Chapter 9: Useful Life and Flexibility Supporting Data

9.1. Information on Useful Life

This Chapter contains information used by the Agency in the development of the proposed useful life categories for Phase 2 small engines.

During the development of the Phase 2 program, and during the development of the Phase 1 regulation, EPA was aware that the nonroad SI category of engines and equipment was comprised of a wide variety of equipment with a wide range of usage patterns. Handheld and nonhandheld engines are designed for many different types of applications, with each application having specific design criteria, resulting in different expected lifetimes. The most obvious example of these differences is the distinction between commercial (or professional) operators and residential (or home) operators. In general, commercial operators expect to accumulate high number of hours on equipment on an annual basis, such as commercial lawn-care companies or rental companies, while a residential operator expects to accumulate a relatively low number of hours on an annual basis, such as a residential chain saw owner. Several organizations have investigated the issues related to average life and annual use of equipment powered by small SI engines, including industry organizations, CARB, and the EPA. A brief summary of several of these reports is presented in the remainder of this Chapter.

9.1.1 Handheld Useful Life Estimates from PPEMA

In 1990 the Portable Power Equipment Manufacturers Association (PPEMA) contracted for a report which contained estimates on useful life periods for 2-stroke powered handheld equipment.(Ref. 1) A summary of the information contained in the report on 2-stroke powered handheld equipment usage is presented in Table 9-01.

Table 9-01
Summary of Information on Useful Life
Available from Heiden Associates Report, July, 1990
(Con. = consumer user, Prof. = professional user)

Equipment Type	Con. Average Annual Use (hours)	Prof. Average Annual Use (hours)	Con. User Expected Life Estimates (years)	Prof. User Expected Life Estimates (years)	% of Equipment Purchased by Prof. Users	Con. User Expected Life Estimates (hours)	Prof. User Expected Life Estimates (hours)
Chain saws	7	405	8	1	25%	56	405
Trimmers & Brushcutters	10	170	6	1.5	16%	60	255
Hand Blowers	9	197	6.67	2	5%	60	394
Back Blowers	12	293	6.67	1.83	95%	80	536
Cut Off Saws	N/A	113		2	100%	N/A	226
Hedge Trimmers	7	75	7.5	3	79%	53	225

This report clearly demonstrates the large disparity between consumer and professional use, with consumer equipment expected life estimates range from 53 to 80 hours, and professional equipment expected life estimates range from 225 to 536 hours.

9.1.2 Handheld and Nonhandheld Useful Life Estimates from CARB

In 1990, the California Air Resources Board (CARB) contracted for a report from Booz, Allen and Hamilton which included estimates of usage rates and life spans for several categories of nonroad equipment powered by small engines.(Ref. 2) A summary of the information contained in the report is

presented in Table 9-02.

Table 9-02
Summary of Information on Useful Life
Available from Booz, Allen & Hamilton Report, Nov. 1990
(Res. = residential user, Com. = commercial user)

Product Category	% of Total Sales, Home Use	% of Total Sales, Commercial Use	Res. Implied Avg. Lifespan (years)	Com. Implied Avg. Lifespan (years)	Res. Annual Hrs Use per Year	Com. Annual Hrs Use per Year	Res. Implied Avg. Lifespan (hours)	Com. Implied Avg. Lifespan (hours)
Walk Behind Mowers	88%	12%	7.04	2.68	20	320	141	858
Riding Mower (Frt. Eng.)	95%	5%	7.04	3.78	38	380	268	1,436
Riding Mower (Rear Eng.)	95%	5%	7.04	3.78	38	380	268	1,436
Garden Tractor	95%	5%	7.04	3.78	56	180	394	680
Tillers	60%	40%	7.04	5.41	18	72	127	390
Snowthrowers	90%	10%	5.41	5.41	10	60	54	325
General Utility	25%	75%	7.04	2.85	5	96	35	274
Shredders/ Grinders	60%	40%	7.04	5.41	17	190	120	1,028
Specialized Turf Care	0%	100%	N/A	3.78	N/A	800	N/A	3,024
4-cyc. blowers/ vacuums	60%	40%	7.04	2.68	10	190	70	509
4-cyc. edgers/ trimmers	60%	40%	7.04	2.68	10	190	70	509
2-cyc. blowers/ vacuums	85%	15%	5.21	2.85	10	170	52	485
2-cyc. edgers/ trimmers	85%	15%	5.21	2.85	10	275	52	784
Chain saws	75%	25%	5.21	1.33	7	405	36	539

This report also indicates there is a large disparity in average life-span between equipment used by residential and commercial applications.

Residential equipment implied average lifespan estimates range from 35 to 394 hours, and commercial equipment implied average lifespan estimates range from 274 to 3024 hours.

9.1.3. Nonhandheld Useful Life Estimates from OPEI

A 1992 report from the Outdoor Power Equipment Institute (OPEI) report studied the issue of usage rates for two types of nonhandheld equipment, a summary of the report was provided in a subsequent memo from OPEI to EPA. (Ref. 3) The OPEI report included a nationwide phone survey of over 6,000 households. A summary of the information on usage rates for consumer owned walk-behind and ride-on mowers is presented in Table 9-03.

Table 9-03
Summary of OPEI 1992 Report on Residential Phone Survey

Equipment Type	B-50 value (years)	Median Annual Use (hours)	Median Hours Accumulated at B-50 value (hours)
Consumer Walk-behind Mower	5	20.0	100
Consumer Ride-on Mower	6	34.5	207

The term B-50 is used to denote the number of years at which 50 percent of the equipment from a particular model year are no longer in service, i.e., for consumer walk-behind mowers, after 5 years one-half of the mowers are no longer in-use.

9.1.4. Small Engine Equipment Usage Estimates used by EPA

The Agency has also developed estimates related to average annual use

and equipment survival, many of these estimates are based on the usage information in the previously cited reports. These estimates were presented in the Small Engine Phase 1 Regulatory Support Document.(Ref. 4) The Phase 1 RSD includes Agency estimates of: average annual sales by equipment type, percentage splits between residential and consumer equipment, average annual use by equipment, B-50 (number of years after which 50 percent of the equipment have failed), and sales splits by equipment between each of the five engine Classes. Figures 9-01 through 9-05 are a series of bar graphs summarizing the Agency's information regarding engine Classes and hours of use.

