sample sizes, response rates, questionnaires, etc.) were not provided, although engine manufacturer, model, equipment

types, usage, and age are variables that are included in PSR's *Power Products Parts Survey* - a copy of the questionnaire is provided in EEA's report for NEVES.<sup>7</sup>

#### 4.3.2 Average Annual of Use and Load Factors

As with estimates of B-50 lives, PSR's estimates of load factor and average annual hours of use will directly influence the attrition rates developed by *Aftermarket* and used to estimate equipment in-use populations. As was experienced during the course of EPA's NEVES, changes to PSR's average annual hours of use greatly influenced the estimated national in-use populations for various lawn and garden equipment.

The underlying sources through which PSR develops annual hours of use estimates and load factors are end-user surveys. PSR's *Power Products Parts Survey* and periodic, smaller end-user surveys provide the necessary data for PSR's usage and load factor estimate development process. PSR uses fuel consumption rates -- obtained from the *Power Products Parts Survey* of over 40,000 owner/operators of the equipment types that are tracked by PSR -- versus time to calculate the load factor that is normally experienced by each engine/equipment combination in the survey. PSR calculates load factor as follows:

$$\text{Load Factor} = \frac{\text{Actual Fuel Consumption/Hour}}{\text{Rated Fuel Consumption/Hour @ Rated HP.}}$$

---

<sup>7</sup>For a discussion of the survey, the reader is referred to EEA's 1991 report to EPA entitled *Methodology to Estimate Nonroad Equipment Populations by Nonattainment Areas*.

An engine's rated fuel consumption per hour is derived through product literature and industry contacts. In this way, PSR estimates load factors for the engine/equipment combinations that are identified in the survey. For those engine/equipment combinations not found in survey results, PSR relies on industry contacts, product literature, and their own analysis and experience to construct the appropriate load factors. As with other parts of PSR's methodology, this alternative approach is likely employed for smaller nonroad engines and equipment (*e.g.*, lawn and garden equipment).

Unlike load factor estimates, however, PSR's annual hours of use estimates are derived exclusively from survey results and PSR's experience and analysis -- industry contacts or product literature are not a source that is employed by PSR for usage information. Details about the types of surveys that are conducted by PSR to estimate usage were not available, although it is clear that the *Power Product Parts Survey* is one of the sources. However, conversations with PSR suggest that to obtain survey results from a representative distribution of an equipment type's end-users, PSR has conducted, through the years, specific end-user surveys. For example, forklifts are used in a number of different industries so that the annual usage of forklifts may vary from one industry to the other. In order to capture this variation and construct a realistic annual hours of use estimate, PSR has established a relationship between industry type (by 3-digit Standard Industrial Classification codes) and equipment usage. In this way, PSR focuses its smaller survey efforts on the industries most likely to use the equipment type in question.

PSR's efforts to estimate annual hours of use by equipment type result with an average figure which is reported in *Aftermarket* for each equipment type. PSR reports (and uses) *average* annual usage rates for all vintages, although PSR recognizes the fact that older equipment is generally used less. Annual hours of use by vintage are optimal from the perspective of an

emissions forecasting model or an emissions inventory development -- since emission benefit estimates from proposed regulation will not be accurately estimated with an average usage estimate that is applied for all vintage years. However, PSR's objectives in developing the database it maintains are not necessarily related to emissions analysis. Therefore, the survey requirements to estimate annual usage as a function of equipment age are likely not cost-effective from PSR's perspective.

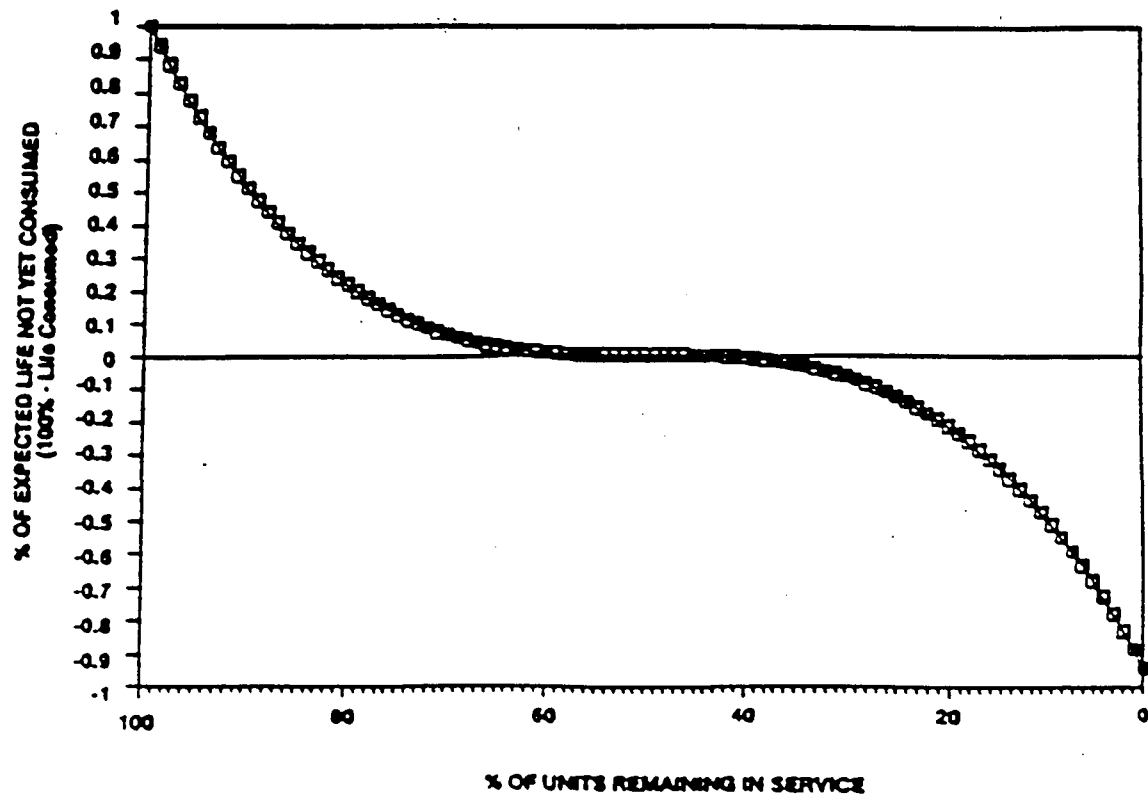
It should be noted, however, that to the extent that PSR's surveys include a representative cross-section of commercial and consumer equipment ownership, differences between commercial annual hours of use and consumer annual hours of use are incorporated in their estimates. But, separate figures for commercial usage versus consumer usage are not available through PSR. Similarly, no information related to temporal usage patterns is compiled or maintained by PSR.

#### 4.3.3 PSR's Attrition Curve

PSR has developed a typical attrition curve which is used, together with the other parameters described above, to determine vintage specific survival rates for each engine/equipment combination in *Aftermarket*. PSR's research has determined that survival rates fit the normal distribution about half-life, or S-curve, shown in Figure 4-1. Estimates of the number of equipment, with a given engine model installed in them, that are placed in service, the equipment's average annual hours of use, its engine's horsepower and load factor are used to determine the expected life of the engine/equipment combination not yet consumed (*i.e.*, where

FIGURE 4-1

PSR'S ATTRITION CURVE USED TO ESTIMATE  
VINTAGE SPECIFIC ATTRITION RATES



you are along the Y-axis of the curve).<sup>8</sup> This in turn provides the vintage specific survival rate found by simply matching the position on the Y-axis to that on the X-axis. Of course, this Y to X correspondence will greatly depend on the shape of the attrition curve that is employed. For instance, a "flatter" S-curve than the one shown in Figure 4-1 would derive lower survival rates, while a "tighter" one would derive higher survival rates.<sup>9</sup>

PSR has not provided a detailed description of the exact methodology that has been used to develop the attrition curve shown in Figure 4-1. Conversations with PSR, however, have provided a general overview of the process. PSR has apparently derived its attrition curve through end-user surveys -- likely the same surveys that determine annual hours of use, load factor, and B-50 life estimates. End-user survey results on the number of engines remaining in service by model year are compared to model year sales estimates from *Engindata* to arrive at PSR's attrition curve.

The fact that PSR uses this same attrition curve for all engines and equipment combinations likely leads to some biased vintage specific survival rates for different types of equipment. According to PSR, however, reported survival rates derived from PSR's research have been found to fit the normal distribution pattern shown in Figure 4-1. Further, PSR contends that 98 percent of all 1.5 million reported cases are found to fit within 1.5 standard deviations of the mean, and that their findings are similar to those described in Society of Automotive Engineers (SAE) paper 851260 (*Reduced Durability due to a Friction Modifier in Heavy Duty*

---

<sup>8</sup> A detailed description of this process is provided on page 3-5 of EEA's report to EPA, which is referenced above.

<sup>9</sup> A "flatter" curve implies that the convex portion (or upper part) of the S-curve and the concave portion (or bottom part) of the S-curve are decreasing at a slower rate than that portrayed by the S-curve in Figure 4-1. A "tighter" curve implies the opposite.

*Diesel Lubricants*, 1985) and SAE paper 750621 (*Engine Maintenance Cost Reduction Through Improved Component Design and Development*, 1975). The former is an analysis of heavy-duty diesel engine wear, encountered in the field, caused by a friction reducing additive used in diesel lubricants, while the latter is an analysis of reductions in maintenance costs through improved aircraft engine durability. Although the results described in these papers may be directly applicable to heavy-duty diesels and aircraft engines, clearly the entire spectrum of nonroad engines is not represented by those results. As such, the notion that PSR's survey findings and attrition results are similar to those found in these SAE papers does not necessarily imply that PSR's attrition curve is representative of survivability across all engines that comprise the nonroad engine emissions source category.

It is not presently evident whether or not manufacturers that do derive survival estimates rely on a normal distribution to statistically describe their observations. Recent conversations with PSR suggest that some manufacturers may employ a Weibull distribution, like those used in the study of breaking strengths of materials.<sup>10</sup> However, JFA has not been successful in obtaining information from manufacturers on this issue.

---

<sup>10</sup> A random variable  $X$  is said to have a Weibull distribution pattern if the probability function of  $X$  is given by:

$$f(X;a,b) = [(a/b^a) X^{a-1} \exp(-(X/b)^a)] \text{ for } X \text{ greater or equal to } 0.$$

The parameter  $a$  is positive and is referred to as the shape parameter, while the parameter  $b$  is also positive and represents the scale parameter. While in some situations there are theoretical justifications for the appropriateness of the Weibull distribution, in many cases the Weibull simply provides a good fit to observed data for particular values of  $a$  and  $b$ . Note that if  $X$  is less than 0,  $f(X;a,b)$  equals 0.

Other examples of distributions often employed in the analysis of product life cycles include the exponential, lognormal, and the smallest extreme value distributions. For a discussion of these distributions the reader is referred to *Applied Life Data Analysis* by Wayne Nelson of General Electric Co. -- published by John Wiley & Sons, 1982.

#### 4.3.4 The Role of Attrition in Emissions

Equipment attrition rates have important implications for emissions calculations. For example, if a particular engine or equipment type has a relatively short life, the effects of implementing an emission standard will be realized more quickly than for an equipment type with a long life. This is a widely recognized phenomenon, and fleet turnover is an important consideration when crafting a regulatory package to mitigate emissions from mobile sources.

One aspect of fleet turnover that can impact an emissions benefit calculation is the *shape* of the equipment attrition curve. As discussed above, PSR assumes that equipment attrition is described by a normal S-curve and that all engines (of a particular model) have the same annual hourly usage regardless of age. On the other hand, in a study performed for CARB, EEA determined (through a limited survey of California construction firms) that as equipment ages, it is generally used less. EEA also developed a survival curve for heavy construction equipment in this work. To illustrate the effect of differing assumptions about equipment attrition and usage, an example emissions benefit calculation is presented below that compares results from utilizing the PSR and EEA data.

The attrition and usage data developed by EEA for heavy construction equipment are summarized in Table 4-4. As seen, the table also contains fractional usage by equipment age.<sup>11</sup> Because it is assumed that the equipment is not used at the same average rate throughout its life, the fractional usage is not equivalent to the population fraction. (This is analogous to on-road motor vehicles where the VMT distribution by model year, *i.e.*, usage,

---

<sup>11</sup>*Feasibility of Controlling Emissions from Off-Road, Heavy-Duty Construction Equipment*, Energy and Environmental Analysis, December 1988.



**Table 4-4**  
**Heavy Construction Equipment Attrition and Usage Data**  
**Developed by EEA**

<b>Age</b>	<b>Fraction Remaining</b>	<b>Fraction of Fleet</b>	<b>Hours/Year</b>	<b>Cumulative Hours</b>	<b>Wtd Hrly Use</b>	<b>Fractional Use</b>
1	1.00	0.064	1400	1,400	89	0.077
2	0.98	0.062	1400	2,800	87	0.075
3	0.96	0.061	1400	4,200	86	0.074
4	0.94	0.060	1400	5,600	84	0.072
5	0.92	0.059	1400	7,000	82	0.070
6	0.90	0.057	1400	8,400	80	0.069
7	0.88	0.056	1400	9,800	78	0.067
8	0.86	0.055	1300	11,100	71	0.061
9	0.84	0.053	1200	12,300	64	0.055
10	0.80	0.051	1100	13,400	56	0.048
11	0.75	0.048	1000	14,400	48	0.041
12	0.70	0.045	1000	15,400	45	0.038
13	0.65	0.041	1000	16,400	41	0.036
14	0.60	0.038	1000	17,400	38	0.033
15	0.55	0.035	1000	18,400	35	0.030
16	0.50	0.032	1000	19,400	32	0.027
17	0.45	0.029	950	20,350	27	0.023
18	0.40	0.025	900	21,250	23	0.020
19	0.35	0.022	850	22,100	19	0.016
20	0.30	0.019	800	22,900	15	0.013
21	0.27	0.017	750	23,650	13	0.011
22	0.24	0.015	700	24,350	11	0.009
23	0.21	0.013	700	25,050	9	0.008
24	0.18	0.011	700	25,750	8	0.007
25	0.15	0.010	700	26,450	7	0.006
26	0.12	0.008	700	27,150	5	0.005
27	0.09	0.006	700	27,850	4	0.003
28	0.06	0.004	700	28,550	3	0.002
29	0.04	0.003	700	29,250	2	0.002
30	0.02	0.001	700	29,950	1	0.001
<b>Total:</b>		<b>1.00</b>			<b>1163</b>	<b>1.00</b>

is not equivalent to the registration distribution, *i.e.*, population.) Also, a "fleet-average" annual use of 1163 hours was calculated based on multiplying the fleet fraction for each equipment age by the annual usage for that age and summing over the 30 "model years" listed in Table 4-4.

A corresponding fractional use by equipment age matrix based on PSR's attrition curve (Figure 4-1) was also developed and is shown in Table 4-5. A number of assumptions were required to produce this table:

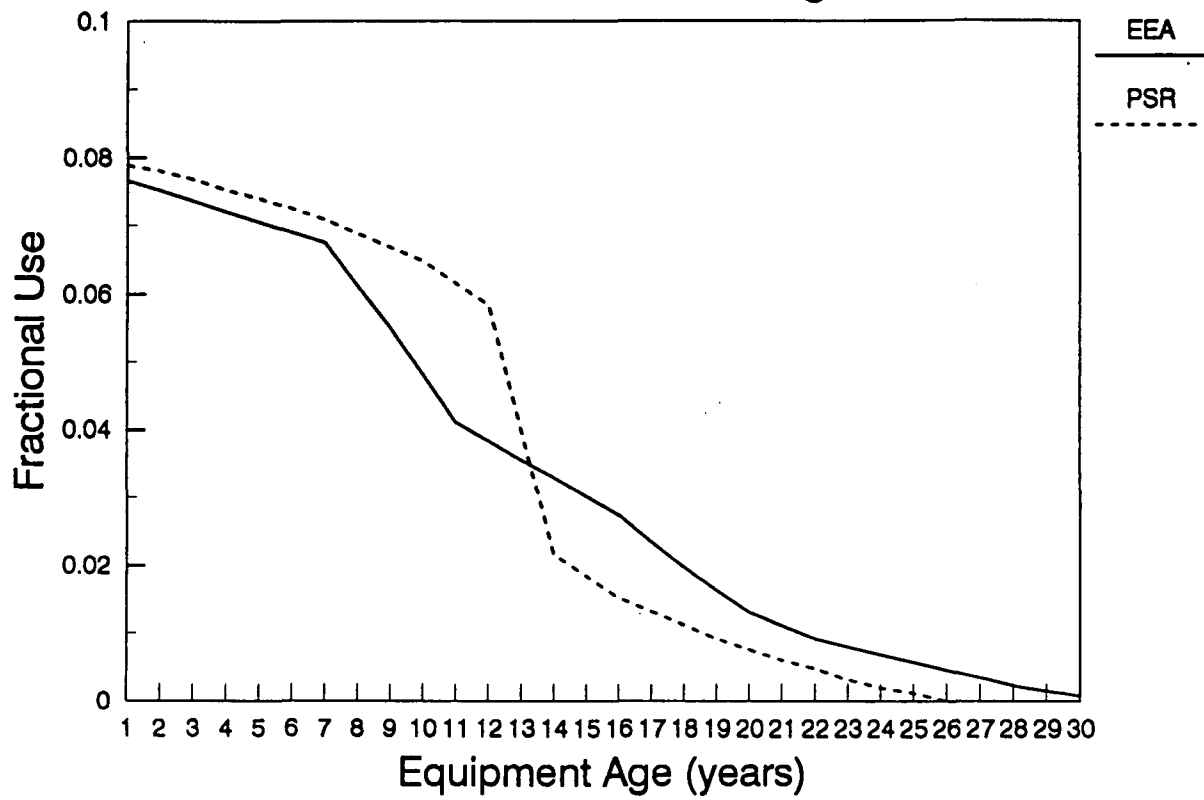
- All "model years" accumulate the same annual hours based on the EEA fleet-weighted estimate (1163 hours),
- The total cumulative hours for the longest-lived machine is based on EEA's estimate (approximately 30,000 hours),
- The B-50 life was assumed to be one-half the longest life (approximately 15,000 hours), and
- Calculations are based on constant sales for each year. (Although this is not likely to be a good assumption for an accurate estimate, it is valid for the comparison being illustrated here.)

The fractional usage estimates developed in Tables 4-4 and 4-5 are depicted graphically in Figure 4-2. As seen, the two methodologies result in different usage versus age curves. The PSR methodology indicates that most of the equipment usage in the fleet is performed by newer equipment, with a sudden drop near the equipment half-life. This is because the S-curve

**Table 4-5**  
**Equipment Attrition and Usage Data Developed**  
**from PSR's Scrappage Curve**

<b>Age</b>	<b>Cumulativ Hours</b>	<b>Fraction of Expected Life</b>	<b>Fraction Remaining</b>	<b>Fraction of Fleet</b>	<b>Wtd Hrly Use</b>	<b>Fractional Use</b>
1	1163	0.923	0.985	0.079	92	0.079
2	2,326	0.846	0.975	0.078	91	0.078
3	3,489	0.769	0.960	0.077	89	0.077
4	4,652	0.692	0.940	0.075	87	0.075
5	5,815	0.615	0.925	0.074	86	0.074
6	6,978	0.538	0.905	0.072	84	0.072
7	8,141	0.462	0.885	0.071	82	0.071
8	9,304	0.385	0.860	0.069	80	0.069
9	10,467	0.308	0.835	0.067	78	0.067
10	11,630	0.231	0.810	0.065	75	0.065
11	12,793	0.154	0.770	0.062	72	0.062
12	13,956	0.077	0.730	0.058	68	0.058
13	15,119	0.000	0.500	0.040	47	0.040
14	16,282	-0.077	0.270	0.022	25	0.022
15	17,445	-0.154	0.230	0.018	21	0.018
16	18,608	-0.231	0.190	0.015	18	0.015
17	19,771	-0.308	0.165	0.013	15	0.013
18	20,934	-0.385	0.140	0.011	13	0.011
19	22,097	-0.462	0.115	0.009	11	0.009
20	23,260	-0.538	0.095	0.008	9	0.008
21	24,423	-0.615	0.075	0.006	7	0.006
22	25,586	-0.692	0.060	0.005	6	0.005
23	26,749	-0.769	0.040	0.003	4	0.003
24	27,912	-0.846	0.025	0.002	2	0.002
25	29,075	-0.923	0.015	0.001	1	0.001
26	30,238	-1.000	0.000	0.000	0	0.000
<b>Total:</b>				<b>1.00</b>	<b>1163</b>	<b>1.00</b>

**Figure 4-2**  
**Usage vs. Age**  
**EEA and PSR Methodologies**



used by PSR assumes very high attrition rates near the equipment half-life. Conversely, EEA's estimates show a much more gradual decrease in fractional usage with age.

The usage curves in Figure 4-2 were used to compute the benefit of hypothetical emission standards. As an example, assume that the NOx emission rate is decreased from 10 to 5 g/Bhp-hr as a result of a standard that takes effect with the 1998 model year. The fleet-average emission rate without the standard would be 10 g/Bhp-hr, assuming all model years emit at the same rate prior to regulation. If the benefit for the year 2010 is desired, a fleet-average emission rate can be determined by applying the fractional usage calculated in Tables 4-4 and 4-5 (and shown in Figure 4-2) to the corresponding model-year emission rate and summing over all model years making up the fleet. This calculation, summarized in Table 4-6, was performed with both EEA and PSR estimates of equipment attrition and usage.

The PSR methodology resulted in a fleet-average NOx emission rate of 5.57 g/Bhp-hr, while the EEA methodology produced a rate of 6.08 g/Bhp-hr. In the year 2010, therefore, the benefit of the hypothetical emission standard was estimated to be 44 percent and 39 percent for the PSR and EEA attrition assumptions, respectively. Although the two methodologies illustrated above did not result in dramatic differences in the benefit calculation, it is clear that the choice of assumptions on equipment attrition does impact emissions estimates. Thus, by obtaining an accurate characterization of equipment attrition, emissions estimates can be improved.

**Table 4-6**

**Calculation of Hypothetical Fleet-Average  
NOx Emission Rates**

Model Year	Emission Rate	EEA		PSR	
		Fraction	Wtd EF	Fraction	Wtd EF
2010	5.0	0.077	0.383	0.079	0.394
2009	5.0	0.075	0.375	0.078	0.390
2008	5.0	0.074	0.368	0.077	0.384
2007	5.0	0.072	0.360	0.075	0.376
2006	5.0	0.070	0.352	0.074	0.370
2005	5.0	0.069	0.345	0.072	0.362
2004	5.0	0.067	0.337	0.071	0.354
2003	5.0	0.061	0.306	0.069	0.344
2002	5.0	0.055	0.276	0.067	0.334
2001	5.0	0.048	0.241	0.065	0.324
2000	5.0	0.041	0.205	0.062	0.308
1999	5.0	0.038	0.192	0.058	0.292
1998	5.0	0.036	0.178	0.040	0.200
1997	10.0	0.033	0.328	0.022	0.216
1996	10.0	0.030	0.301	0.018	0.184
1995	10.0	0.027	0.274	0.015	0.152
1994	10.0	0.023	0.234	0.013	0.132
1993	10.0	0.020	0.197	0.011	0.112
1992	10.0	0.016	0.163	0.009	0.092
1991	10.0	0.013	0.131	0.008	0.076
1990	10.0	0.011	0.111	0.006	0.060
1989	10.0	0.009	0.092	0.005	0.048
1988	10.0	0.008	0.080	0.003	0.032
1987	10.0	0.007	0.069	0.002	0.020
1986	10.0	0.006	0.057	0.001	0.012
1985	10.0	0.005	0.046	0.000	0.000
1984	10.0	0.003	0.034		
1983	10.0	0.002	0.023		
1982	10.0	0.002	0.015		
1981	10.0	0.001	0.008		
<b>Fleet-Wtd Emission Rate:</b>			<b>6.082</b>		<b>5.568</b>

#### 4.4 ENGINE REBUILD/REPLACEMENT RATES

PSR recently submitted a description of their approach to account for the effect of engine rebuild/replacement rates on engine/equipment life expectancy. In their assumptions related to engine and equipment survival, PSR has considered the fact that engines are rebuilt or overhauled during their useful lifetimes and that for some equipment types the engine is often physically replaced. For many equipment types, however, PSR regards this issue as insignificant. For example, air cooled gasoline powered engines and the equipment in which they are installed are assumed to be retired congruently. The reasoning is that it is usually not economic to salvage an operating engine and replace it in another type of equipment when the useful life of the equipment itself has been expended. On the other hand, for many types of heavy-duty equipment, engines routinely outlast the equipment in which they are originally installed and can find further use in other equipment at a reduced capacity. In such cases, PSR has extended the expected useful life to include a factor for the continued survival of a small portion of engines.

PSR also accounts for engine rebuild and overhaul as part of a normal operating lifetime. Such major maintenance is particularly important in the case of heavy-duty equipment, where practices call for partial overhaul once a predetermined number of operating hours have been reached. Rebuilds and overhauls have a considerable effect on engine life. Such major maintenance practices are taken into account by PSR on an equipment by equipment basis depending on the specific industry in which an equipment is employed. However, PSR does not maintain data on rebuild rates at the individual equipment level. Rather, engine rebuild is accounted for in PSR's attrition calculation.

#### 4.5 METHODOLOGY FOR GEOGRAPHIC ALLOCATION

PSR's *Aftermarket* database includes a methodology to distribute national in-use population estimates to State and county levels. Data from the U.S. Bureau of Census' *County Business Patterns* are used to establish the geographic model by which end products are allocated. Economic data for each county in the U.S. from 12 major Standard Industrial Classification (SIC) groups<sup>12</sup> has been compiled and used to derive activity indices. For each engine application, different combinations of these 12 factors are used as a means of geographically allocating in-use equipment.

The geographic distribution of every engine application is accomplished by assessing percentage weights to each of the 12 major SIC based activity sectors and applying these weights to the ratio of county to national activity by sector. This process derives an activity index which is then multiplied by the national in-use population of a given application to arrive at the county population estimate. For example, the percentage weights for compressors by major category are 16 percent mining, 12 percent oil and gas, 34 percent construction, 12 percent metal manufacturing, 7 percent machinery production, 12 percent wholesale trade, and 7 percent retail food distribution. These weights are determined through the analysis of ownership and usage information obtained from PSR's surveys. By combining these so called "correlation factors" with the percentage of national revenue of employment produced in each county for these sectors, PSR estimates the percentage of air compressors that will be found in a given county. A complete profile of PSR's "correlation factors" for each equipment type is available from the *Aftermarket* database.

---

<sup>12</sup> These 12 SIC groups include: total employment, agricultural services, fishing, mining, oil and gas, construction, metal manufacturing, machinery production, trucking, wholesale trade, retail food distribution, and auto dealerships.



The top-down approach used by PSR to distribute national in-use populations of equipment to State and county levels is subject to criticism. PSR's approach assumes that sub-national in-use populations of all types of nonroad equipment are characterized by one or more of the SIC based activity categories described above. Clearly, the regional populations of some types of equipment, such as those used in logging or airport service, cannot be accurately estimated using any of PSR's 12 activity categories. Furthermore, it is not explicitly clear what criteria were employed by PSR to determine the percentage weights or, "correlation factors", used in the estimation methodology. JFA suspects that many of the "correlation factors" were derived from anecdotal information and, thus, may not actually correlate well with regional populations. However, before an analysis of all the indices derived for each equipment type is performed, the true limitations of PSR's geographic distribution methodology cannot be properly assessed. To conduct such an analysis, PSR will have to submit their data to EPA or JFA, or PSR's *Aftermarket* database will have to be purchased.

#### 4.6 SUMMARY AND RECOMMENDATIONS

PSR is a useful and comprehensive source of sales, scrappage, in-use equipment populations, annual hours of use, and load factor estimates. However, some problems are evident in PSR's methodologies that must be resolved before PSR derived statistics can be directly incorporated into an emissions forecasting model. These problems include: 1) PSR's exclusion of imported equipment with installed engines (*i.e., captive imports*) and inclusion of Canadian sales in *Engindata's* sales statistics, 2) discrepancies between PSR's sales estimates and those available from industry and possibly government sources, 3) PSR's employment of one attrition curve for all equipment/engine combinations, and 4) conceptual problems with PSR's geographic distribution methodology. In addition, likely biases in PSR's lifetime expectancy (B-50 life) estimates for various equipment need to be investigated. Finally, although JFA has requested

detailed descriptions of PSR's surveys (such as, sample sizes, response rates, audiences, questionnaires, etc.), no additional information has been provided beyond that described in this section. Likewise, data from which Canadian sales can be backed-out from *Engindata* or data on *captive imports* have not been made available by PSR. The degree of further cooperation from PSR, other than what can be learned from their databases, with respect to emission analyses is not entirely evident at this time.

One important issue that needs to be addressed is the resolution of discrepancies between PSR's sales, usage, load factor, and scrappage estimates and those derived by parties both inside and outside of industry. Such an analysis will be useful in determining where complementary data can be substituted for PSR's estimates. The flexibility of PSR's process will assure that the best possible data will be implemented into an emissions model if their databases and computer models are chosen as the basis for its development. PSR's databases provide an expedient and relatively inexpensive way to derive emission parameters, and they can be altered to reflect more detail (such as commercial and residential sales splits for lawn and garden equipment) and better data (such as MIC's sales and scrappage statistics on ATV's and off-highway motorcycles). PSR's *Engindata* database has already been purchased by EPA, while their *Aftermarket* costs roughly \$25,000. The possibility of using PSR's databases for the development of an emission model should be considered by EPA once detailed evaluations and validations of their estimates are performed, serious discrepancies are resolved, and additional information on methodologies and surveys is obtained.

**SECTION 5:**  
**FUTURE WORK:**  
**DATA SELECTION AND METHODOLOGY DEVELOPMENT**

**5.1 OVERVIEW**

Given that all available nonroad equipment data sources have been identified, after a detailed evaluation and comparative analysis it will be necessary to select the most appropriate data sources to fill out the data matrices needed to support a nonroad emissions model. In cases where data do not currently exist, methodologies must be developed to estimate certain parameters (*e.g.*, attrition rates). Although the data matrices were not completed as part of the current study, it is useful to summarize, for each required data matrix, the availability and likely sources of data that could be used to fill the matrices. Thus, this section briefly outlines the potential data sources for each matrix and identifies areas in which new methodologies are likely to be needed.

As detailed below, data for the following quantities will be necessary:

- Nationwide State-level equipment populations for each equipment type included in NEVES;
- Current year equipment population distributions by horsepower and engine class;
- Historical annual equipment sales matrices for each combination of equipment type, engine class, and horsepower range;

- Historical equipment survival matrices for each combination of engine class and horsepower range;
- Historical engine rebuild/replacement matrices for each combination of equipment type, engine class, and horsepower range;
- Current equipment usage, load factor, and fuel consumption matrices for each combination of engine and equipment type; and
- Temporal distribution matrices by equipment type.

Descriptions of data sources for these elements are provided as follows.

## 5.2 NATIONWIDE STATE-LEVEL POPULATIONS

Although not an absolute requirement for the development of an emissions model (depending upon the methodology chosen to generate equipment usage estimates, *i.e.*, top-down or bottom-up), methodologies to estimate State-level equipment populations for each equipment type included in NEVES should be investigated. State-level equipment populations for the 23 states included in NEVES were derived by PSR from national equipment estimates through the use of activity indicators that relate economic activity at the State-level relative to that at the national-level. The State populations were then used by EPA's contractor, EEA, to derive population estimates at the county-level.

It is recognized that top-down approaches, like those used by PSR and EEA, are likely to result in estimation errors if national-level population estimates are incorrect or if the activity

indicators employed to apportion national data to the local level are biased. However, developing detailed bottom-up estimates for each State and equipment type is not feasible for a generic nonroad model. Thus, State-level equipment populations would have to be estimated using some form of a top-down approach. It is anticipated that the estimates would rely on PSR data, industry-supplied data (*e.g.*, shipment data), or on potential alternative methodologies to allocate national data to the State-level.

### 5.3 ENGINE/EQUIPMENT DISTRIBUTION MATRICES

Based on the results presented in the previous sections, PSR appears to be the only available source for these data. Distributions of equipment by engine type (*i.e.*, 2-stroke gasoline, 4-stroke gasoline, diesel, 4-stroke LPG/CNG) and horsepower range can be developed from PSR's *Aftermarket* database with the assumption that national distributions hold at the sub-national level. Independent distributions (of any kind) at the sub-national level are not available from any of PSR's databases nor are they available from any other known source. Thus, developing a national-level engine/equipment matrix would likely be limited to the use of PSR data. (A moderate amount of validation data for lawn and garden equipment are, however, available from OPEI.)

### 5.4 ANNUAL ENGINE/EQUIPMENT SALES MATRICES

Data matrices describing U.S. equipment consumption for each year from 1960 through the most recent year for each combination of equipment type, engine type, and horsepower range are required. However, to develop current year (or future year) population estimates, it is not necessary to consider, for example, 30 years of historical sales records for a piece of equipment with an average life of 5 years. Alternatively, equipment types with very long useful lives

(*e.g.*, agricultural tractors) may require a more complete accounting of historical sales to generate current year population estimates. Thus, data matrices should be filled out to the extent that the historical sales data will allow calculation of equipment populations for a selected base year (*e.g.*, 1990). Further, based on the results presented above, it is clear that data do not exist to completely fill out such matrices for each equipment type of interest. For equipment types without completed sales matrices, estimates may be possible based on sales trends.

Data sources likely to be utilized for these matrices include manufacturer associations, PSR, and the Department of Commerce.

### 5.5 ENGINE SURVIVAL MATRICES (HISTORICAL)

Developing these matrices would require extensive review of the methods used by PSR, MacKay, and engine manufacturers to develop B50 engine lives and attrition curves. However, the extent to which survival matrices could be developed depends largely upon available data sources and the willingness of those sources to share information. Additionally, although information on engine attrition rates may be available for some selected equipment types, the applicability of these data across equipment categories is questionable (*i.e.*, engine attrition for lawn and garden equipment would not be expected to be the same as for construction equipment). Nonetheless, an evaluation of engine attrition might be possible at the equipment category level. At a minimum, general functional forms of attrition curves should be further investigated.

## 5.6 ENGINE REBUILD/REPLACEMENT RATE MATRICES (HISTORICAL)

Based on results presented above, it is apparent that data on nonroad engine rebuild and replacement rates are not readily available. Additional effort to identify sources of rebuild and replacement would be useful, but the results of such an effort are uncertain, as is the development of an appropriate matrix. However, data on rebuild and replacement rates do exist for heavy-duty, on-road diesel engines. Thus, these data could be considered surrogates for the higher horsepower, nonroad equipment types and might provide a very rough estimate of the number of rebuilds that could be in service at a given time. For some of the more inexpensive, lower horsepower equipment, it is very likely that engines are scrapped rather than rebuilt. (A qualitative assessment of rebuilds and replacements may also be possible based on information developed by EEA in its 1988 report to CARB.)

## 5.7 EQUIPMENT USAGE RATE MATRICES

For these matrices, data would be compiled on state- or regional-level annual hours of operation, load factors, and annual average fuel consumption by equipment and engine type combination. Multi-regional average annual hours of use data are available from NEVES, which used PSR and industry data. However, as discussed previously, NEVES relied on a top-down approach for all equipment usage estimates. Depending upon the equipment category, top-down methodologies may not be the most appropriate to determine local-level activity. Therefore, an assessment should be made to determine whether top-down or bottom-up approaches provide the best estimates of activity for the various equipment categories.

The primary sources of information for these matrices are likely to be PSR, MacKay (particularly for annual hourly usage), and manufacturer associations. Selected manufacturers

might also have information on usage, load factor, and fuel consumption for the engines that they sell, as well as information regarding regional variations in load factors and fuel consumption. However, as discussed in earlier sections of this report, the likelihood of obtaining additional data from manufacturers is questionable.

## **5.8 TEMPORAL DISTRIBUTION MATRICES**

Data identifying the fraction of annual source activity that occurs during each month of the year, each day of the week, and each hour of the day are important from an emission modeling perspective. Such data allow policymakers to determine how much is being emitted in a given region, during a specific time, and by a particular type of nonroad equipment. Ideally, these data would be developed both at the national and State, or multi-State, levels.

Because a single comprehensive source for such data is not available, information from a variety of previous nonroad reports and industry associations would have to be utilized to determine temporal distributions. (Although the quality of such data is questionable.) Thus, a detailed data matrix is not possible in this case, rather, estimates of temporal usage would have to be reported by equipment category (and potentially sub-category, if data in enough detail are discovered). Additionally, a limited amount of effort should be directed at investigating estimation methodologies based on ambient temperature, number of rainy days, and other weather parameters.



## **APPENDICES**

## **APPENDIX A:**

### **SNOWMOBILE REGISTRATION DATA (1977-1992)**

***Source: ISIA***

1991-1992 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

State	Current Registrations	Estimated Number of Unregistered Snowmobiles	County Breakdown Available
Alaska	4,231		
California	9,646	2,191	X
Colorado	18,396	3,000-5,000	
Connecticut	2,600		
Delaware	176		
Idaho	22,790	10,000-15,000	X
Illinois	58,276		X
Indiana	18,178		
Iowa	29,300		X
Maine	63,471		X
Maryland	235		
Massachusetts	8,253		
Michigan	180,340		X
Minnesota	192,926		X
Montana	11,300		X
Nebraska	828		X
New Hampshire	27,330	plus or minus 5%	X
New Jersey	3,000		
New Mexico	1,246*		X
New York	51,723*		X
North Dakota	9,200		X
Ohio	15,421		X
Oregon	10,078		X
Pennsylvania	42,354		X
Rhode Island	353		X
South Dakota	3,480		X
Utah	9,683		X
Vermont	31,515		
Washington	20,414		X
Wisconsin	156,062		X
Wyoming	14,208		X
Total	1,017,013		

\* 1990-91 figure

Note: Registration figures are not available for the remaining states.

1991-1992 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

Province	Current Registrations	Estimated Number of Unregistered Snowmobiles	County Breakdown Available
Alberta	15,194		X
British Columbia	60,162		
Manitoba	18,361		X
New Brunswick	11,526		
Newfoundland	61,000		
Nova Scotia	3,691		
Ontario	346,932		X
Prince Edward Island	3,188		
Quebec	122,189		
Saskatchewan	6,022		
Yukon Territory	654		
TOTAL	<u>648,919</u>		

1990-1991 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

Province	Current Registrations	Estimated Number of Unregistered Snowmobiles	County Breakdown Available
Alberta	13,875		X
British Columbia	53,386		
Manitoba	27,161		
New Brunswick	9,000		
Newfoundland	61,000		
Nova Scotia	4,143		
Ontario	329,976		X
Prince Edward Island	4,153*		
Quebec	113,758		
Saskatchewan	6,086		
Yukon Territory	654		
TOTAL	<u>623,192</u>		

\* 1989-90 figure

1990-1991 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

State	Current Registrations	Estimated Number of Unregistered Snowmobiles	County Breakdown Available
Alaska	4,427		
California	8,849		
Colorado	17,142	6,000	
Connecticut	2,635		
Delaware	290		
Idaho	21,000	10,000-15,000	X
Illinois	58,891		X
Indiana	21,509		X
Iowa	22,000		X
Maine	61,641		X
Maryland	235		
Massachusetts	13,000		
Michigan	202,368		X
Minnesota	191,838		X
Montana	14,500*		
Nebraska	767		X
New Hampshire	32,430	less than 5%	X
New Jersey	2,991		
New Mexico	1,246		
New York	51,239		X
North Dakota	8,200		X
Ohio	18,040		X
Oregon	9,675		
Pennsylvania	39,449		X
Rhode Island	375		X
South Dakota	4,028		X
Utah	14,034		X
Vermont	32,762		
Washington	19,631		X
Wisconsin	155,632		X
Wyoming	14,506		X
Total	1,045,330		

\* 1989-90 figure.

Note: Registration figures are not available for the remaining states.

1989-1990 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

State	Current Registrations	Estimated Number of Unregistered Snowmobiles	County Breakdown Available
Alaska	2,756		
California	7,989	2,330	X
Colorado	16,026	4,000	
Connecticut	3,062		
Delaware	307		
Idaho	15,356	15,000+	X
Illinois	60,510		X
Indiana	22,941		X
Iowa	22,020		X
Maine	63,190		X
Maryland	333		
Massachusetts	23,110		X
Michigan	205,772		X
Minnesota	194,339		X
Montana	14,500	36,462	X
Nebraska	902		X
New Hampshire	33,000	2,475 (5-10%)	
New Jersey	3,641		
New Mexico	1,100	"quite a few"	
New York	46,324		X
North Dakota	10,893		X
Ohio	17,947		
Oregon	9,533		X
Pennsylvania	43,000	25,000	X
Rhode Island	432		
South Dakota	3,200		X
Utah	12,706		X
Vermont	33,961		
Washington	17,280		X
Wisconsin	151,000		X
Wyoming	14,683		
Total	1,051,813	85,267	

Note: Registration figures are not available for the remaining states.

1989-1990 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

Province	Current Registrations	Estimated Number of Unregistered Snowmobiles	County Breakdown Available
-----	-----	-----	-----
Alberta	14,169		X
British Columbia	52,689		
Manitoba	22,723		X
New Brunswick	8,566		
Newfoundland	60,300		
Nova Scotia	5,054		
Ontario	308,373		X
Prince Edward Island	4,153		
Quebec	103,179		
Saskatchewan	6,243		
Yukon Territory	508		
TOTAL	<u>585,957</u>		



1988-1989 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

State	Current Registrations	Estimated Number of Unregistered Snowmobiles	County Breakdown Available
Alaska	2,671		
California	6,847	2,552	X
Colorado	15,060	4,000	
Connecticut	3,503		
Delaware	328		
Idaho	21,024	10,000	X
Illinois	62,047		X
Indiana	19,206		X
Iowa	45,000		X
Maine	58,148		X
Maryland	450		
Massachusetts	22,000		X
Michigan	200,854		X
Minnesota	192,647		X
Montana	50,000		
Nebraska	918		X
New Hampshire	30,000		
New Jersey	2,600		
New Mexico	7,029*		
New York	56,172		X
North Dakota	9,361		X
Ohio	18,782		
Oregon	9,349		X
Pennsylvania	43,785	95,000	X
Rhode Island	395**		
South Dakota	6,433		X
Utah	16,481		X
Vermont	27,953		
Washington	20,032		X
Wisconsin	150,963		
Wyoming	14,958		X
Total	1,114,996	111,552	

\* includes all-terrain vehicles

\*\* 1983 figure used

Note: Registration figures are not available for the remaining states.

1988-1989 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

Province	Current Registrations	Estimated Number of Unregistered Snowmobiles	County Breakdown Available
Alberta	14,986		
British Columbia	51,597		
Manitoba	17,748		X
New Brunswick	10,000		
Newfoundland	56,000		
Nova Scotia	4,967		X
Ontario	286,664		X
Prince Edward Island	n/a		
Quebec	79,287		
Saskatchewan	6,435		
Yukon Territory	494		
TOTAL	528,178		

1987-1988 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

State	Current Registrations	Estimated Number of Unregistered Snowmobiles	County Breakdown Available
Alaska	1,812		
California	6,283	2,860	X
Colorado	14,234	8,000	
Connecticut	3,626		
Delaware	263		
Idaho	20,000	15,000	X
Illinois	59,163		X
Indiana	26,643		X
Iowa	49,033		X
Maine	57,481		X
Maryland	450		
Massachusetts	15,000**		
Michigan	206,544		X
Minnesota	181,598		X
Montana	50,589		X
Nebraska	1,095****		X
New Hampshire	38,332		X
New Jersey	6,000		
New Mexico	6,000***		
New York	54,321		X
North Dakota	6,415		X
Ohio	25,456		
Oregon	8,767		X
Pennsylvania	46,500		X
Rhode Island	395*		
South Dakota	6,459		X
Utah	11,884		X
Vermont	23,573		
Washington	17,922		X
Wisconsin	149,839		X
Wyoming	13,736		X
Total	1,109,413	25,860	

\* 1983 figure used

\*\* 1984 figure used

\*\*\* 1985-86 figure used

\*\*\*\* 1986-87 figure used

Note: Registration figures are not available for the remaining states.

1987-1988 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

Province	Current Registrations	Estimated Number of Unregistered Snowmobiles	County Breakdown Available
Alberta	14,094		
British Columbia	50,840		X
Manitoba	30,705		
New Brunswick	9,912		
Newfoundland	56,000		
Nova Scotia	5,195		
Ontario	263,681		X
Prince Edward Island	1,500**		
Quebec	76,409		
Saskatchewan	8,603		
Territories:			
Yukon Territory	250		
Northwest Territories (City of Yellowknife)	293*		
TOTAL	<u>517,482</u>		

\* 1984 figure used

\*\* 1986-87 figure used

1986-1987 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

State	Current Registrations	Estimated Number of Unregistered Snowmobiles	County Breakdown Available
Alaska	3,593		
California	5,729	3,219	
Colorado	13,600	8,000	
Connecticut	3,667		X
Delaware	280	300	
Idaho	18,000	15,000	X
Illinois	60,490		X
Indiana	23,695		X
Iowa	55,090		X
Maine	56,391		X
Maryland	420		
Massachusetts	15,000*		
Michigan	200,773		X
Minnesota	198,212		X
Montana	12,068		X
Nebraska	1,095		X
New Hampshire	32,974	1,000	
New Jersey	6,000		
New Mexico	6,000**		
New York	60,701		X
North Dakota	10,823		X
Ohio	6,388		
Oregon	8,597	6,300	
Pennsylvania	47,000	30,000	X
Rhode Island	2,700	400	X
South Dakota	5,163		X
Utah	12,951		X
Vermont	19,566		
Washington	15,813		X
Wisconsin	145,609		X
Wyoming	11,868		X
Total	1,060,256	64,219	

\*1984 figure used

\*\*1985-86 figure used

Note: Registration figures are not available for the remaining states.

1986-1987 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

Province	Current Registrations	Estimated Number of Unregistered Snowmobiles	County Breakdown Available
Alberta	15,113		X
British Columbia	50,551		
Manitoba	22,926		
New Brunswick	9,755		
Newfoundland	53,000*		
Nova Scotia	7,922**		X
Ontario	300,000		
Prince Edward Island	1,500		
Quebec	69,948		
Saskatchewan	7,236		
Territories:			
Yukon Territory	437***		
Northwest Territories (City of Yellowknife)	293**		
TOTAL	538,681		

\*1985-86 figure used; includes all-terrain vehicles

\*\*1984 figure used

\*\*\*1985-86 figure used

1985-1986 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

State	Current Registrations	Estimated Number of Unregistered Snowmobiles	County Breakdown Available
Alaska	2,632		
California	5,837	3,500	X
Colorado	14,250	8,000	
Connecticut	3,239		X
Delaware	290		
Idaho	23,000		X
Illinois	65,591		X
Indiana	23,539		
Iowa	55,091		X
Maine	49,722		X
Maryland	400		
Massachusetts	15,000*		
Michigan	287,524		X
Minnesota	202,944*		X
Montana	16,569	29,700	X
Nebraska	994		
New Hampshire	30,586	2,000	
New Jersey	6,000		
New Mexico	6,000		
New York	67,346*		X
North Dakota	13,532		X
Ohio	15,417		
Oregon	7,813		X
Pennsylvania	46,700	80,000	X
Rhode Island	395**		
South Dakota	9,066		X
Utah	13,480		X
Vermont	11,953		
Washington	17,020		X
Wisconsin	154,000		X
Wyoming	11,136		X
Total	<u>1,177,066</u>	<u>123,200</u>	

\* 1984 figure used

\*\*1983 figure used

Note: Registration figures are not available for the remaining states.

1985-1986 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

Province	Current Registrations	Estimated Number of Unregistered Snowmobiles	County Breakdown Available
Alberta	22,305		
British Columbia	49,970		
Manitoba	35,798		
New Brunswick	7,785	25,000	X
Newfoundland	53,000*		
Nova Scotia	7,922**		X
Ontario	200,000		
Prince Edward Island	3,647**		
Quebec	78,521		
Saskatchewan	10,269		X
Territories:			
Yukon Territory	437		
Northwest Territories (City of Yellowknife)	293**		
TOTAL	<u>469,947</u>	<u>25,000</u>	

\* includes all-terrain vehicles

\*\*1984 figure used



1984 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

State	Current Registrations	Estimated Number of Unregistered Snowmobiles	County Breakdown Available
Alaska	2,522		
California	4,816	3,900	X
Colorado	13,788	6,000	
Connecticut	2,379		X
Idaho	20,200	10,000	X
Illinois	66,863		X
Indiana	32,651	15,000	X
Iowa	65,329		X
Maine	47,862		X
Maryland	1,200		
Massachusetts	15,000		
Michigan	271,221		X
Minnesota	202,944		X
Montana	13,261	30,900	X
Nebraska	1,858		X
New Hampshire	29,658	5,000	
New Jersey	4,000		
New Mexico	4,500		
New York	67,346	25,000	X
North Dakota	10,976		X
Ohio	31,971		
Oregon	8,134		X
Pennsylvania	47,000	25,000	X
Rhode Island	395*		
South Dakota	9,617		X
Utah	11,741		
Vermont	21,288		
Washington	14,959		X
Wisconsin	164,124		X
Wyoming	12,197		X
Total	1,199,800	120,800	

\*1983 figure used

Note: Registration figures are not available for the remaining states.

