

Nonroad Engine Population Estimates

Report No. NR-006A

December 9, 1997
revised June 15, 1998

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Purpose

The purpose of this memorandum is to document the source of the nonroad engine population values used in EPA's NONROAD emission inventory model. Engine populations were provided as default values in EPA's NONROAD emission inventory model categorized by equipment type, power level, and fuel type for individual states. This categorization allows the NONROAD model to determine the phase-in of new emission standards and other unique aspects of emissions or allocations by application, fuel type, or power level.

Introduction

The default base year application populations are used as a starting point to estimate future and past year engine populations in the NONROAD emissions model. The NONROAD model tracks engines rather than equipment because present and planned nonroad emissions regulations focus on engines instead of equipment. EPA anticipates that future nonroad emission regulations would also focus on engines.

The engine populations were divided into many applications because of the variety of ways nonroad engines are used. A complete description of these applications is provided in Appendix A of this document. This variety of applications allows for application-specific geographic and temporal allocations, activity, emission rates, and other input factors to characterize nonroad engine usage and emissions.

The engine populations were also divided into 5 fuel types: diesel (2 and 4-stroke combined), gasoline 2-stroke, gasoline 4-stroke, compressed natural gas (CNG) (2 and 4-stroke combined), and liquid petroleum gas (LPG) (2 and 4-stroke combined). The diesel, CNG, and LPG engine populations for 2 and 4-stroke engines were combined because these engines exhibit little difference in emission rates between 2 and 4-stroke engines, most likely because these

engines use fuel injection to deliver the fuel to the combustion chamber. Gasoline 2 and 4-stroke engines were separated because of the availability of information indicating widely different emission rates, especially for hydrocarbon emissions. Each combination of application and fuel has been assigned a unique “Source Classification Code” (SCC).

The engine populations by application and fuel were further divided into 19 power level categories to account for emission regulations and some technology differences associated with power level. The power level categories provided were 0-1 hp, 1-3 hp, 3-6 hp, 6-11 hp, 11-16 hp, 16-25 hp, 25-40 hp, 40-50 hp, 50-100 hp, 100-175 hp, 175-300 hp, 300-600 hp, 600-750 hp, 750-1000 hp, 1000-1500 hp, 1500-2000 hp, 2000-3000 hp, and 3000+ hp. While this detailed disaggregation by application, fuel type, and power level allows users to make fine distinctions in understanding the effects of control strategies, it also might lead to very small engine populations for some states for some application and power segments.

Base Year Population

The base year (1996) default in-use engine populations came from estimates made by Power Systems Research (PSR), an independent marketing research firm.(1) NONROAD uses the PSR estimates for state and national populations, but, as described in the report on geographic allocation, the model uses other methods to allocate populations to the county level. The PSR estimates were determined from engine manufacturer sales surveys, experimentally determined engine life, and surveys of usage of these engines. The population estimates were verified by equipment owner surveys over the course of several years. A review and evaluation of the PSR methodology was provided by Pechan, another independent contractor. (2) The 1996 base year population estimates were released in the middle of 1997, so they represent the most recently available information. The Nonroad Engine and Vehicle Emission Study (NEVES) report (3) used 1989 in-use year estimates from PSR, so the current estimates represent an update to the previous estimates.

PSR developed engine population estimates for 2 and 4-stroke diesel, gasoline, liquid petroleum gas (LPG), and compressed natural gas (CNG) engines. These populations were further divided by power level for the NONROAD model to determine appropriate fleet turnover rates and appropriate engine emission standard phase-in strategies. Appendix A describes how PSR application codes correspond to the source categorization codes (SCC) for 2-stroke gasoline engines. The SCCs for other fuel and engine categories are identical in their last 6 digits, but differ in their prefix. Diesel engines are 2270xxxxxx, 4-stroke gasoline engines are 2265xxxxxx, LPG engines are 2267xxxxxx, and CNG engines are 2268xxxxxx. The remaining numbers marked by the “x” determine the applications where these engines are used.

Exceptions to the coding system just described are marine (recreational, commercial, and military), rail (locomotives and maintenance equipment), and aircraft. Commercial and military vessels, locomotives, and aircraft are not yet included in the NONROAD model. Airport service

equipment is included in the coding system described previously. The recreational marine equipment and coding is described below in a separate section and in Appendix B. Railway maintenance equipment uses 228500x015 for the SCC with the “x” replaced by “2” for diesel, “3” for 2-stroke gasoline, “4” for 4-stroke gasoline, “6” for LPG, and “8” for CNG engines.

Equipment Inventory Changes

Previous equipment estimates in the Nonroad Engine and Vehicle Emission Study (NEVES) were also provided by PSR in 1990 for the 1989 in-use engine populations. (3) The NEVES work led to development of source category codes (SCCs) for given applications. NEVES did not include several equipment classes and power ranges of some types of equipment. The current PSR estimate included those additional engines and revised the 1990 PSR estimate of the 1989 in-use engine population with the 1997 PSR estimate of the 1996 in-use engine population. These two factors, a revised PSR estimate and the new equipment classes and power range additions, accounted for the majority of changes that affect the engine population.