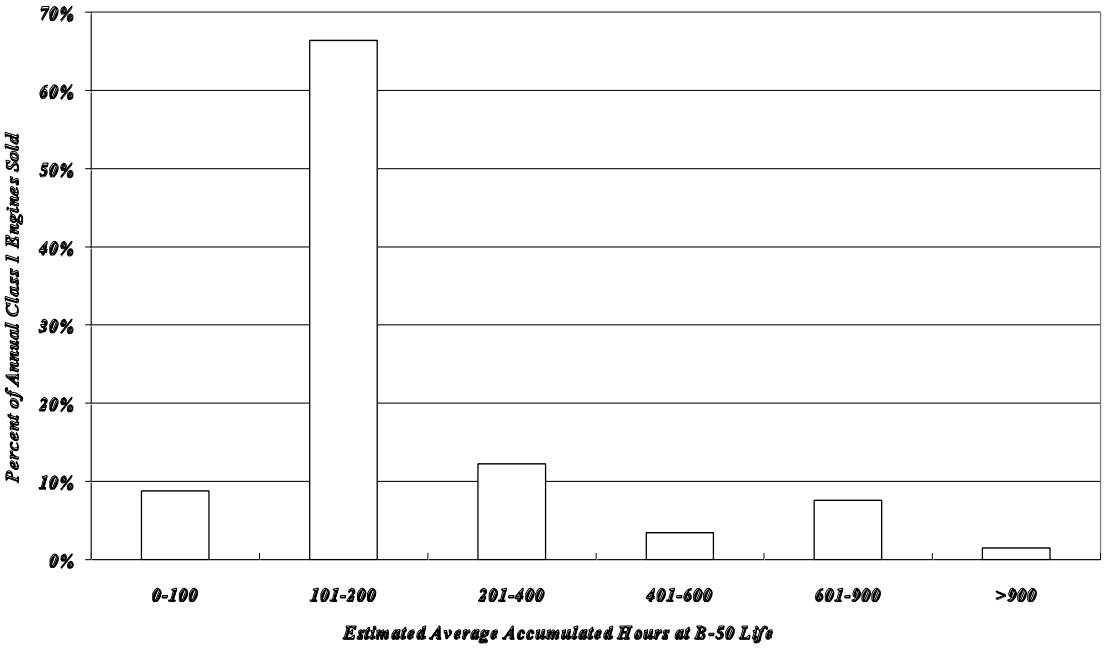

Figure 9-01: Summary of EPA Class 1 Engines Useful Life Estimates

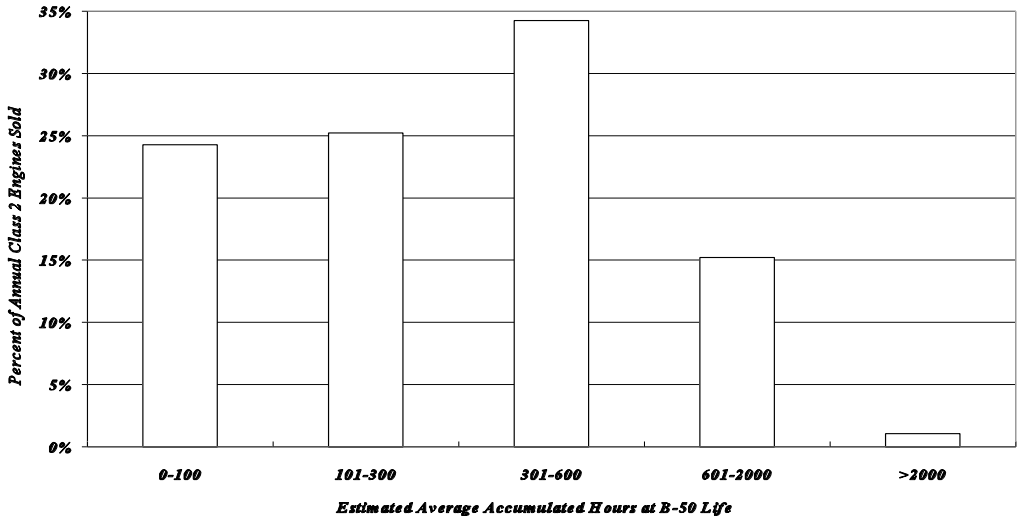

Figure 9-02: Summary of EPA Class 2 Engines Useful Life Estimates

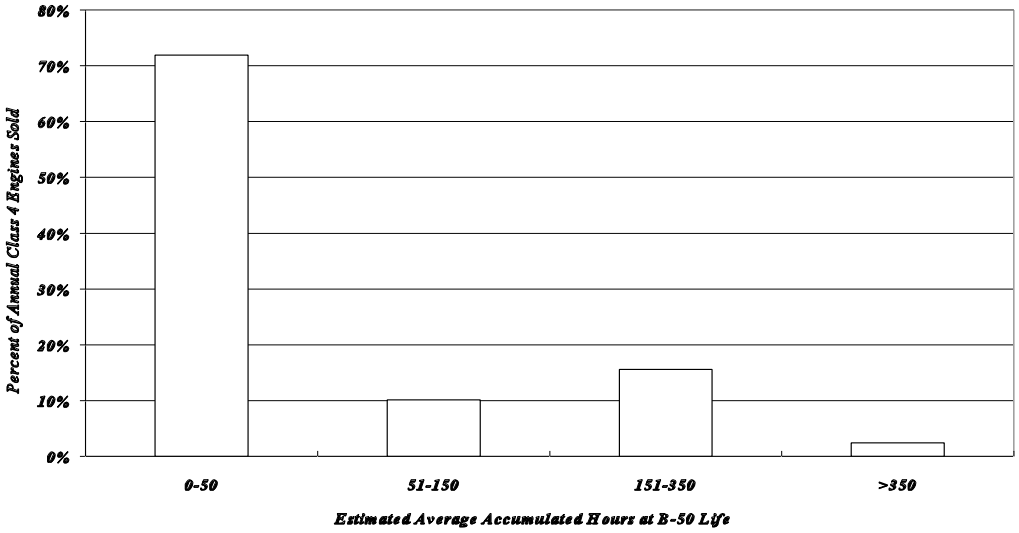

Figure 9-04: Summary of EPA Class 4 Engines Useful Life Estimates

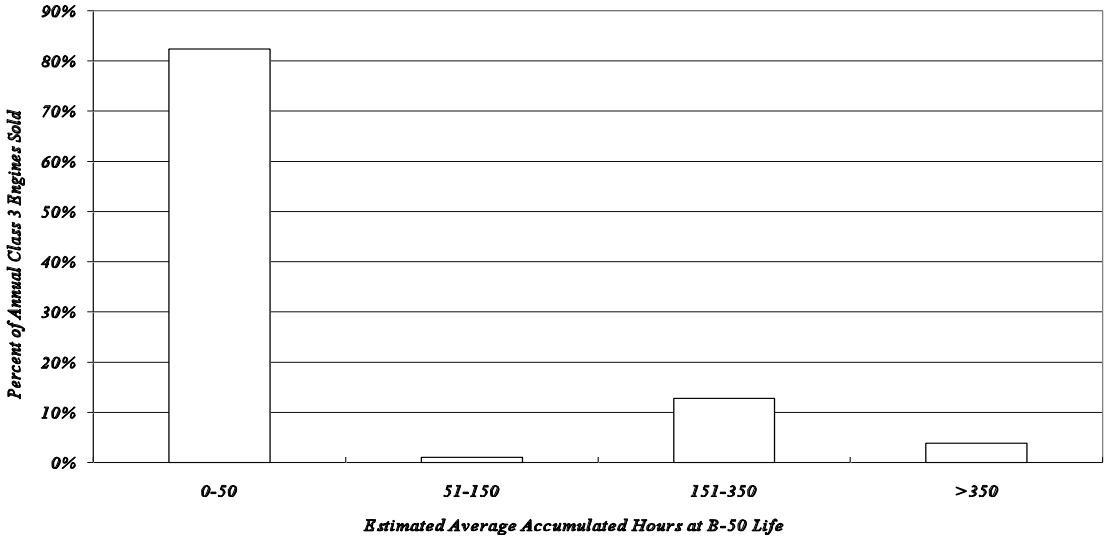

Figure 9-03: Summay of EPA Class 3 Engines Useful Life Estimates

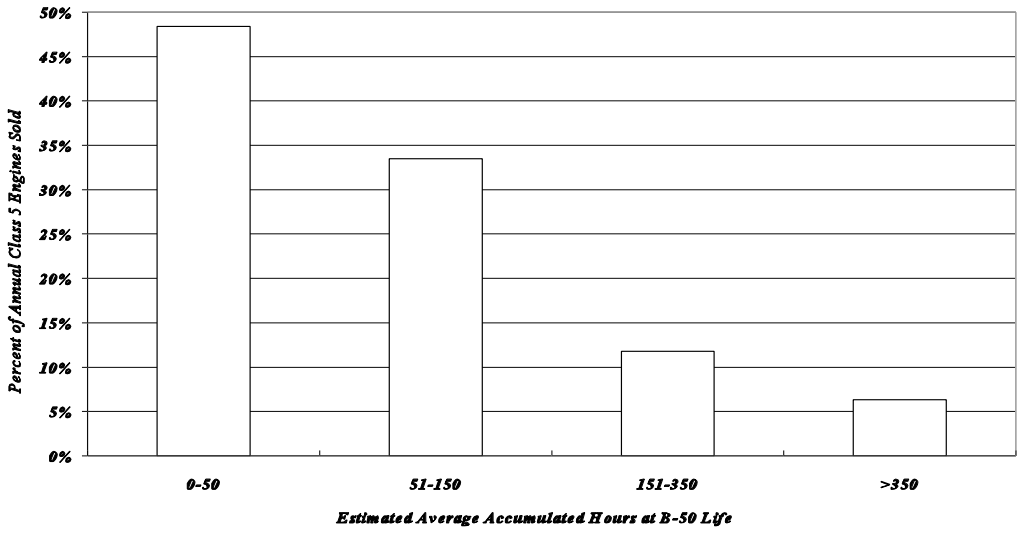

Figure 9-05: Summay of EPA Class 5 Engines Useful Life Estimates

Figures 9-01 thru 9-05 make it clear that small engines can accumulate vastly different hours of use over the life of the equipment. Manufacturers are able to design and build engines

for various design lives which fit the type of equipment the engine is likely to be produced for.

9.1.5 Proposed Phase 2 Useful Life Categories

EPA is proposing several useful life categories for both handheld and nonhandheld engines, the proposed useful life categories are presented in Table 9-04. Based on the data presented in Sections 9.1.1 thru 9.1.4 the Agency believes these useful lives are appropriate for regulatory purposes. The only exception is for the Class I Category C engines where the useful life has been shortened to facilitate a reduced testing burden for compliance purposes.

Table 9-04: Proposed Regulatory Useful Life Values for Small SI Engines

Engine Class	1	1	1	2	2	2	3, 4, 5	3, 4, 5
Category	A	B	C	A	B	C	"residential"	"commercial"
Useful Life (hours)	66	250	500	250	500	1000	50	300

The Agency believes multiple useful life categories are appropriate considering the wide range of useful life values for small SI engines. At the same time, the Agency would like to keep the number of useful life categories small to avoid confusion among consumers. The Agency believes the three categories for nonhandheld engines and two categories for handheld engines fulfils the goal of having a small number of useful life categories, and at the same time, adequately covering the useful lives experienced by engines in actual use.

9.2. Background for Choice of Small Volume and Small Family Cutoffs

The Preamble for this rulemaking contains a number of flexibilities for small volume engine and equipment manufacturers as well as small volume engine families and equipment models, see Table 9-04 at the end of this section. This section describes the methodology utilized to develop these estimates. The main sources for this analysis include the EPA Phase 1 certification database (engine manufacturers) and Power Systems Research 1996 OE LINK database (equipment manufacturers) along with the results from EPA's work to analyze the impact on small businesses which can be found in Chapter 8 of the RSD. EPA requests comment on the assumptions used in this analysis.