1984 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

Province	Current Registrations	Estimated Number of Unregistered Snowmobiles	County Breakdown Available
Alberta	25,000	60,000	
British Columbia	24,000		
Manitoba	29,196		
New Brunswick	9,040		X
Newfoundland	60,000		
Nova Scotia	7,922		X
Ontario	169,385*		X
Prince Edward Island	3,647		
Quebec	78,569		
Saskatchewan	15,526		X
Territories:			
Yukon Territory	238		
Northwest Territories (City of Yellowknife)	293	100	
TOTAL	<u>422,816</u>	<u>60,100</u>	

\*1983 figure used

1983 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

State	Current Registrations	County Breakdown Available
<hr style="border-top: 1px dashed black;"/>		
Alaska	1,602	
California	5,120	X
Colorado	13,959	
Connecticut	2,266	X
Idaho	21,785	X
Illinois	69,439	X
Indiana	32,037	X
Iowa	60,291	X
Maine	42,177	X
Maryland	639	
Massachusetts	16,500	X
Michigan	282,274	X
Minnesota	207,564	X
Montana	16,074	X
Nebraska	1,664	X
New Hampshire	21,154	
New Jersey	4,109	
New Mexico	5,900	
New York	73,244	X
North Dakota	14,739	X
Ohio	24,048	
Oregon	4,113	X
Pennsylvania	55,000	X
Rhode Island	395	
South Dakota	7,839	X
Utah	16,355	X
Vermont	19,971	
Washington	14,959	
Wisconsin	159,561	X
Wyoming	12,972	X
TOTAL	1,207,750	

Note: Registration figures are not available for the remaining states.

1983 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

Province	Current Registrations	County Breakdown Available
Alberta	23,001	
British Columbia	59,593*	X
Manitoba	21,767	
New Brunswick	9,590	
Newfoundland	50,000	
Nova Scotia	9,750	
Ontario	169,385	
Prince Edward Island	3,637	
Quebec	60,918	
Saskatchewan	16,855	X
Territories:		
Yukon Territory	445	
Northwest Territories	<u>No statistics available</u>	
TOTAL	424,941	

\*1982 figures used

1982 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

State	Current Registrations	County Breakdown Available
Alaska	2,522	X
California	5,048	X
Colorado	14,087	X
Connecticut	2,577	
Idaho	18,552	X
Illinois	72,682	X
Indiana	46,361	X
Iowa	56,000	X
Maine	57,178	X
Maryland	896	
Massachusetts	23,000	X
Michigan	386,391	X
Minnesota	220,100	X
Montana	14,064	X
Nebraska	1,016	X
New Hampshire	35,490	
New Jersey	4,015	
New Mexico	3,077	
New York	85,639	X
North Dakota	13,660	X
Ohio	32,045	
Oregon	7,682	X
Pennsylvania	56,459	X
Rhode Island	451	
South Dakota	6,986	X
Utah	17,016	X
Vermont	28,827	
Washington	15,161	X
Wisconsin	175,334	X
Wyoming	12,715	X
TOTAL	1,415,031	

Note: Registration figures are not available for the remaining states.

1982 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

Province	Current Registrations	County Breakdown Available
Alberta	24,161	
British Columbia	59,593	X
Manitoba	35,853	
New Brunswick	12,493*	X
Newfoundland	49,144	
Nova Scotia	11,390*	X
Ontario	170,976	
Prince Edward Island	3,600	X
Quebec	173,094*	
Saskatchewan	17,512	
Territories:		
Yukon Territory	268	
Northwest Territories	<u>No statistics available</u>	
TOTAL	558,084	

\*1981 figures used

1981 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

State	Current Registrations (as of December 1, 1981)	County Breakdown Available
Alaska	1,102	X
California	5,542	X
Colorado	12,832	
Connecticut	2,700	
Idaho	19,961	X
Illinois	70,822	X
Indiana	44,760	X
Iowa	60,000	X
Maine	51,511	X
Maryland	786	
Massachusetts	18,696	X
Michigan	368,858	X
Minnesota	228,764	X
Montana	10,944	X
Nebraska	1,500	X
New Hampshire	26,679	
New Jersey	5,392	
New Mexico	2,543	
New York	86,907	X
North Dakota	14,900	X
Ohio	32,045	
Oregon	7,544	X
Pennsylvania	55,763	X
Rhode Island	400	
South Dakota	4,695	X
Utah	14,984	X
Vermont	22,223	
Washington	14,194	X
Wisconsin	162,600	X
Wyoming	9,468	X
<hr/>		
TOTAL	1,359,115	

Note: Registration figures are not available  
for the remaining states.

1981 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

Province	Current Registrations (as of December 1, 1981)	County Breakdown Available
Alberta	26,364	
British Columbia	46,031	X
Manitoba	36,788	
New Brunswick	12,493	X
Newfoundland	46,550	
Nova Scotia	11,390	X
Ontario	165,882	
Prince Edward Island	3,582	X
Quebec	173,094	
Saskatchewan	19,069	
Territories:		
Yukon Territory	398	
Northwest Territories	No statistics available	
<hr/>		
TOTAL	541,641	



1980 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

<u>State</u>	<u>Current Registration Survey</u>	<u>Estimated Unregistered</u>	<u>County Breakdown Available</u>
Alaska	4,618		x
California	6,335	3,276	x
Colorado	13,776	8,000	
Connecticut	5,016		x
Idaho	20,705		x
Illinois	68,188		x
Indiana	44,513		x
Iowa	58,929		x
Maine	40,869		x
Maryland	106		
Massachusetts	35,147		
Michigan	465,038		x
Minnesota	286,035		x
Montana	8,315		x
Nebraska	1,037		x
New Hampshire	16,755	5,000	
New Jersey	5,044		
New Mexico	2,207	448	
New York	121,713		x
North Dakota	13,157		x
Ohio	21,973		
Oregon	8,458		x
Pennsylvania	68,961	20,000	x
Rhode Island	300		--
South Dakota	6,855		x
Utah	17,211	5-10%	x
Vermont	21,818		
Washington	12,748		x
Wisconsin	212,605	40,000	x
Wyoming	9,806	10-15,000	x
<hr/>			
TOTAL	1,598,238		

Note: Registration figures are not available for the remaining states.

1980 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

<u>State</u>	<u>Current Registration Survey</u>	<u>Estimated Unregistered</u>	<u>County Breakdown Available</u>
Alberta	25,180	75-80,000	x
British Columbia	42,056		x
Manitoba	13,395		x
New Brunswick	12,858		
Newfoundland	38,000		x
Nova Scotia	12,221		
Ontario	195,184	75,000	x
Prince Edward Island	3,400		x
Quebec	46,000	105,000	x
Saskatchewan	24,300		x
Territories:			
Yukon Territory	310	2,000	
Northwest Territory	No statistics available		
TOTAL	412,904		

1979 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

<u>State</u>	<u>Current Registrations</u>	<u>County Breakdown Available</u>	<u>1978 Registration Survey</u>	<u>Notes</u>
Alaska	3,539	x	10,081	1
California	7,176	x	5,744	2
Colorado	13,687		11,257	3
Connecticut	6,630	x	7,119	
Idaho	21,726	x	14,594	
Illinois	58,317	x	45,882	
Indiana	34,883	x	10,481	
Iowa	74,510	x	54,470	
Maine	63,646	x	67,345	
Maryland	104		101	
Massachusetts	37,865	x	47,000	
Michigan	444,212	x	409,266	
Minnesota	300,467	x	307,985	
Montana	28,263	x	15,355	
Nebraska	2,200		1,110	
New Hampshire	36,761		35,905	
New Jersey	5,201		4,521	4
New Mexico	1,702		2,509	
New York	121,713	x	130,109	
North Dakota	21,031	x	18,128	
Ohio	12,855		11,290	
Oregon	7,822	x	7,529	
Pennsylvania	66,195	x	78,000	
Rhode Island	339		378	
South Dakota	7,617	x	7,513	
Utah	17,244	x	16,207	
Vermont	31,328		31,281	
Washington	14,362	x	14,278	
Wisconsin	216,821	x	255,908	
Wyoming	<u>10,040</u>	x	<u>8,862</u>	
Sub Total	1,668,256		1,630,208	
Nevada (est)	2,500		2,400	
West Virginia (est)	5,450		5,350	
Delaware (est)	200		150	
Virginia (est)	550		500	
All other states (est)	6,000		5,000	
U. S. Total	<u>1,682,956</u>		<u>1,643,608</u>	

1. Start of new 2-year registration period for all snowmobiles.
2. Estimated 3,242 unregistered.
3. Estimated 8,000 unregistered.
4. Estimated 1,000 unregistered.

1979 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

<u>State</u>	<u>Current Registrations</u>	<u>County Breakdown Available</u>	<u>1978 Registration Survey</u>	<u>Notes</u>
Alberta	27,626		23,956	
British Columbia	40,000		37,013	
Manitoba	49,159		38,357	
New Brunswick	17,403		20,399	
Newfoundland	37,144		32,284	
Nova Scotia	16,171		13,912	
Ontario	195,000 est.		199,502	
Prince Edward Island	1,524		2,956	
Quebec	175,678	x	223,293	
Saskatchewan	24,540		21,576	
Territories:				
Yukon Territory	173		388	
Northwest Territories	<u>7,000</u>		<u>2,100</u>	1
Canada Total	591,418		615,736	
U. S. Total	1,682,956		1,643,608	
GRAND TOTAL	2,274,374		2,259,344	

1. Estimated 1979 data; Registrar of Motor Vehicles, Northwest Territories

1978 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

State	Current Registrations	County Breakdown Available	1977 Registration Survey	notes
Alaska	10,081	x	9,146	
California	5,744	x	5,363	
Colorado	11,257		11,003	1
Connecticut	7,119	x	7,859	
Idaho	14,594	x	14,306	
Illinois	45,882	x	38,673	
Indiana	10,481	x	13,993	2
Iowa	54,470	x	51,019	
Maine	67,345	x	71,502	
Maryland	101		82	
Massachusetts	47,000		46,000	
Michigan	409,266	x	381,803	3
Minnesota	307,985	x	316,886	
Montana	15,355	x	22,978	3
Nebraska	1,110		346	
New Hampshire	35,905		41,887	
New Jersey	4,521		4,238	1
New Mexico	2,509		2,097	
New York	130,109	x	132,301	
North Dakota	18,128	x	25,115	
Ohio	11,290		8,967	
Oregon	7,529	x	6,791	
Pennsylvania	78,000	x	72,550	4
Rhode Island	345		367	
South Dakota	7,513	x	7,896	
Utah	13,425	x	11,752	
Vermont	31,281		32,222	
Washington	14,278	x	9,420	
Wisconsin	255,908	x	245,542	
Wyoming	8,862	x	7,214	
Sub Total	1,627,393		1,599,318	
Nevada (est)	2,400		2,000	
West Virginia (est)	5,350		5,000	
Delaware (est)	150			
Virginia (est)	500			
All other states (est)	5,000			
U. S. Total	1,640,793		1,606,318	

1. Official estimate of 2,000 unregistered
2. County breakdown available for 1976 only
3. Revised registration procedure
4. County breakdown available 9/78

1978 NORTH AMERICAN SNOWMOBILE  
REGISTRATION SURVEY

Province	Current Registrations	County Breakdown Available	1977 Registration Survey	notes
Alberta	23,956	x	18,087	
British Columbia	37,013		33,742	
Manitoba	38,879		30,374	
New Brunswick	20,399		22,788	1
Newfoundland	32,284		27,000	
Nova Scotia	13,912	x	13,826	2
Ontario	<del>209,304</del> 204,781		<del>225,000</del> 209,304	3, 4
Prince Edward Island	2,956		699	
Quebec	235,776		227,587	
Saskatchewan	<u>21,576</u>		<u>24,096</u>	5
Sub Total	636,055		623,199	
Canada Terri- tories (est)	<u>25,000</u>		<u>22,000</u>	
Canada Total	661,055		645,199	
U. S. Total	<u>1,640,793</u>		<u>1,606,318</u>	
GRAND TOTAL	2,301,848		2,251,517	

1. Final 1978 registration figure available 7/78
2. County breakdown available 11/78
3. Estimated 1977 figure
4. Official estimate of 75,000 unregistered
5. Revised registration procedure

*Ontario notation made 9/11/78*

Revised 10/14/77

**1977 SNOWMOBILE  
REGISTRATION SURVEY**

<u>State</u>	<u>1977 Registration</u>	<u>County Breakdown Available</u>	<u>1976 Registration</u>
Alaska (est.)	15,000	X	9,945
California	5,363	X	6,655
Colorado	11,003		12,991
Connecticut	7,859	X	4,043
Idaho	14,306	X	19,886
Illinois	38,673	X	34,375
Indiana	13,993	X	18,688
Iowa	51,019	X	51,454
Maine	71,502	X	71,222
Maryland	82		48
Massachusetts	46,000		36,800
Michigan	381,803	X	374,458
Minnesota	316,886	X	306,270
Montana	22,978	X	16,854
Nebraska	346		325
New Hampshire	41,887		42,055
New Jersey	4,238		4,715
New Mexico	2,097	X	1,633
New York	132,301		149,401
North Dakota	25,115		22,533
Ohio	8,967		4,387
Oregon	6,791	X	7,864
Pennsylvania	72,550	X	53,952
Rhode Island	367		390
South Dakota	7,896	X	9,746
Utah	11,752	X	15,232
Vermont	32,222		34,806
Washington	9,420	X	11,940
Wisconsin	245,542	X	241,395
Wyoming	7,214	X	8,621
<hr/> Subtotal	<hr/> 1,605,172		<hr/> 1,572,684
Nevada (est.)	2,000		1,900
W. Virginia (est.)	5,000		4,700
<hr/> TOTAL	<hr/> 1,612,172		<hr/> 1,579,284

1977 SNOWMOBILE  
REGISTRATION SURVEY

<u>Province</u>	<u>1977 Registration</u>	<u>County Breakdown Available</u>	<u>1978 Registration</u>
Alberta	18,087	X	19,919
British Columbia	33,742		31,460
Manitoba	30,374		45,236
New Brunswick	22,788		24,600
Nova Scotia	13,826		17,656
Ontario	225,000		209,120
Prince Edward Is.	699		1,672
Quebec	227,587		223,544
Saskatchewan	24,096		26,964
<hr/> TOTAL	<hr/> 596,199		<hr/> 600,171



## **APPENDIX B:**

### **MIC STATE POPULATION, ANNUAL USAGE, SEASONAL USAGE ESTIMATES**

***Source: MIC, Burke Marketing Research***



**MOTORCYCLE  
INDUSTRY  
COUNCIL, INC.**

**EXECUTIVE  
OFFICE**

2 Jenner Street, Suite 150, Irvine, CA 92718 • (714) 727-4211 • FAX (714) 727-4217

**1990 SURVEY  
OF MOTORCYCLE OWNERSHIP AND USAGE  
FINAL RESULTS, WAVES 1 - 12  
MAY, 1991  
VOLUME II**

**CONDUCTED FOR THE**



**MOTORCYCLE INDUSTRY COUNCIL, INC.**

**BY**

**BURKE MARKETING RESEARCH**

**Copyright 1991, Motorcycle Industry Council**

This information may not be distributed to any other company, association, government agency, or other entity, or used in any advertisement or other public communication without the express written permission of the Motorcycle Industry Council.

# INTRODUCTION

1

## Background

Every 5 years the MIC intends to conduct a major telephone consumer survey of motorcycle, mini-cycle, scooter, moped and ATV owners and non-owners. Its purpose is to provide nationally projectable data on U.S. motorcycle ownership and usage, to update information on the motorcycle market and to provide comparisons for a trend analysis. This is the third report prepared by Burke Marketing Research. The first survey was conducted in 1974.

## Purpose

The primary purpose of this research is to provide information to support MIC programs in government relations, land use, technical issues, public awareness and statistics. The secondary purpose is to provide information to MIC members.

## Method/Interviewing Dates/Locations

Burke Marketing Research conducted telephone interviews via CRT's from its WATS interviewing facility in Cincinnati, Ohio from January through December, 1990. A twelve month period was used for the entire study to eliminate seasonal bias. Weekday late afternoon/evening and weekend dialing was used. All interviews were completed by "exclusively Burke" investigators operating under constant supervision. Up to six callbacks on identified owning households were made, and additional callbacks if felt to be productive.

## Research Design

Telephone interviews were conducted via CRT's. There was an owner and a non-owner version of the questionnaire. The following is an outline of each version.

## Questionnaire Outline

Screening and Ownership

### Non-Owner

Previous Ownership

Reasons Never or No Longer Own

Importance of Reasons For Not Owning

Household Operators of Vehicles in Past Year

Attitude toward Motorcycles/ATV's

Reasons for Attitude

Demographics

BMR# 40-088

# INTRODUCTION

2

## Owner

Vehicles Currently Owned  
Year, Make, Model, Engine Size of Vehicles  
Where Vehicle Operated  
Number of Wheels on ATV's  
Whether or Not In Running Order  
Number of Household Member Operators  
Number of Operators on the Streets/Off-Highway

## Primary Rider Questions

Month/Year Vehicle Purchased New/Used  
Where Purchased  
Where Vehicle Operated

## Street Riding

Annual Mileage  
Usage By Season/Weekend/Urban vs. Rural  
Primary Means of Transportation  
Fuel Consumption  
Commuting  
Helmet Usage  
Motorcycle Licensing and Rider Education

## Off-Highway Riding

Usage by Season/Weekend/Urban vs. Rural  
Mileage of ATV for Utility Purposes  
Days, Miles, Hours, Gallons Used for Vehicle  
Fuel Consumption  
Helmet Usage

## Motorcycle Aftermarket

Muffler System Replacement  
Purchase of Riding Apparels  
Maintenance of Vehicle  
Insurance Coverage  
Demographics and Interests

A copy of the questionnaire and all field supplies can be found in the Appendix of this report.

# INTRODUCTION

3

## Sample

A total of 1896 (approximately 158 per month) interviews of motorcycle owners were completed from January through December 1990 using Super Survey Sampling National Probability Sample (NPS). Completes with incorrect or non-classifiable vehicles as the selected vehicle were deleted each month from the data, and replaced in following months. A total of 43 NPS interviews had to be deleted from the data throughout the year. The sample was plus 1 and our Telephone Number Management System (TNMS) was used to monitor the quota, control callbacks, and release sample efficiently.

A total of 1204 interviews (100 per month) of households not currently owning a motorcycle were also completed using the NPS.

An additional 699 interviews of motorcycle owners were completed using Piggyback sample. A piggyback question screening for motorcycle owners was asked on other Burke studies to obtain this sample. Again, completes with an invalid selected vehicle were deleted, and replaced in following months. A total of 27 piggyback completes had to be deleted throughout the year.

The final dispositions can be found in the appendix of this report.

## Sample Control

Control of sampling was executed on a month by month basis. A new random sample was drawn each month to provide discrete time segments over which sample analysis could be evaluated.

## Multiple Ownership

For households owning more than one motorcycle, a random selection procedure of all vehicles in operation was used to select one vehicle for the in-depth interview.

## Respondent Selection

The primary rider of each selected motorcycle was interviewed. Names of the primary riders were collected to do an analysis of what else they ride. The assistance of an adult for children under 12 may have been sought. However, the demographics will be of the child, not the adult.

# INTRODUCTION

4

## Coding

At the end of each month, Burke sent to MIC a computerized print out of the owner completes sorted by make with the phone number and information about the vehicle's year, brand, model, engine type, nominal engine size and actual engine size. MIC recontacted respondents if necessary to obtain information to make the interview a valid complete. MIC returned these sheets for key-punching and indicated those to be deleted due to insufficient or incorrect information.

A print out of the other responses for QB was sent to MIC monthly, along with other responses for Q's 26, 36, 41, 43, 56, 59, 61, 69 and N4. A pre-list was developed for Q61 - magazines.

## Interpretation of the Data

- 1) Questions (tables) based on TOTAL VEHICLES and TOTAL VEHICLES IN RUNNING ORDER are run against Banners A-D.
- 2) Questions (tables) based on SELECTED VEHICLES are run against Banners A-G.
- 3) Questions (tables) based on NON-OWNERS are run against Banner H-I.

# INTRODUCTION

## Number of Bikes Owned

For interviews from January - April, the number of bikes owned is the number of bikes asked about, up to 5. For interviews from May - December, the number is the exact number of bikes owned, from QX2, which was added to the interview in May.

## Non-Owner Weighting

The non-owner tables, as was done in the 1985 wave, are weighted 50% male, 50% female.

- . In some instances, base sizes are small. Where this occurs, caution should be used in the interpretation of data.
- . Individual bases within the banner may add to less than the Total base because some respondents refused, were unable to answer or were not asked some questions. Bases may add to more than the Total when base selections are not mutually exclusive.
- . In some cases, percentages may add to slightly more or less than 100% due to rounding. Percentages may also add to more than 100% due to the acceptance of more than one answer from a respondent to a particular question.
- . When means were calculated, "Don't Know" answers were removed from the base.
- . Throughout this report, the data are presented with numbers appearing on each line with the corresponding percentages immediately below them.
- . A blank space or a dash indicates no response was made for a particular answer or comment.
- . The abbreviation "N.S." means "Non-Specific."
- . The word "Net" often appears after the description of a category. A given respondent may have made more than one comment in the detail lines beneath the category net but is counted only once in the net line.

BMR# 40-088

# GEOGRAPHIC POPULATION SPREAD



DMR # 40-088  
MIC SURVEY OF MOTORCYCLE OWNERSHIP AND USAGE  
OWNERS

7 FEB 91

TABLE 33A

STATE

	MODEL TYPE											ON-HIGHWAY BY SPECIFIC TYPE			
	TOTAL	SCOOT 1	ON- Hwy 2	DUAL PURP 3	OFF Hwy 4	COMP 5	ATV 6	ALL MOTOR/ SCOOT 1-5	SCOOT/ ON- Hwy 1-2	OFF/ COMP/ ATV 4-6	OFF/ COMP 4-5	STAN- DARD	CRUIS	SPORT BIKE	TOUR
BASE-SELECTED VEHICLES	2505	80	1340	223	143	108	600	1084	1420	950	341	813	272	90	150
<u>EAST (NET)</u>	472	11	293	20	18	32	100	372	304	148	48	173	68	17	35
	18.2	13.8	21.9	9.0	11.2	10.2	18.4	18.8	21.4	15.6	14.1	21.3	24.3	18.9	22.4
<u>NEW ENGLAND (SUB-NET)</u>	111	3	73	2	3	12	18	93	78	33	15	45	11	8	11
	4.3	3.8	5.4	0.9	2.1	6.1	3.0	4.7	5.4	3.5	4.4	5.5	4.0	6.7	7.1
CONNECTICUT	19	1	12	-	-	3	3	16	13	6	3	7	4	-	1
	0.7	1.3	0.9	-	-	1.5	0.5	0.8	0.9	0.6	0.9	0.9	1.5	-	0.6
MAINE	17	-	10	1	-	2	4	13	10	6	2	7	3	-	-
	0.7	-	0.7	0.4	-	1.0	0.7	0.7	0.7	0.6	0.6	0.9	1.1	-	-
MASSACHUSETTS	49	2	31	1	3	5	7	42	33	15	8	19	1	5	6
	1.9	2.5	2.3	0.4	2.1	2.5	1.1	2.1	2.3	1.0	2.3	2.3	0.4	5.6	3.8
NEW HAMPSHIRE	14	-	8	-	-	2	4	10	8	6	2	5	2	-	1
	0.5	-	0.6	-	-	1.0	0.7	0.5	0.6	0.6	0.6	0.6	0.7	-	0.6
RHODE ISLAND	8	-	8	-	-	-	-	8	8	-	-	6	1	1	-
	0.3	-	0.6	-	-	-	-	0.4	0.6	-	-	0.7	0.4	1.1	-
VERMONT	4	-	4	-	-	-	-	4	4	-	-	1	-	-	3
	0.2	-	0.3	-	-	-	-	0.2	0.3	-	-	0.1	-	-	1.9
<u>MIDDLE ATLANTIC (SUB-NET)</u>	381	8	220	18	13	20	82	279	228	115	33	128	55	11	24
	13.9	10.0	18.4	8.1	9.1	10.1	13.5	14.1	18.1	12.1	9.7	15.7	20.2	12.2	15.4
DELAWARE	5	-	1	-	1	-	3	2	1	4	1	-	-	1	-
	0.2	-	0.1	-	0.7	-	0.5	0.1	0.1	0.4	0.3	-	-	1.1	-
MARYLAND	40	1	30	-	1	-	8	32	31	9	1	17	10	-	3
	1.5	1.3	2.2	-	0.7	-	1.3	1.8	2.2	0.9	0.3	2.1	3.7	-	1.9
NEW JERSEY	46	-	28	3	-	5	10	38	28	15	5	18	10	-	2
	1.8	-	2.1	1.3	-	2.5	1.8	1.8	2.0	1.6	1.5	2.0	3.7	-	1.3
NEW YORK	119	4	82	2	4	8	19	100	88	31	12	48	21	6	6
	4.8	5.0	6.1	0.9	2.8	4.0	3.1	5.0	6.1	3.3	3.5	5.9	7.7	6.7	3.8
PENNSYLVANIA	125	3	72	11	6	4	29	98	75	39	10	45	12	3	11
	4.8	3.8	5.4	4.9	4.2	2.0	4.8	4.8	5.3	4.1	2.9	5.5	4.4	3.3	7.1
WEST VIRGINIA	26	-	7	2	1	3	13	13	7	17	4	2	2	1	2
	1.0	-	0.5	0.9	0.7	1.5	2.1	0.7	0.5	1.8	1.2	0.2	0.7	1.1	1.3
<u>MIDWEST (NET)</u>	777	22	446	65	35	40	108	608	468	243	75	281	83	30	50
	20.9	27.5	33.3	20.1	24.5	20.2	27.6	30.6	33.0	25.6	22.0	34.6	30.5	33.3	32.1
<u>EAST CENTRAL (SUB-NET)</u>	300	12	210	28	21	21	85	301	231	127	42	135	40	17	25
	14.9	15.0	18.3	12.6	14.7	10.6	14.0	15.2	16.3	13.4	12.3	16.6	14.7	18.9	16.0
ILLINOIS	94	4	54	5	4	6	21	73	58	31	10	32	9	4	9
	3.8	5.0	4.0	2.2	2.8	3.0	3.4	3.7	4.1	3.3	2.9	3.9	3.3	4.4	5.8
INDIANA	62	1	30	3	3	1	15	47	40	19	4	16	11	3	9
	2.4	1.3	2.9	1.3	2.1	0.5	2.4	2.6	2.0	2.0	1.2	2.0	4.0	3.3	5.8

DMR # 40-088  
MIC SURVEY OF MOTORCYCLE OWNERSHIP AND USAGE  
OWNERS

7 FEB 91

TABLE 33A

STATE

	MODEL TYPE										ON-HIGHWAY BY SPECIFIC TYPE				
	TOTAL	SCOOT 1	ON- HWY 2	DUAL PURP 3	OFF HWY 4	COMP 5	ATV 6	ALL	SCOOT/	OFF/	OFF/ COMP 4-5	STAN- DARD	CRUIS	SPORT BIKE	TOUR
								MOTOR/ SCOOT 1-5	ON- HWY 1-2	ATV 4-6					
BASE-SELECTED VEHICLES	2595	80	1340	223	143	100	009	1984	1420	950	341	813	272	90	150
MICHIGAN	121	8	53	17	10	8	29	92	50	45	10	30	7	4	4
	4.7	7.5	4.0	7.6	7.0	3.0	4.0	4.0	4.2	4.7	4.7	4.4	2.0	4.4	2.0
OHIO	109	1	73	3	4	8	20	89	74	32	12	51	13	6	3
	4.2	1.3	5.4	1.3	2.8	4.0	3.3	4.5	5.2	3.4	3.5	6.3	4.0	0.7	1.9
WEST CENTRAL (SUB-	391	10	227	37	14	10	83	307	237	110	33	146	43	13	25
NET)	15.1	12.5	10.9	10.6	9.8	9.0	13.0	15.5	10.7	12.2	9.7	10.0	15.0	14.4	10.0
IOWA	45	2	26	8	3	-	0	39	20	9	3	17	2	2	5
	1.7	2.5	1.9	3.6	2.1	-	1.0	2.0	2.0	0.9	0.9	2.1	0.7	2.2	3.2
KANSAS	08	3	30	8	5	3	10	58	42	18	0	29	7	1	2
	2.6	3.8	2.0	3.6	3.5	1.5	1.0	2.0	3.0	1.0	2.3	3.6	2.0	1.1	1.3
MINNESOTA	94	2	45	9	3	5	30	64	47	30	8	29	7	5	4
	3.0	2.5	3.4	4.0	2.1	2.5	4.0	3.2	3.3	4.0	2.3	3.0	2.0	5.0	2.0
MISSOURI	56	-	31	2	2	6	15	41	31	23	0	21	4	2	4
	2.2	-	2.3	0.9	1.4	3.0	2.5	2.1	2.2	2.4	2.3	2.0	1.5	2.2	2.0
NEBRASKA	27	-	18	2	1	1	5	22	18	7	2	7	9	1	1
	1.0	-	1.3	0.9	0.7	0.5	0.8	1.1	1.3	0.7	0.6	0.9	3.3	1.1	0.0
NORTH DAKOTA	12	-	6	2	-	-	4	8	6	4	-	3	2	-	1
	0.5	-	0.4	0.9	-	-	0.7	0.4	0.4	0.4	-	0.4	0.7	-	0.0
SOUTH DAKOTA	11	-	5	2	-	3	1	10	5	4	3	2	2	-	1
	0.4	-	0.4	0.9	-	1.5	0.2	0.5	0.4	0.4	0.9	0.2	0.7	-	0.0
WISCONSIN	78	3	57	4	-	1	12	65	60	13	1	38	10	2	7
	3.0	3.8	4.3	1.8	-	0.5	2.0	3.3	4.2	1.4	0.3	4.7	3.7	2.2	4.5
SOUTH (NET)	640	19	297	33	43	40	202	430	310	291	80	171	50	22	43
	24.7	23.8	22.2	14.8	30.1	23.2	33.2	22.1	22.3	30.6	20.1	21.0	21.3	24.4	27.0
SOUTH EAST (SUB-NET)	420	11	204	18	30	20	120	292	215	107	59	110	39	10	29
	16.2	13.8	15.2	8.1	21.0	14.0	21.0	14.7	15.1	19.7	17.3	14.3	14.3	20.0	10.0
ALABAMA	41	-	13	1	2	4	21	20	13	27	6	10	-	-	3
	1.8	-	1.0	0.4	1.4	2.0	3.4	1.0	0.9	2.0	1.0	1.2	-	-	1.9
FLORIDA	71	4	45	2	1	7	12	50	40	20	8	21	0	0	9
	2.7	5.0	3.4	0.9	0.7	3.5	2.0	3.0	3.5	2.1	2.3	2.0	3.3	0.7	5.0
GEORGIA	42	-	17	2	5	2	10	20	17	23	7	7	0	2	1
	1.0	-	1.3	0.9	3.5	1.0	2.0	1.3	1.2	2.4	2.1	0.9	2.2	2.2	0.0
KENTUCKY	41	1	10	3	5	4	0	32	20	10	9	11	2	1	5
	1.6	1.3	1.4	1.3	3.5	2.0	1.5	1.0	1.4	1.9	2.0	1.4	0.7	1.1	3.2
MISSISSIPPI	37	-	12	1	1	1	22	15	12	24	2	0	2	1	1
	1.4	-	0.0	0.4	0.7	0.5	3.0	0.0	0.0	2.5	0.0	1.0	0.7	1.1	0.0

B8

DMR # 40-000  
MIC SURVEY OF MOTORCYCLE OWNERSHIP AND USAGE  
OWNERS

7 FEB 91

TABLE 33A

STATE

	MODEL TYPE											ON-HIGHWAY BY SPECIFIC TYPE			
	TOTAL	SCOOT 1	ON- HWY 2	DUAL PURP 3	OFF HWY 4	COMP 5	ATV 6	ALL MOTOR/ SCOOT 1-5	SCOOT/ ON- HWY 1-2	COMP/ ATV 4-6	OFF/ COMP 4-5	STAN- DARD	CRUIS	SPORT BIKE	TOUR
BASE-SELECTED VEHICLES	2505	80	1340	223	143	108	609	1084	1420	950	341	813	272	90	156
SOUTH CAROLINA	38	-	23	1	4	2	8	30	23	14	0	9	0	4	3
	1.5	-	1.7	0.4	2.8	1.0	1.3	1.5	1.8	1.5	1.8	1.1	2.2	4.4	1.9
TENNESSEE	50	4	21	3	2	2	18	32	25	22	4	11	5	2	3
	1.9	5.0	1.8	1.3	1.4	1.0	3.0	1.8	1.8	2.3	1.2	1.4	1.8	2.2	1.9
VIRGINIA	54	1	31	2	5	4	11	43	32	20	9	23	5	-	3
	2.1	1.3	2.3	0.0	3.5	2.0	1.8	2.2	2.3	2.1	2.0	2.8	1.8	-	1.9
<u>SOUTH WEST (SUB-NET)</u>	220	8	93	15	13	17	74	140	101	104	30	55	19	4	14
	8.5	10.0	8.0	8.7	0.1	8.8	12.2	7.4	7.1	10.9	8.8	8.8	7.0	4.4	9.0
ARKANSAS	20	1	8	2	-	-	15	11	9	15	-	2	5	1	-
	1.0	1.3	0.8	0.8	-	-	2.5	0.6	0.8	1.8	-	0.2	1.8	1.1	-
LOUISIANA	30	1	8	1	1	4	21	15	9	20	5	0	2	-	-
	1.4	1.3	0.8	0.4	0.7	2.0	3.4	0.8	0.8	2.7	1.5	0.7	0.7	-	-
OKLAHOMA	47	2	23	2	5	4	11	30	25	20	9	18	2	-	3
	1.8	2.5	1.7	0.8	3.5	2.0	1.8	1.8	1.8	2.1	2.0	2.2	0.7	-	1.9
TEXAS	111	4	54	10	7	9	27	84	58	43	10	29	10	3	11
	4.3	5.0	4.0	4.5	4.0	4.5	4.4	4.2	4.1	4.5	4.7	3.0	3.7	3.3	7.1
<u>WEST (NET)</u>	708	28	304	105	49	80	130	508	332	268	129	188	65	21	20
	27.2	35.0	22.7	47.1	34.3	40.4	22.8	28.5	23.4	28.2	37.8	23.1	23.9	23.3	17.9
<u>ROCKY MOUNTAIN (SUB-NET)</u>	284	2	128	51	19	25	58	225	130	102	44	79	31	8	10
	10.9	2.5	9.6	22.9	13.3	12.8	9.5	11.3	9.2	10.7	12.9	9.7	11.4	6.7	8.4
ARIZONA	40	-	25	3	1	3	14	32	25	18	4	7	12	3	3
	1.8	-	1.9	1.3	0.7	1.5	2.3	1.8	1.8	1.9	1.2	0.9	4.4	3.3	1.9
COLORADO	52	-	30	8	1	7	8	40	30	14	8	10	9	-	1
	2.0	-	2.2	3.6	0.7	3.5	1.0	2.3	2.1	1.5	2.3	2.3	3.3	-	0.8
IDAHIO	111	-	38	33	12	5	22	88	38	39	17	28	5	2	3
	4.3	-	2.8	14.0	8.4	2.5	3.8	4.4	2.7	4.1	5.0	3.4	1.8	2.2	1.9
MONTANA	12	-	8	1	1	1	3	8	6	6	2	3	1	-	2
	0.5	-	0.4	0.4	0.7	0.5	0.5	0.5	0.4	0.5	0.8	0.4	0.4	-	1.3
NEVADA	20	1	5	2	2	5	5	15	8	12	7	3	1	-	-
	0.8	1.3	0.4	0.8	1.4	2.5	0.8	0.8	0.4	1.3	2.1	0.4	0.4	-	-
UTAH	22	1	11	3	1	2	4	18	12	7	3	8	2	-	1
	0.8	1.3	0.8	1.3	0.7	1.0	0.7	0.9	0.8	0.7	0.9	1.0	0.7	-	0.8
NEW MEXICO	14	-	10	1	-	1	2	12	10	3	1	8	1	1	-
	0.5	-	0.7	0.4	-	0.5	0.3	0.8	0.7	0.3	0.3	1.0	0.4	1.1	-
WYOMING	7	-	3	-	1	1	2	5	3	4	2	3	-	-	-
	0.2	-	0.2	-	0.7	0.5	0.3	0.3	0.2	0.4	0.8	0.4	-	-	-
												100	34	15	18

BMR # 40-088  
MIC SURVEY OF MOTORCYCLE OWNERSHIP AND USAGE  
OWNERS

7 FEB 91

TABLE 33A

STATE

	MODEL TYPE												ON-HIGHWAY BY SPECIFIC TYPE			
	TOTAL	SCOOT 1	ON- Hwy 2	DUAL PURP 3	OFF Hwy 4	COMP 5	ATV 6	ALL	SCOOT/	OFF/	OFF/ COMP 4-5	STAN- DARD	CRUIS	SPORT BIKE	TOUR	
								MOTOR/	ON-	COMP/						
								SCOOT	Hwy	ATV						
								1-5	1-2	4-6						
BASE-SELECTED VEHICLES	2595	80	1340	223	143	198	609	1084	1420	950	341	813	272	90	150	
CALIFORNIA	258	18	111	26	16	39	48	210	120	101	55	69	20	13	9	
	9.9	22.5	8.3	11.7	11.2	19.7	7.6	10.6	9.1	10.6	16.1	8.5	7.4	14.4	5.0	
OREGON	64	4	15	11	6	11	17	47	19	34	17	0	5	-	4	
	2.5	5.0	1.1	4.9	4.2	5.6	2.8	2.4	1.3	3.6	5.0	0.7	1.8	-	2.0	
WASHINGTON	102	4	50	17	8	5	18	84	54	31	13	34	9	2	5	
	3.9	5.0	3.7	7.6	5.6	2.5	3.0	4.2	3.8	3.3	3.8	4.2	3.3	2.2	3.2	
TOTAL	2595	80	1340	223	143	198	609	1084	1420	950	341	813	272	90	150	
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	

B-10

ANNUAL USAGE

DMR # 40-000

NIC SURVEY OF MOTORCYCLE OWNERSHIP AND USAGE  
OWNERS

23 MAY 91

TABLE 47

MILES RIDDEN IN PAST 12 MONTHS OFF-ROAD  
Q.31

	REGION					REGION							
	TOTAL	EAST	MID WEST	SOUTH	WEST	NEW ENG	MID ATL	EAST CNTRL	WEST CNTRL	SOUTH EAST	SOUTH WEST	ROCKY MTN	PAC
BASE-SELECTED VEHICLES USED OFF-ROAD	1200	191	330	357	390	41	150	160	162	230	127	162	220
0 - 25	320	43	91	90	96	0	35	56	35	62	36	37	59
26 - 50	102	24	52	53	53	2	22	26	26	27	26	21	32
51 - 75	14.4	12.0	15.0	14.0	13.6	4.9	14.7	15.5	16.0	11.7	20.5	13.0	14.0
76 - 100	45	3	13	17	12	-	3	6	7	12	5	8	4
101 - 200	3.5	1.0	3.9	4.0	3.1	-	2.0	3.6	4.3	5.2	3.9	4.9	1.8
201 - 300	135	21	30	27	51	6	15	19	17	20	7	24	27
301 - 400	10.0	11.0	10.9	7.6	13.1	14.0	10.0	11.3	10.5	8.7	5.5	14.8	11.0
401 - 500	151	20	30	37	40	10	10	22	18	25	12	22	28
501 - 1,000	11.9	14.7	11.5	10.4	12.3	24.4	12.0	13.1	9.9	10.9	9.4	13.6	11.4
1,001 - 1,500	94	14	23	30	27	3	11	10	13	22	0	15	12
1,501 - 2,000	7.4	7.3	7.0	8.4	6.9	7.3	7.3	6.0	8.0	9.6	6.3	9.3	5.3
2,001 - 12,000	31	3	10	8	12	1	2	4	6	5	1	5	7
DO NOT KNOW	2.4	1.6	3.0	1.7	3.1	2.4	1.3	2.4	3.7	2.2	0.8	3.1	3.1
TOTAL	77	20	10	10	21	4	10	0	12	12	6	5	10
0 - 25	6.1	10.5	5.5	5.0	5.4	9.0	10.7	3.6	7.4	5.2	4.7	3.1	7.0
26 - 50	0.2	12	17	22	31	3	9	3	14	13	9	11	20
51 - 75	0.5	0.3	5.2	6.2	7.9	7.3	0.0	1.8	0.6	5.7	7.1	6.0	8.0
76 - 100	12	2	2	3	5	-	2	1	1	1	2	3	2
101 - 200	0.9	1.0	0.0	0.8	1.3	-	1.3	0.0	0.0	0.4	1.6	1.9	0.9
201 - 300	0.24	5	5	0	6	-	5	4	1	5	3	1	5
301 - 400	1.9	2.6	1.5	2.2	1.5	-	3.3	2.4	0.6	2.2	2.4	0.0	2.2
401 - 500	32	9	8	7	8	2	7	4	4	4	3	4	4
501 - 1,000	2.5	4.7	2.4	2.0	2.1	4.9	4.7	2.4	2.5	1.7	2.4	2.5	1.8
1,001 - 1,500	75	7	17	31	20	2	5	7	10	22	9	6	14
1,501 - 2,000	5.0	3.7	5.2	8.7	5.1	4.9	3.3	4.2	0.2	9.6	7.1	3.7	0.1
2,001 - 12,000	1260	191	330	357	390	41	150	160	162	230	127	162	220
DO NOT KNOW	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
BASE	297	370	206	278	201	307	301	253	322	270	202	231	317
STD. DEV.	597	662	661	507	520	602	664	620	695	545	607	374	613
STD. ERR.	17	49	37	32	20	106	50	49	56	30	56	30	42
	100	116	90	75	100	100	100	50	100	100	50	100	100

B-11

BMR # 40-088

NIC SURVEY OF MOTORCYCLE OWNERSHIP AND USAGE  
OWNERS

7 FEB 91

TABLE 49

PERCENT OF RIDING DONE ON WEEKENDS OFF-ROAD  
Q.33

	MODEL TYPE							ON-HIGHWAY <sup>1</sup> BY SPECIFIC TYPE							
	TOTAL	SCOOT	ON- Hwy	DUAL PURP	OFF Hwy	COMP	ATV	ALL MOTOR/ SCOOT	SCOOT/ Hwy	OFF/ COMP	OFF/ Hwy	STAN- DARD	CRUIS	SPORT BIKE	TOUR
		1	2	3	4	5	6	1-5	1-2	4-6	4-5				
BASE-SELECTED VEHICLES USED OFF-ROAD	1268	21	106	203	140	194	603	664	127	937	334	85	12	4	4
0 - 9%	64	2	8	11	6	7	30	34	10	43	13	6	2	-	-
	5.0	9.5	7.5	5.4	4.3	3.6	5.0	5.1	7.9	4.6	3.9	7.1	10.7	-	-
10 - 19	48	2	8	7	2	7	22	26	10	31	9	7	-	-	1
	3.8	9.5	7.5	3.4	1.4	3.6	3.6	3.9	7.9	3.3	2.7	8.2	-	-	25.0
20 - 29	77	-	2	10	9	7	49	28	2	65	16	2	-	-	-
	6.1	-	1.9	4.9	6.4	3.6	8.1	4.2	1.6	6.9	4.8	2.4	-	-	-
30 - 39	53	2	3	8	7	7	20	27	5	40	14	2	-	1	-
	4.2	9.5	2.8	3.9	5.0	3.6	4.3	4.1	3.9	4.3	4.2	2.4	-	25.0	-
40 - 49	27	-	2	5	9	3	8	19	2	20	12	1	1	-	-
	2.1	-	1.9	2.5	6.4	1.5	1.3	2.9	1.6	2.1	3.0	1.2	8.3	-	-
50 - 59	145	3	14	17	21	22	60	77	17	111	43	11	2	1	-
	11.4	14.3	13.2	8.4	15.0	11.3	11.3	11.6	13.4	11.8	12.9	12.9	16.7	25.0	-
60 - 69	43	1	3	7	4	6	22	21	4	32	10	3	-	-	-
	3.4	4.8	2.8	3.4	2.9	3.1	3.0	3.2	3.1	3.4	3.0	3.5	-	-	-
70 - 79	173	6	7	28	15	19	90	75	13	132	34	5	1	1	-
	13.6	28.6	6.6	13.6	10.7	9.8	16.3	11.3	10.2	14.1	10.2	5.9	8.3	25.0	-
80 - 89	141	3	10	20	14	28	60	75	13	108	42	8	1	-	1
	11.1	14.3	9.4	9.9	10.0	14.4	10.0	11.3	10.2	11.5	12.6	9.4	8.3	-	25.0
90 - 100%	450	1	44	86	47	83	188	281	45	318	130	35	5	1	2
	35.5	4.8	41.5	42.4	33.6	42.8	31.2	39.3	35.4	33.9	38.9	41.2	41.7	25.0	50.0
DON'T KNOW	47	1	5	4	6	5	28	21	6	37	11	5	-	-	-
	3.7	4.8	4.7	2.0	4.3	2.6	4.3	3.2	4.7	3.9	3.3	5.0	-	-	-
TOTAL	1268	21	106	203	140	194	603	664	127	937	334	85	12	4	4
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MEAN	67.88	54.75	68.11	70.00	66.52	72.08	65.04	60.57	65.00	67.50	70.30	68.05	60.25	65.00	70.00
STD. DEV.	30.85	29.71	34.33	31.09	29.92	29.23	30.09	30.92	33.88	30.37	29.64	34.50	37.24	28.58	40.82
STD. ERR.	0.88	6.64	3.42	2.20	2.58	2.13	1.20	1.22	3.08	1.01	1.05	3.80	10.75	14.29	20.41
MEDIAN	75.00	70.00	80.00	80.00	75.00	80.00	75.00	80.00	75.00	75.00	80.00	80.00	75.00	82.50	85.00

B-12

DMR # 40-000  
MIC SURVEY OF MOTORCYCLE OWNERSHIP AND USAGE  
OWNERS

TABLE 53

NUMBER OF DAYS RODE VEHICLE IN PAST 12 MONTHS OFF-ROAD  
Q.37

7 FEB 01

	MODEL TYPE							ON-HIGHWAY BY SPECIFIC TYPE							
	TOTAL	SCOOT 1	ON- HWY 2	DUAL PURP 3	OFF HWY 4	COMP 5	ATV 6	ALL MOTOR/ SCOOT 1-5	SCOOT/ ON- HWY 1-2	OFF/ COMP/ ATV 4-6	OFF/ COMP/ 4-5	STAN- DARD	CRUIS	SPORT BIKE	TOUR
BASE-SELECTED VEHICLES USED OFF-ROAD	1208	21	100	203	140	194	003	004	127	037	334	85	12	4	4
1 - 5	192	5	20	40	25	31	03	129	33	119	50	19	5	1	2
	15.1	23.8	20.4	19.7	17.0	10.0	10.4	19.4	20.0	12.7	10.8	22.4	41.7	25.0	50.0
6 - 10	136	-	18	28	22	20	40	88	18	90	42	13	4	1	-
	10.7	-	17.0	13.8	15.7	10.3	0.0	13.3	14.2	9.6	12.0	15.3	33.3	25.0	-
11 - 15	83	2	0	10	8	9	40	43	8	57	17	8	-	-	-
	6.5	9.5	5.7	8.9	5.7	4.0	0.0	6.5	6.3	6.1	5.1	7.1	-	-	-
16 - 20	95	1	3	22	10	14	44	50	4	68	24	3	-	-	-
	7.5	4.8	2.8	10.8	7.1	7.2	7.3	7.5	3.1	7.3	7.2	3.5	-	-	-
21 - 30	150	2	12	23	13	26	74	76	14	113	39	11	1	-	-
	11.8	9.5	11.3	11.3	9.3	13.4	12.3	11.4	11.0	12.1	11.7	12.9	8.3	-	-
31 - 40	48	2	3	6	5	3	20	19	5	37	8	2	-	1	-
	3.8	9.5	2.8	3.0	3.0	1.5	4.8	2.9	3.9	3.9	2.4	2.4	-	25.0	-
41 - 50	71	-	6	10	12	10	33	38	8	55	22	3	1	1	1
	6.8	-	5.7	4.0	8.6	5.2	5.5	5.7	4.7	5.9	6.0	3.5	8.3	25.0	25.0
51 - 75	85	3	3	8	6	17	48	37	6	71	23	3	-	-	-
	6.7	14.3	2.8	3.0	4.3	8.8	8.0	5.6	4.7	7.6	6.0	3.6	-	-	-
76 - 100	102	1	6	6	10	18	55	47	7	80	34	6	-	-	-
	8.0	4.8	5.7	3.0	11.4	9.3	9.1	7.1	5.5	9.5	10.2	7.1	-	-	-
101 - 150	82	1	1	10	3	11	36	26	2	50	14	1	-	-	-
	4.9	4.8	0.9	4.9	2.1	5.7	6.0	3.9	1.8	5.3	4.2	1.2	-	-	-
151 - 200	63	1	5	3	6	6	42	21	6	54	12	4	1	-	-
	5.0	4.8	4.7	1.5	4.3	3.1	7.0	3.2	4.7	5.8	3.6	4.7	8.3	-	-
OVER 200	89	2	4	6	6	12	59	30	6	77	18	4	-	-	-
	7.0	9.5	3.8	3.0	4.3	6.2	9.8	4.5	4.7	8.2	5.4	4.7	-	-	-
UNKNOWN	92	1	11	23	6	17	32	60	12	57	25	10	-	-	1
	7.3	4.8	10.4	11.3	5.7	8.8	5.3	9.0	0.4	0.1	7.5	11.8	-	-	25.0
TOTAL	1208	21	100	203	140	194	003	004	127	037	334	85	12	4	4
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MEAN	65.20	65.70	44.07	40.02	51.10	01.71	01.00	50.40	40.33	72.69	57.21	50.40	25.00	25.25	19.33
	65.17	64.92	74.95	63.00	60.40	00.30	04.46	72.30	70.00	80.70	74.04	01.35	45.00	23.46	20.50