Appendix B describes both significant and minor changes between the data derived from the NEVES report and the NONROAD model for some SCCs. New equipment classes and power range additions for some equipment types were included in the NONROAD model, altering the engine population estimates. There were other minor changes that did not affect engine populations but rather changed the description of the codes.

Another change, not described in Appendix B, is that LPG and CNG engines, which were not included in previous nonroad engine populations, were added to the NONROAD model. New SCCs were added to accommodate these new engines. This added a number of additional engines for some applications and not for other applications. As described below, small CNG and LPG engines were lumped with other small spark-ignition engines for the purpose of keeping consistency with the emissions regulations.

In order to apply the new emission standards expected for small (<25 hp) and recreational marine spark-ignition engines, the 2 and 4-stroke gasoline, LPG, and CNG engines were combined into one category (while still maintaining power level distinctions). The new emission standards intend to produce cleaner engines in part by reducing the number of 2-stroke in favor of 4-stroke engines. The reasons for and associated problems with combining these engines are described in more detail below.

Mobile and Stationary Nonroad Engines

One challenge in preparing a mobile source inventory is that engines used for generators, pumps, compressors and other applications may be either mobile or stationary, and, thus, may be subject to different regulations. Therefore it was necessary to determine the fraction of engines

used as mobile and stationary emission sources. The NONROAD model estimates emissions from ‘mobile’ equipment. The legal definition of a mobile nonroad engine is an engine that moves from one place within a 12-month period. (4) In some cases the distinction may not be clear because engines that might appear stationary are in fact considered as mobile. For example, a palette-mounted engine is easily moved from one site to the next with a forklift or other type of lift truck over the course of several months. To account for mobile nonroad engines, EPA used the only information available which was derived from a report to the California Air Resources Board by Booz, Allen, and Hamilton (5) and given in Table 1 to provide fractions of engines used as mobile nonroad engines for the few application classes in which some of the engines are used and regulated as stationary sources. Generator sets, pumps, compressors, and welders were the applications which were determined to have some stationary engines. The fraction of mobile engines was applied to the state equipment populations for the appropriate applications as provided by PSR in order to avoid counting stationary sources in the nonroad mobile sources inventory. EPA would like reviewers to consider whether other similar applications such as General Industrial (22xx003040), Hydro Power Units (22xx005050), and Irrigation Sets (22xx005060) might also be classified primarily stationary applications for larger engines.

Table 1: Fraction of Generator Sets (22xx006005), Pumps (22xx006010), Compressors (22xx006015 and 22xx006020), and Welders (22xx006025) Considered to be Mobile Sources

Power Range (Hp)	Percent Mobile Equipment
0 to 25	90
25 to 40	90
40 to 100	70
100 to 175	20
175 to 300	15
300 to 500	10
500+	0

Small (<25 hp) Spark-Ignition Engines and Equipment

Two important issues regarding small (<25 hp) spark ignition (SI) engines and equipment require further discussion: treating commercial and residential users separately, and accounting for the effects of new regulations.

Many of the small spark-ignited engines are used in lawn and garden equipment applications, and lawn and garden equipment is used both by commercial and residential users. The commercial users are grounds keepers for nonresidential buildings, large apartment complexes, and some single-family homes. Commercial equipment therefore has significantly different usage in terms of hours per year and hours per weekday versus hours per weekend day than residential equipment. To account for these differences in equipment usage, separate SCCs were defined to account for commercial and residential lawn and garden equipment. The engine populations derived by PSR were then divided into residential and commercial fractions from information derived by California and shown in Table 2. (6) For applications not shown in Table 2, 100% commercial use was assumed for the engines because these applications include such categories as construction, agricultural, commercial, and many other engines applications already considered commercial.

The sales fraction combined with the average life (in years under average operation shown in another report, NR-003) of the engines was used to calculate an in-use population fraction of residential and commercial equipment. The calculation uses the sales fraction multiplied by the average life for both residential and commercial equipment and the population fraction determined from the two populations as shown in the equation below.

$$\text{Commercial Population Fraction} = \frac{(\text{Commercial Sales Fraction} * \text{Commercial Average Life in Years})}{(\text{Commercial Sales Fraction} * \text{Commercial Average Life} + \text{Residential Sales Fraction} * \text{Residential Average Life})}$$

The results of this calculation are shown in Table 2 below. The fraction of in-use population of residential equipment is higher because residential equipment lasts longer (in other words, the average life in years is higher) reducing the attrition. The reduced attrition accounts for the different population fraction.