9.2.1. Small Volume Engine Manufacturers

The work performed to determine the impacts on small businesses, as described in Chapter 8 of this RSD, utilized the SBA definition of 1000 employees as a cutoff for small volume engine manufacturers. Application of this definition to the range of engine manufacturers in this industry resulted in identification of 15 small engine manufacturers with 10 companies analyzed, due to availability of both financial and estimated production information. An overview of the companies showed that the companies varied in income and production volumes. Two of the ten companies were clearly small with low number of employees and annual revenue. However, three of the companies produced 75,000 to 700,000 engines and had very high annual income. The high annual income and the high volume of engine production of some companies raised doubt about the use of the SBA definition in this rulemaking. EPA consulted the Phase 1 certification database for its basis of a new

definition of small volume engine manufacturer.

EPA reviewed the Phase 1 certification database for the range of engine manufacturers and their estimated annual production. EPA observed that there is a clear break between large and small volumes among the engine manufacturers for both the handheld and nonhandheld industries. The total projected sales numbers are seen to be less than 8,700 or greater than 40,000 for the nonhandheld engine manufacturers and less than 20,400 and greater than 45,700 for the handheld engine manufacturers. Based on this, the production cutoffs selected are listed in Table 9-05. Companies that manufacture engines in both the handheld and nonhandheld segments of the industry must meet criteria for both categories in order to be designated a small business.

Table 9-05

Production Cutoffs for Small Volume Engine Manufacturer

HH:	25,000 units
NHH:	10,000 units

Application of these cutoffs to the September 1, 1997 EPA Phase 1 database show that the handheld definition will include 27% of the companies and only 0.98% of the engine production. The nonhandheld definition will include 55% of the companies and 0.29% of the engine production. Current review of the database show there will be no companies that will qualify as small which produce both sets of engines.