# SEASONAL USAGE (Geographic)

DMR # 40-088

MIC SURVEY OF MOTORCYCLE OWNERSHIP AND USAGE  
OWNERS

11 FEB 91

TABLE 40A

PERCENT OF RIDING DONE IN SPRING OFF-ROAD  
Q.32A

	REGION					REGION							
	TOTAL	EAST	MID WEST	SOUTH WEST	WEST	NEW ENG	MID ATL	EAST CNTRL	WEST CNTRL	SOUTH EAST	SOUTH WEST	ROCKY MTH	PAC
BASE-SELECTED VEHICLES USED OFF-ROAD	1268	191	330	357	390	41	150	168	162	230	127	162	228
0X	153	19	42	22	70	4	15	23	19	13	9	35	35
	12.1	9.9	12.7	6.2	17.9	9.8	10.0	13.7	11.7	5.7	7.1	21.6	15.4
1 - 9	38	4	13	14	7	2	2	8	5	9	5	1	8
	3.0	2.1	3.9	3.9	1.8	4.0	1.3	4.8	3.1	3.9	3.9	0.6	2.6
10 - 19	125	24	27	34	40	4	20	16	11	23	11	17	23
	9.9	12.6	8.2	9.5	10.3	9.8	13.3	9.5	6.8	10.0	8.7	10.5	10.1
20 - 29	436	74	111	130	121	18	58	53	58	90	40	52	69
	34.4	38.7	33.6	36.4	31.0	39.0	38.7	31.5	35.8	39.1	31.5	32.1	30.3
30 - 39	176	26	53	40	51	7	19	24	29	26	20	22	29
	13.9	13.6	16.1	12.0	13.1	17.1	12.7	14.3	17.9	11.3	15.7	13.6	12.7
40 - 49	76	10	18	24	24	1	9	6	12	17	7	9	15
	6.0	5.2	5.5	6.7	6.2	2.4	6.0	3.6	7.4	7.4	5.5	5.6	6.6
50 - 59	138	21	35	43	39	3	18	18	17	27	16	16	23
	10.9	11.0	10.6	12.0	10.0	7.3	12.0	10.7	10.5	11.7	12.6	9.9	10.1
60 - 69	28	5	5	8	10	1	4	5	-	4	4	4	6
	2.2	2.6	1.5	2.2	2.6	2.4	2.7	3.0	-	1.7	3.1	2.5	2.6
70 - 79	25	4	8	6	7	2	2	6	2	3	3	1	6
	2.0	2.1	2.4	1.7	1.8	4.9	1.3	3.6	1.2	1.3	2.4	0.6	2.6
80 - 89	10	1	1	4	4	1	-	-	1	2	2	1	3
	0.8	0.5	0.3	1.1	1.0	2.4	-	-	0.6	0.9	1.6	0.6	1.3
90 - 100X	13	1	5	2	5	-	1	1	4	1	1	2	3
	1.0	0.5	1.5	0.8	1.3	-	0.7	0.6	2.5	0.4	0.8	1.2	1.3
DON'T KNOW	50	2	12	24	12	-	2	8	4	15	9	2	10
	3.9	1.0	3.6	6.7	3.1	-	1.3	4.8	2.5	6.5	7.1	1.2	4.4
TOTAL	1268	191	330	357	390	41	150	168	162	230	127	162	228
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MEAN	27.04	26.72	26.96	28.74	25.76	27.78	26.43	26.17	27.75	28.22	29.69	23.85	27.17
STD. DEV.	19.02	17.80	19.49	17.68	20.26	19.80	17.26	19.54	19.47	16.73	19.33	19.28	20.90
STD. ERR.	0.54	1.29	1.09	0.97	1.04	3.09	1.42	1.54	1.55	1.14	1.78	1.52	1.42
MEDIAN	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00

P.14

DMR # 40-008  
MIC SURVEY OF MOTORCYCLE OWNERSHIP AND USAGE  
OWNERS

11 FEB 91

TABLE 48B

PERCENT OF RIDING DONE IN SUMMER OFF-ROAD  
Q.32B

	REGION					REGION							
	TOTAL	EAST	MID WEST	SOUTH	WEST	NEW ENG	MID ATL	EAST CNTRL	WEST CNTRL	SOUTH EAST	SOUTH WEST	ROCKY MTH	PAC
BASE-SELECTED VEHICLES USED OFF-ROAD	1268	191	330	357	390	41	150	168	102	230	127	162	228
0%	83	14	18	22	29	1	13	7	11	16	6	13	16
	6.5	7.3	5.5	6.2	7.4	2.4	8.7	4.2	6.8	7.0	4.7	8.0	7.0
1 - 9	17	2	2	7	6	2	-	1	1	5	2	3	3
	1.3	1.0	0.6	2.0	1.5	4.9	-	0.6	0.6	2.2	1.6	1.9	1.3
10 - 19	68	8	11	25	24	-	8	4	7	13	12	9	15
	5.4	4.2	3.3	7.0	6.2	-	5.3	2.4	4.3	5.7	9.4	5.6	6.6
20 - 29	289	40	58	106	85	12	28	25	33	74	32	31	54
	22.8	20.9	17.6	29.7	21.8	29.3	18.7	14.9	20.4	32.2	25.2	19.1	23.7
30 - 39	131	23	42	34	32	3	20	20	22	19	15	16	16
	10.3	12.0	12.7	9.5	8.2	7.3	13.3	11.9	13.6	8.3	11.8	9.0	7.0
40 - 49	101	18	31	24	28	4	14	10	12	17	7	13	15
	8.0	9.4	9.4	6.7	7.2	9.8	9.3	11.3	7.4	7.4	5.5	8.0	6.6
50 - 59	258	41	73	69	73	9	32	43	30	43	26	32	41
	20.2	21.5	22.1	19.3	18.7	22.0	21.3	25.0	18.5	18.7	20.5	19.8	18.0
60 - 69	64	14	15	16	19	3	11	4	11	11	5	7	12
	5.0	7.3	4.5	4.5	4.9	7.3	7.3	2.4	6.6	4.6	3.9	4.3	5.3
70 - 79	62	11	20	9	22	2	9	10	10	6	3	11	11
	4.9	5.8	6.1	2.5	5.6	4.9	6.0	6.0	6.2	2.6	2.4	6.6	4.8
80 - 89	45	6	16	9	14	1	5	10	6	5	4	5	9
	3.5	3.1	4.8	2.5	3.6	2.4	3.3	6.0	3.7	2.2	3.1	3.1	3.9
90 - 100%	102	12	31	13	46	4	8	17	14	7	6	20	26
	8.0	6.3	9.4	3.6	11.8	9.8	5.3	10.1	8.6	3.0	4.7	12.3	11.4
DON'T KNOW	50	2	13	23	12	-	2	8	5	14	9	2	10
	3.9	1.0	3.9	6.4	3.1	-	1.3	4.8	3.1	6.1	7.1	1.2	4.4
TOTAL	1268	191	330	357	390	41	150	168	102	230	127	162	228
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MEAN	41.61	41.53	45.69	35.54	43.00	44.00	40.84	47.83	43.52	34.82	36.87	44.08	43.24
STD. DEV.	26.04	24.56	25.99	22.41	28.78	25.35	24.38	25.58	26.31	21.00	23.34	26.03	28.72
STD. ERR.	0.75	1.79	1.46	1.23	1.48	3.96	2.00	2.02	2.10	1.49	2.15	2.29	1.95
MEDIAN	40.00	40.00	45.00	30.00	40.00	40.00	40.00	50.00	40.00	27.50	30.00	40.00	40.00

B-15

MIC SURVEY OF MOTORCYCLE OWNERSHIP AND USAGE  
OWNERS

11 FEB 91

TABLE 40C

PERCENT OF RIDING DONE IN FALL OFF-ROAD  
Q.32C

[illegible]

DMR # 40-088  
MIC SURVEY OF MOTORCYCLE OWNERSHIP AND USAGE  
OWNERS

11 FEB 91

TABLE 48D

PERCENT OF RIDING DONE IN WINTER OFF-ROAD  
Q.32D

	REGION					REGION							
	TOTAL	EAST	MID WEST	SOUTH	WEST	NEW ENG	MID ATL	EAST CNTRL	WEST CNTRL	SOUTH EAST	SOUTH WEST	ROCKY MTN	PAC
BASE-SELECTED VEHICLES USED OFF-ROAD	1268	191	330	357	390	41	150	168	162	230	127	162	228
0%	647	104	188	136	219	24	80	96	92	79	57	108	111
	51.0	54.5	57.0	38.1	56.2	58.5	53.3	57.1	56.8	34.3	44.9	66.7	48.7
1 - 9	72	5	22	24	21	-	5	9	13	18	6	8	13
	5.7	2.6	6.7	6.7	5.4	-	3.3	5.4	8.0	7.8	4.7	4.9	5.7
10 - 19	151	24	39	45	43	4	20	23	16	26	19	15	28
	11.9	12.6	11.8	12.6	11.0	9.8	13.3	13.7	9.9	11.3	15.0	9.3	12.3
20 - 29	231	35	49	85	62	8	27	22	27	63	22	20	42
	18.2	18.3	14.8	23.8	15.9	19.5	18.0	13.1	16.7	27.4	17.3	12.3	18.4
30 - 39	33	7	6	12	8	-	7	2	4	8	4	2	6
	2.6	3.7	1.8	3.4	2.1	-	4.7	1.2	2.5	3.5	3.1	1.2	2.6
40 - 49	23	4	1	12	6	1	3	-	1	7	5	-	6
	1.8	2.1	0.3	3.4	1.5	2.4	2.0	-	0.6	3.0	3.9	-	2.6
50 - 59	28	4	7	11	6	2	2	3	4	8	3	1	5
	2.2	2.1	2.1	3.1	1.5	4.9	1.3	1.8	2.5	3.5	2.4	0.6	2.2
60 - 69	4	-	1	2	1	-	-	1	-	2	-	1	-
	0.3	-	0.3	0.6	0.3	-	-	0.6	-	0.9	-	0.6	-
70 - 79	11	2	1	4	4	-	2	1	-	1	3	3	1
	0.9	1.0	0.3	1.1	1.0	-	1.3	0.6	-	0.4	2.4	1.9	0.4
80 - 89	4	1	1	1	1	1	-	1	-	1	-	-	1
	0.3	0.5	0.3	0.3	0.3	2.4	-	0.6	-	0.4	-	-	0.4
90 - 100%	18	4	2	5	7	1	3	2	-	5	-	2	5
	1.4	2.1	0.6	1.4	1.8	2.4	2.0	1.2	-	2.2	-	1.2	2.2
DON'T KNOW	46	1	13	20	12	-	1	8	5	12	8	2	10
	3.6	0.5	3.9	5.6	3.1	-	0.7	4.8	3.1	5.2	6.3	1.2	4.4
TOTAL	1268	191	330	357	390	41	150	168	162	230	127	162	228
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MEAN	11.52	12.18	8.42	15.14	10.55	13.73	11.78	8.94	7.90	16.66	12.34	7.88	12.52
STD. DEV.	18.32	19.85	15.07	19.21	18.07	23.34	18.85	17.27	12.48	20.34	16.67	17.20	19.49
STD. ERR.	0.52	1.44	0.85	1.05	0.96	3.64	1.54	1.37	1.00	1.38	1.53	1.38	1.32
MEDIAN	-	-	-	10.00	-	-	-	-	-	10.00	5.00	-	-

B-17

# SEASONAL USAGE by Vehicle Type

DMR # 40-000  
MIC SURVEY OF MOTORCYCLE OWNERSHIP AND USAGE  
OWNERS

7 FEB 91

TABLE 40A

PERCENT OF RIDING DONE IN SPRING OFF-ROAD  
Q.32A

	MODEL TYPE											ON-HIGHWAY BY SPECIFIC TYPE			
	TOTAL	SCOOT 1	ON- HMY 2	DUAL PURP 3	OFF HMY 4	COMP 5	ATV 6	ALL MOTOR/ SCOOT 1-5	SCOOT/ ON- HMY 1-2	OFF/ COMP/ ATV 4-6	OFF/ COMP 4-5	STAN- DARD	CRUIS	SPORT BIKE	TOUR
BASE-SELECTED VEHICLES USED OFF-ROAD	1208	21	100	203	140	194	603	664	127	937	334	85	12	4	4
0%	153	3	20	40	13	10	61	62	23	90	29	14	4	-	1
	12.1	14.3	18.0	19.7	9.3	6.2	10.1	13.9	18.1	9.6	8.7	16.5	33.3	-	25.0
1 - 9	30	2	3	10	4	1	18	20	5	23	5	2	-	1	-
	3.0	9.5	2.8	4.9	2.8	0.5	3.0	3.0	3.9	2.5	1.5	2.4	-	25.0	-
10 - 19	125	-	9	21	10	15	69	55	9	94	25	9	-	-	-
	9.9	-	8.5	10.3	7.1	7.7	11.4	8.3	7.1	10.0	7.5	10.6	-	-	-
20 - 29	436	8	25	57	42	58	248	190	33	348	100	19	3	2	1
	34.4	38.1	23.0	28.1	30.0	29.9	40.8	28.6	26.0	36.9	29.9	22.4	25.0	50.0	25.0
30 - 39	176	2	20	28	20	39	67	109	22	128	59	17	1	1	1
	13.9	9.5	18.9	13.8	14.3	20.1	11.1	16.4	17.3	13.4	17.7	20.0	8.3	25.0	25.0
40 - 49	76	2	4	8	14	19	29	47	8	62	33	3	1	-	-
	6.0	9.5	3.8	3.9	10.0	9.8	4.6	7.1	4.7	6.6	9.9	3.5	8.3	-	-
50 - 59	138	1	12	25	20	20	54	64	13	100	46	10	1	-	1
	10.9	4.8	11.3	12.3	14.3	13.4	9.0	12.7	10.2	10.7	13.8	11.8	8.3	-	25.0
60 - 69	28	-	3	2	3	6	14	14	3	23	9	2	1	-	-
	2.2	-	2.8	1.0	2.1	3.1	2.3	2.1	2.4	2.5	2.7	2.4	8.3	-	-
70 - 79	25	1	-	2	4	7	11	14	1	22	11	-	-	-	-
	2.0	4.8	-	1.0	2.9	3.6	1.6	2.1	0.8	2.3	3.3	-	-	-	-
80 - 89	10	-	-	4	1	1	4	6	-	6	2	-	-	-	-
	0.8	-	-	2.0	0.7	0.5	0.7	0.9	-	0.6	0.6	-	-	-	-
90 - 100%	13	1	2	1	2	1	6	7	3	9	3	2	-	-	-
	1.0	4.8	1.9	0.5	1.4	0.5	1.0	1.1	2.4	1.0	0.9	2.4	-	-	-
DON'T KNOW	50	1	8	5	7	5	24	20	9	30	12	7	1	-	-
	3.9	4.8	7.5	2.5	6.0	2.6	4.0	3.0	7.1	3.8	3.6	8.2	8.3	-	-
TOTAL	1208	21	100	203	140	194	603	664	127	937	334	85	12	4	4
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MEAN	27.04	27.05	25.20	23.02	30.71	31.10	20.23	27.70	25.71	27.01	30.04	26.12	22.18	21.50	27.00
STD. DEV.	10.02	24.05	20.28	10.84	10.46	10.10	10.10	10.73	20.98	18.50	18.70	20.57	21.55	12.07	20.80
STD. ERR.	0.54	5.51	2.05	1.41	1.00	1.32	0.76	0.78	1.93	0.62	1.04	2.33	6.50	6.03	10.40
MEDIAN	25.00	25.00	25.00	25.00	25.00	30.00	25.00	25.00	25.00	25.00	30.00	25.00	20.00	22.50	20.00

B-18

DMR # 40-008  
 MIC SURVEY OF MOTORCYCLE OWNERSHIP AND USAGE  
 OWNERS

7 FEB 91

TABLE 400

PERCENT OF RIDING DONE IN SUMMER OFF-ROAD  
 Q.32D

	MODEL TYPE							ON-HIGHWAY BY SPECIFIC TYPE							
	TOTAL	SCOOT	ON- Hwy	DUAL PURP	OFF Hwy	COMP	ATV	ALL MOTOR/ SCOOT	SCOOT/ ON- Hwy	OFF/ COMP/ ATV	OFF/ COMP	STAN- DARD	CRUIS	SPORT BIKE	TOUR
		1	2	3	4	5	6	1-5	1-2	4-6	4-5				
BASE-SELECTED VEHICLES USED OFF-ROAD	1268	21	108	203	140	194	603	664	127	937	334	85	12	4	4
0%	83	1	5	7	13	10	47	36	6	70	23	3	1	-	-
1 - 9	6.5	4.8	4.7	3.4	9.3	5.2	7.8	5.4	4.7	7.5	6.9	3.5	8.3	-	-
10 - 19	17	1	1	-	1	-	14	3	2	15	1	1	-	-	-
	1.3	4.8	0.9	-	0.7	-	2.3	0.5	1.6	1.6	0.3	1.2	-	-	-
	68	-	1	6	7	10	38	30	1	61	23	1	-	-	-
	5.4	-	0.9	3.0	5.0	0.2	0.3	4.5	0.8	0.5	0.9	1.2	-	-	-
20 - 29	200	3	12	39	27	30	160	120	15	235	60	10	1	-	1
	22.8	14.3	11.3	19.2	19.3	20.1	28.0	18.1	11.0	25.1	19.0	11.8	8.3	-	25.0
30 - 39	131	2	11	17	15	22	64	67	13	101	37	9	1	-	1
	10.3	9.5	10.4	8.4	10.7	11.3	10.6	10.1	10.2	10.8	11.1	10.6	8.3	-	25.0
40 - 49	101	1	5	16	11	16	52	49	6	79	27	4	1	-	-
	8.0	4.8	4.7	7.9	7.9	8.2	8.6	7.4	4.7	8.4	6.1	4.7	8.3	-	-
50 - 59	256	3	21	42	28	45	117	139	24	190	73	17	1	2	1
	20.2	14.3	19.8	20.7	20.0	23.2	19.4	20.9	18.9	20.3	21.9	20.0	8.3	50.0	25.0
60 - 69	64	3	11	9	8	15	18	46	14	41	23	10	-	1	-
	5.0	14.3	10.4	4.4	5.7	7.7	3.0	6.9	11.0	4.4	6.9	11.8	-	25.0	-
70 - 79	62	2	5	10	8	7	30	32	7	45	15	5	-	-	-
	4.9	9.5	4.7	4.9	5.7	3.6	5.0	4.8	5.5	4.8	4.5	5.9	-	-	-
80 - 89	45	-	0	15	4	7	13	32	6	24	11	4	2	-	-
	3.5	-	5.7	7.4	2.9	3.6	2.2	4.8	4.7	2.6	3.3	4.7	10.7	-	-
90 - 100%	102	4	19	37	10	12	19	82	23	41	22	14	3	1	1
	8.0	19.0	17.0	18.2	7.1	6.2	3.2	12.3	18.1	4.4	6.6	16.5	25.0	25.0	25.0
DON'T KNOW	50	1	9	5	8	5	22	28	10	35	13	7	2	-	-
	3.9	4.8	8.5	2.5	5.7	2.6	3.6	4.2	7.9	3.7	3.9	8.2	16.7	-	-
TOTAL	1268	21	108	203	140	194	603	664	127	937	334	85	12	4	4
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MEAN	41.61	52.20	54.00	52.30	40.00	41.40	35.57	47.08	54.20	37.57	41.20	54.35	60.30	63.50	52.00
STD. DEV.	26.04	30.13	29.03	28.92	25.03	24.50	22.03	27.66	29.11	23.65	25.02	28.04	30.50	20.87	33.00
STD. ERR.	0.75	8.74	2.95	2.00	2.25	1.78	0.94	1.10	2.09	0.79	1.40	3.17	11.50	10.44	16.03
WRTN	40.00	50.00	50.00	50.00	40.00	40.00	30.00	50.00	50.00	33.00	40.00	50.00	65.00	55.00	41.50

B-19



DMR # 40-000

MIC SURVEY OF MOTORCYCLE OWNERSHIP AND USAGE  
OWNERS

7 FEB 91

TABLE 48C

PERCENT OF RIDING DONE IN FALL OFF-ROAD  
Q.32C

	TOTAL	MODEL TYPE										ON-HIGHWAY, BY SPECIFIC TYPE			
		SCOOT	ON- HMY	DUAL PURP	OFF HMY	COMP	ATV	ALL MOTOR/ SCOOT	SCOOT/ ON- HMY	OFF/ COMP/ ATV	OFF/ COMP	STAN- DARD	CRUIS	SPORT BIKE	TOUR
		1	2	3	4	5	6	1-5	1-2	4-6	4-5				
BASE-SELECTED VEHICLES USED OFF-ROAD	1200	21	100	203	140	104	003	004	127	037	334	05	12	4	4
0X	273	8	37	60	20	54	84	188	45	107	83	28	0	1	2
	21.5	38.1	34.9	29.0	20.7	27.8	13.9	28.3	35.4	17.8	24.9	32.0	50.0	25.0	50.0
1 - 9	83	3	2	8	10	5	35	28	5	50	15	2	-	-	-
	5.0	14.3	1.9	3.9	7.1	2.0	5.8	4.2	3.9	5.3	4.5	2.4	-	-	-
10 - 19	200	2	18	33	23	25	100	101	20	156	48	10	1	1	-
	16.5	9.5	17.0	16.3	16.4	12.0	17.0	15.2	15.7	16.6	14.4	18.0	8.3	25.0	-
20 - 29	402	5	20	53	30	62	220	182	31	318	90	21	2	2	1
	31.7	23.8	24.5	26.1	25.7	32.0	30.5	27.4	24.4	33.0	29.3	24.7	16.7	50.0	25.0
30 - 39	122	1	9	17	11	20	50	64	10	95	37	7	1	-	1
	0.8	4.0	8.5	8.4	7.9	13.4	9.6	9.6	7.9	10.1	11.1	8.2	8.3	-	25.0
40 - 49	40	-	5	7	6	3	28	21	5	37	9	5	-	-	-
	3.0	-	4.7	3.4	4.3	1.5	4.0	3.2	3.9	3.9	2.7	5.8	-	-	-
50 - 59	57	1	-	11	10	7	28	20	1	45	17	-	-	-	-
	4.5	4.8	-	5.4	7.1	3.6	4.0	4.4	0.8	4.8	5.1	-	-	-	-
60 - 69	7	-	-	1	-	3	3	4	-	0	3	-	-	-	-
	0.6	-	-	0.5	-	1.5	0.5	0.6	-	0.6	0.9	-	-	-	-
70 - 79	13	-	-	4	1	2	6	7	-	9	3	-	-	-	-
	1.0	-	-	2.0	0.7	1.0	1.0	1.1	-	1.0	0.9	-	-	-	-
80 - 89	0	-	-	2	1	1	2	4	-	4	2	-	-	-	-
	0.5	-	-	1.0	0.7	0.5	0.3	0.6	-	0.4	0.8	-	-	-	-
90 - 100X	20	-	2	2	5	2	9	11	2	16	7	-	1	-	-
	1.6	-	1.9	1.0	3.6	1.0	1.5	1.7	1.6	1.7	2.1	-	8.3	-	-
DO NOT KNOW	47	1	7	5	8	4	22	25	8	34	12	0	1	-	-
	3.7	4.0	0.0	2.5	5.7	2.1	3.0	3.0	0.3	3.0	3.0	7.1	8.3	-	-
TOTAL	1200	21	100	203	140	104	003	004	127	037	334	05	12	4	4
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MEAN	20.19	11.45	15.11	18.03	21.04	19.04	21.60	18.07	14.50	21.12	20.11	13.05	10.04	15.00	14.75
STD. DEV.	10.73	13.77	17.77	19.85	22.39	10.23	17.04	10.58	17.17	18.54	20.05	13.10	29.91	10.80	17.42
COEFF. VAR.	0.54	0.88	1.70	1.41	1.05	1.32	0.73	0.77	1.57	0.82	1.12	1.47	9.02	5.40	8.71

B-20

DMR # 40-088  
MIC SURVEY OF MOTORCYCLE OWNERSHIP AND USAGE  
OWNERS

7 FEB 91

TABLE 48D

PERCENT OF RIDING DONE IN WINTER OFF-ROAD  
Q.32D

	MODEL TYPE											ON-HIGHWAY BY SPECIFIC TYPE			
	TOTAL	SCOOT 1	ON- HWY 2	DUAL PURP 3	OFF HWY 4	COMP 5	ATV 6	ALL MOTOR/ SCOOT 1-5	SCOOT/ ON- HWY 1-2	OFF/ COMP/ ATV 4-6	OFF/ COMP/ 4-5	STAN- DARD	CRUIS	SPORT BIKE	TOUR
BASE-SELECTED VEHICLES USED OFF-ROAD	1268	21	106	203	140	104	003	064	127	037	334	85	12	4	4
0%	047	11	78	151	78	118	210	430	89	400	100	60	10	4	3
1 - 9	51.0	52.4	73.6	74.4	55.7	60.8	34.8	65.7	70.1	43.3	58.7	70.0	83.3	100.0	75.0
	72	4	1	6	12	12	37	35	5	61	24	1	-	-	-
10 - 19	5.7	19.0	0.0	3.0	8.0	0.2	0.1	5.3	3.9	0.5	7.2	1.2	-	-	-
	151	3	7	14	19	21	87	64	10	127	40	7	-	-	-
	11.9	14.3	6.6	6.9	13.0	10.0	14.4	9.6	7.9	13.0	12.0	8.2	-	-	-
20 - 29	231	1	0	22	19	25	155	76	10	100	44	8	-	-	1
	18.2	4.8	8.5	10.8	13.6	12.9	25.7	11.4	7.9	21.2	13.2	9.4	-	-	25.0
30 - 39	33	-	-	1	1	5	20	7	-	32	6	-	-	-	-
	2.6	-	-	0.5	0.7	2.6	4.3	1.1	-	3.4	1.8	-	-	-	-
40 - 49	23	-	1	1	-	2	19	4	1	21	2	1	-	-	-
	1.8	-	0.9	0.5	-	1.0	3.2	0.6	0.8	2.2	0.6	1.2	-	-	-
50 - 59	28	-	2	2	-	4	20	8	2	24	4	1	1	-	-
	2.2	-	1.9	1.0	-	2.1	3.3	1.2	1.6	2.6	1.2	1.2	0.3	-	-
60 - 69	4	-	-	-	-	-	4	-	-	4	-	-	-	-	-
	0.3	-	-	-	-	-	0.7	-	-	0.4	-	-	-	-	-
70 - 79	11	-	1	-	1	-	9	2	1	10	1	1	-	-	-
	0.9	-	0.9	-	0.7	-	1.5	0.3	0.8	1.1	0.3	1.2	-	-	-
80 - 89	4	-	-	-	-	-	4	-	-	4	-	-	-	-	-
	0.3	-	-	-	-	-	0.7	-	-	0.4	-	-	-	-	-
90 - 100%	18	1	-	1	2	3	11	7	1	10	5	-	-	-	-
	1.4	4.8	-	0.5	1.4	1.5	1.8	1.1	0.8	1.7	1.5	-	-	-	-
DON'T KNOW	46	1	7	5	8	4	21	25	8	33	12	0	1	-	-
	3.6	4.8	6.6	2.5	5.7	2.1	3.5	3.8	0.3	3.5	3.0	7.1	8.3	-	-
TOTAL	1268	21	106	203	140	104	003	064	127	037	334	85	12	4	4
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MEAN	11.52	8.40	5.25	4.98	7.72	8.55	10.78	9.78	5.78	13.72	8.21	5.03	4.55	-	0.25
STD. DEV.	18.32	21.00	12.72	11.87	15.58	18.30	20.43	14.03	14.62	10.40	15.09	12.09	15.00	-	12.50
STD. ERR.	0.52	4.02	1.28	0.84	1.36	1.18	0.85	0.58	1.34	0.85	0.80	1.45	4.55	-	0.25

B-21

# ATV UTILITY USAGE

BMR # 40-000

NIC SURVEY OF MOTORCYCLE OWNERSHIP AND USAGE  
OWNERS

11 FEB 91

TABLE 51

PERCENT OF OFF-ROAD RIDING FOR UTILITY PURPOSES - ATV'S ONLY  
Q.35

	REGION					REGION							
	TOTAL	EAST	MID WEST	SOUTH WEST	NEW ENG	MID ATL	EAST CNTRL	WEST CNTRL	SOUTH EAST	SOUTH WEST	ROCKY MTH	PAC	
BASE-SELECTED ATV'S USED OFF-ROAD	003	99	167	190	130	18	81	84	83	127	72	57	81
0%	208	57	74	84	81	12	45	38	38	52	32	33	48
1 - 9%	40.1	57.6	44.3	42.2	50.7	08.7	55.0	45.2	43.4	40.9	44.4	57.9	59.3
10 - 19%	17	4	3	7	3	-	4	2	1	6	1	-	3
20 - 29%	2.8	4.0	1.8	3.5	2.2	-	4.0	2.4	1.2	4.7	1.4	-	3.7
30 - 39%	42	8	8	10	7	1	7	5	3	12	7	2	5
40 - 49%	7.0	8.1	4.8	0.5	5.1	5.0	8.0	8.0	3.8	9.4	9.7	3.5	8.2
50 - 59%	40	8	15	12	5	2	8	8	7	7	5	3	2
60 - 69%	0.8	8.1	0.0	8.0	3.0	11.1	7.4	0.5	8.4	5.5	8.0	5.3	2.5
70 - 79%	15	4	3	8	-	1	3	2	1	6	2	-	-
80 - 89%	2.5	4.0	1.8	4.0	-	5.0	3.7	2.4	1.2	4.7	2.8	-	-
90 - 99%	15	-	6	7	3	-	-	3	2	4	3	-	3
100%	2.5	-	3.0	3.5	2.2	-	-	3.8	2.4	3.1	4.2	-	3.7
DON'T KNOW	37	7	9	10	5	-	7	7	2	11	6	2	3
TOTAL	0.1	7.1	5.4	8.0	3.0	-	8.0	8.3	2.4	8.7	8.9	3.5	3.7
00 - 09%	4	1	1	2	-	-	1	1	-	2	-	-	-
10 - 19%	0.7	1.0	0.8	1.0	-	-	1.2	1.2	-	1.8	-	-	-
20 - 29%	13	1	7	4	1	-	1	3	4	3	1	1	-
30 - 39%	2.2	1.0	4.2	2.0	0.7	-	1.2	3.8	4.8	2.4	1.4	1.8	-
40 - 49%	20	1	5	9	5	-	1	3	2	5	4	3	2
50 - 59%	3.3	1.0	3.0	4.5	3.0	-	1.2	3.8	2.4	3.9	5.8	5.3	2.5
60 - 69%	82	7	33	24	18	2	5	9	24	15	9	11	7
70 - 79%	13.8	7.1	10.8	12.1	13.0	11.1	8.2	10.7	20.9	11.8	12.5	19.3	8.6
80 - 89%	22	1	4	7	10	-	1	3	1	4	3	2	8
90 - 99%	3.8	1.0	2.4	3.5	7.2	-	1.2	3.8	1.2	3.1	4.2	3.5	9.9
TOTAL	003	99	167	190	130	18	81	84	83	127	72	57	81
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MEAN	28.13	18.99	32.95	27.78	21.95	10.39	17.13	28.81	39.01	27.75	27.83	28.73	16.05
STD. DEV.	30.19	28.06	39.41	35.37	30.49	32.30	28.37	34.41	43.18	34.99	30.20	40.95	32.09
STD. ERR.	1.50	2.93	3.09	2.55	3.23	7.61	3.17	3.82	4.77	3.18	4.37	5.52	3.76
MEDIAN	-	-	10.00	10.00	-	-	-	10.00	20.00	10.00	10.00	-	-

B-22

BMR # 40-088  
 MIC SURVEY OF MOTORCYCLE OWNERSHIP AND USAGE  
 OWNERS

11 FEB 91

TABLE 52

UTILITY PURPOSES FOR WHICH USE ATV'S  
 Q.36

	REGION					REGION							
	TOTAL	EAST	MID WEST	SOUTH	WEST	NEW ENG	MID ATL	EAST CNTRL	WEST CNTRL	SOUTH EAST	SOUTH WEST	ROCKY MTN	PAC
BASE-USE ATV'S FOR UTILITY PURPOSES	307	42	93	115	57	6	30	46	47	75	40	24	33
FARMING/ RANCHING	158	18	47	68	29	2	14	18	31	43	23	14	15
51.5	38.1	50.5	57.4	50.9	33.3	38.0	34.8	60.0	57.3	57.5	58.3	45.5	
GROUNDS KEEPING	64	8	25	21	10	1	7	15	10	13	8	4	6
20.8	19.0	26.0	18.3	17.5	16.7	19.4	32.6	21.3	17.3	20.0	16.7	18.2	
PROPERTY MANAGEMENT	23	10	6	5	2	2	8	4	2	3	2	1	1
7.5	23.8	6.5	4.3	3.5	33.3	22.2	8.7	4.3	4.0	5.0	4.2	3.0	
TRANSPORTATION (MARCH-DEC)	21	1	7	7	6	1	-	4	3	4	3	5	1
6.8	2.4	7.5	6.1	10.5	16.7	-	8.7	6.4	5.3	7.5	20.8	3.0	
CONSTRUCTION	11	1	4	5	1	-	1	3	1	4	1	1	-
3.6	2.4	4.3	4.3	1.8	-	2.8	6.5	2.1	5.3	2.5	4.2	-	
OCCUPATION/ COMMERCIAL WORK	10	1	2	5	2	-	1	1	1	4	1	1	1
3.3	2.4	2.2	4.3	3.5	-	2.8	2.2	2.1	5.3	2.5	4.2	3.0	
OTHER	42	8	11	20	3	1	7	6	5	12	8	1	2
13.7	19.0	11.8	17.4	5.3	16.7	19.4	13.0	10.6	16.0	20.0	4.2	6.1	
DON'T KNOW	18	1	3	4	10	-	1	2	1	3	1	2	8
5.9	2.4	3.2	3.5	17.5	-	2.8	4.3	2.1	4.0	2.5	8.3	24.2	
TOTAL	347	46	105	133	63	7	39	51	54	86	47	29	34
113.0	109.5	112.9	115.7	110.5	116.7	108.3	110.9	114.9	114.7	117.5	120.8	103.0	

# YEAR 2000 ATV & OFF-HIGHWAY MOTORCYCLE POPULATION ESTIMATES

Year	Total Sold	Op <sup>1</sup> Rate	In Use in Year 2000	Total Sold	Op <sup>1</sup> Rate	In Use in Year 2000
<b>ATVs</b>			<b>MOTORCYCLES</b>			
1988 <sup>2</sup>	290,000	0.10	29,000	80,000	0.04	3,200
1989 <sup>2</sup>	200,000	0.15	30,000	70,000	0.10	7,000
1990 <sup>2</sup>	145,000	0.19	27,550	84,000	0.16	13,440
1991 <sup>3</sup>	145,000	0.21	30,450	84,000	0.22	18,480
1992 <sup>3</sup>	145,000	0.39	56,550	84,000	0.26	21,840
1993 <sup>3</sup>	145,000	0.48	69,600	84,000	0.35	29,400
1994 <sup>3</sup>	145,000	0.57	82,650	84,000	0.48	40,320
1995 <sup>3</sup>	145,000	0.69	100,050	84,000	0.59	49,560
1996 <sup>3</sup>	145,000	0.74	107,300	84,000	0.70	58,800
1997 <sup>3</sup>	145,000	0.88	127,600	84,000	0.82	68,880
1998 <sup>3</sup>	145,000	0.93	134,850	84,000	0.89	74,760
1999 <sup>3</sup>	145,000	0.98	142,100	84,000	0.98	82,320
Total	1,940,000		937,700	990,000		468,000

Estimated ATV In Use in Yr 2000: 937,700

Estimated Off-Road M/C In Use in Yr 2000: 468,000

Estimated Total In Use in Yr 2000: 1,405,700

<sup>1</sup> Operability Rates source is MIC 1991 Motorcycle Statistical Annual

<sup>2</sup> Sales information compiled from actual 1988, 1989 & 1990 Sales.

<sup>3</sup> 1991 - 1999 sales estimates are based on 1990 sales, and assume a constant sales rate thru 1999.



**EXECUTIVE  
OFFICE**

**MOTORCYCLE  
INDUSTRY  
COUNCIL, INC.**

2 Jenner Street, Suite 150, Irvine, CA 92718-3812 • (714) 727-4211 • FAX (714) 727-4217

**COPYRIGHT PERMISSION AGREEMENT**

February 9, 1993

Mr. Sergio J. Ostria  
Jack Faucett Associates  
4550 Montgomery Avenue STE 300 North  
Bethesda, Maryland 20814

In response to your request, the Motorcycle Industry Council grants non-exclusive, non-transferable copyright permission to reproduce all, or portions of the text and illustrations contained in the publications listed below, subject to the following conditions:

1. The reproduced material must not be altered in any way to defeat the original spirit and intent of the messages.
2. The reproduced material must not be misrepresented, taken out of context, or used in any fashion derogatory to the off highway vehicle industry or the Motorcycle Industry Council.
3. Each new publication presenting all or portions of MIC materials must carry an acknowledgement of MIC copyright, i.e., "Portions of this publication are reprinted with copyright permission of the Motorcycle Industry Council."
4. A free copy of the total publication in which the material is used must be provided to the Motorcycle Industry Council.
5. This permission is revocable for cause at any time upon notice from the Motorcycle Industry Council.

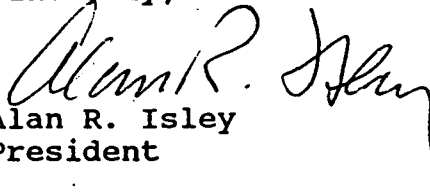
This permission is limited to excerpts from the Motorcycle Industry Council 1990 Survey of Motorcycle Ownership & Usage; including the Introduction and tables 33A, 47, 49, 53, 48A-D, 51, & 52.

If possible, advance approval is requested of the portions of the new publication in which MIC material is to appear. This is especially important if the use of the MIC material or copyright permission may be interpreted by the reader as endorsing the balance of the new publication.

Aside from the above permission expressly given, the Motorcycle Industry Council reserves all other rights in the copyrighted material.

Please return one signed copy indicating your agreement with these conditions.

Sincerely,

  
Alan R. Isley  
President

These terms and conditions are accepted by:

Spio L. H. 2 February 17, 1993  
Name Date



## **APPENDIX C:**

### **SURVEY METHODOLOGY FOR THE 1987 CENSUS OF AGRICULTURE**

*Source: Bureau of the Census*

## MAIL LIST MODEL

A statistical discriminant model was developed to predict the probability that a mail list addressee operated a farm. The model was used to identify the 4.1 million records from the preliminary census mail list of 6.0 million records that would receive a census of agriculture report form. Records from the 1982 census mail list were used to build the model. Record characteristics such as the source of the mail list record (see appendix A for a description of record sources), number of source lists on which the record appeared, expected value of agricultural sales, and geographic location were used to separate mail list records into model groups. The proportion of 1982 census farm records in each group was calculated to provide an estimate of the probability that an addressee in the group operated a farm.

Using these same group definitions, the 1987 census mail list records were separated into groups, each with an associated estimate of farm probability from the model. The 4.1 million mail list records in groups with the largest estimate of farm probability were selected to receive the census report form. A large percentage of the 1.9 million records that were dropped from the 6.0 million preliminary census mail list were nonfarm records from the previous census. This procedure was used to obtain a more complete census enumeration without excessive respondent burden and data collection cost.

## CENSUS SAMPLE DESIGN

Each of the 4.1 million name and address records on the census mail list was designated to receive one of three different types of census report forms. The three forms were the nonsample census form (a four-page form), the sample form (a six-page form), and the short form (a two-page form). Sections 1 through 22 of the sample form were identical to sections on the nonsample census form. However, the sample form contained additional sections on farm production expenditures, usage of fertilizers and insecticides, value of machinery and equipment, value of land and buildings, and farm-related income. The short form contained abbreviated versions of the sections on the nonsample census form. These three different forms were used to reduce the response burden of the census, while providing quality information on a large number of data items at the county level.

The sample form was mailed to all mail list records in Alaska and Hawaii and to a sample of records in other States identified when the mail list was constructed. Addresses were selected into the sample with certainty if they were expected to have large total values of agricultural products sold or large acreage, if they were firms with two or more farms, or if they had other special characteristics. When a nonsample large farm was identified during processing, a supplemental form that contained the additional data inquiries was mailed. All farms in counties with less than 100 farms in 1982 were included in the sample with certainty; counties containing 100 to 199 farms in 1982 were systematically sampled at a rate of 1 in 2; and counties containing 200 or more farms in 1982 were systematically sampled at a rate of 1 in 6. This differential sample scheme was used to provide reliable data for sections 23 through 28 of the report form for all counties.

To determine which mail list records would receive the short form, all mail list records not designated for the sample were sorted into model groups according to farm probability as specified by the mail list model. The 906,000 mail list records in the model groups with the lowest probability of being farms and with an expected total value of agricultural product sales less than \$20,000 were designated to receive the short form. The remaining mail list records were selected to receive the nonsample census form.

## CENSUS ESTIMATION

The 1987 Census of Agriculture used two types of statistical estimation procedures. These estimation

procedures accounted both for nonresponse to the data collection and for the sample data collection. These procedures are used because some farm operators never respond to the census despite numerous attempts to contact them, and not all farm operators are requested to provide the sample data items.

## Whole Farm Nonresponse Estimation

A statistical estimation procedure was used to account for the census farms among mail list nonrespondents that were not designated for telephone followup. A stratified systematic sample of eligible census nonrespondents were mailed a simplified report form. Five sample strata were defined based on form type, expected value of sales, and previous census status. The report form was designed to provide sufficient information to determine farm status. Additional mail and telephone contacts were made to survey nonrespondents to obtain sufficient response for survey estimates.

Estimates of the proportion of census nonrespondents that operated farms were made for each stratum in the State using survey results and applied to the total number of census nonrespondents in that stratum. A synthetic estimation procedure was used to estimate the number of census nonrespondents that operated farms for each county by stratum. This estimation procedure is based on the assumption that the distribution of farms in a stratum by county is the same for census nonrespondents as for census respondents.

Within each stratum in a county, a noninteger nonresponse weight was calculated and assigned to each eligible respondent farm record. The procedure used for calculating the nonresponse weight assumed the eligible census respondents and the nonrespondent farm operations in a county had similar characteristics within each stratum. The noninteger nonresponse weight was the ratio of the sum of the estimated number of nonrespondent farms (using nonresponse survey results) and the number of eligible census respondent farms to the number of eligible census respondent farms. Stratum controls were established to ensure that this weight was never greater than 2.0. The noninteger nonresponse weight was used in the estimation of the final weight for the sample items. It was randomly rounded to an integer weight of either 1 or 2 for each record for tabulating the complete count items.

The procedure assumed that we obtain complete response from large and unique farm operations because these cases received intensive telephone followup during census processing. In situations where addressees could not be contacted by telephone or refused to cooperate, secondary sources such as Agricultural Stabilization and Conservation Service offices or county extension agents were asked to provide information as to whether or not the addressee had agricultural activities. Data from previous census reports for the specific addressee, in conjunction with other information, were used to complete the census report form.

Tables A and B quantify the effect of the nonresponse estimation procedure on selected census data items. The percentage of the census value contributed by nonresponse estimation as provided in these tables indicates the potential for bias in published figures resulting from this procedure. The estimates provided in these tables do not reflect the effect of nonresponse to individual data items on respondents' census report forms. The effect of this item nonresponse is discussed further under Census Non-sampling Error.

## Sample Estimation

All respondent sample records received a sample weight. The sample data estimates the actual figures that would have resulted from a complete census of the items in sections 23 through 28 of the report form. The estimates were obtained from an iterative ratio estimation procedure that resulted in the assignment of a weight to each record containing sample items. For any given county, a sample item total was estimated by multiplying the data items for each farm in the county by the corresponding sample weight and summing overall sample records in the county.

Each sample farm was assigned one sample weight to be used to produce estimates for all sample items. For example, if the weight given to a sample farm had the value 5, all sample data items reported by that farm would be multiplied by 5. The weight assigned a certainty farm was 1. The estimation procedure used to assign weights was performed for each county.

Within a county, the ratio estimation procedure for farms was performed in three steps using three variables. The first variable contained eight 1987 total value of agricultural production (TVP) groups. Both the second and third variables, Standard Industrial Classification (SIC) code and farm acreage, contained two groups. The variable groups were as follows:

TVP	SIC	Acres
\$1 to \$999	01 All crops	0 to 69
\$1,000 to \$ 2,499	02 All live-stock	70 or more
\$2,500 to \$ 4,999		
\$5,000 to \$ 9,999		
\$10,000 to \$24,999		
\$25,000 to \$49,999		
\$50,000 to \$99,999		
\$100,000 or more		

The first step in the estimation procedure was to partition the sample records into 32 mutually exclusive initial post strata formed by combining the three variable groups. This produced a three dimensional array where the cells of the array corresponded to the initial post strata groups. Each sample farm record was assigned an initial weight equal to the ratio of the total farm count to the sample farm

count, expanded for nonresponse estimation, for the cell containing the sample farm. This weight was approximately equal to the inverse of the probability of selecting a farm for the census sample.

The second step in the estimation procedure was to combine, if necessary, the cells of the array (prior to the repeated ratio estimation) to increase the reliability of the ratio estimation procedure. Any cell within the array that either contained less than 10 sample farms or had a ratio of total farms to sample farms that was more than 2 times the mail sample rate was collapsed with another cell (in the same variable) according to a specified collapsing pattern. New total farm counts and sample farm counts were computed for each of the collapsed cells (final post strata) and were used in the ratio estimation procedure to calculate final sample weights.

In the third step in the ratio estimation procedure, complete counts for the three variables (TVP, SIC, acreage) were used to compute the marginals of the array defined by the final post strata. Factors were then applied to expanded sample totals in each cell of the array to obtain agreement with the row marginal (TVP) complete counts. The sample totals then had factors applied to obtain agreement with the column marginal (SIC) complete counts. Lastly, the sample totals had factors applied to obtain agreement with the depth marginal (acreage) complete counts. This procedure that requires the row totals, then the column totals, and then the depth totals to agree with the complete counts for the rows, columns, and depths, respectively, is continued iteratively until the process converges (the marginal totals agree with the complete count totals).

The ratio of the adjusted total farm count to the sample farm count obtained from the second iteration of the estimation procedure was the noninteger final post stratum sample weight assigned to the sample farm records in that post stratum. The noninteger sample weight, the product of the noninteger final post stratum sample weight and the nonresponse weight, was randomly rounded to an integer weight for tabulation. If, for example, the final weight for the farms in a particular group was 7.2, then one-fifth of the sample farms in this group were randomly assigned a weight of 8 and the remaining four-fifths received a weight of 7.

## CENSUS SAMPLING ERROR

Sampling error in the census data results from the nonresponse sample and the census sample data collection. Census items were classified as either complete count or sample data items. The complete count items were asked of all farm operators. The complete count data items included land in farms, harvested cropland, livestock inventory and sales, crop acreages, quantities harvested and crop sales, land use, irrigation, government loans and payments, conservation acreage, type of organization, and operator characteristics (sections 1 through 22 of the

census report form). Variability in the complete count data items is considerably smaller than in the sample items as the variation is due only to the nonresponse sample estimation procedure. The sample items were asked of approximately 25 percent of the total census farm operators. The sample data items included farm production expenditures, fertilizer and chemical usage, farm machinery and equipment, value of land and buildings, and farm-related income (sections 23 through 28 of the census report form). Variability in the estimates of sample items is due both to the census sample selection and estimation procedure and the nonresponse sample estimation procedure.