Table 2: Residential and Commercial Percentages of Small Spark-Ignition Engine Equipment

SCC	Application	Residential		Commercial	
		Sales	Population	Sales	Population
22xx004010 22xx004011	Lawn mowers	90.00%	96.3%	10.00%	3.7%
22xx004025 22xx004026	Trimmers/edgers/cutters	81.85	89.4	18.15	10.6
22xx004020 22xx004021	Chainsaws	75.00	93.5	25.00	6.5
22xx004030 22xx004031	Leaf blowers/vacuums	86.87	92.5	13.13	7.5
22xx004015 22xx004016	Tillers <6 hp	82.00	85.7	18.00	14.3
22xx004035 22xx004036	Snowblowers	90.00	90.0	10.00	10.0
22xx004071	Commercial turf equipment	0.00	0.0	100.00	100.0
22xx004040 22xx004041	Rear engine rider	95.00	97.4	5.00	2.6
22xx004055 22xx004056	Lawn and garden tractors	95.00	97.4	5.00	2.6
22xx004075 22xx004076	Other lawn and garden equipment	25.00	45.7	75.00	54.3
22xx004045 22xx004046 22xx004065 22xx004066 22xx004070 22xx004071 All others	Front Mowers Chippers\Stump Grinders Commercial Turf All other equipment	0.00	0.0	100.00	100.0

Lawn and garden and other small (<25 hp) spark-ignition engines fall under EPA regulations targeting mainly hydrocarbon emissions. (7) The regulations to be proposed define new engine classes (I through V) based on use and displacement, while the NONROAD model classifies engines by application and power level. The regulations to be proposed require reduced emission rates in future years, and, among other consequences, are estimated to reduce the number of two-stroke engines sold in favor of four-stroke engines. With the current NONROAD modeling methodology, it was not possible to keep the 2-stroke and 4-stroke spark-

ignition engines in separate SCCs in the emissions model and account for the shift of 2-stroke to 4-stroke engines. Therefore, spark-ignition engines of less than 25 horsepower were lumped into one SCC category, eliminating the SCC distinction between 2 and 4-stroke gasoline, LPG, and CNG engines. The SCC description was changed to reflect the new engine classes described below. The distinction between 2 and 4-stroke gasoline, LPG, and CNG engines will be maintained for sales fraction and emission rates by using technology groups within the SCC.

The small spark-ignition engine regulations to be proposed incorporate five classes of engines defined by use (handheld versus nonhandheld) and displacement. For the purposes of inventory modeling, the five classes are defined by application and power level. Table 3 below describes the definitions of engine class by application and power level that were used in the NONROAD model. The PSR populations were used to define the total population, and to assign the base year technology group sales fractions distinguishing 2 and 4-stroke gasoline, LPG, and CNG engines.

Table 3: Initial Year Engine Population by Small Engine Class

SCC	Description	Power Range & Engine Cycle	Engine Class
22xx004020(1) 22xx007005	Chainsaws	0 to 1 hp (2 and 4-stroke)	III
		1 to 3 hp (2 and 4-stroke)	IV
		3 to 25 hp (2 and 4-stroke)	V
22xx002006 22xx002039 22xx004025(6) 22xx004030(1) 22xx004035(6) 22xx004071	Tampers and Rammers Concrete\Industrial Saws Trimmers\Edgers\Cutters Leaf blowers Snow blowers Commercial Turf	0 to 1 hp (2 and 4-stroke)	III
		1 to 3 hp (2 and 4-stroke)	IV
		3 to 6 hp (2-stroke)	V
		3 to 6 hp (4 stroke)	I
		6 to 25 hp (2 and 4-stroke)	II
22xx004015(6) 22xx005040 All Others	Tillers All Others	0 to 1 hp (2 and 4-stroke)	III
		1 to 3 hp (2 and 4-stroke)	IV
		3 to 6 hp (2 and 4-stroke)	I
		6 to 25 hp (2 and 4-stroke)	II
22xx001050 22xx001060 22xx002015 22xx002024 22xx002030 22xx002033 22xx002042 22xx002072 22xx002078 22xx003050 22xx004010 (1) 22xx004040 (1) 22xx004045 (6) 22xx004050 (1) 22xx007010 22xx004055 (6) 22xx004065 (6) 22xx004075 (6) 22xx005030 22xx008005 228500x015	Golf Carts Speciality Carts Rollers Surfacing Equipment Trenchers Bore\Drill Rigs Cement\Motar Mixers Skid Steer Loaders Dumpers\Tenders Other Material Handling Lawnmower Rear Engine Riding Mower Front Mowers Shredders Lawn & Garden Tractors Chippers and Stump Grinders Other Lawn & Garden Equipment Agricultural Mowers Aircraft Support Railway Maintenance	0 to 6 hp (2 and 4-stroke)	I
		6 to 25 hp (2 and 4-stroke)	II

22xx004065(6) indicates that both 22xx004065 and 22xx004066 SCC are considered, for instance.

One problem with lumping 2-stroke and 4-stroke engines together is that the different engine types have different conversion factors for converting total hydrocarbons (THC) to other hydrocarbon types (TOG, NMHC, NMOG, and VOC). This problem was ameliorated somewhat by defining the population to be primarily 2-stroke or primarily 4-stroke fuel types. In the base year, engine classes of III, IV, and V were primarily 2-stroke gasoline engines, so they were assigned SCCs of 2260xxxxxx. Engine classes I and II are primarily 4-stroke gasoline, therefore they were assigned SCCs of 2265xxxxxx. This means that 2-stroke hydrocarbon conversion factors were used for engine classes III, IV, and V, and 4-stroke conversion factors were used for engine classes I and II.