9.2.2. Small Volume Engine Family

Data utilized to determine small engine families for the handheld and nonhandheld sections of this industry were from the EPA Phase I certification

database. Engine family and confidential family estimated production were utilized.

The small engine family cutoff for nonhandheld and handheld engines is presented in Table 9-06. A value of 1000 is set for nonhandheld engine families and is an extension of the current provision in the rule for Class II SV engines.

The handheld engine industry is different from the nonhandheld industry in that, in general, the engines are less expensive to manufacture and are less costly to the consumer. As a result, it is assumed that a company that manufacturers handheld engines must manufacture more engines than a company that manufacturers nonhandheld engines in order to stay in the marketplace. In order to assure that the small volume definition was comparable to the nonhandheld industry, the number of engine families that would fall under the definition of 1000 units/family was calculated and the corresponding number of handheld engine families was determined. The unit cutoff for the same number of engine families was 2,500 units.

Table 9-06
Small Engine Family Definition

HH:	2,500
NHH:	1,000

The result is that approximately 30% of total number of engine families in both the handheld and nonhandheld industries will be considered small engine families. While this may seem like a large number of families, when one compares the number of engines represented by these families and the total number of engines, only 0.6% of the annual production of small engines will be included in this definition.

EPA acknowledges that PPEMA has stated that a small engine family is

10,000 units or less for handheld engines. EPA does not have any data to date to support this number and requests comment on the proposed definitions.

Overall, the total engine production that will fall under the two definitions of small engine family and small engine manufacturer are only 0.6% for both the handheld and nonhandheld industries.

9.2.3. Small Volume Equipment Manufacturer

The 1996 Power Systems Research EO LINK database and information from various equipment manufacturer associations were utilized to determine the cutoffs for small volume equipment manufacturers.

For nonhandheld equipment manufacturers, it is estimated that there will be an impact on equipment manufacturers currently using Class II SV engines. It is also estimated that there will be no equipment impact for engines using Class II OHV or Class I engines. The nonhandheld equipment industry is made of a large number of small companies and some larger well established companies. The basis for the proposal is that this is the general point at which production per equipment manufacturer increases exponentially. As shown in Table 9-07, the cutoff for small volume equipment is selected at 2,500 units. Based on PSR, this would affect only 2% of the equipment production and 82% of the equipment manufacturers. However, this impact is very likely to be less than that calculated with the data in the PSR database based on the results from the work done to analyze the impacts of this rulemaking on small businesses (see Chapter 8 of the RSD). The results showed that many of the small[41] volume equipment manufacturers have already converted their products

[41] The definition of small in the study was determined by the Small Business Administration for the corresponding SIC codes. The definition was based on employment of the ultimate parent. For this industry it was set at 500 employees or less.

to utilize OHV engines. This is mainly due to market competition or engine manufacturers already beginning to Phase out Class II SV engines.

For handheld equipment manufacturers, the proposed cutoff is 5,000 units which is the same for the handheld engine manufacturer. The basis for this proposal is that the majority of small handheld equipment manufacturers also manufacturer their own engines. This provision affects 67% of the equipment manufacturers identified in the PSR database as producing equipment with handheld engines. However only 0.46% of the engines are manufactured by these equipment companies.

Table 9-07
Small Volume Equipment Manufacturer

	Manufacturer Cutoff
Nonhandheld	2,500
Handheld	5,000

9.2.4. Small Volume Equipment Model

For nonhandheld equipment, the analysis to determine the cutoff for small volume equipment model, see Table 9-08, was based on the greatest price impact the change due to this regulation on a Class II piece of equipment[42]. The lowest price equipment that utilized a Class II engine was a generator set estimated to cost $250.00. Based on amortization of the estimated cost for that equipment type with 7% interest over 10 years, the yearly estimated cost increase would be $7,119.00. Dividing this number by 500 yielded a price increase of $14.24. The increase from the engine

[42] Based on the expected engine technologies for this proposed rulemaking, it is estimated that Class II equipment will experience the most impact and therefore is the focus of the analysis.

manufacturer is also included and is estimated at $17.17. The total price increase would then be $31.41 or 12.6% of the original $250.00[43]. Equipment lines with larger production will result in a lower cost per equipment and therefore the impact will be less. It is estimated that this price increase would be acceptable to the industry since it is likely that nearly all equipment companies that currently use SV engines will experience this impact and thereby will be able to pass this price increase along to the consumer. Based on the PSR 1996 OELINK database, approximately 2.5 % of the equipment (7% of Class II equipment and 2% of Class I equipment) will be allowed to utilize the flexibility of using a Phase 1 engine throughout Phase 2. In actuality, it is very likely that this will result in less than 1% due to the fact that the equipment manufacturer must prove that he is applicable for this flexibility[44], as outlined in the regulatory language for this rulemaking and for the fact that the database for this analysis does not consider whether the equipment manufacturer or engine manufacturer has or will have already converted the line to be in compliance with anticipated CARB Tier 2 standards.

For handheld equipment, no costs were assumed for handheld equipment manufacturers to incorporate a new Phase 2 handheld engine due to the assumption that the majority of changes to handheld engines will be internal design changes. If equipment manufacturers do need to make equipment design changes, the large majority of equipment manufacturers in this industry are also engine manufacturers and can likely time changes in die design with their production cycle, thereby minimizing the costs. Therefore,

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[43] The analysis assumes a 16% engine manufacturer and 5% equipment manufacturer markup on engine variable hardware costs (no hardware variable costs are assumed for equipment modifications).

[44] This analysis assumes only Class II SV engines will undergo changes which will require changes in equipment design.

the basis for a small equipment model is related to that for a small engine family. The cutoff for handheld equipment model is 2,500 units/model. This results in an estimated 1% of the equipment being allowed to utilize a Phase 1 engine[45].

There are a number of factors that will influence whether this definition is put to use by equipment manufacturers. These include 1) the likelihood that no change to equipment will be required[46] and therefore the use of this flexibility will be less than estimated, 2) manufacturers will produce engines and equipment for California[47] separate from those that are sold in the remaining 49 states (there is more control over where product is delivered in the handheld industry compared to the nonhandheld industry and therefore the flexibility may be utilized, and 3) market pressure for a Phase 2 certified engine may result in less use of this flexibility.

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[45] This is greater than the 0.6% of engines that will fall under the small engine family definition. This is likely due to the fact that it includes models by equipment manufacturers that do not make their own engines. As for engine manufacturers being allowed to produce more Phase 1 engines, EPA has included provisions for small engine manufacturers to fulfill the need for Phase 1 engines for equipment manufacturers that qualify.