The sample for the 1987 Census of Agriculture is one of a large number of possible samples of the same size that could have been selected using the same sample design. Estimates derived from the different samples would differ from each other. The difference between a sample estimate and the average of all possible sample estimates is called the sampling deviation. The standard error or sampling error of a survey estimate is a measure of the variation among the estimates from all possible samples, and thus is a measure of the precision with which an estimate from a particular sample approximates the average result of all possible samples. The percent relative standard error of estimate is defined as the standard error of the estimate divided by the value being estimated multiplied by 100. If all possible samples were selected, each of the samples were surveyed under essentially the same conditions, and an estimate and its standard error were calculated from each sample, then:

1. Approximately 67 percent of the intervals from one standard error below the estimate to one standard error above the estimate would include the average value of all possible samples.
2. Approximately 90 percent of the intervals from 1.65 standard errors below the estimate to 1.65 standard errors above the estimate would include the average value of all possible samples.

The computations involved to define the above confidence statements are illustrated in the following example. Assume that the estimate of number of farms for the State is 94,382 and the relative standard error of the estimate (percent) is .1 percent (0.001). Multiplying 94,382 by 0.001 yields 94, the standard error. Therefore, a 67-percent confidence interval is 94,288 to 94,476 (i.e., 94,382 plus or minus 94). If corresponding confidence intervals were constructed for all possible samples of the same size and design, approximately 2 out of 3 (67 percent) of these intervals would contain the figure obtained from a complete enumeration. Similarly, a 90 percent confidence interval is 94,227 to 94,538 (i.e., 94,382 plus or minus 1.65 x 94).

Table C presents the relative standard error of selected U.S. data items for all farms and for all farms with sales of \$10,000 or more. The percent relative standard error of the

estimate for complete count data measures the variation associated with the sample-based adjustment for whole farm nonresponse. The percent relative standard error of the estimate for sample items measures both the sampling error due to the nonresponse sample estimation procedure and the census sample selection and estimation procedure. The reliability of State estimates may vary substantially from State to State. Generally, State estimates for a given data item are less reliable than the corresponding U.S. estimate.

Table D presents the standard error (not relative standard error) for percent change in U.S. totals from 1982 to 1987. The general purpose of the percent change estimate is to provide a relative measure of the difference in a characteristic between censuses. The relative change for a given characteristic is defined as the ratio of the difference of the 1987 and the 1982 estimate for that characteristic to the 1982 estimate. This ratio is multiplied by 100 to obtain the percent change. The percent standard error of a percent change estimate, then, is the standard error of the ratio multiplied by 100.

Table E presents the relative standard error for U.S. and State totals for 10 major complete count items and 7 sample items. The relative standard error of the estimate (percent) for the same item differs among States. Reasons for this are differences among States in (1) the total number of farms, (2) the number of large farms included with certainty, (3) the size classifications of the farms sampled, (4) the amount of nonresponse, (5) the general agricultural characteristics, and (6) the specific characteristic being measured.

## CENSUS NONSAMPLING ERROR

The accuracy of the census counts are affected by the joint effects of the sampling errors described in the previous section and nonsampling errors. Extensive efforts were made to compile a complete and accurate mail list for the census, to design an understandable report form and instructions, and to minimize processing errors through the use of quality control, verification, and check measures on specific operations. Nonsampling errors arise from incompleteness of the census mail list, duplication in the mail list, incorrect data reporting, errors in editing of reported data, and errors in imputation for missing data. These specific nonsampling errors are further discussed in this section. Evaluation studies will be conducted to measure the extent of certain nonsampling errors such as coverage error, classification error, and item imputation.

### Census Coverage

The main objective of the census of agriculture is to obtain a complete and accurate enumeration of U.S. farms with accurate data on all aspects of the agricultural operation. However, the cost and availability of resources for

this enumeration place restrictions on operationally feasible data collection methodologies. The past five agriculture censuses have been conducted by mail enumeration with telephone contact for selected nonrespondents. The completeness of such an enumeration thus depends to a large extent on the coverage of farm operations by the census mail list.

Historically, the census of agriculture has included approximately 90 percent of the farms in the United States and over 96 percent of the agricultural production. Complete enumeration of agricultural operations satisfying the farm definition of \$1,000 or more in agricultural sales is complicated by fluctuations in agricultural operations qualifying for enumeration, the variety of arrangements under which farms are operated, the multiplicity of names used by an operation, the number of operations in which an operator participates, the accuracy of data reporting, etc. A new mail list is compiled for each census because no current single list of agricultural operations is comprehensive.

An evaluation of census coverage has been conducted for each census of agriculture since 1945. The evaluation provides estimates of the completeness of census farm count and major census data items. In addition, the evaluation helps to identify problems in the census enumeration and provide information that can form the basis for improvements. The results of the 1987 Coverage Evaluation program will be published in volume 2, part 2.

The evaluation of coverage conducted in 1987 was designed to measure errors in the census mail list and in farm classification. Mail list error includes a measurement of farms not on the census mail list (undercount), and a measurement of farms enumerated more than once in the census (overcount). Classification error includes a measurement of farms classified as nonfarms in the census (undercount) and of nonfarms classified as farms in the census (overcount). Classification error arises from reporting and processing errors. Mail list undercount dominates all coverage errors. Net coverage error is defined as the difference of undercounted and overcounted farms. Measurements of these errors, as well as a description of the complete coverage program, will be available in the Coverage Evaluation report.

### Mail List Coverage

A major problem with the use of a mail list for the census of agriculture enumeration is the difficulties that are encountered in compiling a complete list. The percentage of farms on the census mail list varies considerably by State. Several reasons have contributed to farm operators' names not being included on the census mail list—the operation may have been started after the mail list was developed, the operation may be so small as not to appear in agricultural related source lists used in compiling the census list, or the operation may have been falsely classified as a nonfarm prior to mailout. A large proportion of the farms not included on the mail list were small in both acres and sales of agricultural products.

The 1987 Census of Agriculture Coverage Evaluation used the area segment sample of the 1987 June Enumerative Survey (JES) of the National Agricultural Statistical Service (NASS) to estimate farms not on the census mail list. The Census Bureau contracted with the NASS to augment the JES data collection and receive survey data under the confidentiality protection afforded by Title 13, U.S. Code, from all residents of area sample segments with agricultural activity. These survey records were matched to the census mail list. Records that did not match were mailed a census of agriculture report form to estimate mail list coverage. Estimates of farms not on the census mail list used the capture-recapture dual frame estimator that will be described in the Coverage Evaluation report.

Table F provides coverage evaluation estimates of the number of farms not on the mail list and selected characteristics of those farms with their percent relative standard error. The table also provides an estimate of characteristics of farms not on the mail list as a percentage of total farms in the United States. The estimate of total farms in the United States is based on census farm count and the estimated number of farms not on the census mail list. This estimate of total farms in the United States was not adjusted for classification and list duplication errors. Estimates of these errors will be available in the Coverage Evaluation report at the regional and U.S. levels. The table provides the standard error (not relative standard error) of this percent estimate.

## Respondent and Enumerator Error

Incorrect or incomplete responses to the mailed census report form or to the questions posed by a telephone enumerator introduce error into the census data. Such incorrect information can lead, in some cases, to incorrect enumeration of farms. This type of reporting error is measured by the Classification Error Study discussed later in this section. To reduce all types of reporting error, questions were phrased as clearly as possible based on tests of the census report form, and detailed instructions for completing the report form were provided to each addressee. In addition, each respondent's answers were checked for completeness and consistency.

## Item Nonresponse

Nonresponse to particular questions on the census report that we would logically or statistically expect to be present may create a type of nonsampling error in both complete count and sample data. When information reported for another farm with similar characteristics is used to edit or impute for item nonresponse, the data may be biased because the characteristics of the nonrespondents have not been observed and may differ from those reported by respondents. Any attempt to correct the data for nonresponse may not completely reflect this difference either at the element level (individual farm operation) or on the average.

## Processing Error

The many steps of processing of each census report form are sources for the introduction of nonsampling error. The processing of the census report forms includes clerical screening for farm activity, computerized check-in of report forms and followup of nonrespondents, keying and transmittal of completed report forms, computerized editing of inconsistent and missing data, review and correction of individual records referred from the computer edit, review and correction of tabulated data, and electronic data processing. These operations undergo a number of quality control checks to ensure as accurate an application as possible, yet some errors are not detected and corrected.

## Classification Error

An evaluation study of classification errors was conducted in the 1987 Census of Agriculture as part of the census coverage evaluation program. A sample of mail list respondents was selected, and these addresses reenumerated to determine whether they were a farm or non-farm. A farm status determination was made based on the evaluation questionnaire and compared with the status based on the data reported on the census form. Differences in status were reconciled.

In past censuses, the proportion of farms undercounted due to classification errors was higher for farms with small values of sales. The classification error rate was higher for (1) livestock farms than crop farms, (2) farms with a small number of acres than larger farms, or (3) tenant farms than full or part-owner farms. Results from the 1987 classification error study will be published in the Coverage Evaluation report.

## EDITING DATA AND IMPUTATION FOR ITEM NONRESPONSE

For the 1987 Census of Agriculture, as in previous censuses, all reported data were keyed and then edited by computer. The edits were used to determine whether the reports met the minimum criteria to be counted as farms in the census. Computer edits also performed a series of complex, logical checks of consistency and completeness of item responses. They provided the basis for deciding to accept, impute (supply), delete, or alter the reported value for each data record item.

Whenever possible, edit imputations, deletions, and changes were based on component or related data on the respondent's report form. For some items, such as operator characteristics, data from the previous census were used when available. Values for other missing or unacceptable reported data items were calculated based on reported quantities and known price parameters.

When these and similar methods were not available and values had to be supplied, the imputation process used information reported for another farm operation in a geographically adjacent area with characteristics similar to those of the farm operation with incomplete data. For example, a farm operation that reported acres of corn harvested, but did not report quantity of corn harvested, was assigned the same bushels of corn per acre harvested as that of the last nearby farm with similar characteristics that reported acceptable yields during that particular execution of the computer edit. The imputation for missing items in each section of the report form was conducted separately; thus, assigned values for one operation could come from more than one respondent.

Prior to the imputation operation, a set of default values and relationships were assigned to the possible imputation variables. The relationships and values varied depending on the item being imputed. For example, different default values were assigned for several standard industrial classification and total value of sales categories when imputing hired farm labor expenses. These values and item relationships for the possible imputation variables were stored in the computer in a series of matrices. The computer records were sorted by reported State and county, where the county sequence was based on similar types of farms and agricultural practices.

Each execution of the computer edit consisted of records from only one State. For a given execution of the edit, the stored entries in the various matrices were retained in the computer only until a succeeding record having acceptable characteristics for some sections of the report form was processed by the computer. Then the acceptable response of the succeeding operation replaced those previously stored. When a record processed through the edit had unreported or unacceptable data, the record was assigned the last acceptable ratio or response from an operation with a similar set of characteristics. Once each execution of the computer edit for a State was completed, the possible imputation variables were reset to the default values and relationships for subsequent executions.

After the initial computer edit, keyed reports not meeting the census farm definition were reviewed to ensure that the data were keyed correctly. Edit referrals were generated for about 30 percent of the reports included as farms, and they were also reviewed for keying accuracy and to ensure that the computer edit actions were correct. If the results of the computer edit were not acceptable, corrections were made and the record was reedited. More extensive discussions of the edit and item imputation methodology with measures of the extent of imputation in the census estimates will be provided in a separate research report.

## **APPENDIX D:**

**1991 CURRENT INDUSTRIAL REPORTS FOR:**

**CONSTRUCTION MACHINERY**

**FARM MACHINERY AND LAWN & GARDEN EQUIPMENT**

**PUMPS AND COMPRESSORS**

**MOTORS AND GENERATORS**



# Construction Machinery



U.S. Department of Commerce  
Economics and Statistics Administration  
BUREAU OF THE CENSUS

1991

MA35D(91)-1  
Issued January 1993

## SUMMARY OF FINDINGS

Shipments of construction machinery as collected on this survey totaled \$6.7 billion in 1991, a 17.5 percent decrease from the 1990 total of \$8.1 billion. Shipments of contractors off-highway wheels tractors, totaled \$244.5 million, representing a 32-percent decrease from the 1990 shipments of \$360.5 million. Shipments of tracklaying tractors in 1991 were \$998.7 million, a decrease of 9-percent from the 1990 shipments of \$1,092.6 million. The 1991 shipments of track shovel loaders totaled \$1,854.5 million, a decrease of 17-percent from the 1990 total of \$2,235.9 million. Shipments of power cranes, draglines, and shovels in 1991 totaled \$1,237.0 million, a

decrease of 18 percent from the 1990 shipments of \$1,511.8 million. The 1991 shipments of mixers, pavers, and related equipments totaled \$518.6 million, a decrease of 15-percent from the 1990 total of \$609.6 million.

The 1991 shipments of scrapers bowls totaled \$98.9 million. Other 1991 shipments included motor graders, \$356.7 million; rollers and compactors, \$187.2 million; off-highway vehicles \$822.7 million; and rough terrain forklifts, \$167.9 million. Shipments of equipment for mounting on tractors in 1991 totaled \$196.3 million, a decrease of 24-percent from the 1990 shipments of \$258.6 million.

A description of the survey methodology and other related information appears on page 12.

Table 1. VALUE OF SHIPMENTS OF CONSTRUCTION MACHINERY: 1982 TO 1991

(Millions of dollars)

Product code	Product description	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982
3531A	Contractors off-highway wheel tractors.....	244.5	360.5	366.2	408.1	374.8	421.9	486.6	421.9	292.4	254.7
3531B	Tracklaying tractors.....	998.7	1,092.6	1,163.7	1,145.1	975.9	821.2	628.7	785.4	633.6	577.3
3531C	Tractor shovel loaders.....	1,854.5	2,235.9	2,212.0	2,027.6	1,782.5	1,679.0	1,754.1	1,791.9	1,515.9	1,241.9
3531E	Power cranes, draglines, and shovels.....	1,237.0	1,511.8	1,318.3	1,050.7	1,955.4	1,308.6	1,445.5	1,479.9	1,540.6	1,447.3
3531F	Mixers, pavers, and related equipment.....	518.6	609.6	701.8	565.3	569.9	566.2	632.1	485.5	366.5	311.7
3531G	Scrapers; graders; compactors; rollers; off-highway trucks, trailers, and wagons; and rough terrain forklifts.....	1,633.3	2,023.7	1,881.3	1,524.2	1,249.9	2,023.8	2,322.0	1,799.4	1,305.6	1,111.7
3531H	Equipment for mounting on tractors.....	196.3	258.6	343.0	363.8	481.1					

<sup>†</sup> Revised by 5 percent or more from previously published figures.

<sup>1</sup> Beginning in 1987, parts for power cranes, draglines, and shovels (product code 3531H 03) are not included in product class 3531E (power cranes, draglines, and shovels). Prior to 1987, these data are included with old product class 35314.

Table 2. QUANTITY AND VALUE OF SHIPMENTS OF SELECTED TYPES OF CONSTRUCTION MACHINERY: 1991 AND 1990

(Quantity in number of units; value in thousands of dollars)

Product code	Product description	Number of companies	1991		1990	
			Quantity	Value	Quantity	Value
3531A 00	Contractors' off-highway wheel tractors.....	13	2,609	244,520	4,081	360,540
	Towing tractors.....	(NA)	1,427	127,547	2,127	199,839
3531A 13	Single axle.....	4	1,181	101,528	1,721	159,839
	Two axle:					
3531A 20	Under 100 HP.....	1				
3531A 22	100 through 149 HP.....	3				
3531A 24	150 HP and over.....	4	246	26,019	406	40,000
3531A 34	Rubber-tired dozers.....	2				
3531A 37	Wheeled log skidders, self-propelled.....	5	1,182	116,973	1,954	160,701
3531B 00	Crawler tractors.....	5	7,423	998,740	8,781	1,092,559
3531B 30	Under 90 NEHP.....	4	(D)	(D)	3,065	130,413
3531B 36	90 through 159 NEHP.....	4	1,566	125,411	(D)	(D)
3531B 40	160 NEHP and over.....	3	(D)	(D)	(D)	(D)
3531C 00	Loaders.....	(NA)	56,094	1,854,487	68,135	2,235,881
3531C 60	Skid steer loaders.....	7	(D)	(D)	(D)	(D)
	Wheel loaders, non-skid steer.....	(NA)	7,376	893,287	9,890	1,094,839
3531C 71	Under 79 NEHP.....	6	570	15,351	901	24,242
3531C 72	80 through 149 NEHP.....	5	2,914	186,642	4,002	256,861
3531C 73	150 through 249 NEHP.....	7	2,432	274,209	3,267	355,615
3531C 74	250 NEHP and over.....	6	1,460	417,085	1,720	458,121
	Crawler loaders.....	4	(D)	(D)	(D)	(D)
3531C 81	Under 90 NEHP.....	4	(D)	(D)	(D)	(D)
3531C 84	90 NEHP and over.....	3	(D)	(D)	(D)	(D)
3531C 95	Backhoes (wheel tractor-chassis shipped as part of front engine mount).....	4	(D)	(D)	(D)	(D)
3531E 00	Power cranes, draglines, shovels (excavators), and attachments.....	47	17,040	1,236,998	23,055	1,511,757
	Excavators.....	(NA)	3,070	452,780	4,502	705,574
	Crawler mounted.....	(NA)	2,650	390,690	3,955	631,451
3531E 03	Cable operated.....	2	(D)	(D)	(D)	(D)
	Hydraulic operated:					
3531E 05	Under 25 metric tons.....	10	1,753	176,620	2,357	256,798
3531E 06	25 through 40 metric tons.....	5	355	49,383	531	75,268
3531E 07	Over 40 metric tons.....	6	(D)	(D)	(D)	(D)
3531E 19	Wheel (rubber) mounted.....	6	420	62,090	547	74,123
	Power cranes.....	(NA)	4,138	534,072	5,847	537,204
	Lattice boom.....	(NA)	160	192,399	156	131,798
	Crawler mounted.....	(NA)	106	162,943	117	131,798
	Maximum working load:					
3531E 20	Under 91 tons.....	5	44	15,118	62	18,118
3531E 26	91 through 120 tons.....	3				
3531E 29	121 tons and over.....	4	62	147,825	155	171,335
	Wheel (rubber) mounted.....	(NA)	54	29,456	39	22,681
	Maximum working load:					
3531E 37	Under 121 tons.....	4	36	14,729	22	8,155
3531E 38	121 tons and over.....	4	18	14,727	17	14,526
	Hydraulic operated, telescopic boom.....	(NA)	3,978	441,673	5,691	523,406
3531E 41	Crawler mounted.....	1	(D)	(D)	(D)	(D)
	Wheel (rubber mounted), multiple control stations.....	(NA)	(D)	(D)	(D)	(D)
	Maximum working load:					
3531E 51	Under 21 tons.....	6	(D)	(D)	(D)	(D)
3531E 52	21 through 30 tons.....	5	116	17,594	117	18,427
3531E 53	31 through 55 tons.....	4				
3531E 54	56 tons and over.....	3	339	108,920	240	78,143
3531E 57	Pinned on type, telescopic and articulated.....	3	(D)	(D)	1,510	52,591
	Wheel (rubber mounted), one control station.....	(NA)	1,791	255,496	2,738	337,359
	Maximum working load:					
3531E 68	Under 19 tons.....	9	828	59,714	1,374	93,035
3531E 65	19 through 25 tons.....	5	277	34,782	276	32,510
3531E 66	26 tons and over.....	5	686	161,000	1,088	211,814
3531E 75	Draglines, crawler and/or tub.....	2	(1)	(1)	(1)	(1)
	Other cranes.....	(NA)	3,013	81,866	3,560	43,112
3531E 81	Locomotive (except wrecking).....	4	12	4,304	12	5,113
	Pedestal or ship-mounted marine cranes:					
3531E 82	Telescopic or box boom.....	4				
3531E 86	Lattice boom.....	3				
3531E 85	All other cranes (including locomotive wrecking).....	7	2,926	57,502	3,463	59,143
	Attachments for power cranes, draglines, and excavators (sold separately).....	(NA)	6,819	68,280	9,146	85,351
3531E 94	Hoe.....	4	5,058	7,754	6,264	11,494
3531E 95	Dragline buckets.....	5	144	7,021	176	3,841
3531E 97	Clamshell/grapple.....	5	430	31,553	1,382	37,822
3531E 98	All other attachments.....	9	1,187	21,952	1,324	25,704
3531F 00	Mixers, pavers, and related equipment.....	83	113,332	518,572	134,902	609,356
	Concrete:					
	Mixers:					
	Portable (except plaster and mortar):					
3531F 21	Truck-mixer or agitator.....	10	3,615	94,933	4,264	104,425
3531F 25	Other than truck-mixer.....	8	1,240	5,769	2,460	10,777
3531F 31	Plaster and mortar.....	9	5,944	13,120	8,538	19,477
	Concrete pavers:					
3531F 33	Slipform machines (including multipurpose, automated curb and gutter and concrete slipform pavers).....	10	268	46,462	354	75,704

See footnotes at end of table.

Table 2. QUANTITY AND VALUE OF SHIPMENTS OF SELECTED TYPES OF CONSTRUCTION MACHINERY: 1991 AND 1990--Continued

(Quantity in number of units; value in thousands of dollars)

Product code	Product description	Number of companies	1991		1990	
			Quantity	Value	Quantity	Value
	Mixers, pavers, and related equipment--Continued					
	Concrete--Continued					
	Concrete pavers--Continued					
3531F 34	Nonautomated (extruder) curbers and concrete placer spreaders.....	7	106	6,557	<sup>F</sup> 107	<sup>F</sup> 6,309
3531F 39	Concrete trowels.....	8	5,047	3,169	<sup>F</sup> 6,771	<sup>F</sup> 4,133
3531F 40	Concrete vibrators.....	11	90,046	19,038	88,336	20,357
3531F 42	Concrete screeds.....	7	2,366	1,455	<sup>F</sup> 18,311	<sup>F</sup> 5,048
3531F 43	Concrete batching plants.....	12	289	32,316	317	42,856
	Concrete pumps, mobile:					
	Trailer mounted:					
3531F 60	Under 25 cu. yds./hr.....	3	710	64,323	958	77,548
3531F 62	25 cu. yds./hr. and over.....	4				
3531F 64	Truck mounted.....	4				
	Bituminous:					
3531F 66	Distributors.....	7	483	19,252	421	11,566
	Pavers, self-propelled:					
3531F 71	Under 22,000 lbs. gross weight.....	10	460	17,266	<sup>F</sup> 444	17,082
3531F 75	22,000 lbs. gross weight and over.....	6	408	59,600	526	74,799
3531F 80	Pavers, not self-propelled.....	4	76	717	122	1,251
	Asphalt plants (including cold mix central plants):					
3531F 82	Less than 7,500 lbs. (239 TPH).....	4	31	12,843	27	12,948
3531F 84	7,500 lbs. and over (240 TPH and over).....	7	67	62,076	81	69,988
3531F 85	Stabilization mixing equipment (including central plants and mix-in-place).....	6	138	31,155	91	17,605
3531F 89	Cold planers/milling machines (self-propelled).....	4			72	17,447
3531F 98	Other concrete and bituminous equipment, including mixers, heating kettles, heaters, circulators, travel mix-type, and spreader boxes.....	18	2,038	28,521	2,058	23,771
3531G pt.	Scraper bowls.....	7	1,250	98,876	1,885	181,556
3531G 01	Conventional scraper bowls, (dig, carrying, and hauling) used as part of a self-propelled, nonelevating, 2-wheel type scraper, S.A.E. struck rating.....	2	1,250	98,876	1,885	181,556
3531G 03	Elevating scraper bowls, (dig, carrying, and hauling), 2- and 4- wheel type, S.A.E. heaped rating.....	5				
3531G 05	All other scraper bowls, including towed type.....	2				
3531G pt.	Motor graders and light maintainers.....	8	3,312	356,674	4,136	407,987
3531G 11	Under 145 NEHP.....	7	3,312	356,674	1,816	146,153
3531G 17	145 NEHP and over.....	4			2,320	261,824
3531G pt.	Rollers and compactors (except hand-held).....	22	4,111	187,234	5,719	267,213
	Self-propelled type, ride on.....	(NA)	(D)	(D)	(D)	(D)
	Static compaction equipment (fully ballasted).....	(NA)	1,614	87,641	2,203	120,293
	Smooth steel wheel rollers, tandem:					
3531G 21	Under 3 metric tons.....	10	750	4,738	911	5,044
3531G 23	3 through 5.4 metric tons.....	5	103	2,511	122	2,703
3531G 26	5.5 metric tons and over.....	5	156	6,050	353	10,431
	Pneumatic tire rollers:					
3531G 29	Under 2.5 metric tons.....	4	605	74,342	817	102,115
3531G 31	2.5 metric tons and over.....	3				
	Multiple projection steel wheel rollers:					
3531G 33	Embankment.....	2	605	74,342	817	102,115
3531G 35	Landfill.....	2				
	Vibratory compaction equipment (fully ballasted).....	(NA)	(D)	(D)	(D)	(D)
	Single drum with one or two drive wheels.....	(NA)	1,377	71,893	1,872	70,565
3531G 37	Under 5 metric tons.....	4	162	3,638	308	8,871
3531G 39	5 through 7 metric tons.....	6	240	11,061	550	27,141
3531G 42	8 metric tons and over.....	6	975	57,194	<sup>F</sup> 1,014	<sup>F</sup> 54,553
	Double drum, two drums vibrating.....	(NA)	731	24,470	<sup>F</sup> 1,189	<sup>F</sup> 52,374
3531G 45	Under 3 metric tons.....	4	419	8,741	<sup>F</sup> 594	<sup>F</sup> 22,374
3531G 47	3 through 4 metric tons.....	4			83	2,658
3531G 49	5 through 7 metric tons.....	4	97	4,679	203	10,187
3531G 51	8 through 11.2 metric tons.....	3	(D)	(D)	246	12,672
3531G 53	11.3 metric tons and over.....	1	(D)	(D)	63	4,583
3531G 55	Double drum with one drum vibrating.....	3	(D)	(D)	(D)	(D)
3531G 57	Other compactors, except hand-held.....	1	(D)	(D)	(D)	(D)
3531G 91	Towed type rollers, including pneumatic tire, static-padfoot, sheepsfoot, bar type, vibratory-smooth.....	3	(D)	(D)	(D)	(D)
3531G pt.	Off-highway vehicles.....	14	2,500	822,697	3,280	457,726
3531G 71	Rear dump haulers.....	11	2,500	822,697	3,280	457,726
3531G 73	Integral self-powered side and bottom dumps, including coal haulers.....	1				
3531G 75	Off-highway truck-type, rear dump chassis used as a tractor for towing earth, rock, coal, and ore trailers.....	1				
3531G 77	Other truck-type tractor chassis used for log hauling, oilfields, desert, and other uses.....	3	2,500	822,697	3,280	457,726
3531G 79	Off-highway trailers and wagons (end, side, and bottom dump).....	1				
3531G pt.	Rough terrain forklifts (integral units only).....	13	2,609	167,853	<sup>F</sup> 3,637	<sup>F</sup> 134,260
3531G 81	2-wheel drive, vertical mast.....	9	1,082	70,896	<sup>F</sup> 1,947	<sup>F</sup> 8,124
3531G 83	4-wheel drive, vertical mast.....	6	41	1,401	<sup>F</sup> 431	<sup>F</sup> 2,400
3531G 85	2- and 4- wheel drive, variable reach.....	6	1,486	95,556	<sup>F</sup> 1,597	<sup>F</sup> 107,216

See footnotes at end of table.

Table 2. QUANTITY AND VALUE OF SHIPMENTS OF SELECTED TYPES OF CONSTRUCTION MACHINERY: 1991 AND 1990--Continued

(Quantity in number of units; value in thousands of dollars)

Product code	Product description	Number of companies	1991		1990	
			Quantity	Value	Quantity	Value
3531H 00	Construction machinery for mounting.....	31	66,964	196,302	<sup>1</sup> 81,607	<sup>1</sup> 258,605
3531H 01	Sidebooms or pipehandlers.....	2	(D)	(D)	(D)	(D)
3531H 03	Dozers for crawler and wheel tractors.....	6	1,077	7,066	2,925	13,929
	Winches (towing, logging and oil-field types):					
3531H 05	Electric.....	3	47,777	69,575	53,147	75,477
3531H 07	Other, including hydraulic.....	6				
	Backhoes:					
3531H 09	Under 14 ft. digging depth.....	8	7,342	55,610	<sup>1</sup> 9,392	<sup>1</sup> 71,524
3531H 11	14 ft. digging depth and over.....	2				
3531H 13	Front-end loaders, including shovel loaders.....	3	(D)	(D)	(D)	(D)
3531H 15	Logging arches.....	3	(D)	(D)	(D)	(D)
3531H 17	Rippers and rooters, heavy rear-mounted.....	3	(D)	(D)	(D)	(D)
3531H 19	Continuous ditching and trenching attachments.....	3	154	588	150	813
3531H 21	Forklift attachments (includes only forklift mast sold separately).....	5	3,354	13,281	<sup>1</sup> 6,398	<sup>1</sup> 29,789
3531H 23	All other construction machinery for mounting, including cranes, cable power control units, hydraulic power control units, etc.....	7	713	13,765	969	15,466
3531K 20	Self-propelled continuous ditchers and trenchers (integral units only).....	10	5,876	111,816	7,687	129,715
	Ladder-type digging element.....	(NA)	(D)	(D)	(D)	(D)
3531K 14	Under 2,000 lbs. gross weight.....	4	2,550	14,691	<sup>1</sup> 3,449	<sup>1</sup> 17,677
3531K 15	2,000 through 4,999 lbs. gross weight.....	5	2,389	46,510	<sup>1</sup> 3,169	<sup>1</sup> 58,008
3531K 16	5,000 lbs. gross weight and over.....	5	937	50,615	<sup>1</sup> 1,069	<sup>1</sup> 5,030
3531K 18	Wheel-type digging element.....	4				
3531K 90	Aerial work platforms.....	29	22,124	566,971	30,266	814,926
3531K 81	Boom-type, self-propelled.....	9	4,464	214,020	8,847	380,689
3531K 83	Scissors, self-propelled.....	13	7,520	107,418	10,341	170,185
3531K 85	Not self-propelled, boom and scissors type.....	8	1,557	8,897	1,687	8,793
3531K 87	Truck mounted.....	17	8,583	236,636	9,391	255,259

(D) Data withheld to avoid disclosing figures for individual companies. (NA) Not available. <sup>1</sup>Revised by 5 percent or more from previously published figures.

<sup>1</sup>Data for draglines, crawler and/or tub, (product code 3531E 75), are included with data for crawler mounted, lattice boom cranes, (product codes 3531E 26 and 3531E 29), to avoid disclosing figures for individual companies.

Table 3. COMPARISON OF VALUES OF SHIPMENTS OF CONSTRUCTION MACHINERY, AS REPORTED IN THE MAJSD, THE 1987 CENSUS OF MANUFACTURES, AND THE 1990 ANNUAL SURVEY OF MANUFACTURES

(Value in thousands of dollars)

Product code	Product description	1990			1987	
		MAJSD	Annual Survey of Manufactures		MAJSD	Census of Manufactures
			Value	Standard error of estimates <sup>1</sup>		
3531	Construction machinery.....	(X)	14,888.0	1	(X)	11,704.6
3531A	Contractors' off-highway wheel tractors.....	360.5	364.6	1	374.8	379.7
3531B	Tracklaying tractors.....	1,092.6	1,106.3	1	975.9	945.6
3531C	Tractor shovel loaders.....	2,235.9	2,167.4	1	1,782.5	1,741.8
	Wheel loaders.....	(D)	(NA)	(NA)	1,055.0	(NA)
	Tracklaying shovel loaders.....	(D)	(NA)	(NA)	100.0	(NA)
	Wheel tractor chassis, shipped as part of front-engine mount, integral design tractor shovel loader backhoe.....	(D)	(NA)	(NA)	627.5	(NA)
3531E	Power cranes, shovels and draglines.....	1,511.8	1,655.6	1	955.4	957.1
	Excavators.....	705.6	(NA)	(NA)	423.0	(NA)
	Cranes.....	637.2	(NA)	(NA)	268.7	(NA)
	Draglines.....	169.0	(NA)	(NA)	45.4	(NA)
	Other cranes and attachments.....		(NA)	(NA)	218.3	(NA)
3531F	Mixers, pavers, and related equipment.....	609.6	612.3	4	569.9	586.1
	Concrete equipment.....	363.1	(NA)	(NA)	297.7	(NA)
	Bituminous equipment.....	227.7	(NA)	(NA)	232.4	(NA)
	Other related equipment.....	23.8	(NA)	(NA)	39.8	(NA)
3531G	Scrapers, graders, compactors, off-highway trucks and trailers, and rough terrain fork lifts.....	2,023.8	~2,000.4	3	1,249.9	1,221.4
	Scrapers.....	181.6	(NA)	(NA)	145.4	(NA)
	Graders.....	408.0	(NA)	(NA)	327.7	(NA)
	Compaction equipment.....	267.2	(NA)	(NA)	264.3	(NA)
	Off-highway trucks and trailers.....	957.7	(NA)	(NA)	391.5	(NA)
	Rough terrain fork lifts.....	209.3	(NA)	(NA)	121.0	(NA)
3531H	Construction machinery for mounting on tractors and other prime movers.....	2,258.6	2,543.7	7	2,481.1	2,593.5
3531K	Other construction machinery and equipment.....	(X)	1,814.5	2	(X)	1,356.9
	Self-propelled ditchers and trenchers.....	129.7	(NA)	(NA)	127.6	125.8
	Personnel aerial work platforms.....	814.9	(NA)	(NA)	529.3	501.9
	Portable crushing, screening, washing, and combination plants.....	385.1	(NA)	(NA)	371.6	71.0
3531M	Parts for construction machinery and equipment.....	(X)	3,890.6	2	(X)	3,269.1
	Contractors' off-highway wheel tractors, tracklaying tractors, and tractor shovel loaders.....	(4)	(NA)	(NA)	(4)	1,401.2
	Power cranes, shovels, and draglines.....	(4)	(NA)	(NA)	270.7	270.7
	Mixers, pavers, and related equipment.....	(4)	(NA)	(NA)	(4)	191.6
	Scrapers, graders, compactors, off-highway trucks and trailers, and rough terrain fork lifts.....	(4)	(NA)	(NA)	(4)	240.8
	Construction machinery for mounting on tractors and other prime movers.....	(4)	(NA)	(NA)	(4)	397.8
	Other construction machinery and equipment.....	(4)	(NA)	(NA)	(4)	590.3
35310 00	Construction machinery n.s.k., typically for establishments with 10 employees or more.....	(4)	732.7	1	(4)	344.5
35310 02	Construction machinery n.s.k., typically for establishments with less than 10 employees.....	(4)			(4)	308.9

Note: In the 1987 Census of Manufactures, shipments for small companies, typically those with fewer than 10 employees, were estimated from administrative records data rather than collected on census questionnaires. These shipments are included in product code 35310 02. Products not adequately identified by detail product were coded in some cases to industry 3531 (four-digits) followed "000."

(D) Data withheld to avoid disclosing figures for individual companies. (NA) Not available. n.s.k. Not specified by kind. (X) Not applicable.

<sup>1</sup>The annual survey of manufactures percentage standard errors shown are the approximate relative standard errors of the estimates of level. A more detailed description of the standard error of estimate is given in the introduction of the annual survey of manufactures, Value of Product Shipments, M90(AS)-2, under "Qualifications of the Data."

<sup>2</sup>Data for snow clearing attachments for mounting on tractors or trucks are included with the census of manufactures shipments, but excluded from the MAJSD shipments.

<sup>3</sup>Collected on the MAJSD, Mining Machinery.

<sup>4</sup>Available only from the annual survey of manufactures and census of manufactures.

Table 4A. SHIPMENTS, EXPORTS, AND IMPORTS OF CONSTRUCTION MACHINERY: 1991

(Quantity in units; value in thousands of dollars)

Product code	Product description	Manufacturers' shipments <sup>1</sup>		Export shipments <sup>1</sup>			Percent Exports to manufacturers' shipments		Imports for consumption <sup>4</sup>		Apparent <sup>5</sup> consumption		Percent imports to apparent consumption	
		Quantity	Value	Quantity	Value as reported <sup>2</sup>	Estimated producers' Value <sup>3</sup>	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
3531A 13, 20, 22, 24	Contractors off-highway wheel tractors for use as towing unit.....	1,427	127,547	1,040	39,949	32,383	73	25	4,104	20,546	4,491	115,710	91	18
3531A 34	Rubber-tired dozers.....	1,182	116,973	(NA)	44,582	36,138	(NA)	31	2,569	54,239	(NA)	135,074	(NA)	40
3531A 37	Wheeled log skidders, self-propelled.....													
3531B 30, 36	Crawler tractors (net engine horsepower): Under 159 NEHP.....	7,423	998,740	1,992	370,501	300,328	27	30	2,231	101,637	7,662	800,049	29	13
3531B 40	160 NEHP and over.....													
3531C 60	Skid steer loaders; 4-wheel drive, skid steer.	(D)	(D)	2,189	92,615	75,074	(NA)	(NA)	2,060	76,552	(NA)	(NA)	(NA)	(NA)
3531C 71, 72, 73, 74	Wheel loaders, rear engine mount, integral design; 4-wheel drive, non-skid steer.....	7,376	893,287	(NA)	387,564	314,159	(NA)	35	2,406	138,268	(NA)	717,396	(NA)	19
3531C 81	Crawler loaders (net engine horsepower): Under 90 NEHP.....	(D)	(D)	97	4,203	3,407	(NA)	(NA)	114	5,803	(NA)	(NA)	(NA)	(NA)
3531C 84	90 NEHP and over.....	(D)	(D)	36	3,868	3,135	(NA)	(NA)	273	31,673	(NA)	(NA)	(NA)	(NA)
3531E 03	Excavators, cable operated, crawler mounted...													
3531E 05	Excavators, hydraulic operated, crawler mounted.....	2,650	390,690	1,168	163,586	132,603	44	34	2,513	217,686	3,995	475,773	63	46
3531E 06														
3531E 07														
3531E 14	Excavators, hydraulic operated, wheel (rubber) mounted, all sizes.....	420	62,090	54	14,624	11,854	13	19	275	20,369	641	70,605	43	29
3531E 20														
3531E 26														
3531E 29	Cranes, crawler mounted.....													
3531E 41														
3531E 57														
3531E 37		4,138	634,072	2,436	164,959	133,746	59	21	4,645	36,672	6,347	537,028	73	1
3531E 38														
3531E 51														
3531E 52														
3531E 53	Cranes, wheel mounted.....													
3531E 54														
3531E 65														
3531E 66														
3531E 68														
3531E 82	Cranes, pedestal or shipmounted.....	75	20,060	(NA)	3,966	3,215	(NA)	16	184	15,734	(NA)	32,579	(NA)	48
3531E 86														
3531E 95	Dragline buckets, attachment.....	144	7,021	(NA)	2,823	2,288	(NA)	33	45	1,724	(NA)	6,457	(NA)	17
3531E 97	Clamshell/grapple attachment.....	430	31,553	(NA)	3,685	2,987	(NA)	9	647	859	(NA)	29,425	(NA)	1

See footnotes at end of table.

Table 4A. SHIPMENTS, EXPORTS, AND IMPORTS OF CONSTRUCTION MACHINERY: 1991--Continued

(Quantity in units; value in thousands of dollars)

Product code	Product description	Manufacturers' shipments <sup>1</sup>		Export shipments <sup>1</sup>			Percent Exports to manufacturers' shipments		Imports for consumption <sup>4</sup>		Apparent consumption <sup>5</sup>		Percent imports to apparent consumption	
		Quantity	Value	Quantity	Value as reported <sup>2</sup>	Estimated producers' Value <sup>3</sup>	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
3531F 33, 34	Concrete pavers.....	374	53,019	(NA)	19,613	15,898	(NA)	30	89	448	(NA)	37,569	(NA)	1
3531F 66, 71, 75, 80	Bituminous pavers.....	1,427	96,835	(NA)	22,267	18,050	(NA)	19	702	6,271	(NA)	85,056	(NA)	7
3531F 60, 62, 64	Concrete pumps.....	710	64,323	(NA)	25,813	20,924	(NA)	33	523	9,612	(NA)	53,011	(NA)	18
3531G 01, 03, 05	Scraper bowls.....	1,250	98,876	315	3,355	2,720	25	3	38	405	973	96,561	4	1
3531G 11, 17	Motor graders and light maintainers.....	3,312	356,674	2,627	215,430	174,628	79	49	307	20,322	992	202,368	31	10
3531G 21, 23, 26, 29, 31, 33, 35	Self-propelled static compaction equipment.....	1,614	87,641	732	37,830	30,665	45	35	300	6,510	1,182	63,486	25	10
3531G 37, 39, 42, 45, 47, 49, 51, 53, 55, 57	Self-propelled vibratory compaction equipment..	(D)	(D)	1,223	37,848	30,680	(NA)	(NA)	3,065	40,416	(NA)	(NA)	(NA)	(NA)
3531G 91	Towed type rollers and compactors.....	(D)	(D)	20,171	30,537	24,753	(NA)	(NA)	2,001	5,034	(NA)	(NA)	(NA)	(NA)
3531G 71	Off-highway rear dump haulers.....	2,500	822,697	(NA)	497,588	403,345	(NA)	49	760	43,822	(NA)	463,174	(NA)	9
3531G 73	Off-highway integral self-powered wide and bottom dumps, including coal haulers.....													
3531G 75, 77	All other off-highway truck-type tractor chassis.....													
3531H 01	Construction machinery for mounting: Sidebooms or pipehandlers.....	(D)	(D)	273	17,406	14,109	(NA)	(NA)	43	4,023	(NA)	(NA)	(NA)	(NA)
3531H 03	Dosers, for crawler and wheel tractors.....	1,077	7,066	(NA)	(NA)	(NA)	(NA)	(NA)	7,283	20,563	(NA)	(NA)	(NA)	(NA)
3531H 05, 07	Winches (towing, logging, and oil-field types).....	47,777	69,575	(NA)	51,159	41,469	(NA)	60	389,885	29,391	(NA)	57,497	(NA)	51
3531H 09, 11	Backhoes.....	7,342	55,610	1,333	5,239	4,247	18	8	640	1,037	6,649	52,400	10	2
3531H 13	Front-end loaders.....	(D)	(D)	14,303	13,837	11,216	(NA)	(NA)	25,330	6,835	(NA)	(NA)	(NA)	(NA)
3531H 17	Rippers and rooters.....	(D)	(D)	223	2,608	2,114	(NA)	(NA)	796	873	(NA)	(NA)	(NA)	(NA)
3531K 14, 15, 16	Self-propelled continuous ditchers and trenchers (integral units): Ladder-type digging element.....	5,876	111,816	1,536	25,485	20,658	26	18	20	680	4,360	91,838	1	1
3531K 18	Wheel-type digging element.....													

(D) Data withheld to avoid disclosing figures for individual companies.

(NA) Not available.

NEHP = Net engine horsepower.

1. System of Standard Industrial Classification-based product codes, Schedule B export numbers, and HTSUSA import numbers, see table 6.

2. Bureau of the Census report, IM 345, U.S. Exports.

3. Values were derived by the use of adjustment factors to exclude freight, insurance, and other charges incurred in moving goods to the port of export. This adjustment is made to convert the gross value of the producers' value of exported goods. Current adjustment factors are based on data for 1989 which are published in Exports from Manufacturing Establishments, AR89-1.

4. The adjustment factor for this report is 0.8106.

5. Bureau of the Census report, IM 145, U.S. Imports for Consumption.

Apparent consumption is derived by subtracting exports from the total of shipments plus imports.

Table 48. SHIPMENTS, EXPORTS, AND IMPORTS OF CONSTRUCTION MACHINERY: 1990

(Quantity in units; value in thousands of dollars)

Product code	Product description	Manufacturers' shipments <sup>1</sup>		Export shipments <sup>1</sup>			Percent Exports to manufacturers' shipments		Imports for consumption <sup>1 4</sup>		Apparent <sup>3</sup> consumption		Percent imports to apparent consumption	
		Quantity	Value	Quantity	Value as reported <sup>2</sup>	Estimated producers' Value <sup>3</sup>	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
3531A 13, 20, 22, 24	Contractors off-highway wheel tractors for use as towing unit.....	2,127	199,839	1,190	42,836	34,723	56	17	10,778	45,007	11,715	210,123	92	21
3531A 34	Rubber-tired dozers.....	1,954	160,701	828	45,852	37,168	42	23	4,833	89,097	5,959	212,630	81	42
3531A 37	Wheeled log skidders, self-propelled.....													
3531B 30, 36	Crawler tractors (net engine horsepower): Under 159 NEHP.....	8,781	1,092,559	1,660	308,749	250,272	19	23	3,953	164,751	11,074	1,007,038	36	16
3531B 40	160 NEHP and over.....													
3531C 60	Skid steer loaders; 4-wheel drive, skid steer.	(D)	(D)	2,932	74,721	60,569	(NA)	(NA)	4,786	181,079	(NA)	(NA)	(NA)	(NA)
3531C 71, 72, 73, 74	Wheel loaders, rear engine mount, integral design; 4-wheel drive, non-skid steer.....	9,890	1,094,839	(NA)	421,321	341,523	(NA)	31	4,476	261,040	(NA)	1,014,356	(NA)	26
3531C 81	Crawler loaders (net engine horsepower): Under 90 NEHP.....	(D)	(D)	155	4,675	3,790	(NA)	(NA)	277	14,944	(NA)	(NA)	(NA)	(NA)
3531C 84	90 NEHP and over.....	(D)	(D)	34	2,731	2,214	(NA)	(NA)	877	91,179	(NA)	(NA)	(NA)	(NA)
3531E 03	Excavators, cable operated, crawler mounted...	3,955	631,451	1,194	198,288	160,732	30	25	5,947	437,659	8,708	908,378	68	48
3531E 05	Excavators, hydraulic operated, crawler mounted.....													
3531E 06	Excavators, hydraulic operated, wheel (rubber) mounted, all sizes.....													
3531E 19	Excavators, hydraulic operated, wheel (rubber) mounted, all sizes.....	547	74,123	55	3,539	2,869	10	4	538	38,442	1,030	109,696	52	35
3531E 20	Cranes, crawler mounted.....	5,847	637,204	1,786	96,637	78,334	31	12	5,343	54,733	9,404	613,603	57	9
3531E 26														
3531E 29														
3531E 41														
3531E 57														
3531E 37	Cranes, wheel mounted.....													
3531E 38														
3531E 51														
3531E 52														
3531E 53														
3531E 54														
3531E 65														
3531E 66														
3531E 82	Cranes, pedestal or shipmounted.....	85	18,857	(NA)	3,231	2,619	(NA)	14	117	9,990	(NA)	26,228	(NA)	38
3531E 86														
3531E 95	Dragline buckets, attachment.....	176	9,841	(NA)	1,352	1,096	(NA)	11	3,751	2,428	(NA)	11,173	(NA)	22
3531E 97	Climshell/grapple attachment.....	1,382	37,822	1,217	3,189	2,585	88	7	2,410	1,319	2,575	36,556	94	4

See footnotes at end of table.