Recreational Marine Equipment

In its rulemaking on recreational marine equipment, EPA determined that alternatives to PSR population estimates provided more accurate information for spark-ignition recreational marine engines. The new population estimates were derived from sales information provided to EPA during the rulemaking to produce base year 1996 national population estimates. (8)

The LPG and CNG recreational marine engine population values were estimated to be zero, which was confirmed with the PSR estimates. There were some diesel recreational marine engines not covered by the emissions regulations for spark-ignition marine engines and therefore not included in the recreational marine estimate just described.

Recreational marine spark-ignition engines fall under EPA regulations targeting mainly hydrocarbon emissions. (9) The regulations require reduced emission rates and, among other consequences, are estimated to reduce the number of two-stroke engines sold in favor of four-stroke engines. With the current NONROAD modeling methodology, it was not possible to keep the 2-stroke and 4-stroke spark-ignition engines in separate SCCs in the emissions model and account for the expected effects of the regulations. Therefore, spark-ignition engines are lumped into one SCC, which eliminates two and four-stroke distinctions.

As with small gasoline engines, one problem with lumping 2-stroke and 4-stroke recreational marine engines into a single SCC is that the different engine types have different conversion factors for converting total hydrocarbons (THC) to other hydrocarbon types (TOG, NMHC, NMOG, and VOC). This problem is ameliorated somewhat by defining the population to be primarily 2-stroke or primarily 4-stroke fuel types. For outboard (SCC 2282005010) and personal water craft (SCC 2282005015), the primary engine type in the base year is 2-stroke; for inboard engines (SCC 2282010005), the primary engine type in the base year is 4-stroke. The NONROAD model uses these primary engine types as the basis for the conversion factors for these SCCs.

As described in Appendix A, three types of recreational marine equipment are differentiated: inboard, outboard, and personal water craft. The NEVES report documents three

types of recreational applications; inboard, outboard, and sterndrive. Sterndrive was not considered to be a unique application type, and was eliminated. Personal water craft, sometimes known by the brand name Jet Ski, were added to what was formerly the sterndrive category, and the SCC description was changed accordingly.

The base year 1996 national engine populations for recreational marine engines were estimated by EPA, departing in this category from the PSR estimates. (8) These base year populations are 8,619,722 for outboard engines, 2,567,067 for inboard, and 1,026,387 for personal water craft. These populations are totals derived from sales information and are higher than the PSR estimates. In order to reflect the average power level accurately, the national engine populations just described were assigned to power ranges using the fraction of engines in each power range as derived from the PSR information. The final assignments are shown in Table 4 below.

Table 4: 1996 National Population Estimates for Spark-Ignition Recreational Marine Engines

SCC	Description	Power Range	2-Stroke Population	4-Stroke Population
2282005010	Outboard Engines	1 to 3 hp	193,730	3,862
		3 to 6	2,343,410	6,501
		6 to 11	1,515,688	56,799
		11 to 16	472,490	14,093
		16 to 25	1,189,604	677
		25 to 40	786,243	4,493
		40 to 50	374,852	2,767
		50 to 100	761,251	0
		100 to 175	730,785	0
		175 to 300	162,479	0
2282010005	Inboard Engines	25 to 40 hp	0	2,016
		40 to 50 hp	0	0
		50 to 100 hp	0	17,225
		100 to 175 hp	0	1,775,317
		175 to 300 hp	0	772,509
2282005015	Personal Water craft	16 to 25 hp	1,340	4,806
		25 to 40 hp	34,225	0
		40 to 50 hp	83,392	0
		50 to 100 hp	734,208	0
		100 to 175 hp	168,416	0

Sailboat auxiliary propulsion engines are also included in the outboard and inboard engine categories. The national estimates include these engines, so NONROAD does not use this category to avoid double counting. PSR estimates that these engines only account for slightly

more than 30,000 engines nationwide and thus represent a small percentage of recreational marine engines.

The population of diesel recreation marine engines provided in the default engine populations was derived from the PSR estimates and uses SCCs of 22820200xx. The 'xx' here denotes inboard as '05', outboard as '10', and sailboat auxiliary as '25.' The categories of '15' and '20' were not used because sterndrive is no longer a category, and the sailboat auxiliary diesel engines were of a low horsepower design resembling outboard engines rather than inboard engines. There is little distinction between inboard and outboard for activity, allocations, or any other parameter, so assigning these sailboat auxiliary engines to outboard rather than inboard is a moot issue.