[46] EPA estimates that 5% of the Class IV and V engines will utilize a low efficiency catalyst to meet the Phase 2 standards. There will be some equipment changes required to accommodate the use of a catalyst. This analysis was not based on the use of a catalyst since its assumed use in the marketplace is minimal.

[47] Due to the stringency of the proposed CARB standards for the handheld engines as of 1990, it is likely that 4 stroke technology or very advanced 2 stroke technology with a catalyst system will be required in order to meet the standards

Table 9-08
Small Volume Equipment Model

	Unit Cutoff
Nonhandheld	500
Handheld	2,500

Table 9-04

SUMMARY OF RULEMAKING FLEXIBILITIES

FLEXIBILITY PROVISION	APPLICABILITY	PRODUCTION CUTOFF	DISCUSSION
ENGINE: Meet adjusted Phase 1 standard throughout Phase 2.	Any Class II SV family	1000/family	The cost for conversion of small volume engine families to OHV is costly. This allows the special niche market engines to remain in the marketplace.
ENGINE: Waiver of PLT unless nonconformity discovered	Small volume engine manufacturer	hh: 25,000 nhh: 10,000	Small volume engine manufacturers likely outsource certification testing and thereby do not have in-house test equipment. PLT waived unless nonconformity found.
ENGINE: Waiver of PLT for very clean engines (50% below FEL)	Any engine family	--	EPA is confident that engine families that are 50% below the engine family's FEL will not exceed their FEL in production. Resources better used elsewhere.
ENGINE: Waiver of phase-in requirements	Small volume engine manufacturers	hh: 25,000 nhh: 10,000	Engine manufacturers have until the last year of the phase-in to produce Phase 2 compliant engines.
EQUIPMENT: Continued use of Phase 1 enginesfor 3 years after phase-in of applicable standards	Small volume equipment manufacturer	hh: 5,000 nhh: 2,500	Small equipment manufacturers may not know engine model is discontinued until last year of phase-in. This flexibility gives time for equipment redesign.
EQUIPMENT: Continued use of Phase 1 engines; low volume model exemption	Any equipment manufacturer	--	Changes to low volume equipment production may mean the end of that product offering. This flexibility works to assure that those engines remain in the marketplace. These engine families are likely niche markets.
EQUIPMENT: Hardship Provision	Any equipment manufacturer	--	Equipment manufacturer may use Phase 1 engine through 2002 for Class I and 2006 for ClassII-V engines.

* The majority of these flexibilities require the applicant to apply to the

Administrator to prove the need for the flexibility.

Chapter 9: References

1. "A 1989 California Baseline Emissions Inventory for Total Hydrocarbon & Carbon Monoxide Emissions from Portable Two-Stroke Power Equipment", prepared by Heiden Associates, Inc, for the Portable Power Equipment Manufacturers Association, July 24, 1990. This report is available in EPA Air Docket A-96-55, Docket Item # II-D-14.

2. "Utility Engine Emission Report", prepared by Booz, Allen & Hamilton Inc., for the California Air Resources Board, November 20, 1990. This report is available in EPA Air Docket A-93-25, Docket Item # II-I-02.

3. "Useful Life, Annual usage, and In-use Emissions of Consumer Utility Engines", memo from the OPEI CAAC In-Use Working Group to Ms. Gay MacGregor, US EPA, EPA Air Docket A-96-55, Docket Item # II-D-13.

4. "Regulatory Support Document, Control of Air Pollution, Emission Standards for New Nonroad Spark-Ignition Engines at or Below 19 kiloWatts" US EPA, May 1995, EPA Air Docket A-93-25, Docket Item # V-B-01.

APPENDIX A

APPENDIX A: INDUSTRY CHARACTERIZATION

This Appendix discusses the structure of the industries producing engines and equipment affected by this NPRM. The industry characterization presented here is taken from a report prepared under a contract work assignment for EPA by Jack Faucett Associates.(1) The purpose of the work assignment was to prepare a report describing and analyzing the market structure, conduct, and performance of the small nonroad engine and equipment industry and to assess the technologies represented by the most common engines and equipment. The following descriptions are excerpted from that report. Some sections which are excerpted are specific to the Lawn and Garden Equipment Standard Industrial Code (SIC) 3524, although 11 SIC code categories were analyzed in the report. The reason this section is focusing on the lawn and garden equipment category is that most of the engines and equipment covered by this regulation are in that category.

> [T]he small nonroad engine market is best described as a chain of industries that: convert raw materials into components, engines, and equipment; distribute the final product to end users; and, provide service and parts as required. The establishment of regulation or alternative-market based regulatory approaches will impact this chain of industries in a variety of ways. The structure of this chain, and the characteristics of the industries that comprise it, will influence how successful alternative control strategies will be in practice.
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> ...
>
> Figure 1 provides a schematic of the relationships and flow of goods for engine manufacturers. To begin the process, raw materials and components are purchased from suppliers. Necessary raw materials include the steel and aluminum required to manufacture engine parts. The amounts and types of purchased components will vary from one manufacturer to another. Some engine manufacturers make their own parts, others purchase components. Die-cast molds are used to forge parts. The finished parts and components are assembled into engines on an assembly line.
>
> Complete engines are sent to one of three places: equipment manufacturers, distributors, or export markets. A great deal of engines are sold directly to equipment manufacturers. In cases where engine manufacturers are vertically integrated, these sales would be recorded as intra-company transfers. Direct sales to equipment manufacturers is particularly common for high volume consumer equipment and for technically demanding equipment for the commercial market. The large volume engine manufacturers such as Briggs & Stratton and Tecumseh sell directly to mass merchandiser equipment manufacturers such as Murray Ohio Manufacturing and American Yard Products. Price and economies of scale[48] are the primary factors of competition for engine sales to mass merchandisers. For direct sales to equipment manufacturers producing mid-range and premium priced equipment, engineering and design cooperation is essential. In these cases, the engine manufacturers also work closely with the equipment manufacturers to develop superior products.
>
> For smaller equipment manufacturers, or for some of the cases where there is no need for technical cooperation, it is usually not cost-effective for the engine manufacturer to

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[48] An economy of scale is said to exist when larger output is associated with lower average cost.

sell engines directly to the equipment manufacturer. In those cases, engine manufacturers often ship engines to independent wholesale distributors. As independent businesses, these distributors carry engines from multiple manufacturers. The distributors then sell the engines to original equipment manufacturers (OEM's) to be installed as product components. Distributors also sell "loose" engines as replacement parts. Large-scale end-users and dealers/retailers who provide service on used equipment are the most frequent purchasers of replacement engines. Engines not sold to equipment manufacturers or domestic distributors are shipped as exports.