Table 4B. SHIPMENTS, EXPORTS, AND IMPORTS OF CONSTRUCTION MACHINERY: 1990--Continued

(Quantity in units; value in thousands of dollars)

Product code	Product description	Manufacturers' shipments <sup>1</sup>		Export shipments <sup>1</sup>			Percent Exports to manufacturers' shipments		Imports for consumption <sup>1 4</sup>		Apparent <sup>5</sup> consumption		Percent imports to apparent consumption	
		Quantity	Value	Quantity	Value as reported <sup>2</sup>	Estimated producers' Value <sup>3</sup>	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
3531F 33, 34	Concrete pavers.....	451	56,539	(NA)	13,865	11,239	(NA)	20	1,645	2,339	(NA)	47,639	(NA)	5
3531F 66, 71, 75, 80	Bituminous pavers.....	1,513	104,698	(NA)	22,992	18,637	(NA)	18	645	5,424	(NA)	91,485	(NA)	6
3531F 60, 62, 64	Concrete pumps.....	958	77,548	(NA)	19,026	15,422	(NA)	20	4,022	19,805	(NA)	81,931	(NA)	24
3531G 01, 03, 05	Scraper bowls.....	1,885	181,556	75	4,118	3,338	4	2	74	1,216	1,884	179,434	4	1
3531G 11, 17	Motor graders and light maintainers.....	4,136	407,987	1,957	161,646	131,030	47	32	518	29,497	2,697	306,454	19	10
3531G 21, 23, 26, 29, 31, 33, 35	Self-propelled static compaction equipment.....	2,203	120,293	629	34,851	28,250	29	23	678	8,748	2,252	100,791	30	9
3531G 37, 39, 42, 45, 47, 49, 51, 53, 55, 57	Self-propelled vibratory compaction equipment..	(D)	(D)	1,176	30,915	25,060	(NA)	(NA)	5,370	83,653	(NA)	(NA)	(NA)	(NA)
3531G 41	Towed type rollers and compactors.....	(D)	(D)	17,174	22,717	18,414	(NA)	(NA)	1,994	5,036	(NA)	(NA)	(NA)	(NA)
3531G 71	Off-highway rear dump haulers.....	3,280	957,726	3,126	531,715	431,008	95	45	5,724	130,583	5,878	657,301	97	20
3531G 73	Off-highway integral self-powered side and bottom dumps, including coal haulers.....													
3531G 75, 77	All other off-highway truck-type tractor chassis.....													
3531H 01	Construction machinery for mounting: Sidebooms or pipehandlers.....	(D)	(D)	125	17,560	14,234	(NA)	(NA)	13	1,717	(NA)	(NA)	(NA)	(NA)
3531H 03	Dozers, for crawler and wheel tractors.....	2,925	13,929	1,966	16,615	13,468	67	97	11,339	21,861	12,298	22,322	92	98
3531H 05, 07	Winches (towing, logging, and oil-field types).....	53,147	75,477	(NA)	58,858	47,710	(NA)	63	404,077	30,997	(NA)	58,764	(NA)	53
3531H 09, 11	Backhoes.....	9,392	71,524	1,321	5,696	4,617	14	6	2,852	4,072	10,923	70,979	26	6
3531H 13	Front-end loaders.....	(D)	(D)	16,617	16,025	12,990	(NA)	(NA)	34,977	17,690	(NA)	(NA)	(NA)	(NA)
3531H 17	Rippers and rooters.....	(D)	(D)	209	1,337	1,084	(NA)	(NA)	899	1,562	(NA)	(NA)	(NA)	(NA)
3531K 14, 15, 16	Self-propelled continuous ditchers and trenchers (integral units): Ladder-type digging element.....	7,687	129,715	1,727	22,873	18,541	22	14	18	24	5,978	111,198	1	1
3531K 18	Wheel-type digging element.....													

(D) Data withheld to avoid disclosing figures for individual companies. (NA) Not available. NEHP = Net engine horsepower.

<sup>1</sup> For comparison of Standard Industrial Classification-based product codes, Schedule B export numbers, and HTSUSA import numbers, see table 6.<sup>2</sup> Source: Bureau of the Census report, EM 545, U.S. Exports.<sup>3</sup> Values were derived by the use of adjustment factors to exclude freight, insurance, and other charges incurred in moving goods to the port of export. This adjustment is made to convert the export value of the producers' value of exported goods. Current adjustment factors are based on data for 1989 which are published in Exports from Manufacturing Establishments, AR89-1.<sup>4</sup> For comparison factor for this report is 0.8106.<sup>5</sup> Source: Bureau of the Census report, IM 145, U.S. Imports for Consumption.<sup>6</sup> Apparent consumption is derived by subtracting exports from the total of shipments plus imports.

Table 5. COMPARISON OF STANDARD INDUSTRIAL CLASSIFICATION-BASED PRODUCT CODES WITH SCHEDULE B EXPORT NUMBERS, AND HTSUSA IMPORT NUMBERS: 1991

Product code	Product description	Export number <sup>1</sup>	Import number
3531A 13, 20, 22, 24	Contractors off-highway wheel tractors for use as towing unit.....	{ 8701.90.5015 8701.90.5020 8701.90.5025	{ 8701.90.5015 8701.90.5020 8701.90.5025
3531A 34	Rubber-tired dozers.....	8429.19.0010	8429.19.0010
3531A 37	Wheeled log skidders, self-propelled.....	8701.90.1001	8701.90.1001
	Crawler tractors (net engine horsepower):		
3531B 30, 36	Under 159 NEHP.....	{ 8701.30.0015 8701.30.0030	{ 8701.30.1015 8701.30.5015 8701.30.1030 8701.30.503Q
3531B 40	160 NEHP and over.....	{ 8701.30.0045 8701.30.0060 8701.30.0075	{ 8701.30.1045 8701.30.5045 8701.30.1060 8701.30.5060 8701.30.1075 8701.30.5075
3531C 60	Skid steer loaders; 4-wheel drive, skid steer.....	8429.51.1060	8429.51.1060
3531C 71, 72, 73, 74	Wheel loaders, rear engine mount, integral design; 4-wheel drive, non-skid steer.....	{ 8429.51.1015 8429.51.1025 8429.51.1030 8429.51.1035 8429.51.1040 8429.51.1045 8429.51.1050 8429.51.1055	{ 8429.51.1015 8429.51.1025 8429.51.1030 8429.51.1035 8429.51.1040 8429.51.1045 8429.51.1050 8429.51.1055
	Crawler loaders (net engine horsepower):		
3531C 81	Under 90 NEHP.....	{ 8429.51.5010 8429.51.5020	{ 8429.51.5010 8429.51.5020
3531C 84	90 NEHP and over.....	{ 8429.51.5030 8429.51.5040 8429.51.5050	{ 8429.51.5030 8429.51.5040 8429.51.5050
3531E 03	Excavators, cable operated, crawler mounted.....	8429.52.1020	8429.52.1020
3531E 05 3531E 06 3531E 07	Excavators, hydraulic operated, crawler mounted....	8429.52.1010	8429.52.1010
3531E 19	Excavators, hydraulic operated, wheel (rubber) mounted, all sizes.....	8429.52.1030	8429.52.1030
3531E 20 3531E 26 3531E 29 3531E 41 3531E 57	Cranes, crawler mounted.....	8426.99.0000	8426.99.0000
3531E 37 3531E 38 3531E 51 3531E 52 3531E 53 3531E 54 3531E 65 3531E 66 3531E 68	Cranes, wheel mounted.....	{ 8705.10.0010 8705.10.0050	{ 8705.10.0010 8705.10.0050
3531E 82 3531E 86	Cranes, pedestal or shipmounted.....	8426.30.0000	8426.30.0000
3531E 95	Dragline buckets, attachment.....	8431.41.0060	8431.41.0060
3531E 97	Clamshell/grapple attachment.....	8431.41.0040	8431.41.0040

See footnotes at end of table.

Table 5. COMPARISON OF STANDARD INDUSTRIAL CLASSIFICATION-BASED PRODUCT CODES WITH  
SCHEDULE B EXPORT NUMBERS, AND HTSUSA IMPORT NUMBERS: 1991--Continued

Product code	Product description	Export number <sup>1</sup>	Import number <sup>2</sup>
3531F 33, 34	Concrete pavers.....	8479.10.0040	8479.10.0040
3531F 66, 71, 75, 80	} Bituminous pavers.....	8479.10.0060	8479.10.0060
3531F 60, 62, 64	} Concrete pumps.....	8413.40.0000	8413.40.0000
3531G 01, 03, 05	} Scraper bowls.....	8430.62.0000	8430.62.0000
3531G 11, 17	Motor graders and light maintainers.....	8429.20.0000	8429.20.0000
3531G 21, 23, 26, 29, 31, 33, 35	} Self-propelled static compaction equipment.....	8429.40.0040	8429.40.0040
3531G 37, 39, 42, 45, 47, 49, 51, 53, 55, 57	} Self-propelled vibratory compaction equipment.....	8429.40.0020	8429.40.0020
3531G 91	Towed type rollers and compactors.....	8430.61.0000	8430.61.0000
3531G 71	Off-highway rear dump haulers.....	{ 8704.10.5020 8704.10.5030 8704.10.5040 8704.10.5050	{ 8704.10.5020 8704.10.5030 8704.10.5040 8704.10.5050
3531G 73	Off-highway integral self-powered side and bottom dumps, including coal haulers.....	8704.10.5060	8704.10.5060
3531G 75, 77	All other off-highway truck-type tractor chassis...	8704.10.1000	8704.10.1000
3531H 01	Construction machinery for mounting: Sidebooms or pipehandlers.....	8428.90.0030	8428.90.0030
3531H 03	Dozers, for crawler and wheel tractors.....	8431.42.0000	8431.42.0000
3531H 05, 07	Winches (towing, logging, and oil-field types)...	{ 8425.31.0000 8425.39.0000	{ 8425.31.0000 8425.39.0000
3531H 09, 11	Backhoes.....	8431.49.9005	8431.49.9005
3531H 13	Front-end loaders.....	8431.49.9010	8431.49.9010
3531H 17	Rippers and rooters.....	8431.49.9015	8431.49.9015
3531K 14, 15, 16	Self-propelled continuous ditchers and trenchers (integral units): } Ladder-type digging element.....	8429.59.5020	8429.59.5020
3531K 18	} Wheel-type digging element.....	8429.59.5040	8429.59.5040

<sup>1</sup> Source: 1991 edition, Harmonized System Based Schedule B, Statistical Classification of Domestic and Foreign Commodities Exported from the United States.

<sup>2</sup> Source: Harmonized Tariff Schedule of the United States, Annotated (1991).

## DESCRIPTION OF SURVEY

**Scope of Survey.** This survey covers firms engaged in the manufacture of selected types of construction machinery. Very small firms (Generally less than five employees) for which 1987 Census of Manufactures data were derived from Administrative records of other government agencies are excluded.

**Survey Methodology.** The statistics in this publication were collected by mail on Bureau of the Census annual Form MA35D, Construction Machinery. The survey panel includes all known producers of the types of construction machinery covered on the survey, except the very small firms excluded from the scope of the survey. Approximately 270 companies are included. No estimate is derived for the small firms excluded from the survey.

**Reliability of Data.** Survey error may result from several sources: (1) inability to obtain information about all cases in the survey; (2) response errors; (3) definitional difficulties; (4) differences in the interpretation of questions; (5) mistakes in recording or coding the data obtained; and (6) other errors of collection, response, coverage, and estimation for missing data. These nonsampling errors also occur in complete censuses. Although no direct measurement of the biases due to nonsampling errors has been obtained, precautionary steps were taken in all phases of the collection, processing, and tabulation of the data in an effort to minimize their influence.

A major source of bias in the published estimates is due to imputing data for nonrespondents, for late reporters, and for data which fail logic edits. Missing figures are imputed based on yearly movements shown by reporting firms. Imputation generally is limited to a maximum of 10 percent for any one data cell. Figures with imputation rates greater than 10 percent are footnoted.

The imputation rate is not an explicit indicator of the potential error in published figures due to nonresponse, because the actual yearly movements for nonrespondents may or may not closely agree with the imputed movements. The range of difference between the actual and imputed figures is not precisely known, but is assumed to be small. The degree of uncertainty regarding the accuracy of the published data increases as the percentage of imputation increases. Figures with imputation rates above 10 percent should be used with caution.

**Revisions to Previous Period Data.** Statistics for previous years may be revised as the result of corrected data from respondents, late reports for which imputations were made as described above, or other corrections. Figures which have been revised by more than 5 percent from previously published figures are indicated by footnotes.

Revisions include changes to prior period data resulting from reconciliation of the results of these surveys with the 1987 Census of Manufactures to correct differences in reported data between the two series and to identify and verify new establishments included in the scope of this survey. Table 3 presents a comparison of data from the two series by census product class following the reconciliation.

**Adjustment for Price Change.** All dollar figures included in this publication are in current dollars; i.e., they have not been adjusted for price change.

## EXPLANATION OF TERMS

**Quantity and Value of Shipments.** The figures on quantity and value of shipments represent physical shipments of all products sold, transferred to other establishments of the same company, or shipped on consignment whether for domestic or export sale. The value represents the net sales price, f.o.b. plant, to the customer or branch to which the products are shipped, net of discounts, allowances, freight charges, and returns. Shipments to a company's own branches are assigned the same value as comparable sales to unaffiliated customers; i.e., the value includes an appropriate allocation of company overhead and profit. Products bought and resold without further manufacture are excluded.

**Wheel Tractors, Contractors' Off-Highway Type.** Wheel tractors designed primarily to be used as towing units for scrapers, trailers, wagons, and similar types of towed equipment for use on natural terrain. These units may be 2- or 4-wheel type.

**Tractor Shovel Loaders—Wheel Type, Front-End Load (Integral Design, Rear Engine Mount).** Complete machines originally conceived and designed as heavy duty, wheel type, front-end loaders, and not as wheel tractors, to receive shovel loading attachments.

**Off-Highway Vehicles.** Vehicles designed for operation off public highways to transport material or equipment on mining, construction, logging, petroleum development, and similar project sites.

**Excavator.** A commercial earth-moving machine equipped with a bucket-mounted front-end attachment mounted on a 360-degree revolving superstructure.

**Crane.** A machine having a front-end lifting attachment and operating machinery mounted on a revolving superstructure.

**Cable Operated.** A machine with front-end attachment functions performed by wire rope.

**Hydraulic Excavator.** A machine with front-end attachment functions performed hydraulically.

**Crawler Mounted.** A machine with two parallel continuous crawlers or tread belts.

**Truck Mounted (Rubber).** A machine which generally has two engines, one to propel the carrier and another to power the work functions. A truck- or carrier-mounted machine will have two operator stations and is designed for on- and off-highway travel.

**Self-Propelled (Rubber).** A machine which has only one engine and one operator station. The engine may be mounted in either the upper or lower works.

**Net Engine Horsepower (NEHP).** Net flywheel performance as measured by manufacturer, with all standard accessories installed, operated, and corrected to 29.38 inches mercury (Hg) and temperature of 85 degrees Fahrenheit.

Tractors with torque converter transmission should be included in the same horsepower group as the comparable model tractor equipped with direct drive transmission. Where there is no comparable direct drive model tractor, include such tractors at 80 percent of net horsepower at the flywheel.

**Hydraulic Crane.** A machine with 360-degree rotation on which the boom is designed primarily for lifting the load by wire rope, and which can be extended, retracted, raised, and lowered hydraulically.

**Integrated Hydraulic Truck Mounted Crane.** A telescopic truck mounted (rubber) crane mounted on a purpose-designed crane carrier chassis.

**Pinned on Telescopic Crane.** A hydraulically-powered multipurpose rotating crane with fixed or telescoping booms designed to lift and place materials by winch and load line and which is mounted onto a commercially available vehicle having a platform or body.

**Pinned on Articulated Crane.** A stationary or vehicle mounted hydraulically powered multipurpose knuckle boom crane consisting of an inner and outer boom that can fold to a stowable position. Excluded are those machines commonly known as knuckle boom loaders.

**Unmounted Cranes.** These cranes are classified under "Construction machinery for mounting."

## ABBREVIATIONS AND METRIC EQUIVALENTS

hp	horsepower = .7457 kilowatts (kW)
cu. yd.	cubic yard = .7646 cubic meters (cu. m.)
kg	kilogram = 2.205 pounds (lbs)
ft	feet = .305 meters (m)
s.t.	short ton = .907 metric tons
NEHP	net engine horsepower
t.p.h.	tons per hour
lbs	pounds

## COMPARISON OF EXPORT, IMPORT, AND DOMESTIC OUTPUT DATA

The trade comparisons shown in this report should be considered only as approximations. Several problems prevent precise comparisons among imports, exports, and domestic output. These problems include the following:

- Export and import comparisons do not account for the origin of materials used to manufacture the finished product. Domestic output includes any goods that undergo substantial transformation into a finished product in the U.S., even if the goods are partially constructed abroad or are constructed of imported materials.
- There will be a lag between the time a producer makes or ships a product and the time it is actually exported. Similarly, there may be a lag between the time a product is imported and when it enters into U.S. distribution channels.
- The basic structures of these classification systems differ. The Standard Industrial Classification (SIC) system used for domestic output was developed independently of the Harmonized System (HS) used to classify imports and exports. The level of detail provided by the different systems varies substantially, reflecting their different objectives. For example, there are a number of imported commodities that have no comparable domestic output classification.
- Because producers' shipments of some commodities may be used as materials for incorporation into other commodities, combinations of domestic output data for such commodities may contain some duplication.
- Import and export data reflect the movement of merchandise into and out of U.S. foreign trade zones, the U.S. Virgin Islands, and the U.S. customs territory of the 50 States, the District of Columbia, and Puerto Rico. Domestic output reflects activity in the 50 States and, only if specified, in Puerto Rico.
- Import and export data generally do not distinguish between new, used or rebuilt commodities.

- The valuations of the three data sets differ. Domestic output is valued at the point of production. It includes the net sales price, f.o.b. plant, after discounts and allowances, and excludes freight charges and excise taxes. Exports are valued at the point of exportation. Export value includes the net sales price or value, and inland freight, insurance and other charges to the export point. Imports are valued at the first port of entry in the United States. They include the cost, insurance, freight, duty, and other charges to the import point.
- Detailed commodity information is not included for individual export or import shipments at or below a certain dollar limit. This dollar limit is \$2,500 for exports and \$1,250 for imports, except for import of textiles and textile products, gloves, footwear, and miscellaneous rubber and plastics products, where the limit is \$250.

## HISTORICAL NOTE

Data on construction machinery have been collected by the Bureau of the Census since 1942. Historical data may be obtained from Current Industrial Reports (called Facts for Industry before 1959) available at your local Federal Depository Library. A list of these libraries may be obtained from the Bureau of the Census regional offices:

Office	Telephone
Atlanta, Georgia	404-730-3833
Boston, Massachusetts	617-565-7100
Charlotte, North Carolina	704-344-6142
Chicago, Illinois	312-353-6251
Dallas, Texas	214-767-0621
Denver, Colorado	303-969-6750
Detroit, Michigan	313-354-4654
Kansas City, Kansas	913-236-3728
Van Nuys, California	818-904-6336
New York, New York	212-264-4730
Philadelphia, Pennsylvania	215-597-8313
Seattle, Washington	206-728-5314

Historical data are also available on microfiche. For further information contact the Bureau of the Census, Data User Services Division, 301-763-4100.

## RELATED REPORTS

The Bureau of the Census also publishes the following related reports:

Series	Frequency	Title
<i>Current Industrial Reports</i>		
M37L	Monthly	<i>Truck Trailers</i>

Series	Frequency	Title
MA35A	Annually	<i>Farm Machinery and Land and Garden Equipment</i>
MA35F	Annually	<i>Mining Machinery</i>
MA35L	Annually	<i>Internal Combustion Engines</i>
MA35P	Annually	<i>Pumps and Compressors</i>

## Other Industry Reports

M3-1	Monthly	<i>Manufacturers' Shipments, Inventories, and Orders</i>
(AS)	Annually	<i>Annual Survey of Manufacturers (ASM)</i>
(MC)	Quinquennially	<i>Census of Manufactures</i>

## Foreign Trade Reports

CD-ROM	Monthly/Annually	<i>U.S. Exports—Schedule B—Commodity by Country</i>
FT 447	Annually	
CD-ROM	Monthly/Annually	<i>U.S. Imports for Consumption—HTSUSA—Commodity by Country</i>
FT 247	Annually	

## CONTACTS FOR DATA USERS

Subject Area	Contact	Phone Number
Current Industrial Report MA35D	Donald Burgess	301-763-7492
Classification Systems Comparability	Francis McCormick (ESD)	301-763-1935
Foreign Trade	Trade Data Inquiries Staff (FTD)	301-763-5140
Census/ASM	Tom Lee	301-763-5752
International Trade Administration	Leonard Heimowitz	202-377-0558
To order a Current Industrial Report	Superintendent of Documents (GPO)	202-783-3238
To subscribe to a Census Bureau publication	Superintendent of Documents (GPO)	202-512-2303

## ACKNOWLEDGMENTS

This report was prepared in the Industry Division Bureau of the Census, under the direction of Thomas Flood, Chief, Current Durables Branch, and Thomas Thomas, Chief, Machinery and Equipment Section. Donald Burgess was directly responsible for the review of the data and preparation of the report. Robert H. Bugenhagen, Acting Chief of the Division, and Robert Tinari, Assistant Chief for Current Industrial Reports, provided overall direction and coordination to the project.

# Statistical Briefs....Fast Data for Those in a Hurry!

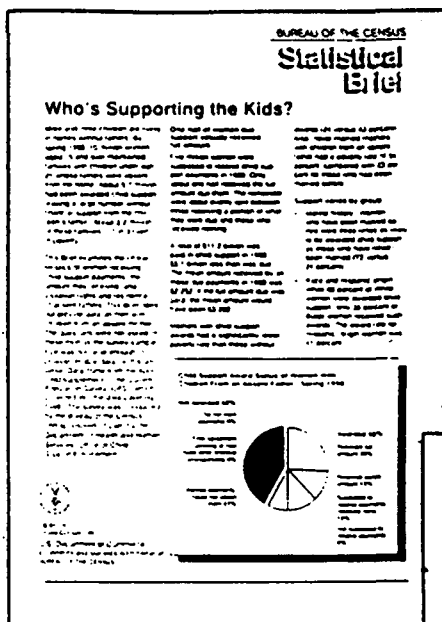
Need Census Bureau data quickly? Don't have time to wade through long reports to get the data you need? *Statistical Briefs* are the answer!

*Statistical Briefs* are short, usually only 2 pages. They're easy to read too. And each has colorful graphs.

*Briefs* present the latest demographic, economic, and housing data from the Census Bureau's many survey and census programs. Any data user will find them useful!

*Briefs* are now available covering a multitude of topics, including children, education, housing, computer use, pension coverage, voter turnout, defense industries, consumer spending, and many, many more!

Briefs can also be used as scripts for slide shows on various trends. You can order these slides from the Census Bureau.


☐

Yes, please send me information on Statistical Briefs and a listing of all available Briefs. Tell me too about Census Bureau slide programs.

Name

Additional address / attention line

Street address

City, State, and ZIP Code

Mail to: Customer Services, Bureau of the Census, Data User Services Division, Washington, DC 20233



U.S. Department of Commerce  
Economics and Statistics Administration  
BUREAU OF THE CENSUS

# Farm Machinery and Lawn and Garden Equipment

1991

MA35A(91)-1  
Issued February 1993

## SUMMARY OF FINDINGS

During 1991, factory shipments of farm machinery and equipment, including parts and attachments produced by original equipment manufacturers (OEM), totaled \$7,708.6 million, a decrease of 12 percent from 1990 shipments of \$8,809.2 million. The 1991 total included planting, seeding, and fertilizing machinery, \$604.6 million, a decrease of 11 percent from the 1990 level of shipments; harrows, rollers, pulverizers and stalk cutters, \$327.3 million, a decrease of 18 percent from 1990; plows and listers, \$119.8 million, a decrease of 12 percent; harvesting machinery, \$2,158.0 million, a decrease of 6 percent; haying machinery, \$658.9 million, a decrease of 25 percent; farm dairy machines, sprayers and dusters, farm elevators, and farm blowers, \$450.8 million, a decrease of 13 percent; and all other farm machinery and equipment (including farm tractors), \$3,389.2 million, a decrease of 13 percent.

The dollar value of factory shipments of commercial turf and ground equipment, including parts, was \$716.6 million in 1991, an increase of 1 percent from 1990 shipments of \$707.9 million. The 1991 total included commercial turf and grounds mowing equipment, \$558.1 million, a decrease of 2 percent; and other commercial turf and grounds care equipment, \$158.4 million, an increase of 13 percent.

The dollar value of factory shipments of consumer lawn, garden, and snow equipment, including parts, was \$4,109.9 million in 1991, virtually unchanged from 1990 shipments of \$4,101.8 million. The 1991 total included consumer nonriding lawn, garden, and snow equipment and parts, \$2,030.5 million, an increase of 3 percent; and consumer riding lawn, garden, and snow equipment and parts, \$2,079.4 million, a decrease of 2 percent.

A description of the survey methodology and related information appears on page 14.

Table 1. VALUE OF SHIPMENTS OF FARM MACHINERY AND LAWN AND GARDEN EQUIPMENT, BY TYPE OF MACHINERY OR EQUIPMENT: 1982 TO 1991

(Millions of current dollars)

Product description <sup>1</sup>	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982
Wheel tractors, farm type.....	(D)	(D)	(D)	(D)	958.6	893.4	1,443.2	2,045.3	1,720.7	2,215.5
Farm dairy machines, sprayers and dusters, farm elevators and farm blowers.....	450.8	516.0	478.2	434.8	364.7	371.7	403.6	428.2	417.2	441.0
Planting, seeding, and fertilizing machinery.....	604.6	676.2	638.2	508.6	409.1	371.2	453.3	601.1	447.5	673.1
Harvesting machinery.....	2,158.0	2,302.5	1,858.8	1,422.8	1,282.3	1,230.1	1,190.8	1,424.6	1,478.8	2,069.6
Haying machinery.....	658.9	875.1	731.1	574.6	433.7	383.4	498.1	611.6	541.9	575.1
Plows and listers.....	119.8	136.0	130.8	117.7	74.6	75.3	111.0	152.5	129.7	151.9
Harrows, rollers, pulverizers, and similar equipment.....	157.3	212.4	207.8	136.9	99.9	99.2	166.0	369.7	341.0	300.3
All other farm machinery and equipment <sup>2</sup> .....	3,559.2	4,091.1	3,586.6	3,002.8	1,186.5	933.1	1,051.9	1,204.3	1,135.9	1,170.5
Commercial turf and grounds mowing and care equipment.....	716.6	707.9	633.9	595.0	514.6	412.8	376.7	333.8	263.2	257.4
Consumer lawn, garden, and snow equipment.....	4,109.9	4,101.8	3,708.5	3,937.0	3,979.9	3,385.8	3,155.1	2,978.1	2,475.4	2,111.1

(D) Data withheld to avoid disclosing figures of individual companies.

<sup>2</sup> Revised by 5 percent or more from previously published figures.

<sup>1</sup> Each type of farm machinery includes parts and attachments.

<sup>2</sup> Includes irrigation systems, and for years 1988 through 1991 wheel tractors, farm type.

Address inquiries concerning these figures to U.S. Department of Commerce, Bureau of the Census, Industry Division, Washington, D.C. 20533, or call Donald Burgess, 301-763-7492.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.



Table 2. VALUE OF MANUFACTURERS' SHIPMENTS OF FARM MACHINERY AND LAWN AND GARDEN EQUIPMENT, BY PRODUCT GROUP: 1987 TO 1991

(Thousands of dollars)

Product group and year	Total	Complete units	Attachments and parts	Product group and year	Total	Complete units	
<b>Total:</b>				<b>Stalk shredders and cutters or rotary mowers:</b>			
1991.....	12,535,087	(NA)	(NA)	1991.....	170,002	134,439	35,563
1990.....	13,618,986	(NA)	(NA)	1990.....	188,769	151,326	37,443
1989.....	11,973,918	9,939,340	2,034,578	1989.....	194,099	160,158	33,941
1988.....	10,730,213	8,580,321	2,149,892	1988.....	197,576	168,998	28,578
1987.....	9,303,973	7,341,148	1,962,825	1987.....	161,462	131,557	29,905
<b>Total farm machinery:</b>				<b>Machines for preparing crops for market or for use:</b>			
1991.....	8,425,140	(NA)	(NA)	1991.....	204,602	173,147	31,455
1990.....	9,517,158	(NA)	(NA)	1990.....	230,809	197,510	33,299
1989.....	8,265,407	6,764,779	1,500,628	1989.....	207,521	176,942	30,579
1988.....	6,793,254	5,297,325	1,495,929	1988.....	193,275	161,817	31,458
1987.....	5,324,024	4,037,691	1,286,333	1987.....	208,189	169,454	38,735
<b>Wheel tractors, farm type:</b>				<b>Farm poultry equipment:</b>			
1991.....	(1)	(1)	213,206	1991.....	193,380	156,550	36,830
1990.....	(1)	(1)	257,994	1990.....	197,124	163,547	33,577
1989.....	(1)	(1)	201,815	1989.....	161,832	129,412	32,420
1988.....	(1)	(1)	227,860	1988.....	144,149	116,670	27,479
1987.....	958,597	742,454	216,143	1987.....	116,763	90,252	26,511
<b>Farm dairy machines and equipment:</b>				<b>Hog equipment:</b>			
1991.....	89,832	(D)	(D)	1991.....	82,542	73,868	8,674
1990.....	110,563	(D)	(D)	1990.....	78,788	68,705	10,083
1989.....	111,489	43,105	68,384	1989.....	68,131	57,274	10,857
1988.....	95,492	36,963	58,529	1988.....	75,717	66,753	8,964
1987.....	76,584	30,263	46,321	1987.....	66,415	57,706	8,709
<b>Sprayers and dusters:</b>				<b>Other barn and barnyard equipment:</b>			
1991.....	299,213	231,831	67,382	1991.....	190,880	155,440	35,440
1990.....	335,132	258,533	76,599	1990.....	204,062	164,775	39,287
1989.....	304,311	229,610	74,701	1989.....	181,914	146,130	35,784
1988.....	274,994	195,548	79,446	1988.....	214,133	179,241	34,892
1987.....	214,484	153,196	61,288	1987.....	164,142	131,329	32,813
<b>Farm elevators and blowers:</b>				<b>Farm wagons and other farm transportation equipment:</b>			
1991.....	61,764	47,837	13,927	1991.....	2,200,836	1,933,322	264,514
1990.....	70,314	57,946	12,368	1990.....	2,603,246	2,303,790	299,456
1989.....	62,397	48,214	14,183	1989.....	2,189,999	1,948,580	241,419
1988.....	64,342	49,499	14,843	1988.....	1,725,202	1,462,301	262,901
1987.....	73,648	61,901	11,747	1987.....	2,149,217	1,828,415	320,802
<b>Planting, seeding, and fertilizing machinery:</b>				<b>Irrigation systems:</b>			
1991.....	604,600	457,248	147,352	1991.....	350,421	274,518	75,903
1990.....	676,159	526,360	149,799	1990.....	363,343	282,764	80,579
1989.....	638,248	497,347	140,901	1989.....	381,951	318,640	63,311
1988.....	508,566	372,356	136,210	1988.....	298,307	247,839	50,468
1987.....	409,082	299,468	109,614	1987.....	215,689	177,925	37,764
<b>Harvesting machinery:</b>				<b>Commercial turf and grounds mowing equipment:</b>			
1991.....	2,157,966	1,764,271	393,695	1991.....	558,116	427,725	130,391
1990.....	2,302,510	1,899,462	403,048	1990.....	568,098	444,199	123,899
1989.....	1,858,777	1,518,259	340,518	1989.....	494,313	390,769	103,544
1988.....	1,422,751	1,057,910	364,841	1988.....	473,509	362,319	111,190
1987.....	1,282,315	960,326	321,989	1987.....	416,240	331,115	85,125
<b>Haying machinery:</b>				<b>Other commercial turf and grounds care equipment:</b>			
1991.....	658,905	(D)	(D)	1991.....	158,441	129,386	29,055
1990.....	875,104	697,321	177,783	1990.....	139,842	114,789	25,053
1989.....	731,077	581,999	149,078	1989.....	139,598	116,395	23,203
1988.....	574,587	437,643	136,944	1988.....	121,535	99,313	22,222
1987.....	433,671	309,861	123,810	1987.....	98,346	80,961	17,385
<b>Plows:</b>				<b>Total lawn and garden equipment:</b>			
1991.....	119,781	83,652	36,129	1991.....	4,109,947	3,491,976	617,971
1990.....	135,972	106,296	29,676	1990.....	4,101,828	3,520,595	581,233
1989.....	130,754	94,847	35,907	1989.....	3,708,511	3,174,566	533,945
1988.....	117,725	81,025	36,700	1988.....	3,936,959	3,242,496	694,463
1987.....	74,643	52,406	22,237	1987.....	3,979,949	3,303,457	676,492
<b>Harrows, rollers, pulverizers, and similar equipment:</b>				<b>Consumer nonriding lawn, garden, and snow equipment:</b>			
1991.....	157,274	129,796	27,478	1991.....	2,030,503	1,411,111	619,392
1990.....	212,376	184,720	27,656	1990.....	1,974,982	1,278,817	696,165
1989.....	207,834	181,146	26,688	1989.....	1,843,847	1,270,729	573,118
1988.....	136,923	112,960	23,963	1988.....	1,993,863	1,277,111	716,752
1987.....	99,918	75,334	24,584	1987.....	1,911,663	1,216,111	695,552
<b>Cultivators and weedeers:</b>				<b>Consumer riding lawn, garden, and snow equipment:</b>			
1991.....	166,545	91,270	75,275	1991.....	2,079,443	1,278,817	800,626
1990.....	224,947	133,252	91,695	1990.....	2,126,846	1,278,817	848,029
1989.....	201,162	125,952	75,210	1989.....	1,864,664	1,278,817	585,847
1988.....	154,471	88,150	66,321	1988.....	1,943,096	1,278,817	664,279
1987.....	104,619	53,768	50,851	1987.....	2,068,286	1,278,817	789,469

(D) Data withheld to avoid disclosing figures for individual companies. (NA) Not available. Revised by 5 percent or more from previous figures.

<sup>1</sup> Wheel tractors, farm type, are included with farm wagons and other farm transportation equipment to avoid disclosing figures of individual companies.

<sup>2</sup> Includes operator cabs in the attachments and parts for this item.

Table 3. MANUFACTURERS' SHIPMENTS OF FARM MACHINERY AND LAWN AND GARDEN EQUIPMENT, BY TYPE: 1991 AND 1990

(Quantity in units; value in thousands of dollars)

Product code	Product description	Number of companies	1991		1990	
			Quantity	Value	Quantity	Value
35231 --	Wheel tractors, farm type (except contractors' off-highway wheel tractors, garden tractors, turf tractors, and motor tillers) and attachments.....	14	(X)	(1)	(X)	(1)
	Wheel tractors, farm type (power take off hp).....	(NA)	(D)	(D)	(D)	(D)
	2-wheel drive (including front wheel assist types).....	6	(D)	(D)	(D)	(D)
35231 10	Under 100 PTO hp (under 75 PTO kW).....	5	(D)	(D)	(D)	(D)
35231 12	100-159 PTO hp (75-119 PTO kW).....	3	(D)	(D)	(D)	(D)
35231 14	160 PTO hp and over (120 PTO kW and over).....	3	(D)	(D)	(D)	(D)
35231 30	4-wheel drive (including tractors with equal size tires, front and rear).....	4	(D)	(D)	(D)	(D)
35231 87	Attachments for wheel tractors, farm type.....	8	(X)	5,611	(X)	10,747
35239 26	Parts for wheel tractors, farm type.....	13	(X)	207,595	(X)	247,247
35232 --	Farm dairy machines, sprayers, dusters, elevators, and farm blowers.....	(NA)	(X)	361,815	(X)	418,559
35232 pt.	Farm dairy machines and equipment.....	15	(X)	69,450	(X)	88,232
	Mechanical installations:					
35232 03	Vacuum pumping outfits for milking machines with or without motors and/or reserve tanks.....	6	(D)	(D)	5,917	8,372
35232 04	Milking machines, complete, suspended and floor type bucket, single and double units.....	3	310	<sup>a</sup> 48	(D)	(D)
35232 08	Pipeline milking units, complete, including claws, shells, inflations, air tubes, with or without pulsator.....	7	25,618	<sup>a</sup> 14,721	36,666	<sup>a</sup> 19,620
35232 11	Cream separators.....	-	-	-	-	-
35232 12	Other farm dairy machines and equipment.....	10	<sup>a</sup> 19,766	<sup>a</sup> 14,768	<sup>a</sup> 22,565	17,609
35232 16	Attachments for farm dairy machines and equipment.....	7	(X)	(D)	(X)	(D)
35239 30	Parts for farm dairy machines and equipment, replacement units only.....	9	(X)	20,382	(X)	22,331
35232 pt.	Sprayers and dusters.....	71	(X)	<sup>a</sup> 240,709	(X)	270,228
	Power sprayers, field and row crop types only:					
35232 19	Self-propelled.....	13	<sup>a</sup> 2,099	<sup>a</sup> 98,982	2,781	129,477
35232 30	Tractor mounted.....	29	<sup>a</sup> 9,075	<sup>a</sup> 12,163	11,144	13,718
	Other than tractor mounted:					
	Piston pump type:					
35232 40	Power take-off driven.....	10	<sup>a</sup> 439	<sup>a</sup> 1,972	<sup>r</sup> 1,224	<sup>r</sup> 4,153
35232 44	Engine driven.....	4	(D)	(D)	(D)	(D)
35232 45	Nonpiston pump type.....	13	<sup>b</sup> 1,931	<sup>b</sup> 4,962	1,783	<sup>a</sup> 3,646
35232 46	Other power sprayers, over 4 g.p.m.....	7	(D)	(D)	(D)	(D)
	Power sprayers, other than row crop and field types, over 4 g.p.m.:					
35232 47	Power take-off driven.....	12	1,394	4,064	2,225	4,683
35232 49	Engine driven.....	16	2,995	6,195	3,816	6,215
35232 50	Air carried type power sprayers (field, row crop, and orchard types).....	9	<sup>a</sup> 1,943	<sup>a</sup> 7,169	<sup>r</sup> 1,766	<sup>r</sup> 6,630
35232 51	Foggers and mist sprayers portable.....	8	<sup>b</sup> 27,905	<sup>b</sup> 9,435	<sup>r</sup> 26,654	<sup>r</sup> 8,343
35232 58	Hand pulled and garden type 4 g.p.m. and under.....	15	<sup>b</sup> 22,701	<sup>b</sup> 6,442	25,253	8,001
	Sprayers, agricultural hand:					
35232 59	Under 1 gallon.....	4	523,517	2,808	<sup>r</sup> 535,398	<sup>r</sup> 2,284
	1 gallon and over:					
35232 61	Compressed air or gas.....	5	4,166,804	60,709	3,871,680	56,950
35232 62	Other, including knapsack, hose end and flame sprayers and sprayer pumps.....	9	3,807,901	6,063	1,182,536	4,179
35232 67	Dusters, power, hand, all types.....	7	95,281	971	86,717	786
35232 68	All other sprayers.....	12	(X)	3,384	(X)	3,152
35232 69	Attachments for sprayers and dusters.....	18	(X)	8,878	(X)	11,699
35239 35	Parts for sprayers and dusters, replacement units only.....	42	(X)	58,504	(X)	64,906

See footnotes at end of table.

Table 3. MANUFACTURERS' SHIPMENTS OF FARM MACHINERY AND LAWN AND GARDEN EQUIPMENT, BY TYPE: 1991 AND 1990--Continued

(Quantity in units; value in thousands of dollars)

Product code	Product description	Number of companies	1991		1990	
			Quantity	Value	Quantity	Value
35232 pt.	Farm elevators and blowers.....	44	(X)	51,656	(X)	60,099
	Farm elevators, portable:					
35232 70	Single and double chain.....	15	2,934	4,870	3,415	6,999
35232 72	Auger type.....	15	15,722	20,675	21,180	24,962
35232 73	Other farm portable and stationary augers and elevators.....	16	6,687	14,570	7,585	17,396
35232 74	Other farm blowers, including forage blowers, combination grain and forage blowers.....	9	2,668	7,722	2,867	8,589
35232 75	Attachments for farm elevators and blowers.....	11	(X)	3,819	(X)	2,153
35239 40	Parts for farm elevators and for grain and forage blowers, replacement units only.....	25	(X)	10,108	(X)	10,215
35233 --	Planting, seeding, and fertilizing machinery.....	126	(X)	495,120	(X)	568,837
	Corn planters, corn and cotton planters, and lister planters:					
35233 20	Pull type.....	8	45,129	132,954	58,408	169,298
35233 22	Mounted planters (total rows mounted).....	5				
35233 24	Grain drills (fixed frame) all types.....	10	10,473	106,712	13,000	121,643
35233 40	Transplanters (pull type or mounted) and broadcast seeders (end-gate, mounted and drawn).....	11	40,878	8,518	41,528	8,098
	Fertilizer distributors, pull type or mounted:					
35233 50	Dry, including lime spreaders.....	31	5,586	26,878	5,854	28,271
35233 58	Liquid.....	9	3,812	13,622	3,859	12,416
35233 59	Anhydrous ammonia.....	6				
35233 61	Manure spreaders, rear discharge.....	18	6,613	31,349	9,576	44,303
35233 65	Manure spreaders, side discharge.....	9	2,949	19,089	3,402	19,747
35233 69	Manure pumps, liquid.....	11	4898	43,315	7687	72,946
35233 73	Front and rear tractor mounted loaders (farm type), manure and general utility (except beet and sugar cane loaders).....	15	<sup>a</sup> 15,343	<sup>a</sup> 39,111	18,445	44,961
35233 77	Row crop unit planters (quantity in rows).....	10	<sup>a</sup> 24,903	<sup>a</sup> 15,511	<sup>a</sup> 29,503	<sup>b</sup> 14,696
35233 79	Other planting, seeding, and fertilizing machinery.....	33	366,837	60,189	283,604	59,981
35233 84	Attachments for planting, seeding, and fertilizing machinery.....	28	(X)	37,872	(X)	42,477
35239 71	Parts for planting, seeding, and fertilizing machinery, replacement units, only.....	79	(X)	109,480	(X)	107,320
35235 --	Harvesting machinery.....	67	(X)	1,834,072	(X)	1,990,059
35235 11	Combines (harvester-threshers), grain types only (self-propelled and pull type).....	8	11,555	1,064,358	14,629	1,216,893
35235 21	Small grain header for combines, all sizes.....	6	11,701	111,583	18,168	162,473
35235 31	Corn heads, all sizes.....	6	5,268	87,658	6,405	100,244
35235 41	Other grain type combines.....	9	<sup>a</sup> 1,865	<sup>a</sup> 31,267	1,932	30,833
	Field forage harvesters:					
35235 63	Shear bar, self-propelled type and pull type (basic machines)....	6	3,192	93,114	4,631	103,764
	Attachments for shear bar type forage harvester:					
35235 64	Pickup hay unit and cutter bar hay unit.....	7	(X)	4,128	(X)	(D)
35235 65	Row crop unit, all sizes.....	5	(X)	(D)	(X)	(D)
35235 70	Flail type (horizontal knives or vertical free-swinging knives or hammers), including discharge spouts.....	4	612	3,352	784	4,189
35235 78	Cotton strippers and pickers (all types).....	3	(D)	(D)	(D)	(D)
35235 79	Other harvesting machinery, including potato diggers, cane harvesting equipment, picker-shellers, and field shelling attachments for corn pickers.....	40	5,905	109,000	5,511	87,761
35235 83	Attachments for harvesting machinery (including platform and seeder, reel, straw spreaders, load levelers, weed stripper, grate unit, knife grinders, and stalk walkers).....	25	(X)	69,801	(X)	90,597
35239 50	Parts for harvesting machinery, replacement units only.....	49	(X)	323,894	(X)	312,451
35236 --	Haying machinery.....	39	(X)	535,455	(X)	727,719
35236 13	Mowers, cutter bar type.....	5	5,708	17,530	9,815	29,348
35236 23	Mower-conditioners and windrowers with conditioner auger and draper type (pull type and self-propelled).....	6	15,468	166,046	19,491	217,380
35236 31	Rakes, side delivery, cylinder type and finger wheel type.....	11	8,738	27,326	12,251	32,485
35236 55	Hay balers, hat stackers, hay bale loaders (field type), bale throwing attachments.....	14	25,336	293,502	40,934	404,145
35236 82	Other haying machinery.....	20	24,205	31,051	21,925	13,963
35236 83	Other attachments for haying machinery (stripper, bale chute, and knife attachments).....	9	(X)			
35239 55	Parts for haying machinery, replacement units only.....	25	(X)	123,450	(X)	127,345

See footnotes at end of table.

Table 3. MANUFACTURERS' SHIPMENTS OF FARM MACHINERY AND LAWN AND GARDEN EQUIPMENT, BY TYPE: 1991 AND 1990--Continued

(Quantity in units; value in thousands of dollars)

Product code	Product description	Number of companies	1991		1990	
			Quantity	Value	Quantity	Value
3523C --	Plows, harrows, rollers, pulverizers, cultivators, and weeders.....	(NA)	(X)	353,461	(X)	485,961
3523C pt.	Plows (primary tillage equipment).....	65	(X)	93,802	(X)	115,718
3523C 02	Moldboard plows (pull, mounted, semi-mounted, 1-way and 2-way).....	9	1,382	5,038	2,665	10,844
3523C 15	Subsoilers, deep tillage.....	26	1,999	8,787	2,516	10,433
3523C 17	Terracing and ditching plows.....	10	283	432	391	655
	Chisel plows, deep tillage (chisel or sweep type):					
3523C 19	Pull type.....	14	1,326	12,410	2,278	24,902
3523C 21	Mounted.....	13	2,087	15,040	1,947	13,207
3523C 23	Disc-chisel combination.....	9	3,021	30,470	3,573	33,981
3523C 25	Other plows, except snow plows.....	5				
3523C 27	Middlebusters and disc bedders.....	11	2,114	2,235	2,331	2,823
3523C 29	Attachments for plows (coulters, jointers, root cutters, subsoilers, fertilizer distributors, etc.), excluding lister planting attachments.....	24	(X)	10,150	(X)	9,422
3523C 31	Plowshares (quantity in thousands of pounds).....	9	(X)	89,240	(X)	9,451
35239 60	Parts for plows except plowshares, replacement units only.....	25	(X)	25,979	(X)	20,254
3523C pt.	Harrows, rollers, pulverizers and similar equipment (secondary tillage).....	84	(X)	135,033	(X)	191,384
3523C 41	Spike-tooth harrow sections and spring-tooth and tine-tooth harrow sections.....	26	20,435	7,188	27,340	9,822
3523C 43	Power harrows.....	-	-	-	-	-
3523C 44	Disc harrows (single, tandem and offset).....	26	11,367	56,381	15,339	76,487
3523C 53	Combination tillage equipment, roller/harrows, disc or coulters/field cultivators, disc or coulters/spring tooth.....	28	6,022	41,485	7,754	64,036
3523C 54	Blade terracers or scrapers, farm size.....	32	25,556	9,329	29,714	12,277
3523C 59	Land levelers.....	10	1,087	1,400	1,336	1,113
3523C 61	Other harrows, rollers, pulverizers, and similar equipment.....	24	4,923	14,013	7,357	20,985
3523C 63	Attachments for harrows, rollers, pulverizers, and similar equipment.....	16	(X)	<sup>a</sup> 5,237	(X)	6,664
35239 45	Parts for harrows, rollers, pulverizers, and similar equipment, replacement units only.....	41	(X)	22,241	(X)	20,992
3523C pt.	Cultivators and weeders.....	62	(X)	124,626	(X)	178,859
3523C 70	Corn and cotton type cultivators, shank and sweep type (front and rear mounted).....	29	10,580	41,644	15,449	53,084
3523C 80	Rotary cultivators, ground and power driven.....	11	4,116	12,383	4,335	14,261
3523C 90	Field cultivators.....	18	3,829	31,957	7,255	58,437
3523C 94	Other cultivators and weeders, including tool bars (basic units)...	23	5,122	5,286	4,669	7,465
3523C 98	Attachments for cultivators and weeders (front mounting frame, disc weeders, rear section, and drawbars).....	30	(X)	33,356	(X)	<sup>r</sup> 45,607
35239 65	Parts for cultivators and weeders, replacement units only.....	38	(X)	41,959	(X)	46,088
3523E --	All other farm machinery and equipment, except parts.....	(NA)	(X)	<sup>1</sup> 2,936,908	(X)	<sup>1</sup> 3,370,914
3523E pt.	Stalk shredders and cutters or rotary mowers (PTO).....	35	(X)	<sup>a</sup> 134,439	(X)	151,326
3523E 01	Flail type, without spout.....	15	3,457	14,141	4,591	17,577
	Horizontal blade type:					
3523E 05	66 inches cutting width and under.....	23	55,478	29,345	67,568	35,375
3523E 07	Over 66 inches up to 100 inches cutting width.....	18	25,715	<sup>a</sup> 34,677	27,117	37,021
3523E 09	Over 100 inches cutting width.....	12	<sup>a</sup> 10,116	<sup>a</sup> 56,276	11,612	61,351
35239 85	Parts for stalk shredders, and cutters or rotary mowers (PTO), replacement units only.....	24	(X)	<sup>a</sup> 35,563	(X)	37,441

See footnotes at end of table.