References

- (1) Power Systems Research, "US Parts Link Edition 6.2," St. Paul, MN.
- (2) E.H. Pechan, "Evaluation of Power Systems Research (PSR) Nonroad Population Data Base," prepared for Office of Mobile Sources, U.S. Environmental Protection Agency, September 1997, EPA Contract No. 68-D3-0035, Work Assignment No. III-107, Pechan Report No. 97.09.003/1807.
- (3) EPA, "Nonroad Engine and Vehicle Emission Study," EPA-21A-2001, November, 1991.
- (4) EPA, "Determination of Significance for Nonroad Sources and Emission Standards for New Nonroad Compression-Ignition Engines At or Above 37 kW; Final Rule," 59 FR 31306, June, 17, 1994.
- (5) Booz, Allen and Hamilton Inc., "Off-Road Mobile Equipment Emission Inventory," January, 1992.
- (6) California Air Resources Board, "Technical Support Document for California Exhaust Emission Standards and Test Procedures for 1994 and Subsequent Model-Year Utility and Lawn and Garden Equipment Engines," Attachment C to CARB Mailout # 92-06, El Monte, CA. January 1992.
- (7) EPA, "Statement of Principles for Nonroad Phase 2 Small Spark-Ignited Engines; Proposed Rule," 62 FR 14740, March, 27, 1997.
- (8) EPA, "Regulatory Impact Analysis: Control of Air Pollution Emission Standards for New Spark-Ignition Marine Engines," October, 1996.
- (9) EPA, "Air Pollution Control; Gasoline Spark-Ignition Marine Engines; New Nonroad Compression-Ignition and Spark-Ignition Engines, Exemptions; Rule", 61 FR 52088, October 4, 1996.

Appendix A

The conversion from PSR applications to SCC categories.

SCC	SCC Description	PSR Code	PSR Description
22xx001010	Mobile Sources Off-Highway Vehicle Gasoline, Recreational Vehicles Motorcycles: Off-Road		Included in 22xx001030
22xx001020	Mobile Sources Off-Highway Vehicle Gasoline, Recreational Vehicles Snowmobiles	71	Snowmobile
22xx001030	Mobile Sources Off-Highway Vehicle Gasoline, Recreational Vehicles All Terrain Vehicles	91	All-Terrain Vehicles
22xx001040	Mobile Sources Off-Highway Vehicle Gasoline, Recreational Vehicles Minibikes	93	Mini-Bikes
22xx001050	Mobile Sources Off-Highway Vehicle Gasoline, Recreational Vehicles Golf Carts	94	Golf Carts
22xx001060	Mobile Sources Off-Highway Vehicle Gasoline, Recreational Vehicles Speciality Vehicle Carts	62	Specialty Veh./Carts
22xx002003	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Asphalt Pavers	41	Pavers
22xx002006	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Tampers/Rammers	95	Tampers/Rammer
22xx002009	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Plate Compactors	61	Plate Compactors
22xx002012	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Concrete Pavers		Unused
22xx002015	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Rollers	39	Rollers
22xx002018	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Scrapers	29	Scrapers
22xx002021	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Paving Equipment	35	Paving Equipment
22xx002024	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Surfacing Equipment	23	Surfacing Equipment
22xx002027	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Signal Boards	73	Light Plants
22xx002030	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Trenchers	42	Trenchers
22xx002033	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Bore/Drill Rigs	37	Bore/Drill Rigs
22xx002036	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Excavators	28	Excavators
22xx002039	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Concrete/Industrial Saws	77	Concrete/Ind Saws
22xx002042	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Cement & Mortar Mixers	57	Cem/Mtr Mixers
22xx002045	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Cranes	27	Cranes
22xx002048	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Graders	30	Graders
22xx002051	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Off-highway Trucks	40	Off-Highway Truck
22xx002054	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Crushing/Proc. Equipment	34	Crush/Proc Equipment
22xx002057	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Rough Terrain Forklifts	84	Rough Terrain Forklifts
22xx002060	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Rubber Tire Loaders	33	R/T Loader
22xx002063	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Rubber Tire Dozers	32	R/T Dozer
22xx002066	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Tractors/Loaders/Backhoes	43	Tractor\Loader\Backhoe
22xx002069	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Crawler Dozer	31	Crawler Dozers
22xx002072	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Skid Steer Loaders	38	S/S Loader
22xx002075	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Off-Highway Tractors	68	Off-Hwy Tractors
22xx002078	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Dumpers/Tenders	60	Dumpers/Tenders
22xx002081	Mobile Sources Off-Highway Vehicle Gasoline, Construction Equipment Other Construction Equipment	36	Other Construction
22xx003010	Mobile Sources Off-Highway Vehicle Gasoline, Industrial Equipment Aerial Lifts	64	Aerial Lifts
22xx003020	Mobile Sources Off-Highway Vehicle Gasoline, Industrial Equipment Forklifts	18	Forklifts
22xx003030	Mobile Sources Off-Highway Vehicle Gasoline, Industrial Equipment Sweepers/Scrubbers	21	Scrubbers/Sweepers