In every segment of the utility industry, equipment manufacturers must decide whether to use "two-tiered" distribution channels or to interface directly with their dealer network. In a two-tiered distribution system, an independent wholesale distributor acts as an interface between the equipment manufacturers and the dealer network. Distributors add value by providing service to both the equipment manufacturers and the dealer network. Distributors remove a great deal of the inventory burden from dealers. Because dealers generally do not have the facilities or financial strength to maintain large inventories, they must frequently order parts for repair. Successful distributors can usually provide parts within 24 hours. In the absence of a distributor, parts must be shipped from the equipment manufacturers by package delivery services (such as UPS). This can take several days or more, depending on manufacturer location and the availability of the part. Furthermore, because many dealerships are small businesses, they often rely on their distributors for bookkeeping and general business support. Enhanced service provided by the distributors improves the reputation of the equipment manufacturers. Also, distributors provide market information to manufacturers because they are closer to the consumers and are often able to identify emerging trends faster than the manufacturers themselves.

Despite the added value that distributors provide for both dealers and manufacturers, they are declining in numbers and importance. This shift is generally attributed to the ever increasing price competition in the consumer marketplace. The value added by distributors must be offset by the profit margin required by the additional tier in the distribution chain. Although distributors will remain important, particularly for premium line equipment, their impact on the market is projected to decline.

The distribution system for lawn and garden equipment manufacturers is probably the most diverse and complex in the utility market. This is primarily due to the different needs of the commercial and consumer markets. The bulk of all lawn and garden unit sales go to consumer end-users.[49] However, commercial customers represent too large a market to ignore, and some equipment manufacturers and members of the distribution chain focus strictly on the commercial business. Balancing the commercial customers need for performance and service with the consumer customers need for a low price is the challenge facing manufacturers and the distribution channels they have developed.

Figure 2 provides a schematic of the relationships and flow of goods from the viewpoint of the lawn and garden equipment manufacturers. These manufacturers design and manufacture their own parts and/or purchase components. The finished parts and components are assembled into end-user equipment. Finished goods are sent to one of three places: wholesale distribution dealers or other retail establishments, or shipped for export.

Some manufacturers use a direct (i.e., one-tier rather than two-tier) distribution system, dealing directly with dealers or other retail establishments. The larger the manufacturers and the larger the retail unit, the more likely that this link will be direct. Mass merchandiser manufacturers deal directly with mass merchant and discount retail outlets. Some manufacturers deal directly with all types of retail outlets. The trend towards direct distribution is expected to continue, as is the trend towards the mass merchandisers. These trends serve to keep prices low, foster price based competition, and put a squeeze on

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[49] For example, OPEI estimates that 90% of walk behind lawnmower sales go to the residential market.

distributors and local dealers. The average service dealer makes $100,000 to $250,000 in sales per year. There are 300 dealers that bring in over $1,000,000 in revenues annually. There are also a great many dealers that have less than $100,000 annual revenues. Dealers are extremely dependent on service revenue to stay in business. Approximately 50 percent of the average dealers revenues are realized through parts and repair work.[50]

As emission requirements force small nonroad engines to be more complex, more will be expected of small engine technicians. The situation is similar to automobile dealers who must perform vehicle emission compliance work. Jeff Voelz, Marketing Director at Onan Corporation, noted that, "dealers will have to get savvy and understand that this is their future."[51] As in the automotive industry, emission control advances are likely to reduce the user's maintenance abilities and require an increase in small engine technician skills.

Although two-tier distribution is declining, it is still an important feature of the distribution network. According to a survey of its members, OPEI found that 41.4 percent of shipments were distributed through wholesale distributors in 1988. Many manufacturers use two-tier distribution for virtually every type of retail establishment, although distributors are generally bypassed when shipments go to mass merchandisers and discounters. Because of fierce price based competition, the pressure is on distributors to prove their ability to add value in order to maintain their volumes of business in the future.

Most manufacturers choose to focus on either the consumer or commercial market. These factors, in turn, influence their choice of distribution channels. Manufacturers that focus strictly on the consumer market, especially at lower end prices, generally retail exclusively through mass merchandisers. Manufacturers that focus strictly on the commercial market, generally rely exclusively on dealers. Mid-range manufacturers and other manufacturers that wish to compete at the commercial or top-end consumer market and the low-end consumer market face a difficult choice. It is tempting to use both mass merchandisers (for sales volume) and dealers (for value added service). However, this creates tremendous conflict within the channels, particularly for the dealers. The dealers cannot match mass merchandisers on price, and frequently end up as repair shops, merely servicing the equipment that they can no longer sell. The solution to this situation that has been most successful is to sell separate lines of products, restricting the mass merchandisers from selling the higher quality product lines. McCullough has been able to do this successfully. Toro tried to do this, but eventually withdrew from mass merchandiser outlets. Toro is now trying the mass merchandisers again with its Lawnboy subsidiary.

This discussion of lawn and garden manufacturer distribution channels primarily addresses nonhandheld equipment manufacturers, although, in general, it applies to handheld equipment manufacturers as well. There are, however, some unique facets of the handheld manufacturers distribution networks that have not been previously addressed. The major difference is that the handheld manufacturers all make their own engines. This changes the mixture of raw materials and components they purchase as well as their manufacturing and design processes. A separate engine market would not suffice for handheld manufacturers because of the size, performance, and design restrictions placed on their products by the unique end-user requirements for handheld equipment.

There are only a handful of nonhandheld equipment manufacturers that are vertically integrated. ? of these, producing a broad line of premium engines and products from its North Carolina plant. Kubota is also another example of a major manufacturer of both engines and equipment.(2)

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50 North American Equipment Dealers Association.

51 Phone conversation on June 8, 1992.

The Lawn and Garden Equipment Industry (SIC 3524) accounted for 0.11 percent of GDP in 1990. ... Constant dollar shipments have increased sharply, with a 33.1 percent increase from 1984 to 1990. ... [R]oughly the same number of companies were responsible for the increased out, indicating that new firms entering the industry may not have been responsible for higher output. Value added as a percent of output for the industry in 1990 was 40.9 percent, roughly the same as the internal combustion engine industry.

This industry does not seem to be capital intensive, as assets were only 18.8 percent of output in 1990, less than the corresponding percentage for All Manufacturing Industries. ... In addition, capital turnover rates are 15.6 years, slightly above the average for All Manufacturing Industries. As a result, should regulation result in new purchases of capital, the industry may not have as much difficulty as other industries in adapting to regulatory actions.

Concentration in this industry is high, as the 8 largest companies control 71 percent of the market. These companies may have the ability to influence the price of their products. Yet the industry does not seem to have excess capacity, with a capacity utilization rate of 73 percent. This figure is slightly less than the 76 percent rate for All Manufacturing Industries. ...