Table 3. MANUFACTURERS' SHIPMENTS OF FARM MACHINERY AND LAWN AND GARDEN EQUIPMENT, BY TYPE: 1991 AND 1990—Continued

(Quantity in units; value in thousands of dollars)

Product code	Product description	Number of companies	1991		1990	
			Quantity	Value	Quantity	Value
3523E pt.	Machines for preparing crops for market or for use.....	91	(X)	180,709	(X)	205,242
3523E 11	Feed grinders and crushers, power.....	17	2,000	15,386	<sup>r</sup> 2,211	<sup>r</sup> 15,353
3523E 13	Feed mixers, farm size, stationary and portable.....	22	3,673	37,259	3,891	42,586
3523E 14	Combination grinder-mixers.....	9	2,589	21,882	3,039	23,880
	Dryers (grain, hay, and seed):					
3523E 07	Heated air crop dryers.....	20	5,165	26,217	7,411	39,169
3523E 09	Crop drying fans (over 15,000 c.f.m. at approximately 1-inch pressure).....	12	5,036	2,705	10,970	5,710
3523E 23	Other machines for preparing crops for market or for use.....	45	42,239	69,698	<sup>r</sup> 40,580	70,812
3523E 24	Attachments for machines for preparing crops for market or for use.	16	(X)	7,562	(X)	<sup>r</sup> 7,732
35239 70	Parts for machines for preparing crops for market or for use, replacement units only.....	54	(X)	23,893	(X)	25,567
3523E pt.	Farm poultry equipment.....	42	(X)	171,804	(X)	178,262
3523E 31	Incubators, quantity represents egg capacity in thousands.....	7	(D)	21,008	(D)	23,237
3523E 33	Brooders, floor and hanging (gas, electric, oil, coal, and wood)....	8	80,230	10,781	121,814	10,838
3523E 35	Brooders, battery (starting and growing), quantity in number of decks.....	2				
3523E 36	Nests and cages.....	5	1,789,056	21,158	1,759,527	21,669
3523E 39	Poultry feeders, except turkey feeders (trough, hanging, and mechanical).....	10	11,428,465	58,964	12,026,132	66,906
3523E 43	Poultry waterers, except turkey waterers.....	14				
3523E 48	Other farm poultry equipment, including turkey waterers, mechanized egg graders, and egg washers.....	23	(X)	<sup>a</sup> 44,639	(X)	40,897
3523E 49	Attachments for farm poultry equipment.....	13	(X)	15,254	(X)	14,715
35239 75	Parts for farm poultry equipment, replacement units only.....	18	(X)	<sup>a</sup> 21,576	(X)	<sup>a</sup> 18,862
3523E pt.	Hog equipment.....	47	(X)	76,150	(X)	73,920
3523E 50	Feeding equipment.....	26	271,915	30,402	273,049	32,826
3523E 55	Handling equipment.....	16	700,024	16,668	467,540	13,631
3523E 59	Watering equipment.....	23	837,738	11,719	687,313	9,507
3523E 61	Other hog equipment.....	28	367,777	15,079	<sup>r</sup> 335,250	12,741
3523E 62	Attachments for hog equipment.....	12	(X)	2,282	(X)	5,215
35239 88	Parts for hog equipment, replacement units only.....	17	(X)	6,392	(X)	4,868
3523E pt.	Other barn and barnyard equipment.....	98	(X)	159,493	(X)	169,912
3523E 63	Silo and grain bin unloaders, forage and grain including sealed storage unloaders (farm type).....	17	19,227	28,798	18,490	35,877
	Cattle and dairy barn equipment:					
3523E 64	Feeding equipment.....	38	156,184	21,580	116,788	20,147
3523E 71	Handling equipment.....	32	1,150,617	31,274	893,215	30,511
3523E 79	Water equipment.....	37	434,285	21,781	473,652	22,627
3523E 85	Other barn and barnyard equipment.....	54	910,504	52,007	954,832	55,613
3523E 86	Attachments for barn and barnyard equipment.....	21	(X)	4,053	(X)	5,137
35239 80	Parts for barn and barnyard equipment, replacement units only.....	31	(X)	<sup>a</sup> 31,387	(X)	<sup>a</sup> 34,150

See footnotes at end of table.

Table 3. MANUFACTURERS' SHIPMENTS OF FARM MACHINERY AND LAWN AND GARDEN EQUIPMENT, BY TYPE: 1991 AND 1990—Continued

(Quantity in units; value in thousands of dollars)

Product code	Product description	Number of companies	1991		1990	
			Quantity	Value	Quantity	Value
3523E pt.	Farm wagons, and other farm transportation equipment.....	82	(X)	<sup>1</sup> 1,939,795	(X)	<sup>1</sup> 2,309,493
3523E 88	Wagons (chassis only) and trailer gears, excluding motor trucks: 4-wheel.....	35	(D)	(D)	(D)	(D)
	Boxes and racks for mounting on wagons and trailer gears:					
3523E 90	Manual unloading or dump.....	9	(D)	(D)	(D)	(D)
3523E 91	Gravity unloading, grain type only.....	13	(D)	(D)	(D)	(D)
3523E 92	Power unloading.....	22	(D)	(D)	(D)	(D)
3523E 94	Boxes with integral running gear, grain and forage types.....	12	(D)	(D)	(D)	(D)
3523E 95	Other farm transportation equipment.....	28	(D)	(D)	(D)	(D)
3523E 96	Attachments for farm transportation equipment.....	18	(X)	2 6,473	(X)	2 5,703
35239 84	Parts for farm transportation equipment, replacement units only....	39	(X)	47,835	(X)	35,759
3523E pt.	Irrigation systems.....	18	<sup>a</sup> 13,828	<sup>a</sup> 274,518	<sup>r</sup> 14,525	<sup>r</sup> 282,764
3523E 98	Self-propelled irrigation systems, center-pivot, quantity is in ten-tower equivalents.....	10	8,276	232,557	8,104	237,272
3523E 99	All other systems using 100 feet flexible hose feeder line and over.....	12	<sup>b</sup> 5,552	<sup>b</sup> 41,961	<sup>r</sup> 6,421	<sup>r</sup> 45,492
35239 82	Parts for irrigation systems, replacement units only.....	10	(X)	75,903	(X)	80,579
	Operator cabs.....	(NA)	(X)	(2)	(X)	(2)
	Operator cabs (metal) for farm equipment, shipped separately:					
35239 90	Farm tractors.....	5	(D)	(D)	(D)	(D)
35239 95	All other including windrowers, combines, power sprayers, etc....	1	(D)	(D)	(D)	(D)
3523F --	Commercial turf and grounds care equipment, including parts and attachments.....	(NA)	(X)	716,557	(X)	707,940
3523F pt.	Commercial turf and grounds mowing equipment.....	38	(X)	558,116	(X)	568,098
3523F 01	Powered nonriding mowers.....	16	49,278	68,606	48,697	63,044
3523F 03	Riding reel type turf mowers, including greens mowers.....	7	15,842	128,583	17,063	133,161
3523F 07	Riding rotary turf mowers.....	21	27,970	161,356	29,036	159,642
3523F 09	Gang rotary cutting units, reel and rotary, individual sections....	8	41,140	45,233	42,216	47,512
3523F 11	Flail mower cutting units, including gang.....	7	<sup>b2</sup> 6,333	<sup>b8</sup> 226	2,818	8,750
3523F 13	Other mowing equipment.....	8	12,314	15,721	15,955	32,090
3523F 17	Parts for commercial turf and grounds mowing equipment.....	29	(X)	<sup>a</sup> 91,047	(X)	90,348
3523F 19	Attachments for commercial turf and grounds mowing equipment.....	20	(X)	39,344	(X)	33,551
3523F pt.	Other commercial turf and grounds care equipment.....	40	(X)	158,441	(X)	139,842
3523F 21	Turf tractors.....	2	<sup>3</sup> 210,133	<sup>3</sup> 32,422	<sup>3</sup> 205,648	<sup>3</sup> 29,948
3523F 23	Sod cutters and sod harvesters.....	3				
3523F 25	Seeders, spreaders, and top dresser attachments.....	10				
3523F 27	Aerators, spikers, and pluggers.....	14	10,757	35,687	10,394	24,226
3523F 29	Dethatchers.....	9	4,940	4,095	7,566	5,130
3523F 31	Power brooms, blowers, vacuums, and sweepers.....	13	9,096	12,705	10,904	16,989
3523F 33	Irrigation systems, except agricultural and residential.....	3	(3)	(3)	(3)	(3)
3523F 35	Turf trucks.....	5	9,936	44,477	9,127	38,496
3523F 37	Other commercial turf and grounds care equipment.....	19				
3523F 41	Parts for other commercial turf and ground care equipment.....	19				
3523F 43	Attachments for other commercial turf and ground care equipment....	10	(X)	22,720	(X)	18,178
			(X)	6,335	(X)	6,875
3524	Lawn and garden equipment.....	(NA)	(X)	4,109,947	(X)	<sup>r</sup> 4,101,828
35241	Consumer nonriding lawn, garden, and snow equipment.....	52	17,073,948	1,813,195	<sup>r</sup> 16,070,427	<sup>r</sup> 1,775,675
	Lawnmowers:					
35241 01	Reel, push type.....	4	<sup>4</sup> 4,374,856	633,723	3,992,183	580,231
35241 11	Rotary, push type, gas powered.....	22				
35241 12	Rotary, self-propelled, gas powered.....	23				
35241 15	Electric, all types, including battery powered.....	2	1,256,552	324,691	1,625,298	<sup>r</sup> 390,060
35241 20	Rotary garden motor tillers.....	16	<sup>5</sup> 379,908	158,352	403,367	162,661
35241 30	2-wheel tractors walking type, except rotary tillers.....	2				
	Snow throwers (snow blower), except attachment type:					
35241 41	Single stage.....	6	131,266	38,512	<sup>r</sup> 177,783	<sup>r</sup> 50,034
35241 42	Dual stage.....	9	77,016	48,829	<sup>r</sup> 92,592	<sup>r</sup> 52,496
	Powered lawn edgers/trimmers:					
35241 50	Fixed blade.....	15	<sup>a</sup> 615,887	<sup>a</sup> 39,546	353,967	34,104
	Other than fixed blades:					
35241 54	Gasoline engine.....	10	<sup>6</sup> 6,876,001	325,117	5,768,841	275,605
35241 55	Other, including electric.....	5				

See footnotes at end of table.

Table 3. MANUFACTURERS' SHIPMENTS OF FARM MACHINERY AND LAWN AND GARDEN EQUIPMENT, BY TYPE: 1991 AND 1990--Continued

(Quantity in units; value in thousands of dollars)

Product code	Product description	Number of companies	1991		1990	
			Quantity	Value	Quantity	Value
	Consumer nonriding lawn, garden, and snow equipment--Continued					
35241 61	Shredders and shredder-grinders.....	9	138,522	73,230	108,556	40,487
35241 63	Yard vacuums and blowers.....	17	1,543,506	91,351	1,672,609	106,792
35241 64	Lawn sweepers, push type and powered, except attachment type.....	3	1,680,434	79,844	1,875,231	83,182
35241 91	Other consumer nonriding lawn, garden, and snow equipment.....	15				
35244	Consumer riding lawn, garden, and snow equipment.....	22	1,358,053	1,680,781	1,453,013	1,744,830
	Lawn tractors and riding mowers, front engine:					
35244 03	Under 10.0 hp (under 7.5 kW).....	7	24,298	24,192	29,561	29,995
35244 07	10.0 hp and over (7.5 kW and over).....	13	956,762	1,013,660	1,012,447	1,034,536
	Lawn tractors and riding mowers, rear engine:					
35244 08	Under 8.0 hp (under 6.0 kW).....	3	70,058	79,156	108,184	98,878
35244 10	8.0 to 9.9 hp (6.0 to 7.4 kW).....	12				
35244 11	10.0 hp and over (7.5 kW and over).....	16				
	Garden tractors:					
35244 12	Under 14.0 hp (under 10.5 kW).....	6	19,595	44,189	15,255	31,013
35244 15	14.0 hp to 15.9 hp (10.5 to 11.9 kW).....	7	13,910	35,243	12,330	35,625
35244 17	16.0 hp to 19.9 hp (12.0 to 14.9 kW).....	11	63,089	183,835	79,828	245,732
35244 19	20.0 hp and over (15.0 kW and over).....	6	13,643	60,901	15,875	68,339
35244 31	Other consumer riding lawn, garden, and snow equipment.....	4	5,272	17,804	3,829	13,355
35246 00	Parts and attachments for consumer lawn, garden, and snow equipment.....	(NA)	(X)	615,971	(X)	581,323
	Nonriding:					
35246 03	Parts.....	47	(X)	146,857	(X)	138,466
35246 05	Attachments.....	26	(X)	70,451	(X)	60,841
	Riding:					
	Parts:					
35246 11	For tractors and riding mowers.....	22	(X)	199,955	(X)	197,920
35246 13	For other equipment.....	7	(X)	7,278	(X)	8,926
	Attachments:					
35246 15	Rotary, mower decks.....	14	(X)	73,365	(X)	60,332
35246 17	Rotary tiller attachments.....	12	(X)	7,228	(X)	6,428
35246 19	Blades, dozer.....	11	(X)	13,295	(X)	12,878
35246 21	Snow throwers.....	6	(X)	8,500	(X)	8,067
35246 23	Carts and wagons.....	10	(X)	6,394	(X)	5,428
35246 25	All other attachments.....	25	(X)	82,648	(X)	82,037

Note: The percent of estimation of each item is indicated as follows (see "Description of Survey" for a discussion of estimation of missing reports: <sup>a</sup>10 to 25 percent of this item is estimated. <sup>b</sup>25 to 50 percent of this item is estimated.

- Represents zero. (D) Data withheld to avoid disclosing figures for individual companies. (NA) Not available. pt. Partial.  
<sup>r</sup>Revised by 5 percent or more from previously published figures. (X) Not applicable.

<sup>1</sup>Data for product class 35231, wheel tractors, are combined with product class 3523E, farm wagons, and other farm transportation equipment, to avoid disclosing figures for individual companies (except 35231 87, attachments for wheel tractors).

<sup>2</sup>Data for operator cabs are included with product code 35239 84, parts for farm transportation equipment, to avoid disclosing figures for individual companies.

<sup>3</sup>Data for product codes 3523F 21, 3523F 23, 3523F 25, and 3523F 33 are combined to avoid disclosing figures

Table 4. COMPARISON OF VALUES OF SHIPMENTS OF FARM MACHINERY AND LAWN EQUIPMENTS, AS REPORTED IN THE MA35A, THE 1987 CENSUS OF MANUFACTURES, AND THE 1990 ANNUAL SURVEY OF MANUFACTURES

(Value in thousands of dollars)

Product code	Product description	1990			1987	
		MA35A	Annual Survey of Manufactures		MA35A	Census of Manufactures
			Value	Standard error of estimates <sup>1</sup>		
3523	Farm machinery and equipment.....	(X)	10,871.4	2	(X)	6,384.7
35231	Wheel tractors and attachments.....	(2)	(D)	(X)	745.8	751.2
35232	Farm dairy machines, sprayers and dusters, elevators and blowers.....	418.6	352.8	5	278.9	263.8
35233	Planting, seeding, and fertilizing machinery.....	568.8	585.0	6	321.8	313.2
35235	Harvesting machinery.....	1,990.1	1,969.5	2	1,017.2	1,014.8
35236	Haying machinery.....	727.7	730.7	2	326.0	326.6
3523C	Plows, harrows, rollers, pulverizers, and cultivators and weeder.....	486.0	462.8	12	199.5	189.6
3523E	All other farm machinery and equipment.....	2,381.7	(D)	(X)	938.4	909.9
35239	Parts for farm machinery and equipment, for sale separately.....	(NA)	1,652.8	4	(NA)	1,282.5
35239 pt.	Parts for wheel tractors.....	247.2	(NA)	(NA)	212.8	218.3
35239 pt.	Parts for other farm machinery and equipment.....	(NA)	(NA)	(NA)	(NA)	1,019.3
35239 pt.	Operator cabs for farm equipment <sup>3</sup> .....	(NA)	(NA)	(NA)	4.6	4.5
3523F	Commercial turf and grounds care equipment, including mowing equipment, parts and attachments.....	707.9	726.0	6	514.6	516.9
35230 00	Farm machinery and equipment n.s.k., typically for establishments with 20 employees or more.....	(4)	917.3	2	(4)	340.1
35230 02	Farm machinery and equipment n.s.k., typically for establishments with less than 20 employees.....					476.1
3524	Lawn and garden equipment.....	4,101.8	4,342.9	1	3,979.9	4,061.0
35241	Consumer nonriding lawn, garden, and snow equipment.....	1,775.7	1,864.0	1	1,716.8	1,697.0
35244	Consumer riding lawn, garden, and snow equipment.....	1,744.8	1,746.5	1	1,586.6	1,567.4
35246	Parts and attachments for consumer lawn, garden and snow equipment.....	581.3	599.8	3	675.5	699.5
35240 00	Lawn and garden equipment n.s.k., typically for establishments with 20 employees or more.....	(4)	132.6	1	(4)	26.7
35240 02	Lawn and garden equipment n.s.k., typically for establishments with less than 20 employees.....					70.5

Note: Effective with 1979 annual reports (annual summaries for monthly and quarterly series) most Current Industrial Reports are being benchmarked to the 1987 Census of Manufactures. However, this was not possible for CIR MA35A since it excludes parts sold to plants producing farm equipment (original equipment). The lawn and garden industry 3524 was added to the survey in 1979. It is not possible to determine what portion of those products not specified by kind in the census (product codes 35230 00 and 35230 02) are covered by the survey.

In the 1987 Census of Manufactures, shipments data for establishments of small companies, typically those with fewer than five employees, were estimated from administrative records data rather than collected on census questionnaires. These shipments are included in product code 35230 02. Products not adequately identified by detail product were coded in some cases to the appropriate industry (four-digits) followed by "000."

Product class totals in this table do not agree with comparable values in tables 1 and 2. This results from the fact that the values in tables 1 and 2 include the value of parts in the comparable product class total. In this table, all industry 3523 parts are collected in product class 35239.

CIR MA35A does not include part of product class 35239, parts for farm machinery and equipment sold to plants producing farm machinery. Also, product class 3523F was not included prior to 1979.

(D) Data withheld to avoid disclosing figures for individual companies. (NA) Not available. n.s.k. Not specified by kind.  
pt. Part. (X) Not applicable.

<sup>1</sup> The annual survey of manufactures percentage standard errors shown are the approximate relative errors of the estimates of level. A more detailed description of the standard error of estimate is given in the introduction of the annual survey of manufactures, Value of Product Shipments, M90(AS)-2, under "Qualifications of the Data."

<sup>2</sup> Data for wheel tractors and attachments (product class 35231) are combined with all other farm machinery and equipment (product class 3523E) to avoid disclosing figures for individual companies.

<sup>3</sup> Data collected in the 1987 Census of Manufactures include operator cabs whether shipped to original equipment manufacturers or to others. The MA35A excludes products shipped to original equipment manufacturers.

<sup>4</sup> Available only from the annual survey of manufactures and census of manufactures. Most of these data are derived from administrative records.



Table 5. SHIPMENTS, EXPORTS, AND IMPORTS OF FARM MACHINERY AND EQUIPMENT: 1991

(Quantity in units; value in thousands of dollars)

Product description	Manufacturers' shipments		Exports of domestic merchandise <sup>1</sup>			Percent exports to manufacturers' shipments		Imports for consumption <sup>3</sup>		Apparent consumption <sup>4</sup>		Percent imports to apparent consumption	
			Quantity	Value	Estimated producers' value <sup>2</sup>								
Farm-type wheel tractors.....	(D)	(D)	19,789	434,073	338,143	(NA)	(NA)	79,738	988,562	(NA)	(NA)	(NA)	(NA)
Farm dairy mechanical installations, including milking machines and vacuum pumping outfits.....	(D)	(D)	1,564	12,655	9,858	(NA)	(NA)	8,504	269	(NA)	(NA)	(NA)	(NA)
Cream separator machines.....	-	-	208	1,996	1,555	(NA)	(NA)	2,429	4,496	(NA)	(NA)	(NA)	(NA)
Sprayers and dusters except aerial types.....	(X)	231,831	(X)	89,431	69,667	(NA)	30	(X)	19,491	(NA)	181,655	(NA)	11
Planting machinery.....	121,383	263,695	7,522	29,108	22,675	6	9	14,733	19,267	128,594	260,287	11	7
Fertilizer distributors, pull-type or mounted.....	18,960	90,938	10,662	21,551	16,788	56	18	47,397	14,564	55,695	88,714	85	16
Other harrows, rollers, pulverizers, and similar equipment.....	58,023	73,415	5,493	6,731	5,243	9	7	10,798	3,529	63,328	71,701	17	5
Disc harrows.....	11,367	56,381	1,102	5,065	3,946	10	7	44,120	33,699	54,385	86,134	81	39
Combines.....	11,555	1,064,358	3,631	181,407	141,316	31	13	1,719	22,827	9,643	945,869	18	2
Other harvesting machines.....	(D)	(D)	3,111	42,826	33,361	(NA)	(NA)	4,125	26,201	(NA)	(NA)	(NA)	(NA)
Field forage harvesters.....	3,804	96,466	1,508	32,430	25,263	40	26	312	4,377	2,608	75,580	12	6
Hay mowers, mower-conditioners and windrowers.....	115,942	318,015	53,592	68,749	53,555	46	17	66,280	76,800	128,630	341,260	52	23
Other haymaking machines.....	32,943	(D)	2,685	23,011	17,926	8	(NA)	9,937	14,348	40,195	(NA)	25	(NA)
Balers, including pickup balers.....	25,336	293,502	5,830	58,652	45,690	23	16	1,115	8,492	20,621	256,304	5	3
Moldboard plows.....	1,382	5,038	223	851	663	16	13	1,501	6,245	2,660	10,620	56	59
Other plows.....	10,830	69,374	4,127	9,767	7,608	38	11	33,664	14,392	40,367	76,158	83	19
Cultivators and weedeers.....	23,647	91,270	(NA)	22,807	17,767	(NA)	19	34,755	41,207	(NA)	114,710	(NA)	36
Machinery for preparing animal feed.....	8,262	74,527	5,992	31,932	24,875	73	33	1,485	2,069	3,755	51,721	40	4
Other machines for preparing crops for market or for use.....	52,440	98,620	4,512	16,321	12,714	9	13	25,321	2,678	73,249	88,584	35	3
Farm poultry incubators and brooders.....	(X)	31,789	19,290	14,177	11,044	(NA)	35	90,924	6,871	(NA)	27,616	(NA)	25
Nests and cages (poultry equipments).....	1,789,056	21,158	72,566	(NA)	(NA)	4	(NA)	59,679	12,529	1,776,169	(NA)	3	(NA)
Other barn and barnyard equipment.....	(X)	332,911	21,246	54,740	42,642	(NA)	13	231,059	15,665	(NA)	305,934	(NA)	5
Self-propelled irrigation systems, center-pivot.....	8,276	232,557	2,667	48,494	37,777	32	16	2	26	5,611	194,806	1	1
All other self-propelled irrigation systems using 100 feet flexible hose feeder line and over.....	5,552	41,961	(X)	(NA)	(NA)	(NA)	(NA)	16,467,628	13,699	(NA)	(NA)	(NA)	(NA)
Farm wagons and other farm transportation equipment...	(D)	(D)	-	-	-	-	-	5,888	2,297	(NA)	(NA)	(NA)	(NA)
Other commercial and turf grounds mowers.....	61,592	84,327	(NA)	33,484	26,084	(NA)	31	9,069	4,138	(NA)	62,381	(NA)	7
Kidney turf mowers.....	43,812	289,939	10,298	35,460	27,623	24	10	1,550	4,257	35,064	266,573	4	2
Flail and gang mowers.....	43,773	53,459	1,160	7,425	5,784	3	11	373	1,001	42,986	48,676	1	2
Mowers for lawns, parks, or sports grounds.....	6,873,952	2,297,223	537,608	296,292	230,811	8	10	102,569	15,406	6,438,913	2,081,818	2	1
Snowblowers (snowthrowers).....	208,282	87,341	12,227	8,854	6,897	6	8	22,199	13,740	218,254	94,184	10	15
Powered lawn and hedge trimmers.....	7,491,888	364,663	829,311	42,924	33,438	11	9	525,720	46,227	7,188,297	377,452	7	12

See footnotes at end of table b.

Table 6. SHIPMENTS, EXPORTS, AND IMPORTS OF FARM MACHINERY AND EQUIPMENT: 1990

(Quantity in units; value in thousands of dollars)

Product description	Manufacturers' shipments		Exports of domestic merchandise <sup>1</sup>			Percent exports to manufacturers' shipments		Imports for consumption <sup>3</sup>		Apparent consumption <sup>4</sup>		Percent imports to apparent consumption	
			Quantity	Value	Estimated producers' value <sup>2</sup>								
	Quantity	Value	Quantity	Value		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Farm-type wheel tractors.....	(D)	(D)	23,986	450,392	350,855	(NA)	(NA)	103,477	1,254,022	(NA)	(NA)	(NA)	(NA)
Farm dairy mechanical installations, including milking machines and vacuum pumping outfits.....	(D)	(D)	1,243	9,806	7,639	(NA)	(NA)	49,137	448	(NA)	(NA)	(NA)	(NA)
Cream separator machines.....	-	-	477	2,043	1,591	(NA)	(NA)	1,459	4,380	(NA)	(NA)	(NA)	(NA)
Sprayers and dusters except aerial types.....	(X)	258,533	(X)	55,457	43,201	(X)	17	(X)	26,332	(X)	241,664	(X)	11
Planting machinery.....	142,439	313,735	10,255	35,872	27,944	7	9	39,426	41,010	171,610	326,801	23	13
Fertilizer distributors, pull-type or mounted.....	22,691	104,737	8,281	17,671	13,766	36	13	70,582	17,430	84,992	108,401	83	16
Other harrows, rollers, pulverizers, and similar equipment.....	73,501	108,233	4,281	4,628	3,605	6	3	14,828	7,685	84,048	112,313	18	7
Disc harrows.....	15,339	76,487	1,692	6,446	5,021	11	7	27,423	62,083	41,070	133,549	67	46
Combines.....	14,629	1,216,893	4,581	209,157	162,933	31	13	2,399	36,007	12,447	1,089,967	19	3
Other harvesting machines.....	(D)	(D)	2,074	31,029	24,172	(NA)	(NA)	4,727	28,753	(NA)	(NA)	(NA)	(NA)
Field forage harvesters.....	5,415	107,953	1,598	29,860	23,261	30	22	247	1,942	4,064	86,634	6	2
Hay mowers, mower-conditioners and windrowers.....	140,194	398,054	41,010	57,845	45,061	29	11	77,695	100,667	176,879	453,660	44	22
Other haymaking machines.....	34,176	46,448	3,947	30,769	23,969	12	52	13,074	14,507	43,303	36,986	30	39
Balers, including pickup balers.....	40,934	404,145	8,355	72,065	56,139	20	14	2,028	10,803	34,607	358,809	6	3
Moldboard plows.....	2,665	10,844	347	1,611	1,255	13	12	1,320	6,514	3,638	16,103	36	40
Other plows.....	13,036	86,001	3,182	8,873	6,912	24	8	30,122	19,663	39,976	98,752	75	20
Cultivators and weeder.....	31,708	133,252	(NA)	22,504	17,531	(NA)	13	64,637	68,107	(NA)	183,828	(NA)	37
Machinery for preparing animal feed.....	9,141	81,819	3,012	22,906	17,844	33	22	49,900	4,929	56,029	68,904	89	7
Other machines for preparing crops for market or for use.....	58,961	115,691	3,075	14,758	11,496	5	10	3,385	3,028	59,271	107,223	6	3
Farm poultry incubators and brooders.....	(X)	34,075	8,886	12,657	9,860	(X)	29	14,138	5,112	(X)	29,327	(X)	17
Nests and cages (poultry equipments).....	1,759,527	21,669	32,126	(NA)	(NA)	2	(NA)	45,355	10,698	1,772,756	(NA)	3	(NA)
Other barn and barnyard equipment.....	(X)	341,283	14,711	52,039	40,538	(X)	12	331,745	23,634	(NA)	324,379	(NA)	7
Self-propelled irrigation systems, center-pivot.....	8,104	237,272	3,906	62,916	49,012	48	21	6	201	4,204	188,461	1	1
All other self-propelled irrigation systems using 100 feet flexible hose feeder line and over.....	6,421	45,492	(X)	(NA)	(NA)	(NA)	(NA)	6,776,668	7,289	(NA)	(NA)	(NA)	(NA)
Farm wagons and other farm transportation equipment.....	(D)	(D)	-	-	-	-	-	4,394	4,504	(NA)	(NA)	(NA)	(NA)
Other commercial and turf grounds mowers.....	64,652	95,134	(NA)	20,817	16,216	(NA)	17	18,929	7,411	(NA)	86,329	(NA)	9
Riding turf mowers.....	46,099	292,803	15,425	37,885	29,512	33	10	1,725	4,966	32,399	268,257	5	2
Flail and gang mowers.....	45,034	56,262	1,349	7,726	6,019	3	11	309	170	43,994	50,413	1	1
Mowers for lawns, parks, or sports grounds.....	6,943,377	2,321,057	481,158	266,286	207,437	7	9	166,650	45,522	6,628,869	2,159,142	3	2
Snowblowers (snowthrowers).....	270,375	102,545	10,563	10,775	8,394	4	8	17,496	10,570	277,308	104,721	6	10
Powered lawn and hedge trimmers.....	6,122,808	309,717	365,680	14,761	11,499	6	4	467,069	9,442	6,224,197	307,660	8	1

Note: For comparison of Standard Industrial Classification-based product codes, Schedule B export numbers, and HTSUSA import numbers, see table 7.

- Represents zero. (D) Data withheld to avoid disclosing figures for individual companies. (NA) Not available. Revised by 5 percent or more from previously published figures.  
(X) Not applicable.

<sup>1</sup>Source: Bureau of the Census report, EM 545, U.S. Exports.<sup>2</sup>These values were derived by use of adjustment factors to exclude freight, insurance, and other charges incurred in moving goods to the port of export. This adjustment is made to convert the values to an approximation of the producers' value of export goods. Current adjustment factors are based on data for 1989 which are published in Exports From Manufacturing Establishments, AR89-1, appendix B. The adjustment factor for this report is 0.7790.<sup>3</sup>Source: Bureau of the Census report IM 145, U.S. Imports for Consumption.<sup>4</sup>Apparent consumption is derived by subtracting exports from the total of shipments plus imports.

Table 7. COMPARISON OF STANDARD INDUSTRIAL CLASSIFICATION-BASED PRODUCT CODES WITH  
SCHEDULE B EXPORT NUMBERS, AND HTSUSA IMPORT NUMBERS: 1991

Product code	Product description	Export number <sup>1</sup>	Import number <sup>2</sup>
35231 10	Farm-type wheel tractors.....	8701.90.1005	8701.90.1005
35231 12		8701.90.1010	8701.90.1010
35231 14		8701.90.1015	8701.90.1015
35231 30		8701.90.1030	8701.90.1030
3523F 21		8701.90.1035	8701.90.1035
35244 12		8701.90.1040	8701.90.1040
35244 15		8701.90.1045	8701.90.1045
35244 17		8701.90.1050	8701.90.1050
35244 19		8701.90.1055	8701.90.1055
		8701.90.1060	8701.90.1060
		8701.90.1065	8701.90.1065
		8701.90.1070	8701.90.1070
35232 03	Farm dairy mechanical installations, including milking machines and vacuum pumping outfits.....	8434.10.0000	8434.10.0000
35232 04			
35232 08			
35232 11	Cream separator machines.....	8421.11.0000	8421.11.0000
35232 19	Sprayers and dusters except aerial types.....	8424.81.1000	8424.81.1000
35232 30			
35232 40		8424.81.9030	8424.81.9030
35232 44			
35232 45			
35232 46			
35232 47			
35232 49			
35232 50			
35232 51			
35232 58			
35232 59			
35232 61	Planting machinery.....	8432.30.0010	8432.30.0010
35232 62			
35232 67		8432.30.0090	8432.30.0090
35232 68			
35233 20			
35233 22			
35233 24			
35233 40			
35233 77			
35233 50	Fertilizer distributors pull-type or mounted.....	8432.40.0000	8432.40.0000
35233 58			
35233 59			
35233 61			
35233 65	Other harrows, rollers, pulverizers, and similar equipment	8432.29.0090	8432.29.0090
3523C 41			
3523C 43			
3523C 53			
3523C 54			
3523C 59	Disc harrows.....	8432.21.0000	8432.21.0000
3523C 61			
35235 11	Combines.....	8433.51.0010	8433.51.0010
		8433.51.0090	8433.51.0090
35235 21	Other harvesting machines.....	8433.59.0090	8433.59.0090
35235 31			
35235 41			
35235 78			
35235 79	Field forage harvesters.....	8433.59.0010	8433.59.0010
35235 63			
35235 70	Hay mowers, mower-conditioners and windrowers.....	8432.80.0000	8432.80.0000
35236 13			
35236 23			
3523E 01			
3523E 05			
3523E 07	Other haymaking machinery.....	8433.30.0000	8433.30.0000
3523E 09			
35236 31			
35236 82	Balers, including pickup balers.....	8433.40.0000	8433.40.0000
35236 55			
3523C 02	Moldboard plows.....	8432.10.0020	8432.10.0020

See footnotes at end of table.

Table 7. COMPARISON OF STANDARD INDUSTRIAL CLASSIFICATION-BASED PRODUCT CODES WITH  
SCHEDULE B EXPORT NUMBERS, AND HTSUSA IMPORT NUMBERS: 1991—CONTINUED

Product code	Product description	Export number <sup>1</sup>	Import number <sup>2</sup>
3523C 15	Other plows.....	{ 8432.10.0040 8432.10.0060	8432.10.0040 8432.10.0060
3523C 17			
3523C 19			
3523C 21			
3523C 23			
3523C 25			
3523C 27			
3523C 70	Cultivators and weedeers.....	{ 8432.29.0040 8432.29.0060 8432.29.0080	8432.29.0040 8432.29.0060 8432.29.0080
3523C 80			
3523C 90			
3523C 94			
3523E 11	Machinery for preparing animal feed.....	8436.10.0000	8436.10.0000
3523E 13			
3523E 14			
3523E 07	Other machines for preparing crops for market or for use..	{ 8419.31.0000 8436.80.0060	8419.31.0000 8436.80.0060
3523E 09			
3523E 23			
3523E 31	Farm poultry incubators and brooders.....	8436.21.0000	8436.21.0000
3523E 33			
3523E 35			
3523E 36	Nests and cages (poultry equipment).....	8436.29.0000	8436.29.0000
3523E 39	Other barn and barnyard equipment.....	{ 8436.80.0040 8436.80.0080	8436.80.0040 8436.80.0080
3523E 43			
3523E 48			
3523E 50			
3523E 55			
3523E 59			
3523E 61			
3523E 63			
3523E 64			
3523E 71			
3523E 79			
3523E 85			
3523E 98	Self-propelled irrigation systems, center-pivot.....	8424.81.9010	8424.81.9010
3523E 99	All other self-propelled irrigation systems using 100 feet flexible hose feeder line and over.....	8424.81.9020	8424.81.9020
3523E 88	Farm wagons and other farm transportation equipment.....	8716.80.1000	8716.80.1000
3523E 90			
3523E 91			
3523E 92			
3523E 94			
3523E 95			
3523F 01	Other commercial and turf grounds mowers.....	{ 8433.19.0040 8433.19.0050	8433.19.0040 8433.19.0050
3523F 13			
3523F 03	Riding turf mowers.....	{ 8433.19.0010 8433.19.0030	8433.19.0010 8433.19.0030
3523F 07			
3523F 09	Flail and gang mowers.....	8433.19.0020	8433.19.0020
3523F 11			
35241 01	Mowers for lawns, parks, or sports grounds.....	{ 8433.11.0010 8433.11.0020 8433.11.0030 8433.11.0040 8433.11.0050 8433.11.0060	8433.11.0010 8433.11.0020 8433.11.0030 8433.11.0040 8433.11.0050 8433.11.0060
35241 11			
35241 03			
35241 07			
35241 08			
35241 10			
35241 11			
35241 12			
35241 15			
35241 41	Snowblowers (snowthrowers).....	{ 8430.20.0030 8430.20.0060	8430.20.0030 8430.20.0060
35241 42			
35241 50	Powered lawn and hedge trimmers.....	{ 8467.89.5030 8508.80.0070	8467.89.5030 8508.80.0070
35241 54			
35241 55			

<sup>1</sup> Source: 1991 edition, Harmonized System-Based Schedule B, Statistical Classification of Domestic and Foreign Commodities Exported from the United States.

<sup>2</sup> Source: Harmonized Tariff Schedule of the United States, Annotated (1991).

## DESCRIPTION OF SURVEY

**Scope of Survey.** This survey covers firms engaged in the manufacture of farm machinery and lawn and garden equipment. Very small firms (generally less than five employees) for which 1987 Census of Manufactures data were derived from administrative records of other government agencies are excluded.

**Survey Methodology.** The statistics in this publication were collected by mail on Bureau of the Census annual Form MA35A, Farm Machinery and Lawn and Garden Equipment. The survey panel includes all known producers of farm machinery and lawn and garden equipment, except the very small firms excluded from the scope of the survey. Approximately 1,200 companies are included. No estimate is derived for the small firms excluded from the survey.

**Reliability of Data.** Survey error may result from several sources: (1) inability to obtain information about all cases in the survey; (2) response errors; (3) definitional difficulties; (4) differences in the interpretation of questions; (5) mistakes in recording or coding the data obtained; and (6) other errors of collection, response, coverage, and estimation for missing data. These nonsampling errors also occur in complete censuses. Although no direct measurement of the biases due to nonsampling errors has been obtained, precautionary steps were taken in all phases of the collection, processing, and tabulation of the data in an effort to minimize their influence.

A major source of bias in the published estimates is due to imputing data for nonrespondents, for late reporters, and for data which fail logic edits. Missing figures are imputed based on yearly movements shown by reporting firms. Imputation generally is limited to a maximum of 10 percent for any one data cell. Figures with imputation rates greater than 10 percent are footnoted.

The imputation rate is not an explicit indicator of the potential error in published figures due to nonresponse, because the actual yearly movements for nonrespondents may or may not closely agree with the imputed movements. The range of difference between the actual and imputed figures is not precisely known, but is assumed to be small. The degree of uncertainty regarding the accuracy of the published data increases as the percentage of imputation increases. Figures with imputation rates above 10 percent should be used with caution.

**Revisions to Previous Period Data.** Statistics for previous years may be revised as the result of corrected data from respondents, late reports for which imputations were made as described above, or other corrections. Figures which have been revised by more than 5 percent from previously published figures are indicated by footnotes.

Revisions include changes to prior period data resulting from reconciliation of the results of this survey with the 1987 Census of Manufactures to correct differences in reported data between the two series and to identify and verify new establishments included in the scope of this survey. Table 4 presents a comparison of data from the two series by census product class following the reconciliation.

**Adjustment for Price Change.** All dollar figures included in this publication are in current dollars; i.e., they have not been adjusted for price change.

## EXPLANATION OF TERMS

**Quantity and Value of Shipments.** The figures on quantity and value of shipments represent physical shipments of all products sold, transferred to other establishments of the same company, or shipped on consignment, whether for domestic or export sale. The value represents the net sales price, f.o.b. plant, to the customer or branch to which the products are shipped, net of discounts, allowances, freight charges, and returns. Shipments to a company's own branches are assigned the same value as comparable sales to unaffiliated customers; i.e., the value includes an appropriate allocation of company overhead and profit. Products bought and resold without further manufacture are excluded.

**Net Engine Horsepower.** Net engine horsepower (NEHP) is defined as net flywheel performance as measured by the manufacturer, with all standard accessories operated, and corrected to 29.38 inches Hg and temperature of 85°.

**Lawn Tractors and Riding Mowers.** A self-propelled riding vehicle, generally designed for cutting grass, which is not capable of pulling a plow.

**Garden Tractors.** A self-propelled riding vehicle designed for general-purpose lawn and garden work, which is capable of pulling a plow. All attachments for garden tractors are removable.

**Turf Tractors.** A self-propelled riding vehicle, typified by a low center of gravity, equipped with wide turf-tread tires.

**Parts for Farm Machinery and Equipment.** Parts are manufactured components essential to the completeness and proper operation of a machine, vehicle, or apparatus. Parts data include only parts sold for replacement and repair. Parts sold to manufacturers for incorporation in their own products are excluded.

**Attachments for Farm Machinery and Equipment.** Attachments are supplementary devices designed to be attached to a vehicle or apparatus that either (1) vary or extend the function of the unit or (2) add to the convenience or effectiveness of the basic unit.

## COMPARISON OF EXPORT, IMPORT, AND DOMESTIC OUTPUT DATA

The trade comparisons shown in this report should be considered only as approximations. Several problems prevent precise comparisons among imports, exports, and domestic output. These problems include the following:

- Export and import comparisons do not account for the origin of materials used to manufacture the finished product. Domestic output includes any goods that undergo substantial transformation into a finished product in the U.S., even if the goods are partially constructed abroad or are constructed of imported materials.
- There will be a lag between the time a producer makes or ships a product and the time it is actually exported. Similarly, there may be a lag between the time a product is imported and when it enters into U.S. distribution channels.
- The basic structures of these classification systems differ. The Standard Industrial Classification (SIC) system used for domestic output was developed independently of the Harmonized System (HS) used to classify imports and exports. The level of detail provided by the different systems varies substantially, reflecting their different objectives. For example, there are a number of imported commodities that have no comparable domestic output classification.
- Because producers' shipments of some commodities may be used as materials for incorporation into other commodities, combinations of domestic output data for such commodities may contain some duplication.
- Import and export data reflect the movement of merchandise into and out of U.S. foreign trade zones, the U.S. Virgin Islands, and the U.S. customs territory of the 50 States, the District of Columbia, and Puerto Rico. Domestic output reflects activity in the 50 States and, only if specified, in Puerto Rico.
- Import and export data generally do not distinguish between new, used, or rebuilt commodities.
- The valuations of the three data sets differ. Domestic output is valued at the point of production. It includes the net sales price, f.o.b. plant, after discounts and allowances, and excludes freight charges and excise taxes. Exports are valued at the point of exportation. Export value includes the net sales price or value, and inland freight, insurance and other charges to the export point. Imports are valued at the first port of entry in the United States. They include the cost, insurance, freight, duty, and other charges to the import point.

- Detailed commodity information is not included for individual export or import shipments at or below a certain dollar limit. This dollar limit is \$2,500 for exports and \$1,250 for imports, except for import of textiles and textile products, gloves, footwear, and miscellaneous rubber and plastics products, where the limit is \$250.

## HISTORICAL NOTE

Data on farm machinery and equipment have been collected by the Bureau of the Census since 1920; data on lawn and garden equipment since 1978. Historical data may be obtained from Current Industrial Reports (called Facts for Industry before 1959) available at your local Federal Depository Library. A list of these libraries may be obtained from the Bureau of the Census regional offices:

Office	Telephone
Atlanta, Georgia	404-730-3833
Boston, Massachusetts	617-565-7100
Charlotte, North Carolina	704-344-6142
Chicago, Illinois	312-353-6251
Dallas, Texas	214-767-0621
Denver, Colorado	303-967-6750
Detroit, Michigan	313-354-4654
Kansas City, Kansas	913-236-3728
Van Nuys, California	818-904-6339
New York, New York	212-264-4730
Philadelphia, Pennsylvania	215-597-8313
Seattle, Washington	206-728-5314

Historical data are also available on microfiche. For further information contact the Bureau of the Census, Data User Services Division, 301-763-4100.

## RELATED REPORTS

The Bureau of the Census publishes the following related reports:

Series	Frequency	Title
<i>Current Industrial Reports</i>		
MA35D	Annually	<i>Construction Machinery</i>
MA35L	Annually	<i>Internal Combustion Engines</i>
MA35P	Annually	<i>Pumps and Compressors</i>
<i>Other Industry Reports</i>		
M3-1	Monthly	<i>Manufacturers' Shipments, Inventories, and Orders</i>

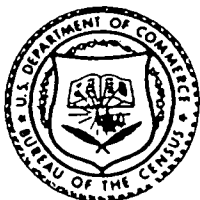
Series	Frequency	Title	Subject Area	Contact	Phone Number
(AS)	Annually	Annual Survey of Manufactures (ASM)	Foreign Trade	Trade Data Inquiries Staff (FTD)	301-763-5140
(MC)	Quinquennially	Census of Manufactures	Census/ASM	Tom Lee	301-763-5752
<i>Foreign Trade Reports</i>			International Trade Administration	Mary Wiening	202-377-4708
CD-ROM FT 447	Monthly/ Annually Annually	<i>U.S. Exports—Schedule B— Commodity by Country</i>	To order a Current Industrial Report	Superintendent of Documents (GPO)	202-783-3238
CD-ROM FT 247	Monthly/ Annually Annually	<i>U.S. Imports for Consumption—HTSUSA— Commodity by Country</i>	To subscribe to Census Bureau publication	Superintendent of Documents (GPO)	202-512-2303

#### CONTACTS FOR DATA USERS

Subject Area	Contact	Phone Number
Current Industrial Report MA35A	Donald Burgess	301-763-7492
Manufacturers' Shipments, Inventories, and Orders	Steve Andrews	301-763-2502
Classification Systems Comparability	Francis McCormick (ESD)	301-763-1935

#### ACKNOWLEDGMENTS

This report was prepared in the Industry Division, Bureau of the Census, under the direction of Thomas Flood, Chief, Current Durables Branch, and Milbren Thomas, Chief, Metals Section. Donald Burgess was directly responsible for the review of the data and preparation of the report. Roger H. Bugenhagen, Acting Chief of the Division, and Robert N. Tinari, Assistant Chief for Current Industrial Reports, provided overall direction and coordination to this project.



## Pumps and Compressors



U.S. Department of Commerce  
Economics and Statistics Administration  
BUREAU OF THE CENSUS

1991

MA35P(91)-1  
Issued November 1992

## SUMMARY OF FINDINGS

In 1991, manufacturers' shipments of pumps and compressors totaled \$5,169.1 million, an increase of 7 percent from the 1990 figure of \$4,797.4 million. The 1991 total includes industrial pumps, \$2,284.5 million, an increase of 7 percent from the 1990 total of \$2,131.2 million; compressors and vacuum pumps, \$2,018.6 million, an increase of 9 percent from the 1990 total of

\$1,839.1 million; domestic water systems, \$275.1 million, an increase of 4 percent from the 1990 total of \$263.6 million; and other pumps, \$590.9 million, an increase of 4 percent from the 1990 total of \$563.4 million.

A description of the survey methodology and related information appears on page 9.

Table 1. VALUE OF SHIPMENTS OF PUMPS AND COMPRESSORS, BY CLASS OF PRODUCT: 1983 TO 1991

(In millions of dollars)

Product code	Product description	1991	1990	1989	1988	1987	1986	1985	1984	1983
3561 pt. 3563 pt.	Pumps and compressors <sup>1</sup> .....	5,169.0	4,797.3	4,472.8	4,130.7	3,655.1	4,505.7	4,919.4	5,006.2	4,597.0
35611	Industrial pumps.....	2,284.5	2,131.2	2,023.9	1,795.0	1,677.4	1,632.3	1,724.2	1,753.3	1,749.0
35617,8	Hydraulic fluid power pumps and motors.....	(2)	(2)	(2)	(2)	(2)	881.6	861.0	852.4	684.3
35613	Domestic water systems.....	275.1	263.6	273.8	307.6	268.9	272.0	250.6	264.8	237.1
35615 pt.	Oil well, oilfield, and other pumps (including laboratory pumps).....	590.8	563.4	488.2	496.0	428.7	451.7	627.4	673.1	639.3
35631	Compressors and vacuum pumps <sup>2</sup> .....	2,018.6	1,839.1	1,686.8	1,532.2	1,280.0	1,268.1	1,456.2	1,462.6	1,287.3

pt. Part.

<sup>1</sup>Excludes hand pumps, automotive circulating pumps, compressors for icemaking and refrigeration equipment, air-conditioning units, measuring and dispensing pumps, paint spraying equipment, hydraulic fluid power pumps for passenger automobile power steering units, and replacement and repair parts for pumps and compressors.

<sup>2</sup>Beginning in 1987, product codes 35617 and 35618 changed to 35941.



Table 2. COMPARISON OF VALUES OF SHIPMENTS OF PUMPS AND COMPRESSORS, AS REPORTED IN THE MAJSP, THE 1987 CENSUS OF MANUFACTURES AND THE 1990 ANNUAL SURVEY OF MANUFACTURES

(Value in thousands of dollars)

Product code	Product description	1990			1987	
		MAJSP	Annual Survey of Manufactures		MAJSP	Census of Manufactures
			Value	Standard error of estimates <sup>1</sup>		
3561	Pumps and pumping equipment.....	(X)	4,220.8	3	(X)	3,447.8
35611	Industrial pumps, except hydraulic fluid power.....	2,131.2	2,092.8	3	1,677.4	1,659.8
35613	Domestic water systems and pumps.....	263.6	294.7	11	268.9	276.9
35615	Pumps and pumping equipment n.e.c.....	563.8	528.1	7	428.7	446.9
35616 <sup>2</sup>	Parts and attachments for pumps and pumping equipment, except for hydraulic fluid power, and air and gas compressors.....	(3)	1,119.3	4	(3)	875.3
35610 00	Pumps and pumping equipment not specified by kind, typically companies with 5 employees or more.....	(3)	185.7	6	(3)	108.5
35610 02	Pumps and pumping equipment not specified by kind, typically companies with less than 5 employees.....					80.3
3563	Air and gas compressors.....	(X)	3,548.4	2	(X)	2,600.1
35631	Air and gas compressors, except refrigeration compressors, and vacuum pumps.....	1,839.1	1,743.8	3	1,280.0	1,259.8
35631 30	Air and gas compressors.....	1,369.3	(NA)	(NA)	1,119.0	1,070.9
35631 20	Vacuum pumps.....	142.7	(NA)	(NA)	117.1	124.0
35631 00	Air and gas compressors, n.s.k.....	(X)	(X)	(X)	(3)	64.8
35632	Parts and attachments for air and gas compressors, except refrigeration compressors.....	(3)	831.9	6	(3)	538.5
35635	Industrial spraying equipment.....	(3)	882.5	3	(3)	669.1
35630 00	Air and gas compressors, not specified by kind, typically for establishments with 5 employees or more.....	(3)	9.01	1	(3)	113.5
35630 02	Air and gas compressors, not specified by kind, typically for establishments with less than 5 employees.....					48.