22xx003040	Mobile Sources Off-Highway Vehicle Gasoline, Industrial Equipment Other General Industrial Equipment	74	Other General Industrial
22xx003050	Mobile Sources Off-Highway Vehicle Gasoline, Industrial Equipment Other Material Handling Equipment	19	Other Material Handling
22xx003060	Mobile Sources Off-Highway Vehicle Gasoline, Industrial Equipment AC\Refrigeration	14	Refrigeration/AC
22xx003070	Mobile Sources Off-Highway Vehicle Gasoline, Terminal Tractors	16	Terminal Tractors
22xx004010	Mobile Sources Off-Highway Vehicle Gasoline, Lawn & Garden Equipment Lawn mowers (Residential)	65	Lawn Mowers*
22xx004011	Mobile Sources Off-Highway Vehicle Gasoline, Lawn & Garden Equipment Lawn mowers (Commercial)	65	Lawn Mowers*
22xx004015	Mobile Sources Off-Highway Vehicle Gasoline, Lawn & Garden Equipment Rotary Tillers < 6 HP	59	Tillers*
22xx004016	as above except (Commercial)	59	Tillers*
22xx004020	Mobile Sources Off-Highway Vehicle Gasoline, Lawn & Garden Equipment Chain Saws < 6 HP	70	Chainsaws*
22xx004021	as above except (Commercial)	70	Chainsaws*
22xx004025	Mobile Sources Off-Highway Vehicle Gasoline, Lawn & Garden Equipment Trimmers/Edgers/Brush Cutters	53	Trimmer/Edger/Cutter*
22xx004026	as above except (Commercial)	53	Trimmer/Edger/Cutter*
22xx004030	Mobile Sources Off-Highway Vehicle Gasoline, Lawn & Garden Equipment Leafblowers/Vacuums	66	Leaf Blower/Vac*
22xx004031	as above except (Commercial)	66	Leaf Blower/Vac*
22xx004035	Mobile Sources Off-Highway Vehicle Gasoline, Lawn & Garden Equipment Snowblowers	56	Snowblower*
22xx004036	as above except (Commercial)	56	Snowblower*
22xx004040	Mobile Sources Off-Highway Vehicle Gasoline, Lawn & Garden Equipment Rear Engine Riding Mowers	82	Rear Engine Rider*
22xx004041	as above except (Commercial)	82	Rear Engine Rider*
22xx004045	Mobile Sources Off-Highway Vehicle Gasoline, Lawn & Garden Equipment Front Mowers	88	Front Mowers*
22xx004046	as above except (Commercial)	88	Front Mowers*
22xx004050	Mobile Sources Off-Highway Vehicle Gasoline, Lawn & Garden Equipment Shredders < 6 HP	96	Shredders*
22xx004051	as above except (Commercial)	96	Shredders*
22xx004055	Mobile Sources Off-Highway Vehicle Gasoline, Lawn & Garden Equipment Lawn & Garden Tractors	63	Lawn & Garden Tractor*
22xx004056	as above except (Commercial)	63	LawnGarden Tractor*
22xx004060	Mobile Sources Off-Highway Vehicle Gasoline, Lawn & Garden Equipment Wood Splitters	75	Wood Splitter*
22xx004061	as above except (Commercial)	75	Wood Splitter*
22xx004065	Mobile Sources Off-Highway Vehicle Gasoline, Lawn & Garden Equipment Chippers/Stump Grinders	26	Chippers/Grinders*
22xx004066	as above except (Commercial)	26	Chippers/Grinders*
22xx004070	Mobile Sources Off-Highway Vehicle Gasoline, Lawn & Garden Equipment Commercial Turf Equipment		Unused
22xx004071	as above except (Commercial)	67	Commercial Turf*
22xx004075	Mobile Sources Off-Highway Vehicle Gasoline, Lawn & Garden Equipment Other Lawn & Garden Equipment	76	Other Lawn Garden*
22xx004076	as above except (Commercial)	76	Other Lawn Garden*
22xx005010	Mobile Sources Off-Highway Vehicle Gasoline, Farm Equipment 2-Wheel Tractors	98	2-Wheel Tractors
22xx005015	Mobile Sources Off-Highway Vehicle Gasoline, Farm Equipment Agricultural Tractors	45	Agricultural Tractor
22xx005020	Mobile Sources Off-Highway Vehicle Gasoline, Farm Equipment Combines	47	Combines
22xx005025	Mobile Sources Off-Highway Vehicle Gasoline, Farm Equipment Balers	49	Balers
22xx005030	Mobile Sources Off-Highway Vehicle Gasoline, Farm Equipment Agricultural Mowers	55	Agricultural Mowers
22xx005035	Mobile Sources Off-Highway Vehicle Gasoline, Farm Equipment Sprayers	69	Sprayers
22xx005040	Mobile Sources Off-Highway Vehicle Gasoline, Farm Equipment Tillers > 6 HP	59	Tillers
22xx005045	Mobile Sources Off-Highway Vehicle Gasoline, Farm Equipment Swathers	48	Swathers
22xx005050	Mobile Sources Off-Highway Vehicle Gasoline, Farm Equipment Hydro Power Units	85	Hydro Power Unit