...

Because the Statistics of Income Classification code relevant to the Farm Machinery and Equipment industry includes both 4-digit SIC codes 3523 and 3524, the profitability analysis for the Farm Machinery and Equipment industry also applies to the Lawn and Garden Equipment industry. For 1988, profitability for this industry seemed quite good, with the average return on equity up to 17.9 percent, a 14.1 percent increase from 1990. The average debt to asset ratio, however, is among the higher of the seven minor industries considered ... at 42 percent.

...

Constant dollar shipments are expected to grow at an annual rate of 2 percent over the next 5 years for the Lawn and Garden Equipment industry. The U.S. Industrial Outlook attributes this increase to several factors, first among them are demographic changes in the U.S. population. In particular, the fastest growing age group, 44-54, will be near their maximum earning potential, which should result in larger expenditures on lawn and garden equipment. The report also notes that many of these consumers will be more inclined to upgrade their current properties, which may entail landscaping. The removal of trade barriers in Mexico and Canada as a result of the North American Free Trade Agreement (NAFTA) should give companies in the three North American countries the opportunity to expand their exports. In addition, the report mentions that possible environmental standards may have an impact on sales, but the report does not give a clear indication of whether or not these regulations will cause sales to increase or decrease.(3)

...

[M]any of the eleven 4-digit SIC industries encompassing the small nonroad engine and equipment industry are characterized by significant value added, fairly high concentration, growth in the value of shipments, capital intense production processes, high capital turnover, and relatively efficient capacity utilization. These basic industry trends determine the competitive nature of the industry and condition the interactions of the firms that form these industries with suppliers, consumers and each other.(4)

[T]he competitive features of the small nonroad engine and equipment industry have been reviewed. These features include: channels of product distribution, the levels of vertical and horizontal integration across engine and equipment manufacturers supplying the nonroad engine and equipment industry, the types and extent of barriers to entry that may exist in this industry, the degree of market power inherent in the nonroad engine and equipment industry

at various levels of producer interactions, the availability and importance of substitute power sources for ? engines, the global competitive position of U.S. firms in this industry, and characteristics of end-users which drive the demand for the various products that are sold in the small nonroad equipment industry. Such a comprehensive description of this industry's competitive features has revealed various interesting results which should be summarized.

First, the level of vertical integration in the small nonroad engine and equipment industry appears to be rather small. Where present, vertical integration is concentrated in three areas of the industry: foreign lawn and garden engine and equipment manufacturers, foreign recreational engine and equipment manufacturers, and handheld lawn and garden engine and equipment manufacturers. For example, Honda produces both the engine and equipment components of their lawn and garden products... In fact, most of the vertically integrated companies are foreign companies.

Horizontal integration, on the other hand, is common among engine manufacturers in the small nonroad engine and equipment industry. This follows directly from the fact that a single engine design is often used in many small nonroad equipment applications. ...[T]ecumseh and Briggs & Stratton engines, for example, are employed by various types of equipment including lawn and garden equipment, light commercial and industrial equipment, light agricultural equipment, and others.

Second, advertising and product differentiation, economies of scale, and large capital requirements appear to be the only forms of barriers to entry that may characterize the small nonroad engine and equipment industry. However, the effectiveness of these phenomena is difficult to assess. Nevertheless, advertising plays an important role in the lawn and garden equipment industry, as shown by its relatively high advertising intensity ratio. Similarly, product differentiation is important in this market as evidenced by the large number of brands and product models that are offered for different equipment types, such as lawnmowers or chainsaws...

Economies of scale and large capital requirements, on the other hand, are likely to be more important at the engine manufacturing level of the industry, since this level is capital intensive and characterized by few dominant sellers. It should also be noted that patents may play an important role in deterring new entry as a result of Section 308 of the Clean Air Act. Ryobi, for example, may clearly have a competitive advantage if its new 4-stroke CleanAir Engine is protected through patent.

...[O]ne general characteristic of the industries that comprise the small nonroad engine and equipment industry is high levels of seller concentration. Empirically, high seller concentration has been shown to perpetuate product pricing that is above the marginal cost of the products production.(5) ...[R]esults that are characterized by this pricing outcome are economically inefficient, and display the market power, of at least the market leaders, in the industry. However, although the small nonroad engine and equipment industry is generally characterized by seller concentration, ...the various relationships between the economic agents operating in this industry are not characterized by significant levels of market power. Much of the reasoning behind this conclusion centers on the concept of contestable markets... The fact that the small nonroad engine and equipment industry is not characterized by market power implies that if regulatory actions increase the production costs of the firms producing in this industry, then these incremental costs will likely be passed on to consumers, or end-users, in the form of higher prices. Moreover, the likelihood that market power is not prevalent in the small nonroad engine and equipment industry implies that economic profits are not being accrued in the long run. This in turn suggests that entry into the market is relatively free. Although some aspects of barriers to entry may exist (such as product differentiation, advertising, and economies of scale), their effectiveness at deterring entry is not necessarily evident.

Fourth, the prevalence of substitute power sources and equipment that displace equipment powered by internal combustion engines is most evident in the lawn and garden equipment market where electrically powered machines have been common for many years.

However, the sale of electrified lawn and garden equipment is hampered by various factors. For example, the long extension cords necessary for the operation of electrified equipment are cumbersome, while electrified lawn and garden equipment are generally not a viable option for commercial users. However, use of battery packs could potentially resolve some of the detrimental user oriented externalities associated

Appendix References

1. Jack Faucett Associates, *Small Nonraod Engine and Equipment Industry Study*, JACKFAU-92-413-14, December 1992

2. ibid, pages 68-76

3. ibid, pages 57-58

4. ibid, p. 67

NOTE: Graphs not included in this electronic version

APPENDIX B

Appendix B: Manufacturer and Product Summary

B.1. Introduction

This appendix summarizes information on the equipment related to the category of engines regulated, nonroad 0-19 kilowatt spark-ignited engines. This appendix summarizes the engine manufacturers and their products, the technology used on these engines, and estimates the amount of these engines consumed in the United States.

B.2. Engine Manufacturer Summary

There are a wide variety of engine manufacturers producing engine products which will be regulated. Mostly, engine manufacturers produce either handheld 2-stroke engines or nonhandheld 4-stroke engines, although the major manufacturers produce some of each. Data on the manufacturers and their products is provided from EPA's Phase 1 certification database[52].

B.2.1. Listing of Known Engine Manufacturers

EPA has generated a listing of engine manufacturers from EPA database. It appears that there are approximately 39 engine manufacturers selling gasoline engines under 25 horsepower. Of these, 22 manufacturers produce 2-stroke engines (21 handheld and 1 nonhandheld) and 23 manufacturers produce 4-stroke engines (21 nonhandheld and 2 handheld). There are 5 manufacturers who produce both 2-stroke and 4-stroke engines. Please refer to Table B-01, which summarizes the manufacturers who produce handheld and nonhandheld stroke engines.