Note: In the 1987 Census of Manufactures, shipments data for establishments of small companies, typically those with fewer than five employees, were estimated from administrative records data rather than collected on census questionnaires. These shipments are included in product codes 35610 02 and 35630 02. Products not adequately identified by detail product were coded in some cases to the appropriate industry (four-digits) followed by "000".

(NA) Not available. n.e.c. Not elsewhere classified. n.s.k. Not specified by kind. (X) Not applicable.

<sup>1</sup>The annual survey of manufactures percentage standard errors shown are the approximate relative errors of the estimates of level. A more detailed description of the standard error of estimate is given in the introduction of the annual survey of manufactures, Value of Product Shipments, M89(AS)-2, under "Qualifications of the Data."

<sup>2</sup>Previously published as 3561C.

<sup>3</sup>Available only from the annual survey of manufactures and census of manufactures.

Table 3. QUANTITY AND VALUE OF SHIPMENTS OF PUMPS AND COMPRESSORS: 1991 AND 1990

(Quantity in number of units; value in thousands of dollars)

Product code	Product description	Number of companies	1991		1990	
			Quantity	Value	Quantity	Value
	Pumps and compressors.....	331	15,912,178	5,169,055	15,983,709	4,797,423
35611 --	Industrial pumps.....	(X)	5,192,364	2,284,470	5,186,024	2,131,235
35611 98	Value of drivers (reported separately) <sup>1</sup> .....	132	(X)	424,131	(X)	373,228
	Reciprocating pumps.....	(X)	236,544	113,953	219,179	105,655
35611 01	Direct-acting steam-driven.....	5	65	2,304	57	2,330
35611 02	Electric motor driven.....	29	210,749	98,463	179,794	85,198
35611 04	Engine driven.....	12	25,730	13,186	39,328	18,127
	Turbine pumps, vertical (including deep-well).....	(X)	31,910	197,708	30,804	166,922
35611 05	Submersible, over 5 hp.....	21	9,626	56,416	10,415	41,876
	Other than submersible:					
35611 07	Up to 8" diameter bowl size.....	11	3,920	22,182	5,620	19,187
35611 08	Over 8" to 16" diameter bowl size.....	14	16,863	89,548	13,438	84,098
35611 10	Over 16" diameter bowl size.....	9	1,501	29,562	1,331	21,761
	Centrifugal pumps.....	(X)	3,548,253	1,169,107	3,526,247	1,122,184
	Submersible centrifugal pumps (except submersible sump pumps):					
	Submersible effluent pumps (less than 1" solids handling capacity):					
35611 83	4-3/4 hp.....	11	110,883	11,539	120,963	12,235
35611 84	1 hp. and over.....	7	9,034	5,018	7,558	4,903
	Submersible solids handling pumps (solids 1" to 2" inclusive):					
35611 85	1/3 to 1/2 hp.....	10	134,145	26,329	132,631	23,788
35611 86	3/4 hp. and over.....	13	18,230	8,577	14,440	7,198
	Submersible nonclog pumps (greater than 2" solids handling capacity):					
35611 87	3" discharge outlet and under.....	11	16,862	12,114	17,339	7,556
35611 88	4" to 6" discharge outlet.....	14	8,812	12,942	6,180	10,649
35611 89	7" and 8" discharge outlet.....	6	92	579	60	294
35611 90	9" to 12" discharge outlet.....	5			53	480
35611 91	Over 12" discharge outlet.....	1	117	1,253		
	Single stage, single suction, close coupled:					
35611 11	1/2" discharge outlet and under.....	12	105,841	6,372	118,104	6,368
35611 12	3/4" and 1" discharge outlet.....	38	225,788	30,116	223,563	29,117
35611 14	1-1/4" and 1-1/2" discharge outlet.....	52	292,119	70,616	312,873	73,697
35611 15	2" and 2-1/2" discharge outlet.....	52	104,590	42,780	113,089	44,395
35611 16	3" and 4" discharge outlet.....	50	30,106	28,392	28,590	26,903
35611 19	Over 4" discharge outlet.....	33	12,603	25,274	14,424	24,220
	Single stage, single suction, frame mounted:					
35611 21	1/2" discharge outlet and under.....	8	(D)	(D)	(D)	(D)
35611 22	3/4" and 1" discharge outlet.....	45	(D)	(D)	(D)	(D)
35611 23	1-1/4" and 1-1/2" discharge outlet.....	52	33,010	42,518	38,509	49,092
35611 24	2" and 2-1/2" discharge outlet.....	53	37,959	68,393	38,094	61,754
35611 25	3" discharge outlet.....	57	28,023	51,145	29,601	52,175
35611 26	4" to 6" discharge outlet.....	49	27,853	83,667	29,274	80,983
35611 29	Over 6" discharge outlet.....	36	5,709	53,959	5,536	51,329
	Single stage, double suction:					
35611 42	Under 4" discharge outlet.....	21	6,285	9,850	6,787	11,272
35611 44	4" and 5" discharge outlet.....	21	6,089	23,413	7,219	20,622
35611 46	6" and 7" discharge outlet.....	17	4,570	24,716	5,117	23,753
35611 48	8" to 12" discharge outlet.....	21	4,575	36,261	5,940	28,703
35611 49	Over 12" discharge outlet.....	15	627	36,941	691	30,491
	Multistage (single or double suction):					
35611 52	1-1/2" discharge outlet and under.....	20	26,026	13,784	26,774	13,976
35611 54	2" and 3" discharge outlet.....	21	5,467	31,095	6,510	34,637
35611 56	4" and 5" discharge outlet.....	19	954	31,131	1,034	28,674
35611 58	6" and 7" discharge outlet.....	14	142	13,118	110	5,505
35611 59	8" and over discharge outlet.....	9	102	21,692	149	12,071
	Propeller and mixed flow:					
35611 62	20" and under.....	16	1,774	15,394	2,129	19,506
35611 64	Over 20".....	16	511	40,297	498	28,444
	All other centrifugal pumps (including can, etc.):					
35611 65	1-1/2" discharge outlet and under.....	23	1,523,892	73,439	1,432,595	71,856
35611 66	2" to 6" discharge outlet.....	21	94,327	51,919	105,631	48,929
35611 69	Over 6" discharge outlet.....	11	2,897	106,437	2,648	126,024
	Rotary pumps.....	(X)	848,355	204,818	877,878	202,546
	100 P.S.I. and under designed pressure:					
35611 70	10 G.P.M. and under, designed capacity.....	26	457,561	43,170	476,351	43,949
35611 71	11 to 99 G.P.M., designed capacity.....	21	98,412	28,973	112,370	31,304
35611 72	100 to 299 G.P.M., designed capacity.....	13	19,637	12,416	7,370	9,000
35611 73	300 G.P.M. and over, designed capacity.....	11	3,551	9,766	3,253	9,142
	101 to 250 P.S.I., designed capacity:					
35611 74	10 G.P.M. and under, designed capacity.....	13	134,350	21,488	136,034	20,733
35611 75	11 to 99 G.P.M., designed capacity.....	16	37,938	37,626	41,829	37,554
35611 76	100 G.P.M., and over, designed capacity.....	14	19,332	30,223	16,728	27,926
	251 to 500 P.S.I., designed pressure:					
35611 77	10 G.P.M. and under, designed capacity.....	8	71,751	7,149	77,555	7,254
35611 78	11 G.P.M., and over, designed capacity.....	10	4,441	10,918	4,814	11,757
35611 79	Over 500 P.S.I., designed pressure.....	6	1,382	3,089	1,574	2,771
	Diaphragm pumps.....	(X)	446,987	131,046	452,876	121,500
35611 82	Single diaphragm.....	14	(D)	(D)	(D)	(D)
35611 92	More than one diaphragm.....	10	(D)	(D)	(D)	(D)
35611 97	Other industrial pumps, not elsewhere classified.....	19	80,315	43,707	79,040	16,500

See footnotes at end of table.

Table 3. QUANTITY AND VALUE OF SHIPMENTS OF PUMPS AND COMPRESSORS: 1991 AND 1990—Continued

(Quantity in number of units; value in thousands of dollars)						
Product code	Product description	Number of companies	1991		1990	
			Quantity	Value	Quantity	Value
35613 —	Domestic water systems.....	(X)	1,640,122	275,140	1,637,619	263,615
35613 13	Jet pump and convertible jet pump systems <sup>2</sup> .....	19	813,097	106,631	872,636	112,275
35613 20	Nonjet pump systems (except submersible) <sup>2</sup> .....	7				
	Submersible pump systems, 5 hp. and under <sup>2</sup> :					
35613 26	Up to 1 hp.....	18	675,987	124,723	630,341	116,002
35613 27	Over 1 hp. to 3 hp.....	16	109,066	27,206	99,347	23,359
35613 28	Over 3 hp.....	16	28,885	14,773	22,055	10,336
35613 70	Domestic hand and windmill pumps, pump jacks, and cylinders (sold separately) <sup>2</sup> .....	5	13,087	1,807	13,240	1,643
35615 —	Other pumps.....	(X)	6,772,603	590,864	6,823,180	563,440
35615 98	Value of drivers (reported separately) <sup>1</sup> .....	14	(X)	70,087	(X)	75,618
35615 99	Other pumps, excluding domestic water systems and sump pumps <sup>1</sup> .....	5	(X)	4,361	(X)	2,550
	Oil well and oilfield pumps (except boiler-feed).....	(X)	182,965	206,396	188,473	177,194
35615 11	Subsurface pumps for oil well pumping.....	10	173,939	175,021	179,822	152,003
35615 13	Mud pumps (slush pumps).....	6	444	17,151	489	12,810
35615 15	Other oil well and oilfield pumps.....	6	8,582	14,224	8,162	12,381
	Domestic sump pumps, 1 hp. and under.....	(X)	1,944,293	103,216	2,049,002	109,313
35615 73	Pedestal.....	21	338,586	16,043	397,949	18,843
	Submersible.....	(X)	1,605,707	87,173	1,651,053	90,470
35615 77	1/3 hp. and under.....	21	1,502,880	78,000	1,540,664	80,288
35615 78	Over 1/3 hp.....	11	102,827	9,173	110,389	10,182
35615 93	Packaged pump units assembled from purchased pumps.....	2	4,645,345	206,804	4,585,705	198,765
35615 95	Hot water heating circulator pumps.....	5				
35615 97	Other pumps, except automotive, (include oil burner and appliance pumps, fire engine pumps, laboratory pumps, etc.).....	26				
35631 —	Compressors and vacuum pumps.....	(X)	2,307,089	2,018,581	2,336,886	1,839,133
35631 98	Value of drivers (reported separately) <sup>1</sup> .....	47	(X)	294,511	(X)	245,797
	Air compressors.....	(X)	1,836,146	914,719	1,856,766	923,970
	Stationary.....	(X)	770,295	612,577	830,205	590,705
	Reciprocating, single acting.....	(X)	678,137	207,835	745,795	194,671
35631 01	1-1/2 hp. and under.....	20	454,878	39,589	560,101	36,150
35631 02	Over 1-1/2 hp. to 5 hp.....	25	163,763	72,586	129,488	66,756
35631 03	6 hp. to 25 hp.....	22	41,967	64,806	41,187	61,064
35631 04	26 hp. and over.....	14	17,529	30,854	15,019	30,701
	Reciprocating, double acting.....	(X)	698	32,417	1,971	29,534
35631 05	150 hp. and under.....	9	549	17,776	1,807	12,417
35631 06	151 hp. and over.....	5	149	14,641	164	17,117
	Rotary positive.....	(X)	75,412	234,229	81,403	242,152
35631 07	Discharge pressure 50 PSIG and under, all hp. sizes.....	8	57,800	21,947	63,033	20,754
	Discharge pressure of 51 PSIG and over:					
35631 10	10 hp. and under.....	6	1,331	3,403	814	2,653
35631 11	11-40 hp.....	15	4,654	35,259	5,203	35,935
35631 12	41-150 hp.....	16	9,956	93,440	10,543	102,370
35631 13	151-300 hp.....	10	1,206	46,141	1,365	48,347
35631 15	301 hp. and over.....	7	465	34,039	445	32,093
	Centrifugal and axial.....	(X)	16,048	138,096	1,036	124,348
35631 14	50 PSIG and below.....	7	16,048	138,096	1,036	124,348
35631 17	51 PSIG and over.....	(X)				
35631 19	350 hp. and under.....	2				
	351 hp. and over.....	5				
	Portable.....	(X)	1,065,851	302,142	1,026,561	333,265
35631 29	Under 11 C.F.M.....	11	961,865	137,687	924,724	139,447
35631 33	11 to 74 C.F.M.....	9	91,509	26,436	86,353	33,767
35631 34	75 to 124 C.F.M.....	10	1,130	6,523	1,776	10,324
35631 36	125 to 249 C.F.M.....	10	8,006	56,315	10,113	72,114
35631 37	250 to 599 C.F.M.....	5	1,469	17,159	1,610	18,475
35631 38	600 to 899 C.F.M.....	6	1,414	36,285	1,440	35,015
35631 39	900 C.F.M. and over.....	6	458	21,737	545	24,123
	Gas compressors.....	(X)	4,642	581,394	4,274	445,313
	Stationary, centrifugal and axial.....	(X)	359	198,366	365	127,895
35631 42	Natural gas.....	5	126	137,039	75	75,771
35631 43	All other gases.....	5	233	61,327	290	52,124
	Reciprocating and rotary.....	(X)	4,283	383,028	3,909	317,418
	Stationary reciprocating:					
	Integral engines: <sup>2</sup>					
35631 46	2,000 hp. and under <sup>2</sup> .....	3	252	131,681	308	62,406
35631 47	2,001 to 4,000 hp. <sup>2</sup> .....	2				
35631 48	4,001 hp. and over <sup>2</sup> .....	2				
	Other than integral engines:					
35631 51	1,000 hp. and under.....	16	3,210	136,681	2,872	135,492
35631 53	1,001 hp. and over.....	6	449	104,730	395	107,163
35631 56	Stationary rotary positive.....	6	372	9,936	334	12,357
35631 89	Other compressors (including compressor packages).....	6	(D)	(D)	(D)	(D)
	Vacuum pumps (including laboratory).....	(X)	394,514	131,659	403,201	142,730
35631 93	Low vacuum, 29.5 inches mercury vacuum and lower.....	24	326,293	73,552	318,744	75,484
35631 94	High vacuum 29.6 inches mercury vacuum and over.....	14	68,221	58,107	84,457	67,246
35631 96	Packaged compressor units assembled from purchased compressors.....	4	(D)	(D)	(D)	(D)

(D) Data withheld to avoid disclosing figures for individual companies.  
published figures. (X) Not applicable.

<sup>1</sup>Revised by 5 percent or more from previously

<sup>1</sup>The value of drivers was reported only at the product class level. For each product line, value figures exclude, except as noted for codes 35613 13-70 and 35631 46-48, the value of drivers (electric motor or prime movers) shipped with that product. The extent to which some respondents may have included the value of drivers with the value of specific pumps or compressors is unknown.

<sup>2</sup>Includes the value of drivers.

Table 4. SHIPMENTS, EXPORTS, IMPORTS, AND APPARENT CONSUMPTION OF PUMPS AND COMPRESSORS: 1991

(Quantity in number of units; value in thousands of dollars)

Product code	Product description	Manufacturers' shipments		Export shipments <sup>1 2</sup>			Percent exports to manufacturers' shipments		Imports for consumption <sup>3 5</sup>		Apparent consumption <sup>7</sup>		Percent imports to apparent consumption		
		Quantity	Value f.o.b. plant	Quantity	Value		Quantity	Value	Quantity	Value <sup>6</sup>	Quantity	Value	Quantity	Value	
					As reported <sup>3</sup>	Estimated producers' value <sup>3 4</sup>									
INDUSTRIAL PUMPS															
	Pumps (excluding drivers).....	13,524,774	2,607,836	1,870,998	578,588	511,993	13.8	22.2	28,335,391	300,669	39,989,167	2,329,917	70.9	12.9	
35611 01	Reciprocating pumps.....	236,544	113,593	57,532	46,095	40,789	24.3	40.6	158,170	27,770	337,182	95,268	46.9	29.1	
35611 04															
35611 05															
35611 07		Turbine pumps.....	31,910	197,708	5,667	25,842	22,868	17.8	13.1	2,344	3,132	28,587	174,998	8.2	1.8
35611 08															
35611 10															
35611 83	Centrifugal pumps—submersible.....	298,175	78,351	145,288	31,401	27,787	48.7	40.1	116,615	21,914	269,502	68,864	43.3	31.8	
35611 91															
35611 11	Centrifugal pumps—single stage, single suction, close coupled.....	771,047	203,550	188,552	35,328	31,262	24.5	17.4	101,123	22,722	683,618	190,944	14.8	11.9	
35611 19															
35611 21	Centrifugal pumps—single stage, single suction, frame mounted.....	800,793	357,709	14,113	32,666	28,906	1.8	9.1	37,999	7,985	824,679	333,028	4.6	2.4	
35611 29															
35611 42	Centrifugal pumps—single stage, double suction.....	22,146	131,181	1,340	7,321	6,478	6.1	5.6	7,012	761	27,818	124,621	25.2	0.6	
35611 49															
35611 52	Centrifugal pumps—multistage, single double suction.....	32,691	110,820	5,177	34,689	30,696	15.8	31.3	2,783	6,123	30,297	82,254	9.2	7.4	
35611 59															
35611 62	Other centrifugal pumps, including propeller and mixed flow.....	1,623,401	287,486	83,248	71,558	63,322	5.1	24.9	554,044	72,488	2,094,197	288,416	26.5	25.1	
35611 69															
35611 70	Rotary pumps.....	848,355	204,818	118,150	74,817	66,206	13.9	36.5	227,546	28,581	957,751	158,582	23.8	18.0	
35611 79															
35611 82	Diaphragm pumps, all types.....	446,987	131,054	49,350	25,540	22,600	11.0	19.5	15,996	7,595	413,633	113,109	3.9	6.7	
35611 92															
35613 13	Domestic water systems.....	1,640,122	275,140	67,013	7,887	6,979	1.9	2.1	15,769	624	3,533,171	371,093	0.4	0.2	
35613 70															
35615 73	Domestic sump pumps, 1 hp. and under....	1,944,293	103,216												
35615 78															
35615 11	Oil well and oilfield pumps (except boiler feed).....	182,965	206,396	3,347	50,239	44,456	1.8	24.3	1,041	10,027	180,659	166,184	0.6	6.0	
35615 15															
35615 95	Other pumps, including hot water heating circulator pumps.....	4,645,345	206,804	1,132,221	135,205	119,643	24.4	65.4	27,094,949	90,947	30,608,073	162,546	88.5	56.0	
35615 97															
COMPRESSORS															
	Compressors (excluding drivers)....	2,254,955	1,657,125	519,002	666,349	589,652	23.0	40.2	4,100,260	366,318	5,836,213	1,357,094	70.3	27.0	
35631 01	Air compressors—stationary, reciprocating, single acting.....	678,137	207,835	167,790	68,165	60,319	24.7	28.4	174,098	38,165	685,143	210,252	25.4	18.2	
35631 04															
35631 05															
35631 06															
35631 07															
35631 15	Air compressors—stationary, rotary positive.....	75,412	234,229	60,260	81,497	72,117	79.9	34.8	326,264	58,994	357,464	349,822	91.3	16.9	
35631 14															
35631 17															
35631 19	Air compressors—stationary, centrifugal and axial.....	16,048	138,096												
35631 29															
35631 39	Air compressors—portable.....	1,065,851	302,142	23,888	92,447	81,806	2.2	30.6	2,046,806	43,093	3,088,769	252,788	66.3	17.0	
35631 42															
35631 43	Gas compressors—centrifugal and axial..	359	198,366	6,107	360,690	319,175	25.1	59.1	28,563	103,968	46,751	354,025	61.1	29.4	
35631 46	Gas compressors—reciprocating and rotary.....	4,283	383,028												
35631 56															
35631 89	Other compressors (including compressor packages).....	19,653	29,353												
SELECTED PUMPS															
35631 93	Vacuum pumps.....	394,514	131,659	260,957	63,550	56,235	66.1	48.3	1,524,529	122,098	1,658,086	190,207	91.9	64.2	
35631 94															

<sup>1</sup>For comparison of SIC-based product codes with Schedule B export numbers, and HTSUSA import numbers see table 6.<sup>2</sup>Source: Bureau of Census report EM 545, U.S. Exports.<sup>3</sup>Excludes the value of drivers.<sup>4</sup>These values were derived by use of adjustment factors to exclude freight, insurance, and other charges incurred in moving goods to the port of export. This adjustment is made to convert the values to an approximation of the producers' value of exported goods. Current adjustment factors are based on data for 1989 which are published in *Exports from Manufacturing Establishments: 1989*, AR89-1, appendix B. The adjustment factor applicable to this report is 0.8849.<sup>5</sup>Source: Bureau of Census report IM 145, U.S. Imports for Consumption.<sup>6</sup>This dollar value represents the c.i.f. (cost, insurance, and freight) value at the first port of entry in the United States plus import duties.<sup>7</sup>Apparent consumption is derived by subtracting exports from the total of manufacturers' shipments plus imports.

Table 5. SHIPMENTS, EXPORTS, IMPORTS, AND APPARENT CONSUMPTION OF PUMPS AND COMPRESSORS: 1990

(Quantity in number of units; value in thousands of dollars)

Product code	Product description	Manufacturers' shipments		Export shipments <sup>1 2</sup>			Percent exports to manufacturers' shipments		Imports for consumption <sup>5</sup>		Apparent consumption <sup>7</sup>		Percent imports to apparent consumption		
		Quantity	Value f.o.b. plant	Quantity	Value		Quantity	Value	Quantity	Value <sup>6</sup>	Quantity	Value	Quantity	Value	
					As reported <sup>3</sup>	Estimated producers' value <sup>3 4</sup>									
INDUSTRIAL PUMPS															
	Pumps (excluding drivers).....	13,567,783	2,469,998	1,979,875	472,904	422,020	14.6	19.1	24,932,774	287,332	36,520,682	2,284,426	68.3	12.6	
35611 01	Reciprocating pumps.....	219,179	105,655	67,570	41,838	37,336	30.8	39.6	189,976	22,641	341,585	86,458	55.6	26.2	
35611 04															
35611 05															
35611 07															
35611 08	Turbine pumps.....	30,804	166,922	7,001	26,637	23,771	22.7	16.0	956	4,256	24,759	144,541	3.9	2.9	
35611 10															
35611 83	Centrifugal pumps—submersible.....	299,224	67,103	94,895	19,888	17,748	31.7	29.6	124,763	32,604	329,092	79,819	37.9	40.8	
35611 91															
35611 11	Centrifugal pumps—single stage, single suction, close coupled.....	810,643	204,700	178,802	30,171	26,925	22.1	14.7	62,485	14,140	694,326	188,669	9.0	7.5	
35611 19															
35611 21	Centrifugal pumps—single stage, single suction, frame mounted.....	812,548	345,944	12,113	26,528	23,674	1.5	7.7	8,375	6,875	808,810	326,291	1.0	2.1	
35611 29															
35611 42	Centrifugal pumps—single stage, double suction.....	25,754	114,841	1,276	4,752	4,241	5.0	4.1	92,562	3,467	117,040	113,556	79.1	3.1	
35611 49															
35611 52	Centrifugal pumps—multistage, single double suction.....	34,577	94,813	4,340	23,707	21,156	12.6	25.0	1,238	1,915	31,475	73,021	3.9	2.6	
35611 59															
35611 62	Other centrifugal pumps, including propeller and mixed flow.....	1,543,501	294,783	73,012	51,549	46,002	4.7	17.5	1,000,933	74,054	2,471,422	317,288	40.5	23.3	
35611 69															
35611 70	Rotary pumps.....	877,878	202,546	146,850	67,976	60,662	16.7	33.6	161,380	23,810	892,408	158,380	18.1	15.0	
35611 79															
35611 82	Diaphragm pumps, all types.....	452,876	123,804	48,866	19,277	17,203	10.8	15.6	15,291	5,492	419,301	110,019	3.6	5.0	
35611 92															
35613 13	Domestic water systems.....	1,637,619	263,615	65,762	8,376	7,475	1.8	2.2	69,213	187	3,690,072	364,739	1.9	0.1	
35613 70															
35615 73	Domestic sump pumps, 1 hp. and under....	2,049,002	109,313												
35615 78															
35615 11	Oil well and oilfield pumps (except boiler feed).....	188,473	177,194	1,985	27,388	24,441	1.1	15.5	1,274	5,678	187,762	155,484	0.7	3.7	
35615 15															
35615 95	Other pumps, including hot water heating circulator pumps.....	4,585,705	198,765	1,277,403	124,817	111,387	27.9	62.6	23,204,328	92,213	26,512,630	166,161	67.5	55.5	
35615 97															
COMPRESSORS															
	Compressors (excluding drivers)...	2,288,954	1,536,906	397,902	590,317	526,799	17.4	38.4	3,084,868	354,741	2,686,966	1,301,330	114.8	27.3	
35631 01	Air compressors—stationary, reciprocating, single acting.....	745,795	194,671	155,031	59,337	52,952	20.7	26.5	146,580	42,173	739,315	207,041	19.8	20.4	
35631 04															
35631 05															
35631 06															
35631 07	Air compressors—stationary, rotary positive.....	81,403	242,152	29,929	66,908	59,709	36.8	27.6	305,002	56,838	357,512	356,430	85.3	15.9	
35631 14															
35631 17	Air compressors—stationary, centrifugal and axial.....	1,036	124,348												
35631 19															
35631 29	Air compressors—portable.....	1,026,561	333,265	17,014	66,603	59,437	1.7	20.0	1,354,294	47,105	2,363,841	313,767	57.3	15.0	
35631 39															
35631 42	Gas compressors—centrifugal and axial..	365	127,895	4,528	347,751	310,333	15.6	74.0	25,554	90,187	50,013	212,642	51.1	42.4	
35631 43															
35631 46															
35631 56															
35631 89	Other compressors (including compressor packages).....	24,713	24,893												
SELECTED PUMPS															
35631 93	Vacuum pumps.....	403,201	142,730	191,400	49,718	44,368	47.5	34.8	1,253,438	118,438	1,465,239	211,450	85.5	56.0	
35631 94															

<sup>1</sup>For comparison of SIC-based product codes with Schedule B export numbers, and HTSUSA import numbers see table 6.<sup>2</sup>Source: Bureau of Census report EM 345, U.S. Exports.<sup>3</sup>Excludes the value of drivers.<sup>4</sup>These values were derived by use of adjustment factors to exclude freight, insurance, and other charges incurred in moving goods to the port of export. This adjustment is made to convert the values to an approximation of the producers' value of exported goods. Current adjustment factors are based on data for 1987 which are published in Exports from Manufacturing Establishments: 1987 and 1986, A287-1, appendix B. The adjustment factor applicable to this report is 0.8924.<sup>5</sup>Source: Bureau of Census report IM 145, U.S. Imports for Consumption.<sup>6</sup>This dollar value represents the c.i.f. (cost, insurance, and freight) value at the first port of entry in the United States plus import duties.<sup>7</sup>Apparent consumption is derived by subtracting exports from the total of manufacturers' shipments plus imports.

Table 6. COMPARISON OF STANDARD INDUSTRIAL CLASSIFICATION-BASED PRODUCT CODES WITH SCHEDULE B EXPORT NUMBERS, AND HTSUSA IMPORT NUMBERS: 1991

Product code	Product description	Export number <sup>1</sup>	Import number <sup>2</sup>
35611 01 35611 02 35611 04	Reciprocating pumps.....	8413.50.0090	8413.50.0090
35611 05 35611 07 35611 08 35611 10	Turbine pumps, vertical.....	8413.81.0020	8413.81.0020
35611 83 35611 84 35611 85 35611 86 35611 87 35611 88 35611 89 35611 90 35611 91 35615 77 35615 78	Submersible centrifugal pumps, industrial and domestic....	8413.70.2004	8413.70.2004
35611 11 35611 12 35611 14	Centrifugal pumps, single stage, single suction, close coupled, 1/2" discharge outlet through 1-1/2".....	8413.70.2005	8413.70.2005
35611 15 35611 16 35611 19	Centrifugal pumps, single stage, single suction, close coupled, 2" discharge outlet to over 4".....	8413.70.2015	8413.70.2015
35611 21 35611 22 35611 23 35611 24	Centrifugal pumps, single stage, single suction, frame mounted, 1/2" discharge outlet through 2-1/2".....	8413.70.2022	8413.70.2022
35611 25 35611 26 35611 29	Centrifugal pumps, single stage, single suction, frame mounted, 3" discharge outlet to over 12".....	8413.70.2025	8413.70.2025
35611 42 35611 44 35611 46 35611 48 35611 49	Centrifugal pumps, single stage, double suction, from under 4" discharge outlet to over 12".....	8413.70.2030	8413.70.2030
35611 52 35611 54 35611 56 35611 58 35611 59	Centrifugal pumps, multistage, single or double suction, up to 8" discharge outlet and over.....	8413.70.2040	8413.70.2040
35611 62 35611 64 35611 65 35611 66 35611 69	Other centrifugal pumps, including propeller and mixed flow, and can type.....	{ 8413.70.2090 8413.70.1000	{ 8413.70.2090 8413.70.1000
35611 70 35611 71 35611 72 35611 73 35611 74 35611 75 35611 76 35611 77 35611 78 35611 79 35615 73	Rotary pumps, domestic and industrial.....	{ 8413.60.0070 8413.60.0090	{ 8413.60.0070 8413.60.0090
35611 82 35611 92	Diaphragm pumps, all sizes, industrial type.....	8413.50.0050	8413.50.0050
35611 97 35615 97 35615 95	Other pumps not elsewhere classified including appliance pumps.....	{ 8413.20.0000 8413.81.0040	{ 8413.20.0000 8413.81.0040
35613 13 35613 20 35613 26 35613 27 35613 28 35613 70	Domestic water systems.....	8413.81.0030	8413.81.0030
35615 11 35615 13 35615 15	Oil well and oilfield pumps.....	{ 8413.50.0010 8413.60.0050	{ 8413.50.0010 8413.60.0050
35631 29 35631 33 35631 34 35631 36 35631 37 35631 38 35631 39	Air compressors, portable.....	{ 8414.40.0000 8414.80.1095	{ 8414.40.0000 8414.80.1085 8414.80.1090

See footnotes at end of table.

Table 6. COMPARISON OF STANDARD INDUSTRIAL CLASSIFICATION-BASED PRODUCT CODES WITH  
SCHEDULE B EXPORT NUMBERS, AND HTSUSA IMPORT NUMBERS: 1991—Continued

Product code	Product description	Export number <sup>1</sup>	Import number
35631 01	Stationary reciprocating air compressors, single and double acting.....	{ 8414.80.1018 8414.80.1042 8414.80.1055	8414.80.1005
35631 02			8414.80.1015
35631 03			8414.80.1025
35631 04			8414.80.1035
35631 05			8414.80.1040
35631 06			8414.80.1045 8414.80.1055
35631 42	Gas compressors, stationary, axial and centrifugal.....	8414.80.2010	8414.80.2010
35631 43			
35631 07	Air compressors, stationary, rotary positive, centrifugal, and axial.....	{ 8414.80.1060 8414.80.1067 8414.80.1075 8414.80.1080	8414.80.1060
35631 10			8414.80.1065
35631 11			8414.80.1070
35631 12			8414.80.1075
35631 13			8414.80.1080
35631 14			
35631 15			
35631 17			
35631 19			
35631 46	Reciprocating and rotary gas compressors.....	{ 8414.80.2050 8414.80.2060 8414.80.2070	8414.80.2050
35631 47			8414.80.2060
35631 48			8414.80.2070
35631 51			
35631 53			
35631 56			
35631 89	All other compressors.....	8414.80.9000	8414.80.9000
35631 93	Vacuum pumps.....	8414.10.0000	8414.10.0000
35631 94			

<sup>1</sup>Source: 1991 edition, Harmonized System-Based Schedule B, Statistical Classification of Domestic and Foreign Commodities Exported from the United States.

<sup>2</sup>Source: Harmonized Tariff Schedule of the United States, Annotated (1991).

## DESCRIPTION OF SURVEY

**Scope of Survey.** This survey covers companies engaged in manufacturing industrial pumps, (reciprocating, turbine, centrifugal, and rotary pumps); domestic water systems, including domestic sump pumps; oil well and oilfield pumps; air compressors; gas compressors; and vacuum pumps. Very small firms (generally less than 5 employees) for which 1987 Census of Manufactures data were derived from administrative records of other government agencies are excluded. Excluded from this survey are hand pumps; measuring and dispensing pumps; automotive circulating pumps; hydraulic fluid power pumps; paint-spraying equipment; compressors for ice making, refrigeration equipment, and air-conditioning units; and replacement and repair parts for pumps and compressors.

**Survey Methodology.** The statistics in this publication were collected by mail on Bureau of the Census annual Form MA35P, Pumps and Compressors. The survey panel includes all known manufacturers of the covered products, except the very small firms excluded from the scope of the survey. Approximately 331 companies are included. No estimate is derived for the small firms excluded from the survey.

**Reliability of Data.** Survey error may result from several sources: (1) inability to obtain information about all cases in the survey; (2) response errors; (3) definitional difficulties; (4) differences in the interpretation of questions; (5) mistakes in recording or coding the data obtained; and (6) other errors of collection, response, coverage, and estimation for missing data. These nonsampling errors also occur in complete censuses. Although no direct measurement of the biases due to nonsampling errors has been obtained, precautionary steps were taken in all phases of the collection, processing, and tabulation of the data in an effort to minimize their influence.

A major source of bias in the published estimates is due to imputing data for nonrespondents, for late reporters, and for data which fail logic edits. Missing figures are imputed based on yearly movements shown by reporting firms. Imputation generally is limited to a maximum of 10 percent for any one data cell. Figures with imputation rates greater than 10 percent are footnoted.

The imputation rate is not an explicit indicator of the potential error in published figures due to nonresponse, because the actual yearly movements for nonrespondents may or may not closely agree with the imputed movements. The range of difference between the actual and imputed figures is not precisely known, but is assumed to be small. The degree of uncertainty regarding the accuracy of the published data increases as the percentage of imputation increases. Figures with imputation rates above 10 percent should be used with caution.

**Revisions to Previous Period Data.** Statistics for previous years may be revised as the result of corrected data from respondents, late reports for which imputations were made as described above, or other corrections. Figures which have been revised by more than 5 percent from previously published figures are indicated by footnotes.

**Adjustment for Price Change.** All dollar figures included in this publication are in current dollars; i.e., they have not been adjusted for price change.

## EXPLANATION OF TERMS

**Quantity and Value of Shipments.** The figures on quantity and value of shipments represent physical shipments of all products sold, transferred to other establishments of the same company, or shipped on consignment, whether for domestic or export sale. The value represents the net sales price, f.o.b. plant, to the customer or branch to which the products are shipped, net of discounts, allowances, freight charges, and returns. Shipments to a company's own branches are assigned the same value as comparable sales to unaffiliated customers; i.e., the value includes an appropriate allocation of company overhead and profit. Products bought and resold without further manufacture are excluded.

**Pump.** A device for raising, transferring, or moving fluids or for attenuating gases by suction or pressure or both.

**Driver.** An electric motor, or a prime mover, such as steam engine, steam or gas turbine, or internal combustion engine.

### *Classes of Pumps:*

**Direct-Acting Steam-Driven.** A reciprocating pump and a steam engine built together as a unit. The power to drive the pump is furnished by the steam engine.

**Power-Operated, Other Than Steam.** A reciprocating pump driven by power from an outside source applied to the crankshaft of the pump.

### *Types of Pumps:*

**Single (Simplex) Pump.** A reciprocating pump having one liquid piston or its equivalent single or double acting plunger.

**Duplex Pump.** A reciprocating pump having two liquid pistons or their equivalent single or double acting plungers.

**Triplex Pump.** A reciprocating pump having three pistons or their equivalent single or double acting plungers.



**Multiplex Pump.** A reciprocating pump having more than three pistons or their equivalent single or double acting plungers.

**Horizontal Pump.** A reciprocating pump having the axial centerline of the cylinder or cylinders in a horizontal position.

**Vertical Pump.** A reciprocating pump having the axial centerline of the cylinder or cylinders in a vertical position.

**Vertical Turbine Pumps (Including Deep Well).** A submersible pump system, over 5 horsepower. Submersible pump systems, 5 horsepower and under, are included in domestic water systems.

#### **Centrifugal Pumps:**

##### **Classes of Pumps:**

**Centrifugal Pump.** A pump in which the pressure is developed principally by the action of centrifugal force. Pumps in this class with single inlet impellers usually have a specific speed below 4200, and with double suction impellers, a specific speed of below 6000. In pumps of this class, the liquid normally enters the impeller at the hub and flows radially to the periphery.

**Frame Mounted Pumps.** A pump design in which the impeller is mounted on a shaft, held in a bearing frame and coupled to a motor with a flexible coupling.

**Close Coupled Pumps.** A pump design in which the impeller is mounted on the motor shaft.

**Mixed Flow Pump.** A pump in which the head is developed partly by centrifugal force and partly by the lift of the vanes on the liquid. This type pump has a single inlet impeller with the flow entering axially and discharging in an axial and radial direction. Pumps of this type usually have a specific speed from 4200 to 9000.

**Axial Flow Pump.** A pump of this type, sometimes called a propeller pump, develops most of its head by the propelling or lifting action of the vanes on the liquid. It has a single inlet impeller, with the flow entering axially and discharging nearly axially. Pumps of this type usually have a speed above 9000.

#### **Types of Pumps:**

**Single Stage Pump.** A pump in which the total head is developed by one impeller.

**Multistage Pump.** A pump having two or more impellers acting in series in one casing.

**Single Suction Pump.** A pump equipped with one or

more single suction impellers.

**Double Suction Pump.** A pump equipped with one or more double suction impellers.

**Rotary Pumps.** A positive displacement pump, consisting of a fixed casing containing gears, cams, screws, vanes, plungers, or similar elements actuated by rotation of the drive shaft. These pumps are characterized by their close running clearances and the absence of suction and discharge valves.

**Domestic Water Systems.** Water supply pumps for household and farm use. A pump sold separately as well as a complete system containing driver, tank, and fittings. Includes submersible pump systems 5 hp and under. Submersible pump systems over 5 hp. are reported as vertical turbine pumps. Excluded are irrigation pumps, which are reported under industrial pumps by class and type of pump.

**Jet Pump.** A pump with built-in jet (ejector) assembly for either shallow or deep well use.

**Convertible Jet Pump.** A pump with separate jet (ejector) assembly which permits installation as or conversion to either shallow or deep well settings.

**Nonjet Pump.** An electrical reciprocating piston pump for shallow or deep well use.

**Submersible Pump.** A pump completely submerged in water (well, pond, reservoir, etc.) which utilizes a series of impellers and diffusers (stages) on a single shaft or a helical rotor positive displacement design propelled by an oilfilled or water-lubricated motor.

**Domestic Hand Pumps, Etc.** Hand, windmill, or engine-driven well pumps not electrically powered.

**Oil Well and Oilfield Pumps.** Included are pumps especially designed for oil well and oilfield applications.

**Vacuum Pumps.** A device for withdrawing air, gas, or airgas mixtures from piping systems, enclosed vessels, or enclosed spaces, discharging the air to atmosphere, and removing the moisture.

**Compressors.** Devices for compressing gases, such as air, for motive power or natural gas for the transfer of gas or for the recovery of liquid hydrocarbons.

**Stationary Air Compressors.** Air compressors intended for permanent installation and which are not typically mobile.

**Portable Air Compressors.** Air compressors are mountable on wheels, skids, or motor trucks so as to be typically mobile.

**Gas Compressors.** Engine-compressor units that generally consist of an integral engine compressor block

that houses both the engine and compressor. In such machines, the engine pistons and compressor pistons are mounted on a common crankshaft.

## COMPARISON OF EXPORT, IMPORT, AND DOMESTIC OUTPUT DATA

The trade comparisons shown in this report should be considered only as approximations. Several problems prevent precise comparisons among imports, exports, and domestic output. These problems include the following:

- Export and import comparisons do not account for the origin of materials used to manufacture the finished product. Domestic output includes any goods that undergo substantial transformation into a finished product in the U.S., even if the goods are partially constructed abroad or are constructed of imported materials.
- There will be a lag between the time a producer makes or ships a product and the time it is actually exported. Similarly, there may be a lag between the time a product is imported and when it enters into U.S. distribution channels.

The basic structures of these classification systems differ. The Standard Industrial Classification (SIC) system used for domestic output was developed independently of the Harmonized System (HS) used to classify imports and exports. The level of detail provided by the different systems varies substantially, reflecting their different objectives. For example, there are a number of imported commodities that have no comparable domestic output classification.

- Because producers' shipments of some commodities may be used as materials for incorporation into other commodities, combinations of domestic output data for such commodities may contain some duplication.
- Import and export data reflect the movement of merchandise into and out of U.S. foreign trade zones, the U.S. Virgin Islands, and the U.S. customs territory of the 50 States, the District of Columbia, and Puerto Rico. Domestic output reflects activity in the 50 States and, only if specified, in Puerto Rico.
- Import and export data generally do not distinguish between new, used or rebuilt commodities.
- The valuations of the three data sets differ. Domestic output is valued at the point of production. It includes the net sales price, f.o.b. plant, after discounts and allowances, and excludes freight charges and excise taxes. Exports are valued at the point of exportation. Export value includes the net sales price or value, and inland freight, insurance and other charges to the

export point. Imports are valued at the first port of entry in the United States. They include the cost, insurance, freight, duty, and other charges to the import point.

- Detailed commodity information is not included for individual export or import shipments at or below a certain dollar limit. This dollar limit is \$2,500 for exports and \$1,250 for imports, except for import of textiles and textile products, gloves, footwear, and miscellaneous rubber and plastics products, where the limit is \$250.

## HISTORICAL NOTE

Data on pumps and compressors have been collected by the Bureau of the Census since 1960. Data on hydraulic fluid power pumps and motors formerly collected on this survey are now included in the Current Industrial Report, MA35N, *Fluid Power Products*. Historical data may be obtained from Current Industrial Reports available at your local Federal Depository Library. A list of these libraries may be obtained from the Bureau of the Census regional offices:

Office	Telephone
Atlanta, Georgia	404-730-3833
Boston, Massachusetts	617-565-7100
Charlotte, North Carolina	704-344-6142
Chicago, Illinois	312-353-6251
Dallas, Texas	214-767-0621
Denver, Colorado	303-969-6750
Detroit, Michigan	313-354-4654
Kansas City, Kansas	913-236-3728
Van Nuys, California	818-904-6339
New York, New York	212-264-4730
Philadelphia, Pennsylvania	215-597-8313
Seattle, Washington	206-728-5314

Historical data are also available on microfiche. For further information contact the Bureau of the Census, Data User Services Division, 301-763-4100.

## RELATED REPORTS

The Bureau of the Census publishes the following related reports:

Series	Frequency	Title
<i>Current Industrial Reports</i>		
MA35D	Annually	<i>Construction Machinery</i>
MA35F	Annually	<i>Mining Machinery and Mineral Processing Equipment</i>
MA35L	Annually	<i>Internal Combustion Engines</i>

U.S. Department of Commerce  
BUREAU OF THE CENSUS  
Washington, D.C. 20233

Official Business  
Penalty for Private Use, \$300

FIRST-CLASS MAIL  
POSTAGE & FEES PAID  
CENSUS  
PERMIT No. G-58

Series	Frequency	Title	Subject Area	Contact	Phone Number
MA35M	Annually	<i>Air-Conditioning and Refrigeration Equipment</i>	Classification Systems Comparability	Francis McCormick (ESD)	301-763-1935
MA35N	Annually	<i>Fluid Power Products</i>	Foreign Trade	Trade Data Inquiries Staff (FTD)	301-763-5140
MA36H	Annually	<i>Motors and Generators</i>			
<i>Other Industry Reports</i>					
M3-1	Monthly	<i>Manufacturers' Shipments, Inventories, and Orders</i>	Census/ASM	Tom Lee	301-763-579
(AS)	Annually	Annual Survey of Manufactures (ASM)	International Trade Administration	Edward McDonald	202-377-0680
(MC)	Quinquennially	Census of Manufactures	To order a Current Industrial Report	Superintendent of Documents (GPO)	202-783-3238
<i>Foreign Trade Reports</i>					
CD-ROM	Monthly/Annually	<i>U.S. Exports—Schedule B—Commodity by Country</i>	To subscribe to a Census Bureau publication	Superintendent of Documents (GPO)	202-512-2303
FT 447	Annually				
CD-ROM	Monthly/Annually	<i>U.S. Imports for Consumption—HTSUSA—Commodity by Country</i>			
FT 247	Annually				

#### CONTACTS FOR DATA USERS

Subject Area	Contact	Phone Number
Current Industrial Report MA35P	Lynn Jedrey	301-763-5547

#### ACKNOWLEDGMENTS

This report was prepared in the Industry Division, Bureau of the Census, under the direction of Thomas Flood, Chief, Current Durables Branch, and Milbren Thomas, Chief, Machinery and Equipment Section. Lynn Jedrey was directly responsible for the review of the data and preparation of the report. Roger H. Bugenhagen, Acting Chief of the Division, and Robert N. Tinari, Assistant Chief for Current Industrial Reports, provided overall direction and coordination to this project.



# Motors and Generators

1991

MA36H(91)-1  
Issued November 1992

U.S. Department of Commerce  
Economics and Statistics Administration  
BUREAU OF THE CENSUS

## SUMMARY OF FINDINGS

During 1991, manufacturers' value of shipments of motors and generators, including interplant transfers, totaled \$7,646.3 million, a 1-percent increase above the revised 1990 shipments of \$7,552.8 million.

The 1991 data for individual categories of motors and generators exhibited the following changes: The dollar value of shipments of fractional horsepower motors decreased 3 percent, to \$3,584.2 million in 1991 from \$3,698.3 million in 1990; integral horsepower motors and generators showed an increase of 1 percent in the value of shipments, from \$1,568.3 million in 1990 to

\$1,597.0 million in 1991. The dollar value of shipments of land transportation motors and generators decreased 1 percent, from \$198.6 million to \$195.4 million. There was a 13-percent decrease in the value of shipments of prime mover generator sets sold. In 1991, \$1,139.5 million was reported in this category compared with the \$991.9 million reported in 1990. Electric motor generator sets and other rotating equipment, including hermetics and parts, showed a 2-percent increase in value, from \$1,127.1 million to \$1,098.8 million.

A description of the survey methodology and related information appears on page 10.

Table 1. VALUE OF SHIPMENTS OF MOTORS AND GENERATORS, BY PRODUCT CLASS: 1982 TO 1991

(Millions of dollars)											
Product code	Product description	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982
3621	Motors and generators.....	7,646.3	7,552.8	7,947.3	7,664.1	6,806.2	6,198.6	6,267.3	6,314.6	5,651.5	5,859.1
36211	Fractional horsepower motors, excluding hermetics.....	3,584.2	3,698.3	4,049.7	3,983.5	3,493.8	3,258.6	3,322.3	3,208.3	2,912.4	2,501.5
36212	Integral horsepower motors and generators, other than for land transportation equipment.....	1,597.0	1,568.3	1,573.5	1,477.0	1,249.7	1,191.5	1,201.2	1,209.3	1,134.5	1,409.8
36213	Land transportation motors, generators, and control equipment <sup>1</sup> .....	198.6	195.4	237.4	190.4	228.6	257.4	473.9	461.0	303.4	428.1
36214	Prime mover generator sets, except steam or hydraulic turbine.....	1,139.5	991.9	998.0	<sup>2</sup> 956.2	779.4	789.5	699.8	789.3	731.0	911.8
	Motor generator sets and other rotating equipment:										
36217	Fractional.....	325.4	311.4	281.1	250.5	248.7	231.1	268.4	303.0	260.1	261.4
36218	Integral.....	387.8	359.0	342.7	318.7	282.2	275.4	301.8	343.6	310.1	311.4
36219 <sup>1</sup>	Parts for motors and generators.....	413.9	428.4	464.9	<sup>2</sup> 487.8	<sup>2</sup> 479.6	195.2	(NA)	(NA)	(NA)	(NA)

(NA) Not available. <sup>2</sup> Revised by 5 percent or more from previously published figures.

<sup>1</sup> Prior to 1986, data for product code 36219, parts for motors and generators, were collected only on a partial basis and included with product code 36213.

<sup>2</sup> Revised downward due to reporting errors.