22xx005055	Mobile Sources Off-Highway Vehicle Gasoline, Farm Equipment Other Agricultural Equipment	46	Other Ag Equipment
22xx005060	Mobile Sources Off-Highway Vehicle Gasoline, Farm Equipment Irrigation Sets	44	Irrigation Sets
22xx006005	Mobile Sources Off-Highway Vehicle Gasoline, Light Commercial Generator Sets	9	Generator Sets
22xx006010	Mobile Sources Off-Highway Vehicle Gasoline, Light Commercial Pumps	11	Pumps
22xx006015	Mobile Sources Off-Highway Vehicle Gasoline, Light Commercial Air Compressors	10	Air Compressors
22xx006020	Mobile Sources Off-Highway Vehicle Gasoline, Light Commercial Gas Compressors	89	Gas Compressors
22xx006025	Mobile Sources Off-Highway Vehicle Gasoline, Light Commercial Welders	17	Welders
22xx006030	Mobile Sources Off-Highway Vehicle Gasoline, Light Commercial Pressure Washers	58	Pressure Washer
22xx007005	Mobile Sources Off-Highway Vehicle Gasoline, Logging Equipment Chain Saws > 6 HP	70	Chainsaws
22xx007010	Mobile Sources Off-Highway Vehicle Gasoline, Logging Equipment Shredders > 6 HP	96	Shredders
22xx007015	Mobile Sources Off-Highway Vehicle Gasoline, Logging Equipment Skidders	24	Forest Equipment
22xx007020	Mobile Sources Off-Highway Vehicle Gasoline, Logging Equipment Fellers/Bunchers		Unused
22xx008005	Mobile Sources Off-Highway Vehicle Gasoline, Airport Service Equipment Airport Support Equipment	81	Aircraft Support
22xx008010	Mobile Sources Off-Highway Vehicle Gasoline, Airport Service Equipment Terminal Tractors		Unused
22xx009010	Mobile Sources Off-Highway Vehicle Gasoline, Other Underground Mining Equipment	13	Underground Mine Equipment
22xx010010	Mobile Sources Off-Highway Vehicle Gasoline, Other Oil Field Equipment	12	Oil Field Equipment
22820xx020 22820xx025	Mobile Sources Marine Vessels, Recreational Pleasure Craft, Gasoline Sailboat Aux. Outboard	79	Sailboat Aux. Unused**
228500x015	Mobile Sources Railroad Gasoline Railway Maintenance	80	Railway Maintenance
22820xx005	Mobile Sources Marine Vessels, Recreational Pleasure Craft, Gasoline Inboards	50	Powerboats**
22820xx010	Mobile Sources Marine Vessels, Recreational Pleasure Craft, Gasoline Outboards	99	Outboard Motors**
2282005015	Mobile Sources Marine Vessels, Recreational Pleasure Craft, Gasoline Personal Water Craft	92	New SCC Description**

* See **Small Spark-Ignition Engines** for a more complete description of these categories

** New National Non-PSR Data Source (See **Recreational Marine Equipment** and **Appendix B** for further descriptions of these categories)

Appendix B

Engine Population Inventory Changes in NONROAD from NEVES

SCC	SCC Description	Comment
22xx003060*	Mobile Sources Off-Highway Vehicle, Industrial Equipment AC\Refrigeration	New Category
22xx005060	Mobile Sources Off-Highway Vehicle, Farm Equipment Irrigation Sets	New Category
22xx009010	Mobile Sources Off-Highway Vehicle, Other Underground Mining Equipment	New Category
22xx010010	Mobile Sources Off-Highway Vehicle, Other Oil Field Equipment	New Category
2285002015	Mobile Sources Railroad Diesel Railway Maintenance	New Category
2285003015	Mobile Sources Railroad 2-Stroke Gasoline Railway Maintenance	New Category
2285004015	Mobile Sources Railroad 4-Stroke Gasoline Railway Maintenance	New Category
2285006015	Mobile Sources Railroad LPG Railway Maintenance	New Category
2285008015	Mobile Sources Railroad CNG Railway Maintenance	New Category
22xx006005	Mobile Sources Off-Highway Vehicle Gasoline, Light Commercial Generator Sets	Engines Greater than 50 hp are included
22xx006010	Mobile Sources Off-Highway Vehicle Gasoline, Light Commercial Pumps	Engines Greater than 50 hp are included
22xx006015	Mobile Sources Off-Highway Vehicle Gasoline, Light Commercial Air Compressors	Engines Greater than 50 hp are included
22xx006020	Mobile Sources Off-Highway Vehicle Gasoline, Light Commercial Gas Compressors	Engines Greater than 50 hp are included
22xx006025	Mobile Sources Off-Highway Vehicle Gasoline, Light Commercial Welders	Engines Greater than 50 hp are included
22xx002012	Mobile Sources Off-Highway Vehicle Construction Equipment Concrete Pavers	Unused; population included in 22xx002003
22xx002003	Mobile Sources Off-Highway Vehicle Construction Equipment, Pavers	New Description (Asphalt + Concrete) Pavers
22xx007020	Mobile Sources Off-Highway Vehicle Logging Equipment Fellers/Bunchers	Unused; population included in 22xx007015
22xx008010	Mobile Sources Off-Highway Vehicle Gasoline, 2-Stroke Airport Service Equipment Terminal Tractors	Changed SCC to 22xx003070 because this is not Airport Service Equipment
22xx007015	Mobile Sources Off-Highway Vehicle Logging Equipment Forest Equipment	New Description (Skidders + Fellers\Bunchers)
22xx004010	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Lawn mowers (Residential)	New Description
22xx004011	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Lawn mowers (Commercial)	New SCC
22xx004015	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Rotary Tillers < 6 HP (Residential)	New Power Level, Description
22xx004016	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Rotary Tillers < 6 HP (Commercial)	New SCC
22xx004020	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Chain Saws < 6 HP (Residential)	New Power Level, Description