B.2.2. Listing of Known Engine Models per Manufacturer

The EPA Phase 1 database contains the most extensive listing of information at the engine model level. The data in this section is excerpted from this database. Presented in Table B-01 are the number of engine models per manufacturer and the

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[52] All engine models for production in the 1997 model year were to be certified by September 1, 1997. The only exception are those models that are exempt from CARB's Tier 1 program (Class V engines) which have until January 1, 1998. **CHECK!**

estimated number of engine models in each standard category.

B.2.2.1. Number of Engine Models- Table B-01 shows that there are 151 engine models in Classes I and II (nonhandheld) and 169 in Classes III-V (handheld). The most diverse nonhandheld manufacturer and handheld manufacturer produce nearly the same number of engine models. There are eight manufacturers of handheld engines and nonhandheld engines who produce less than five engine models. There are five nonhandheld engine manufacturers of moderate diversity producing between 15 and 25 engine models for approximately 64%of the number of 4-stroke engine models. There are just two handheld 2-stroke engine manufacturers producing between 15 and 22 models accounting for approximately 24% of the 2-stroke engine models. There is more diversity amongst handheld engine manufacturers.

Other statistics on the handheld and nonhandheld products are similar. For nonhandheld engine manufacturers, the two most diverse engine manufacturers produce 32% of the engine models, while the most diverse engine manufacturer produces 16.5% of the product models. For handheld engines, the two largest manufacturers produce 24% of the engine models, while the most diverse engine manufacturer produces 13% of the product models.

The data these conclusions are based on are summarized in Table B-01.

B.2.2.2. Engine Family and Emissions Per Engine Family Per Class -- Table B-02 through B-06 contain information per engine family per manufacturer on engine family, new engine emissions (HC, Nox, CO), emission control technology, major applications and displacement.

Since the proposed Phase 2 regulation is an in-use set of standards, the new engine values from the Phase 1 certificatin database have been deteriorated to compare to the new engine standard. Deterioration factors were taken from data submitted by industry and EPA's own analysis. Table B-07 lists the deterioration factors applied to the corresponding engine families. EPA requests comment on the accuracy of the information presented in all tables in this Appendix.

Table B-07

Deterioration Factors

CLASS	I	II	III	IV	V
	HC+NOx	HC+NOx	HC/NOx	HC+NOx or HC/NOx	HC/NOx
SV	1.9	1.6	--	--	--
OHV	1.4	1.4	--	2.0	--
2-STROKE	1.1	--	1.1/1.0	1.1/1.0	1.1/1.0
2-STROKE W/ CAT	--	--	--	1.3	--

B.3. Estimate of Historical and Future Equipment Consumption (Sales)

EPA analyzed the information from the PSR database as well as information from Outdoor Power Equipment Institute (OPEI), the Portable Power Equipment Manufacturers Association (PPEMA), and a study done for the California Air Resources Board by Booz, Allen, Hamiliton (BAH).

Data presented in this section shows the estimates of historical consumption from these sources. Data from two regression analyes is also presented. EPA did a regression of historical sales using ordinary least squares methodology. EPA considered using the regression equation produced from this historical sales regression to predict future sales. However, EPA decided to use the regression results from a second regression analysis in which the best estimate historical sales were regressed with estimates of historical and projected population estimates from the Bureau of Economic Analysis[53]. Some regression results predicted negative sales for a few equipment types. In those instances, EPA assumed no change in future sales levels from the last year for which historical sales were estimated. EPA's actual "best estimates" of consumption are presented in Appendix F, Table F-02.

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53 U.S. Department of Commerce, Bureau of Economic Analysis, *BEA Regional Projections to 2040, Volume 3: BEA Economic Areas*, Washington, DC, 1992.

Table B-01
Engine Manufacturers and Engine Families Per Class and Engine Type
EPA Phase 1 Certification Database

Manufacturer	Number of Engine Families for Each Standard Category									TOTAL
	NONHANDHELD					HANDHELD				
	I SV	I OHV	I 2-S	II SV	II OHV	III 2-S	IV 4-S	IV 2-S	V 2-S	
A.L. Cook					2					2
Briggs & Stratton	6	5		4	9					24
Daihatsu Motors					2					2
Emak s.p.a.								3	5	8
Flex Systems					1					1
Fuji Heavy Industries, Ltd.	2	3		2	5				1	13
Fuji Robin Industries								4		4
Generac		2			9					11
Honda	2	6			8		2			18
Husqvarna AB								10	3	13
Ishikawajima Shibaura Machinery Co.								4		4
John Deere Consumer Products, Inc.								10	?	10
Kawasaki		4		1	10	1		6		22
Kioritz								22	1	23
Kohler Company		1		4	12					17
Kohler Company Generator Division					5					5
Komatsu-Zenoah								10	1	11
Kubota		3			5					8
Makita USA, Inc.								7	2	9
Maruyama US Inc.								7		7
McCulloch								7	?	7

Table B-01 continued

Manufacturer	Number of Engine Families for Each Standard Category									TOTAL
	NONHANDHELD					HANDHELD				
	I SV	I OHV	I 2-S	II SV	II OHV	III 2-S	IV 4-S	IV 2-S	V 2-S	
Mitsubishi Engine North America, Inc or Mitsubishi Motors Corporation		2			3			2		7
Onan				5	3					8
Pioneer/Eclipse Corp.					1					1
Poulan						3		10	?	13
Ryobi							1	2		3
Shin-Daiwa Kogyo Co. Ltd								11		11
Solo Incorporated									1	1
Spectrum Industrial Products Inc.		1			2					3
Stihl								13	5	18
Suzuki		1	2		1					4
Tanaka Kogyo Co. Ltd								6		6
Tecumseh	8	6		7	4			1	2	28
Wacker-Werke GmbH&Co KG.									1	1
Westerbeke					7					7
Wis-con Total Power Corp.				2						2
Yamaha Motor Company, Ltd.		3			3					6
TOTALS	18	37	2	14	92	5	3	135	11	338

NOTE: This analysis was taken from the EPA certification database on September 1, 1997. Engine models exempted from CARB rulemaking in Class V have until January 1, 1998 to certify to the Phase 1 standard. It is expected that there will be more Class V models certified and therefore this table is to be updated for the FRM.

NOTE: There may be a few double counted models if families have been certified in more than one model year to date. Some duplicates have been removed.

APPENDIX C

APPENDIX D
(Reserved)

APPENDIX E

APPENDIX F