Address inquiries concerning these figures to U.S. Department of Commerce, Bureau of the Census, Industry Division, Washington, D.C. 20541 or call Robert Wright, 301-763-5573.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Table 2. QUANTITY AND VALUE OF SHIPMENTS OF MOTORS AND GENERATORS: 1991 AND 1990

(Value in thousands of dollars)

Product code	Product description	Number of companies	1991		1990	
			Quantity <sup>1</sup>	Value	Quantity <sup>1</sup>	Value
3621	Motors and generators.....	(NA)	(X)	7,646,263	(X)	7,552,788
36211 --	Fractional horsepower (excluding hermetics and other rotating equipment).	(NA)	282,890	3,584,182	292,579	3,698,323
36211 OM	Used in automobile accessories (excluding starter motors and generators) include a.c. and d.c.....	13	117,997	890,405	130,849	1,007,954
	Used in aircraft and spacecraft (excluding generators):					
36211 OM	A.c.....	22	217	47,516	284	50,500
36211 OP	D.c.....	22	393	85,759	380	88,267
36211 OR	Used in toys (all sizes, a.c. and d.c.).....	1				
36211 OS	Used for clock-type synchronous and subsynchronous timing, a.c and d.c.	8	18,458	72,274	20,776	72,265
	All other uses:					
	A.c. (non-commutated).....	(NA)	116,728	1,875,131	113,391	1,879,162
36211 X2	Single phase or polyphase:					
	Less than 746 watts, under 1 hp (3 digit FS).....	6	2,340	2,64,600	2,364	2,47,516
	Single phase:					
	Skeleton type shaded pole.....	(NA)	25,388	100,783	23,941	97,286
36211 1A	Less than 2.75 inch diameter at widest point.....	10	7,735	37,982	7,101	35,488
36211 1B	2.75 inch diameter and over.....	4	17,653	62,801	16,840	61,798
	Conventional type shaded pole.....	(NA)	48,153	363,549	42,986	340,091
36211 1C	Less than 2.5 inch diameter.....	6	(D)	(D)	(D)	(D)
	2.5 to less than 3.75 inch diameter:					
36211 1D	2 pole.....	6	5,845	68,696	5,567	63,161
36211 1E	4 pole and over.....	7	12,077	107,429	12,038	103,765
36211 1F	3.75 to less than 4.375 inch diameter.....	4	2,718	34,092	2,774	33,431
	4.375 to less than 5.375 inch diameter:					
36211 1G	2 pole and 4 pole.....	6	2,095	33,052	2,107	31,637
36211 1H	6 pole and over.....	6	(D)	(D)	(D)	(D)
36211 1I	5.375 inch diameter and over.....	4	(D)	(D)	(D)	(D)
	Permanent split capacitor.....	(NA)	12,346	317,502	13,344	341,763
36211 1J	Less than 2.5 inch diameter.....	6	(D)	(D)	(D)	(D)
	2.5 to less than 3.75 inch diameter:					
36211 1K	2 pole.....	9	762	18,871	724	15,497
36211 1L	4 pole and over.....	9	990	18,622	1,410	24,423
	3.75 to less than 4.375 inch diameter:					
36211 1M	2 pole.....	3	67	2,714	103	3,826
36211 1N	4 pole and over.....	8	667	13,112	770	13,319
	4.375 to less than 5.375 inch diameter:					
36211 1O	2 pole.....	3	(D)	(D)	(D)	(D)
36211 1P	4 pole.....	9	899	17,099	716	18,607
36211 1R	6 pole and over.....	8	834	22,173	964	23,503
	5.375 to less than 6 inch diameter:					
36211 1S	Less than 746 watts, under 1 hp (2 digit FS).....	11	3,098	3,212,756	3,870	3,231,494
36212 1A	746 watts and over, 1 hp and over (2 digit FS) (see code 36212 X4).....	3	(4)	(4)	(4)	(4)
	6 inch diameter and over:					
36211 1U	Less than 746 watts, under 1 hp (2 digit FS).....	5	(3)	(3)	(3)	(3)
36212 1B	746 watts and over, 1 hp and over (2 digit FS) (see code 36212 X4).....	4	(4)	(4)	(4)	(4)
	Capacitor start.....	(NA)	7,031	218,736	7,703	218,041
36211 12	Less than 2.5 inch diameter.....	4				
36211 13	2.5 to less than 3.75 inch diameter.....	8	5,416	111,835	5,758	118,255
36211 14	3.75 to less than 4.375 inch diameter.....	5	733	49,913	737	50,294
36211 15	4.375 to less than 5.375 inch diameter.....	7	391	16,578	404	17,112
	5.375 to less than 6 inch diameter:					
36211 16	Less than 746 watts, under 1 hp (2 digit FS).....	6	265	15,860	274	11,576
36212 1C	746 watts and over, 1 hp and over (2 digit FS) (see code 36212 X4).....	5	(4)	(4)	(4)	(4)
	6 inch diameter and over:					
36211 18	Less than 746 watts, under 1 hp (2 digit FS).....	7	226	24,550	530	20,804
36212 1D	746 watts and over, 1 hp and over (2 digit FS) (see code 36212 X4).....	7	(4)	(4)	(4)	(4)
	Split phase.....	(NA)	9,403	293,902	10,529	322,097
36211 32	Less than 2.5 inch diameter.....	1				
36211 33	2.5 to less than 3.75 inch diameter.....	4	17	1,855	17	1,775
36211 34	3.75 to less than 4.375 inch diameter.....	3				
36211 35	4.375 to less than 5.375 inch diameter.....	6	1,966	38,570	2,009	38,970
	5.375 to less than 6 inch diameter:					
36211 36	Less than 746 watts, under 1 hp (2 digit FS).....	9	(D)	(D)	(D)	(D)
36212 3E	746 watts and over, 1 hp and over (2 digit FS) (see code 36212 X4).....	4	(4)	(4)	(4)	(4)
	6 inch diameter and over:					
36211 38	Less than 746 watts, under 1 hp (2 digit FS).....	5	(D)	(D)	(D)	(D)
36212 3F	746 watts and over, 1 hp and over (2 digit FS) (see code 36212 X4).....	2	(4)	(4)	(4)	(4)
	All other single phase.....	(NA)	12,565	402,018	12,854	403,734
36211 42	Less than 2.5 inch diameter.....	1				
36211 43	2.5 to less than 3.75 inch diameter.....	1	(D)	(D)	(D)	(D)
36211 44	3.75 to less than 4.375 inch diameter.....	1				
36211 45	4.375 to less than 5.375 inch diameter.....	3				
	5.375 to less than 6 inch diameter:					
36211 46	Less than 746 watts, under 1 hp (2 digit FS).....	4	(D)	(D)	(D)	(D)
36212 4C	746 watts and over, 1 hp and over (2 digit FS) see code 36212 X4).....	3	(4)	(4)	(4)	(4)
	6 inch diameter and over:					
36211 48	Less than 746 watts, under 1 hp (2 digit FS).....	5	6,976	227,113	7,371	249,883
36212 4H	746 watts and over, 1 hp and over (2 digit FS) see code 36212 X4).....	4	(4)	(4)	(4)	(4)

See footnotes at end of table.

Table 2. QUANTITY AND VALUE OF SHIPMENTS OF MOTORS AND GENERATORS: 1991 AND 1990—Continued

(Value in thousands of dollars)

Product code	Product description	Number of companies	1991		1990	
			Quantity <sup>1</sup>	Value	Quantity <sup>1</sup>	Value
	Fractional horsepower (hermetics and other rotating equipment)—Continued					
	All other uses—Continued					
	A.c. (non-commutated)—Continued					
	Single phase or polyphase—Continued					
	Single phase—Continued					
	Polyphase (servo and non-servo).....	(NA)	1,502	114,041	1,670	108,634
	Synchronous stepper motors:					
36211 S1	Less than 3 inch diameter.....	8	732	40,690	927	44,743
36211 S2	3 to less than 4 inch diameter.....	2				
36211 S3	4 to less than 6 inch diameter.....	3				
36211 S4	6 inch diameter and over.....	1				
	All other polyphase:					
	Servo (induction rotor):					
36211 SM	Less than 4.375 inch diameter.....	3	141	14,695	135	11,956
36211 SN	4.375 to less than 5.375 inch diameter.....	2				
36211 SO	5.375 inch diameter and over.....	2				
	Non-servo:					
36211 SP	Less than 4.375 inch diameter.....	9	51	8,662	23	2,971
36211 SR	4.375 to less than 5.375 inch diameter.....	6				
	5.375 to less than 6 inch diameter:					
36211 ST	Less than 736 watts, under 1 hp (2 digit FS).....	10	247	22,758	246	22,068
36212 SI	746 watts and over, 1 hp and over (2 digit FS) (see code 36212 X5).....	5	(4)	(4)	(4)	(4)
	6 inch diameter and over:					
36211 SV	Less than 746 watts, under 1 hp (2 digit FS).....	8	331	27,236	339	26,896
36212 SJ	746 watts and over, 1 hp and over (2 digit FS) (see code 36212 X5).....	6	(4)	(4)	(4)	(4)
	D.c. or universal motors by case size.....	(NA)	29,097	613,097	26,899	600,175
	Less than 4.0 inch diameter.....	45	28,746	349,591	26,532	333,768
	4.0 inch diameter and over.....	12	349	263,506	366	266,407
	By commutation:					
	Mechanically commutated (brushes, for example).....	(NA)	17,909	339,244	16,680	316,188
	Cased or sleeved:					
36211 6E	Less than 2.875 inch diameter.....	17	3,007	42,559	3,575	42,265
36211 6F	2.875 to less than 3.188 inch diameter.....	11	1,224	24,310	1,263	24,373
36211 6G	3.188 to less than 3.563 inch diameter.....	11	116	6,665	88	5,029
	3.563 inch diameter and over:					
36211 6H	Less than 746 watts, under 1 hp (2 digit FS).....	9	(D)	(D)	(D)	(D)
36212 6K	746 watts and over, 1 hp and over (2 digit FS) (see code 36212 X6).....	4	(4)	(4)	(4)	(4)
	Uncased:					
36211 6J	Less than 2.875 inch diameter.....	9	5,403	45,586	4,323	37,728
36211 6K	2.875 to less than 3.188 inch diameter.....	6	7,932	157,815	7,279	149,047
36211 6L	3.188 to less than 3.563 inch diameter.....	—				
36211 6M	3.563 to less than 4.375 inch diameter.....	4				
	4.375 inch diameter and over:					
36211 6N	Less than 746 watts, under 1 hp (2 digit FS).....	2	(D)	(D)	(D)	(D)
36212 6L	746 watts and over, 1 hp and over (2 digit FS) (see code 36212 X6).....	1	(4)	(4)	(4)	(4)
	Permanent magnet (brushes).....	(NA)	10,560	232,526	9,658	244,153
	Servo:					
36211 8F	Less than 2.0 inch diameter.....	7	2,833	55,528	1,921	48,013
36211 8G	2.0 to less than 4.0 inch diameter.....	10				
36211 8H	4.0 inch diameter and over.....	5				
	Non-servo:					
36211 8I	Less than 2.0 inch diameter.....	8	6,910	124,237	6,759	132,906
36211 8J	2.0 to less than 4.0 inch diameter.....	20				
36211 8K	4.0 inch diameter and over.....	11				
	Wound field:					
36211 8L	Less than 2.0 inch diameter.....	—	—	—	—	—
36211 8M	2.0 to less than 4.0 inch diameter.....	8	635	19,853	755	23,234
36211 8N	4.0 inch diameter and over.....	7				
	Electronically commutated.....	(NA)	628	41,327	561	39,834
	Stepper:					
36211 91	Less than 3 inch diameter.....	6	320	23,550	351	22,572
36211 92	3 inch diameter and over.....	6				
	All other:					
	Servo:					
36211 93	Less than 4.375 inch diameter.....	4	18	6,333	27	7,884
36211 94	4.375 to less than 5.375 inch diameter.....	1				
36211 95	5.375 inch diameter and over.....	2				
36211 96	Non-servo.....	5	(D)	(D)	(D)	(D)
36212 --	Integral horsepower (excluding hermetics and other rotating equipment)...	(NA)	7,039,978	1,596,915	7,026,382	1,568,326
36212 04	Used in aircraft and spacecraft (exclude generators).....	4	10,905	38,597	12,742	38,621
	All other uses:					
	A.c. (non-commutated).....	(NA)	4,140,416	1,286,729	4,209,125	1,262,193
	Motors.....	(NA)	2,111,211	140,326	2,202,929	146,141
	Single phase:					
36211 1W	Less than 746 watts, under 1 hp (3 digit FS) (see code 36211 X2).....	3	(2)	(2)	(2)	(2)
36212 12	746 watts and over, 1 hp and over (3 digit FS).....	10	147,637	33,116	148,437	33,001
36212 X4	746 watts and over, 1 hp and over (2 digit FS).....	(NA)	1,963,574	107,210	2,054,492	113,140
	Polyphase induction (exclude synchronous).....	(NA)	1,943,021	914,898	1,912,999	873,805
	All motors, including energy efficient (EE).....	(NA)	1,947,691	945,248	1,917,818	907,371
36211 1X	Less than 0.746 watts, less than 1 hp (3 digit FS) (see code 36211 X3).....	3	(2)	(2)	(2)	(2)
36212 X5	746 watts and over, 1 hp and over (2 digit FS).....	(NA)	350,879	37,377	379,544	43,231
36212 15	0.746 to 3.371 kW, 1 through 5 hp.....	15	889,804	142,880	771,539	137,304
36212 16	3.731 to less than 14.921 Kw, greater than 5 through 20 hp...	18	482,469	153,120	553,446	154,624

See footnotes at end of table.

Table 2. QUANTITY AND VALUE OF SHIPMENTS OF MOTORS AND GENERATORS: 1991 AND 1990—Continued

(Value in thousands of dollars)						
Product code	Product description	Number of companies	1991		1990	
			Quantity <sup>1</sup>	Value	Quantity <sup>1</sup>	Value
	Integral horsepower (excluding hermetics and other rotating equipment)—Continued					
	All other uses—Continued					
	A.c. (non-commutated)—Continued					
	Motors—Continued					
	Polyphase induction (exclude synchronous)—Continued					
	All motors, including energy efficient (EE)—Continued					
36212 17	14.921 to less than 37.301 kW, greater than 20 through 50 hp.....	15	132,852	118,621	126,993	104,724
36212 18	37.301 to less than 74.601 kW, greater than 50 through 100 hp.....	15	39,687	90,782	35,179	78,077
36212 19	74.601 to less than 149.201 kW, greater than 100 through 200 hp.....	17	29,521	117,976	28,546	112,708
36212 20	149.601 kW to less than 373.001 kW, greater than 200 through 500 hp.....	18	15,670	164,095	15,593	159,373
36212 27	373.001 to less than 746.001, greater than 500 through 1,000 hp.....	10				
36212 28	746.001 to less than 1,865.001 kW, greater than 1,000 through 2,500 hp.....	5	2,139	90,047	2,109	83,557
36212 29	1,865.001 kW and over, greater than 2,500 hp.....	4				
	Energy efficient motors (included in product code 36212 15-36212 19 above).....	(NA)	253,848	146,190	235,554	139,161
36212 2K	0.746 to 3.371 kW, 1 through 5 hp.....	8	61,657	34,041	57,710	30,878
36212 2L	3.731 to less than 14.921 kW, greater than 5 through 20 hp.....	8	131,106	40,131	125,687	38,595
36212 2N	14.921 to less than 37.301 kW, greater than 20 through 50 hp.....	8	39,740	27,014	31,784	27,625
36212 2N	37.301 to less than 74.601 kW, greater than 50 through 100 hp.....	8	13,124	22,358	12,620	21,221
36212 2P	74.601 to less than 149.201 kW, greater than 100 through 200 hp.....	8	8,221	22,646	7,753	20,842
	Synchronous (servo and non-servo).....	(NA)	4,670	30,350	4,819	33,566
36212 31	Less than 149.201 kW through 200 hp.....	4	4,670	30,350	4,819	33,566
36212 32	149.201 and over, over 200 hp.....	4				
	A.c. generators (for internal combustion engines).....	(NA)	76,844	170,805	83,559	175,115
36212 36	Less than 1.5 kva.....	3	36,930	14,710	43,259	15,595
36212 37	1.5 to less than 5 kva.....	6				
36212 38	5 to less than 15 kva.....	14	10,956	19,210	9,102	16,486
36212 39	15 to less than 40 kva.....	8	12,827	43,878	14,667	45,989
36212 41	40 to less than 75 kva.....	7				
36212 42	75 to less than 200 kva.....	7	7,311	21,021	7,741	23,119
36212 43	200 to less than 375 kva.....	6				
36212 44	375 to less than 750 kva.....	6	6,617	36,833	6,747	38,390
36212 45	750 to less than 1,250 kva.....	4				
36212 46	1,250 to less than 2,500 kva.....	4	2,203	35,153	2,043	35,536
36212 47	2,500 to less than 10,000 kva.....	4				
36212 48	10,000 kva and over.....	-	-	-	-	-
	D.c. motors and generators (exclude all arc welding and battery charging generators for internal combustion engines).....	(NA)	2,888,657	271,589	2,804,515	267,512
	Motors and generators:					
	0.746 to less than 3.375 kW, 1 through 5 hp:					
36212 61	Permanent magnet.....	8	2,700,154	103,893	2,658,223	106,538
36212 62	Wound field.....	8				
36212 63	Other (includes universal and electric commutated).....	2	63,861	14,469	39,506	10,074
36212 64	746 watts and over, 1 hp and over (2 digit FS).....	(NA)				
36212 66	3.731 to less than 14.921 kW, greater than 5 through 20 hp.....	7	114,367	46,453	96,310	44,908
36212 65	14.921 to less than 74.601 kW, greater than 20 through 100 hp.....	3				
36212 66	74.601 to less than 149.201 kW, greater than 100 through 200 hp.....	3	10,275	106,774	10,476	105,992
36212 67	149.201 kW to less than 373.001 kW, greater than 200 through 500 hp.....	2				
36212 68	373.001 kW and over, greater than 500 hp.....	3				
36213 --	Motors and generators for land transportation (including those used in associated control equipment).....	(NA)	535,401	198,645	537,880	195,425
36213 01	Used for trolley cars, trolley coaches, rapid transit cars, trolley locomotives, third-rail locomotives, multiple unit cars for railway service, and mining locomotives.....	3	535,401	198,645	537,880	195,425
36213 21	Used for gasoline-electric and diesel-electric buses, trucks, locomotives, and rail cars.....	4				
36213 41	All other types of land transportation.....	4				
36214 --	Prime mover generator sets, except steam or hydraulic turbine and electric motor-driven generator sets.....	(NA)	343,317	1,139,465	351,710	991,905
	Gas/gasoline engine-driven generator sets, a.c. and d.c. output.....	(NA)	298,939	259,685	315,339	260,826
36214 03	Under 1.5 kva.....	8	240,899	123,132	258,374	133,474
36214 04	1.5 to less than 5 kva.....	21				
36214 05	5 to less than 15 kva.....	23	48,354	66,283	47,231	66,780
36214 07	15 to less than 50 kva.....	19	4,957	23,894	5,431	23,329
36214 08	50 to less than 100 kva.....	14	4,186	15,875	4,037	17,189
36214 10	100 to less than 500 kva.....	12	457	8,601	208	7,828
36214 12	500 to less than 1,000 kva.....	5	86	21,900	58	12,226
36214 13	1,000 kva and over.....	2				
	Diesel engine-driven generator sets, a.c. and d.c. output.....	(NA)	44,378	879,780	36,371	731,079
36214 41	Under 15 kva.....	22	16,236	85,551	11,138	66,061
36214 42	15 to less than 50 kva.....	27	5,863	48,842	4,914	37,891
36214 43	50 to less than 100 kva.....	30	4,569	46,333	4,058	47,274
36214 44	100 to less than 200 kva.....	29	4,646	68,509	5,243	74,048
36214 45	200 to less than 400 kva.....	28	6,238	170,271	5,101	141,804
36214 46	400 to less than 600 kva.....	20	2,179	76,481	1,559	50,860
36214 47	600 to less than 800 kva.....	19	1,285	66,332	1,178	53,619
36214 48	800 to less than 1,000 kva.....	15	1,024	78,524	981	61,014
36214 49	1,000 to less than 2,000 kva.....	15	1,430	167,301	1,204	127,987
36214 50	2,000 to less than 3,000 kva.....	7				

See footnotes at end of table.

Table 2. QUANTITY AND VALUE OF SHIPMENTS OF MOTORS AND GENERATORS: 1991 AND 1990—Continued

(Value in thousands of dollars)

Product code	Product description	Number of companies	1991		1990	
			Quantity <sup>1</sup>	Value	Quantity <sup>1</sup>	Value
	Prime mover generator sets, except steam or hydraulic turbine and electric motor-driven generator sets—Continued					
	Diesel engine-driven generator sets, a.c. and d.c. output—Continued					
36214 51	3,000 kva and over.....	3	5,608	5,71,636	5,995	5,70,521
	Dual fuel (oil and gas) engine-driven generator sets, a.c. and d.c. output:					
36214 52	Under 2,000 kva.....	1				
36214 53	2,000 kva and over.....	1				
35111 90	Gas turbine-driven generator sets (all sizes).....	8	(6)	(6)	(6)	(6)
36214 75	Other generator set units excluding electric motor-driven generator sets.....	4	(5)	(5)	(5)	(5)
36217 8,9	Electric motor-driven generator sets, other rotating equipment, and parts for motors and generators.....	(NA)	(X)	1,127,056	(X)	1,098,809
	Electric motor-driven generator sets (including dynamotors, converters, inverters, and frequency changers):					
36218 11	Synchro converters and double current generators, 746 watts or more..	3	2,414	9,101	2,563	9,422
	Other motor generator sets:					
36217 21	A.c. and d.c. output rated at less than 746 watts.....	9	13,649	5,027	24,169	7,217
	A.c. and d.c. output rated at 746 watts or more:					
	A.c. output, based on the rating of the largest a.c. generator:					
36218 32	746 watts to less than 150 kW.....	15	10,248	40,609	11,634	48,016
36218 33	150 kW and over.....	8				
	D.c. output, based on the rating of the largest d.c. generator:					
36218 34	746 watts to less than 170 kW.....	3	720	29,634	1,314	26,311
36218 36	170 kW and over.....	1				
	Other rotating equipment:					
36217 53	Rate generators, resolvers, and combinations (less than 746 watts)..	12	234,924	92,028	244,074	90,057
36217 57	Synchro-type components, less than 746 watts.....	4				
	All hermetic motors:					
36217 97	5.5 inch stator core diameters, and smaller.....	6	7,805	203,849	7,827	183,423
36218 97	Over 5.5 inch stator core diameter.....	9	7,915	265,273	6,863	240,545
	All other rotating equipment:					
36217 98	Rated at less than 746 watts.....	8	(X)	24,454	(X)	30,733
36218 98	Rated at 746 watts or more.....	7	(X)	43,176	(X)	34,694
	Parts for motors and generators regardless of output rating.....	(NA)	(X)	413,905	(X)	428,391
36219 90	Commutators.....	15	(X)	129,623	(X)	126,338
36219 59	Land transportation.....	8	(X)	25,342	(X)	29,077
36219 95	All other parts.....	52	(X)	258,940	(X)	272,976

- Represents zero. (D) Data withheld to avoid disclosing figures for individual companies. FS = frame size. (NA) Not available.  
(X) Not applicable.

<sup>1</sup> The unit of measure shown for Fractional horsepower (excluding hermetics and other rotating equipment) is in thousands of units and Integral horsepower (excluding hermetics and other rotating equipment) in number of units.

<sup>2</sup> Data are included in produce class 36211.

<sup>3</sup> Data for SIC 36211 1U are included in 36211 1S.

<sup>4</sup> Data are included in product class 36212.

<sup>5</sup> Data for dual fuel generator sets (over 2,000 kW) includes figures for other generator set units.

<sup>6</sup> Figures for code 35111 90 covering gas turbine-driven generator sets are not included in any of the total figures to avoid disclosing the operations of individual companies.

<sup>7</sup> The unit of measure for this data is in number of units.



Table 3. QUANTITY AND VALUE OF TOTAL SHIPMENTS AND INTERPLANT TRANSFERS OF MOTORS AND GENERATORS, AND QUANTITY OF MOTORS AND GENERATORS PRODUCED AND INCORPORATED INTO OTHER PRODUCTS AT THE SAME ESTABLISHMENT: 1991 AND 1990

(Quantity in thousands of units; value in thousands of dollars)

Product code	Product description	Total shipments, including interplant transfers		Interplant transfers		Produced and incorporated (quantity)
		Quantity	Value	Quantity	Value	
1991						
3621	Motors and generators:					
36211 --	Fractional horsepower motors (excluding hermetics).....	282,890	3,584,184	63,188	782,662	10,663
36212 --	Integral horsepower motors and generators (excluding hermetics).....	7,040	1,596,915	2,490	58,228	1,199
	Alternating current:					
36212 00	Polyphase, induction greater than 1 hp.....	1,592	877,521	11	9,409	9
36212 XX	Other.....	5,448	719,394	2,479	48,819	1,190
36213 --	Motors and generators for land transportation equipment.....	535	198,645	141	8,533	(D)
36214 --	Prime mover generator sets (except steam and hydraulic turbine).....	343	1,139,465			
36217 --	Electric motor generator sets and other rotating equipment (including hermetics) with power rating less than 746 watts.....	(X)	325,358	4,240	49,488	(D)
36218 --	Electric motor generator sets and other rotating equipment (including hermetics) with a power rating of 746 watts or more.....	(X)	387,793	(D)	67,480	(D)
36219 --	Parts for motors and generators.....	(X)	413,905	(X)		
1990						
3621	Motors and generators:					
36211 --	Fractional horsepower motors (excluding hermetics).....	292,579	3,698,323	74,495	877,732	13,269
36212 --	Integral horsepower motors and generators (excluding hermetics).....	7,026	1,568,326	2,441	55,727	1,085
	Alternating current:					
36212 00	Polyphase, induction greater than 1 hp.....	1,533	830,572	6	4,641	4
36212 XX	Other.....	5,493	737,754	2,435	51,086	1,081
36213 --	Motors and generators for land transportation equipment.....	538	195,425	170	17,064	(D)
36214 --	Prime mover generator sets (except steam and hydraulic turbine).....	352	991,905			
36217 --	Electric motor generator sets and other rotating equipment (including hermetics) with power rating less than 746 watts.....	(X)	311,430	4,968	44,575	(D)
36218 --	Electric motor generator sets and other rotating equipment (including hermetics) with a power rating of 746 watts or more.....	(X)	358,988	(D)	69,824	(D)
36219 --	Parts for motors and generators.....	(X)	428,391	(X)		

(D) Data withheld to avoid disclosing figures for individual companies. (X) Not applicable.

Table 4. COMPARISON OF VALUES OF SHIPMENTS, INCLUDING INTERPLANT TRANSFERS, OF MOTORS AND GENERATORS, AS REPORTED IN THE MAJ6H, THE 1990 ANNUAL SURVEY OF MANUFACTURES, AND THE 1987 CENSUS OF MANUFACTURES

(Value in thousands of dollars)

Product code	Product description	1990			1987	
		MAJ6H	Annual Survey of Manufactures		MAJ6H	Census of Manufactures
			Value	Standard error of estimates		
3621	Motors and generators.....	(NA)	7,846.3	1	(NA)	6,982.9
36211	Fractional horsepower motors, excluding hermetics.....	3,698.3	3,519.0	2	3,493.8	3,479.0
36212	Integral horsepower motors.....	1,568.3	1,687.4	2	1,249.7	1,293.5
36213	Land transportation motors, generators, and control equipment and parts.....	195.4	201.7	5	228.6	233.1
36214	Prime mover generators sets, except steam or hydraulic turbine..	991.9	983.5	1	779.4	787.7
36217	Motor-generator sets and other rotating equipment (fractional)..	311.4	259.8	1	248.7	237.9
36218	Motor-generator sets and other rotating equipment (integral)....	359.0	325.2	1	282.2	296.8
36219	Motor, generator, and motor-generator set parts.....	428.4	483.2	4	479.6	535.0
36210 00	Motors and generators n.s.k., typically for establishments with 20 employees or more (see note).....	(1)	386.7	2	(1)	27.9
36210 02	Motors and generators n.s.k., typically for establishments with less than 20 employees (see note).....					92.0

Note: In the census of manufactures, shipments data for establishments of small single-unit companies with up to five employees were estimated from administrative records data rather than data actually collected from respondents. Employment cutoffs used for administrative records were developed for each industry, and shipments figures are included in codes ending with "002." In both the 1987 and 1982 Censuses of Manufactures, products not completely identified on standard forms were coded in appropriate product classes (five-digits) followed by "00" or, in some cases, in appropriate product groups (four-digits) followed by "000."

(NA) Not available. n.s.k. Not specified by kind. Revised by 5 percent or more from previously published figures.

<sup>1</sup> Available only from the annual survey of manufactures and the census of manufactures. Most of these data are derived from administrative records. See note above.

Table 5. SHIPMENTS, EXPORTS, IMPORTS, AND APPARENT CONSUMPTION OF MOTORS AND GENERATORS: 1991 AND 1990

(Quantity in thousands of units; value in \$1,000)

Product code <sup>1</sup>	Product description	Manufacturers' shipments		Exports of domestic merchandise <sup>2</sup>		Percent exports to manufac- turers' shipments (value)	Imports for consump- tion <sup>4</sup> (value)	Apparent consump- tion <sup>5</sup> (value)	Percent imports to apparent consumption (value)
		Quantity	Value f.o.b. plant	Value at port	Estimated producers' value <sup>3</sup>				
	1991								
36211	Fractional horsepower motors and generators, except hermetics.....	282,890	3,584,182	302,763	281,660	7.9	966,801	4,269,323	22.7
36212,3	Integral horsepower motors and generators...	7,575	1,795,560	397,204	369,519	20.6	468,163	1,894,204	24.8
36214	Prime mover generator sets, except steam or hydraulic and electric motor driven: Gas/gasoline driven:								
	Less than 5 kva (36214 03, 04).....	241	123,132	751,491	699,112	67.4	287,346	625,552	46.0
	5 kva and over (36214 05-09).....	57	106,052						
	Diesel engine-driven:								
	Less than 400 kva (36214 41-45).....	38	419,506						
	400 kva to less than 1,000 kva (36214 46-48).....	59	388,638						
	1,000 kva and over (36214 49-51).....								
	Other (36214-75).....	(X)	(X)						
36217 8,9	Electric motor-driven generator sets, hermetics, other rotating equipment, and parts:								
	Synchronous converters, double current generators, and electric motor-driven generator sets (36217 21, 36218 11-36)...	17	43,762	27,298	25,395	3.8	23,264	670,411	3.5
	Hermetic motors (36217 97, 36218 97).....	16,720	469,122						
	Other rotating equipment (36217 53, 57, 98, 36218 98).....	(X)	159,658						
	Parts for all electric motors and generators (36219 59-95) <sup>6</sup> .....	(X)	413,905	537,288	499,839	20.8	382,000	296,066	29.1
	1990								
36211	Fractional horsepower motors and generators, except hermetics.....	292,579	3,698,323	265,240	239,671	6.5	836,142	4,294,794	19.5
36212,3	Integral horsepower motors and generators...	7,564	1,763,751	369,329	333,726	19.0	495,770	1,925,795	25.8
36214	Prime mover generator sets, except steam or hydraulic and electric motor driven: Gas/gasoline driven:								
	Less than 5 kva (36214 03, 04).....	258	133,474	515,243	465,574	51.7	293,478	729,234	40.3
	5 kva and over (36214 05-09).....	57	107,298						
	Diesel engine-driven:								
	Less than 400 kva (36214 41-45).....	30	367,078						
	400 kva to less than 1,000 kva (36214 46-48).....	49	293,480						
	1,000 kva and over (36214 49-51).....								
	Other (36214-75).....	(X)	(X)						
36217 8,9	Electric motor-driven generator sets, hermetics, other rotating equipment, and parts:								
	Synchronous converters, double current generators, and electric motor-driven generator sets (36217 21, 36218 11-36)...	28	42,950	26,454	23,904	3.9	25,830	624,328	4.2
	Hermetic motors (36217 97, 36218 97).....	15,090	423,968						
	Other rotating equipment (36217 53, 57, 98, 36218 98).....	(X)	155,484						
	Parts for all electric motors and generators (36219 59-95) <sup>6</sup> .....	(X)	428,391	418,912	378,529	88.4	358,364	408,226	87.8

Note: Beginning in 1989, data for exports and imports are being classified under a new harmonized system for better comparability.

(X) Not applicable.

<sup>1</sup>For comparison of SIC-based product codes with Schedule B export numbers and HTSUSA import numbers, see table 6. Includes duty.<sup>2</sup>Source: Bureau of the Census Report, EM 545, U.S. Exports.<sup>3</sup>These values were derived by use of adjustment factors to exclude freight, insurance, and other charges incurred in moving goods to the port of export. This adjustment is made to convert the values to an approximation of the producers' value of exported goods. Current adjustment factors are based on data for 1989 which are published in Exports From Manufacturing Establishments, AR89-1, appendix B. The adjustment factor for this report is 0.9303.<sup>4</sup>Source: Bureau of the Census report IM 145, U.S. Imports for Consumption.<sup>5</sup>Apparent consumption is derived by subtracting exports from the sum of manufacturers' shipments plus imports.<sup>6</sup>The data shown in this grouping may not be strictly comparable due to the non-specific nature of the item descriptions.

Table 6. COMPARISON OF STANDARD INDUSTRIAL CLASSIFICATION-BASED PRODUCT CODES WITH  
SCHEDULE B EXPORT NUMBERS, AND HTSUSA IMPORT NUMBERS: 1991

Product code <sup>1</sup>	Product description	Export number <sup>2</sup>	Import number <sup>3</sup>
36211	Fractional horsepower motors and generators.....	{ 8501.10.3000 8501.10.4040 8501.10.4060 8501.10.4080 8501.10.6020 8501.10.6040 8501.10.6060 8501.10.6080 8501.20.2000 8501.20.3000 8501.31.2000 8501.31.3000 8501.31.8000 8501.40.2040 8501.40.3040 8501.51.2040 8501.51.3040           }	{ 8501.10.2000 8501.10.4020 8501.10.4040 8501.10.4040 8501.10.4060 8501.10.4080 8501.10.6040 8501.10.6060 8501.10.6080 8501.20.2000 8501.20.4000 8501.20.5000 8501.31.2000 8501.31.4000 8501.31.5000 8501.31.8000 8501.40.2040 8501.40.4040 8501.40.5040 8501.51.2040 8501.51.4040 8501.51.5040           }
36212	} Integral horsepower motors and generators.....	{ 8501.20.6000 8501.31.6000 8501.32.2000 8501.32.4000 8501.32.6000 8501.33.2000 8501.33.3000 8501.33.4040 8501.33.4060 8501.33.6000 8501.34.3000 8501.34.6000 8501.40.6040 8501.51.6040 8501.52.4000 8501.52.8000 8501.53.4000 8501.53.6000 8501.53.8040 8501.53.8060 8501.61.0000 8501.62.0000 8501.63.0000 8501.64.0020 8501.64.0030 8501.64.0050           }	{ 8501.20.6000 8501.31.6000 8501.32.2000 8501.32.4020 8501.32.4040 8501.32.6000 8501.33.2040 8501.33.2080 8501.33.3000 8501.33.4040 8501.33.4060 8501.33.6000 8501.34.3000 8501.34.6000 8501.40.6040 8501.51.6040 8501.52.4000 8501.52.8020 8501.52.8040 8501.53.4040 8501.53.4080 8501.53.6000 8501.53.8040 8501.53.8060 8501.61.0000 8501.62.0000 8501.63.0000 8501.64.0020 8501.64.0030 8501.64.0050           }
36213			
36214	} Electric generating sets, rotating converters, and parts..	{ 8502.11.0000 8502.12.0000 8502.13.0020 8502.13.0040 8502.20.0040 8502.20.0080 8502.30.0000 8502.40.0000 8503.00.2000 8503.00.5000 8503.00.6040 8503.00.6060           }	{ 8502.11.0000 8502.12.0000 8502.13.0020 8502.13.0040 8502.20.0030 8502.20.0060 8502.00.0080 8502.30.0000 8502.40.0000 8503.00.2000 8503.00.4000 8503.00.6020 8503.00.6040 8503.00.6060           }
36217			
36218			
36219			

<sup>1</sup>Detailed description of the SIC product codes appear in table 2.

<sup>2</sup>Source: 1991 edition, Harmonized System-Based Schedule B, Statistical Classification of Domestic and Foreign Commodities Exported from the United States.

<sup>3</sup>Source: Harmonized Tariff Schedule of the United States, Annotated (1991).

## DESCRIPTION OF SURVEY

**Scope of Survey.** This survey covers firms engaged in the manufacture of electric motors and generators and engine-driven generator sets in the United States.

**Survey of Methodology.** The statistics in this publication were collected by mail on Bureau of the Census annual Form MA36H, Motors and Generators. The survey panel includes all known manufacturers of motors and generators and engine-driven generator sets, approximately 250 companies.

**Reliability of Data.** Survey error may result from several sources: (1) inability to obtain information about all cases in the survey; (2) response errors; (3) definitional difficulties; (4) differences in the interpretation of questions; (5) mistakes in recording or coding the data obtained; and (6) other errors of collection, response, coverage, and estimation for missing data. These nonsampling errors also occur in complete censuses. Although no direct measurement of the biases due to nonsampling errors has been obtained, precautionary steps were taken in all phases of the collection, processing, and tabulation of the data in an effort to minimize their influence.

A major source of bias in the published estimates is due to imputing data for nonrespondents, for late reporters, for small establishments not included in the mail panel, and for data which fail logic edits. Missing figures are imputed based on yearly movements shown by reporting firms. Imputation generally is limited to a maximum of 10 percent for any one data cell. Figures with imputation rates greater than 10 percent are footnoted.

The imputation rate is not an explicit indicator of the potential error in published figures due to nonresponse because the actual yearly movements for nonrespondents may or may not closely agree with the imputed movements. The range of difference between the actual and imputed figures is not precisely known but is assumed to be small. The degree of uncertainty regarding the accuracy of the published data, however, increases as the percentage of imputation increases. Figures with imputation rates above 10 percent should be used with caution.

**Revisions to Previous Period Data.** Statistics for previous years may be revised as the result of corrected data from respondents, late reports for which imputations were made as described above, or other corrections. Figures which have been revised by more than 5 percent from previously published figures are indicated by footnotes.

Revisions include changes to prior period data resulting from reconciliation of the results of this survey with the 1987 Census of Manufactures to correct differences in reported data between the two series and to identify

and verify new establishments included in the scope of this survey. Table 4 presents a comparison of data from the two series by census product class following the reconciliation.

**Adjustment for Price Change.** All dollar figures included in this publication are in current dollars; i.e., they have not been adjusted for price change.

## EXPLANATION OF TERMS

**Quantity and Value of Shipments.** The figures on quantity and value of shipments represent physical shipments of all products sold, transferred to other establishments of the same company, or shipped on consignment, whether for domestic or export sale. The value represents the net sales price, f.o.b. plant, to the customer or branch to which the products are shipped, net of discounts, allowances, freight charges, and returns. Shipments to a company's own branches are assigned the same value as comparable sales to unaffiliated customers; i.e., the value includes an appropriate allocation of company overhead and profit. Products bought and resold without further manufacture are excluded.

## COMPARISON OF EXPORT, IMPORT, AND DOMESTIC OUTPUT DATA

The trade comparisons shown in this report should be considered only as approximations. Several problems prevent precise comparisons among imports, exports, and domestic output. These problems include the following:

- Export and import comparisons do not account for the origin of materials used to manufacture the finished product. Domestic output includes any goods that undergo substantial transformation into a finished product in the U.S., even if the goods are partially constructed abroad or are constructed of imported materials.
- There will be a lag between the time a producer makes or ships a product and the time it is actually exported. Similarly, there may be a lag between the time a product is imported and when it enters into U.S. distribution channels.
- The basic structures of these classification systems differ. The Standard Industrial Classification (SIC) system used for domestic output was developed independently of the Harmonized System (HS) used to classify imports and exports. The level of detail provided by the different systems varies substantially, reflecting their different objectives. For example, there are a number of imported commodities that have no comparable domestic output classification.

- Because producers' shipments of some commodities may be used as materials for incorporation into other commodities, combinations of domestic output data for such commodities may contain some duplication.
- Import and export data reflect the movement of merchandise into and out of U.S. foreign trade zones, the U.S. Virgin Islands, and the U.S. customs territory of the 50 States, the District of Columbia, and Puerto Rico. Domestic output reflects activity in the 50 States and, only if specified, in Puerto Rico.
- Import and export data generally do not distinguish between new, used or rebuilt commodities.
- The valuations of the three data sets differ. Domestic output is valued at the point of production. It includes the net sales price, f.o.b. plant, after discounts and allowances, and excludes freight charges and excise taxes. Exports are valued at the point of exportation. Export value includes the net sales price or value, and inland freight, insurance and other charges to the export point. Imports are valued at the first port of entry in the United States. They include the cost, insurance, freight, duty, and other charges to the import point.
- Detailed commodity information is not included for individual export or import shipments at or below a certain dollar limit. This dollar limit is \$2,500 for exports and \$1,250 for imports, except for import of textiles and textile products, gloves, footwear, and miscellaneous rubber and plastics products, where the limit is \$250.

## HISTORICAL NOTE

Data on motors and generators have been collected by the Bureau of the Census since 1960. Historical data may be obtained from Current Industrial Reports available at your local Federal Depository Library. A list of these libraries may be obtained from the Bureau of the Census regional offices:

Office	Telephone
Atlanta, Georgia	404-730-3833
Boston, Massachusetts	617-223-2327
Charlotte, North Carolina	304-344-6142
Chicago, Illinois	312-353-6251
Dallas, Texas	214-767-0621
Denver, Colorado	303-969-6750
Detroit, Michigan	313-354-4654
Kansas City, Kansas	913-236-3728
Van Nuys, California	818-904-6339
New York, New York	212-264-4730
Philadelphia, Pennsylvania	215-597-8313
Seattle, Washington	206-728-5314

Historical data are also available on microfiche. For further information contact the Bureau of the Census, Data User Services Division, 301-763-4100.

## RELATED REPORTS

The Bureau of the Census publishes the following related reports:

Series	Frequency	Title
<b>Current Industrial Reports</b>		
MQ35D	Quarterly	<i>Construction Machinery</i>
MA35A	Annually	<i>Farm Machinery and Lawn and Garden Equipment</i>
MA35F	Annually	<i>Mining Machinery and Mineral Processing Equipment</i>
MA35L	Annually	<i>Internal Combustion Engines</i>
MA36F	Annually	<i>Major Household Appliances</i>

### Other Industry Reports

M3-1	Monthly	<i>Manufacturers' Shipments, Inventories, and Orders</i>
(AS)	Annually	<i>Annual Survey of Manufactures (ASM)</i>
(MC)	Quinquennially	<i>Census of Manufactures</i>

### Foreign Trade Reports

CD-ROM	Monthly/Annually	<i>U.S. Exports—Schedule B—Commodity by Country</i>
FT 447	Annually	
CD-ROM	Monthly/Annually	<i>U.S. Imports for Consumption—HTSUSA—Commodity by Country</i>
FT 247	Annually	

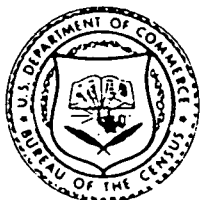
## CONTACTS FOR DATA USERS

Subject Area	Contact	Phone Number
Current Industrial Report MA36H	Robert Wright	301-763-5571
Classifications Systems Comparability	Francis McCormick (ESD)	301-763-1935
Foreign Trade	Trade Data Inquiries Staff (FTD)	301-763-5140
Census/ASM	Tom Lee	301-763-1111

Subject Area	Contact	Phone Number
International Trade Administration	Dick Whitley	202-377-0682
International Trade Commission	John T. Cutchin, Jr.	202-523-0231
To order a Current Industrial Report	Superintendent of Documents (GPO)	202-783-3238
To subscribe to a Census Bureau publication	Superintendent of Documents (GPO)	202-512-2303

#### ACKNOWLEDGMENTS

This report was prepared in the Industry Division, Bureau of the Census, under the direction of Thomas Flood, Chief, Current Durables Branch, and Kenneth McBeth, Chief, Electrical and Electronics Section. Robert Wright was directly responsible for the review of the data and preparation of the report. Roger H Bugenhagen, Acting Chief of the Division, and Robert N Tinari, Assistant Chief for Current Industrial Reports, provided overall direction and coordination to this project.



## **APPENDIX E:**

### **LISTING OF EQUIPMENT TYPES INCLUDED IN *ENGINDATA***

*Source: PSR*



**MARKET SEGMENT/APPLICATION CODES IN PSR'S  
ENGINDATA AND AFTERMARKET DATABASES**

Seg Code	Segment	App Code	Application
HW	HIGHWAY	8	BUSES
		7	CARS
		87	MOTOR HOME CHASSIS
		5	TRUCK CL 1 & 2
		6	TRUCK CL 3 & 4
		1	TRUCK CL 5
		2	TRUCK CL 6
		3	TRUCK CL 7
		4	TRUCK CL 8
LG	LAWN & GARDEN	70	CHAINSaws *
		67	COMM TURF *
		88	FRONT MOWERS *
		66	LEAF BLOW/VACS *
		65	LN MOWERS *
		63	LN/GDN TRACTORS *
		76	OTHER LN GDN *
		82	REAR ENG RIDER *
		96	SHREDDERS *
		56	SNOWBLOWER *
		59	TILLERS *
		53	TRIM/EDGE/CUTTER *
		75	WOOD SPLTR *
MR	MARINE	51	MARINE COM
		99	OUTBOARD ENGINES
		50	POWERBOATS
		79	SAILBT AUX
MH	MATERIAL HANDLING	64	AERIAL LIFTS *
		18	FORKLIFTS *
		19	OTH MAT HD *
		16	TERMINAL TRACTORS *
OT	OTHER	52	DIST LOOSE
		83	EXPORTS CKD
		54	EXPORTS - LOOSE ENG
		86	EXPORTS - MARINE ENG
		15	TACT MIL EQUIP
		78	VEHICLE REPWR
PC	PUMPS & COMPRESSORS	10	AIR COMPRESSORS *
		89	GAS COMPRESSORS *
		85	HYD POWER UNIT *
		58	PRES WASHERS *
		11	PUMPS *

**MARKET SEGMENT/APPLICATION CODES IN PSR'S  
ENGINDATA AND AFTERMARKET DATABASES**

Seg Code	Segment	App Code	Application
AG	AGRICULTURAL	98	2-WHEEL TRACTORS *
		55	AG MOWERS *
		45	AG TRACTOR *
		49	BALERS *
		47	COMBINES *
		44	IRRG SETS
		46	OTH AG/EQ *
		69	SPRAYERS *
		48	SWATHERS *
CN	CONSTRUCTION	41	ASPH PAVER *
		37	BORE/DRILL RIGS *
		57	CEM/MTR MIXERS *
		22	CNCRTE PAV *
		27	CRANES *
		31	CRWLR TRTR *
		60	DUMPERS/TENDERS *
		28	EXCAVATORS *
		24	FELLER/BUNCHER *
		30	GRADERS *
		68	OFF-HWY TRACTORS *
		40	OFF-HWY TRUCK *
		36	OTHER CONST *
		35	PAVING EQ *
		61	PLATE COMPACTORS *
		39	ROLLERS *
		84	ROUGH TRN FORKLFTS *
		32	R/T DOZER *
		33	R/T LOADER *
		29	SCRAPERS *
		25	SKIDDERS *
		38	S/S LOADER *
		95	TAMPERS/RAMMERS *
		43	TRAC/LDR/BCKHOE *
		42	TRENCHERS *
		13	UNDRGND MINE EQUIP
GI	GENERAL INDUSTRIAL	81	AIRCRAFT SUPPORT *
		26	CHIPPERS/GRINDERS *
		77	CONCRETE/IND SAWS *
		34	CRUSH/PROC EQUIP *
		20	LOCOMOTIVE
		12	OIL FLD EQ
		74	OTH GEN INDUST *
		90	PUMP JACKS
		14	REFRIGERATION/AC
		80	RLWY MAINT
		21	SCRUB/SWPR *
		62	SPEC VEH/CARTS *
		23	SURFACING EQUIP *

**MARKET SEGMENT/APPLICATION CODES IN PSR'S  
ENGINDATA AND AFTERMARKET DATABASES**

<b>Seg Code</b>	<b>Segment</b>	<b>App Code</b>	<b>Application</b>
<b>RP</b>	<b>REC PRODUCTS</b>	<b>91</b>	<b>ALL-TERRAIN VEHICLES *</b>
		<b>94</b>	<b>GOLF CARTS *</b>
		<b>93</b>	<b>MINI-BIKES *</b>
		<b>92</b>	<b>OFF-ROAD MOTORCYCLES *</b>
		<b>71</b>	<b>SNOWMOBILE *</b>
<b>WG</b>	<b>WELDERS &amp; GENERATORS</b>	<b>9</b>	<b>GENTR SETS *</b>
		<b>73</b>	<b>LT PLANTS</b>
		<b>72</b>	<b>SIGNAL BRD *</b>
		<b>17</b>	<b>WELDERS *</b>