22xx004021	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Chain Saws < 6 HP (Commercial)	New SCC
22xx004025	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Trimmers/Edgers/Brush Cutters (Residential)	New Description
22xx004026	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Trimmers/Edgers/Brush Cutters (Commercial)	New SCC
22xx004030	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Leafblowers/Vacuums (Residential)	New Description
22xx004031	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Leafblowers/Vacuums (Commercial)	New SCC
22xx004035	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Snowblowers (Residential)	New Description
22xx004036	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Snowblowers (Commercial)	New SCC
22xx004040	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Rear Engine Riding Mowers (Residential)	New Description
22xx004041	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Rear Engine Riding Mowers (Commercial)	New SCC
22xx004045	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Front Mowers (Residential)	New Description
22xx004046	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Front Mowers (Commercial)	New SCC
22xx004050	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Shredders < 6 HP (Residential)	New Power Level, Description
22xx004051	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Shredders < 6 HP (Commercial)	New SCC
22xx004055	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Lawn & Garden Tractors (Residential)	New Description
22xx004056	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Lawn & Garden Tractors (Commercial)	New SCC
22xx004060	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Wood Splitters (Residential)	New Description
22xx004061	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Wood Splitters (Commercial)	New SCC
22xx004065	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Chippers/Stump Grinders (Residential)	New Description
22xx004066	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Chippers/Stump Grinders (Commercial)	New SCC
22xx004070	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Commercial Turf Equipment (Residential)	Unused; no 'residential' commercial turf equipment
22xx004071	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Commercial Turf Equipment (Commercial)	New SCC
22xx004075	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Other Lawn & Garden Equipment (Residential)	New Description
22xx004076	Mobile Sources Off-Highway Vehicle, Lawn & Garden Equipment Other Lawn & Garden Equipment (Commercial)	New SCC
22xx002069	Mobile Sources Off-Highway Vehicle, Construction Equipment Crawler Dozer	New Description (Changed from Tractor to Dozer)
22xx004015	Mobile Sources Off-Highway Vehicle, 2-Stroke Lawn & Garden Equipment Rotary Tillers < 6 HP	New Power Level
22xx007005	Mobile Sources Off-Highway Vehicle, 2-Stroke Logging Equipment Chain Saws > 6 HP	New Power Level
22xx007010	Mobile Sources Off-Highway Vehicle, 2-Stroke Logging Equipment Shredders > 6 HP	New Power Level
2282005015	Mobile Sources Marine Vessels, Recreational Pleasure Craft, Gasoline 2-stroke Personal Water Craft	New Description (Changed from Sterndrive to Personal Water Craft) Primarily 2-stroke
2282005010	Mobile Sources Marine Vessels, Recreational Pleasure Craft, Gasoline 2-Stroke Outboards	Includes 2 and 4-stroke engines

2282010005	Mobile Sources Marine Vessels, Recreational Pleasure Craft, Gasoline 4-Stroke Inboards	Includes 2 and 4-stroke engines
2282010015	Mobile Sources Marine Vessels, Recreational Pleasure Craft, Gasoline 4-Stroke Sterndrive	Unused
2282010010	Mobile Sources Marine Vessels, Recreational Pleasure Craft, Gasoline 4-Stroke Outboard	Unused (included in 2282005010 as a technical type)
2282005020	Mobile Sources Marine Vessels, Recreational Pleasure Craft, Gasoline 2-Stroke Sailboat Aux. Inboard	Unused (included in 4-stroke Inboard)
2282005025	Mobile Sources Marine Vessels, Recreational Pleasure Craft, Gasoline 2-Stroke Sailboat Aux. Outboard	Unused (included in 4-stroke Outboard)
2282010020	Mobile Sources Marine Vessels, Recreational Pleasure Craft, Gasoline 4-Stroke Sailboat Aux. Inboard	Unused (included in 4-stroke Inboard)
2282010025	Mobile Sources Marine Vessels, Recreational Pleasure Craft, Gasoline 4-Stroke Sailboat Aux. Outboard	Unused (included in 4-stroke Outboard)
2282005005	Mobile Sources Marine Vessels, Recreational Pleasure Craft, Gasoline 2-Stroke Inboards	Unused (included in 228201005 as a technical type)
2282020015	Mobile Sources Marine Vessels, Recreational Pleasure Craft, Diesel Sterndrive	Unused (included in 2282020005)
2282020020	Mobile Sources Marine Vessels, Recreational Pleasure Craft, Diesel Sailboat Aux. Inboard	Unused (included in 2282020025)

* The “xx” denotes that all fuel types (diesel (“70”), 2-stroke gasoline (“60”), 4-stroke gasoline (“65”), LPG (“67”), and CNG (“68”) engines) are included with the new or altered application categories.