United States
Department of
Agriculture

Forest Service

**Technology &
Development
Program**

5100—Fire Management
December 2002
0251 1204—SDTDC

EPA and CARB Emission Standards To Control Nonroad Exhaust Emissions of Fire Pumps and Chain Saws

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December 2002

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Introduction

New air emission regulations for all internal combustion engines impact fire pumps and chain saws used in wildland fire suppression. San Dimas Technology and Development Center (SDTDC) staff assessed the impact of these regulations and determined what equipment meets these standards. According to the Environmental Protection Agency (EPA), small internal combustion engines contribute 5 percent of the total manmade hydrocarbons in ground-level ozone formation, resulting in increased pollution-related urban health problems.

In 1995 the EPA established a regulatory process to set emission standards for several categories of nonroad engines at or below 25 hp. Allowable emission levels depend on engine size and use. Phase I and II standards for emission control of nonroad engines will continue to be phased in until the year 2007. Lower emission levels will be required in later years. Under the new regulations, engines are certified for a specific application/engine. For example, a chain saw manufacturer is responsible for certifying an engine/chain saw combination. A pump manufacturer who can show a low volume in sales, however, is responsible only for using an emission-certified engine for an engine/pump head combination.

The Canadian government and manufacturers, having entered into a memorandum of understanding regarding emissions standards, also agree to comply with the emissions standards and test procedures cited in EPA regulations.

When EPA Phase I went into effect in 1997, certain size classes of fire pumps and chain saws were discontinued. Pump manufacturers halted production of several 2-cycle lightweight water pumps, such as the Shindaiwa GP25, GP45, and STIHL® minilightweight portable pumps.

This SDTDC study found that chain saw manufacturers offer a full range of chain saw/engine combinations currently certified to EPA and California Air Resources Board (CARB) standards. The pump industry has also developed commercially available pumps that use EPA- and CARB-compliant engines. In the next step of the regulatory process, as required by EPA and CARB, all commercially available pumps will include an EPA-compliant engine.

When using an EPA-compliant engine, pump manufacturers who produce fewer than 10,000 units are not required to certify pump/engine combinations, unlike chain saw manufacturers, providing there is no available EPA- and CARB-compliant pump/engine combination, as is the current situation. If a manufacturer can prove a low-volume production status, the EPA Phase I certification overrides the mandated year 2001 deadline until model year 2009. Phase II would be required in the year 2010.

EPA penalties for noncompliance include a $25,000 fine to the manufacturer for each engine sold in the United States that is not EPA compliant. Federal law requires annual product certification with the EPA by manufacturers even if the products remain unchanged from the previous year's certification. However, after a new product has been certified, a manufacturer can carry over the certification by paying the EPA an additional $1,400 per year per engine family, providing the product still meets the standards for the new year.

Background

The Clean Air Act of 1990 directed the EPA to study, and regulate if warranted, the contribution of nonroad internal combustion engines to urban air pollution. Because a 1991 EPA study documented higher-than-expected emission levels across a broad spectrum of engines and equipment, the EPA is seeking emission reductions for the following engine types:

- Small spark-ignition, mostly gasoline-fueled lawn and garden equipment, including lightweight portable pumps and chain saws;
- Spark-ignition, nonroad pumps, including gasoline-powered, medium-size pumps;
- Large compression-ignition, mostly diesel-fueled farm and construction equipment and commercial marine vessels;
- Marine propulsion engines, mostly gasoline-fueled pleasure craft;
- Recreational spark-ignition engines, mostly used in snowmobiles, all-terrain vehicles, dirt bikes, and go-carts;
- Locomotives.

The EPA developed a comprehensive strategy for reducing these emissions, including creating public awareness and implementing a regulatory process. The EPA has developed public information programs to teach consumers how to prevent pollution from nonroad engines by reducing gasoline spillage and choosing clean equipment.

These programs also inform consumers that electric equipment is cleaner than equipment powered by gasoline engines. Electrically powered lawn and garden tools, for example, produce essentially no pollution from exhaust emissions or from fuel evaporation. Even electric equipment is not pollution-free, however; power plants that generate the electricity do pollute.

Nonroad Engine Emission Control

Most nonroad or off-highway equipment and vehicles are powered by engines that burn gasoline or diesel fuel. Pollution from these engines is from byproducts of the combustion process/exhaust and from evaporation of the fuel itself.

Until now, because of the nonroad engines' relatively low overall contribution to air pollution, emission control for these engines has not been a major design consideration. Consequently, these engines are not as clean as highway vehicles, which have been subject to regulatory controls for more than 20 years. Emissions from nonroad engines contribute as much as 15 to 20 percent of pollution in cities across the United States. Those emissions, described below, include hydrocarbons, particulate matter, nitrogen oxides, carbon monoxide, and carbon dioxide.

Hydrocarbons (HC) are unburned or partially burned fuel molecules that react in the atmosphere to form ground-level ozone, a major component of smog. Some hydrocarbons are toxic and may cause cancer or other health problems. Hydrocarbon pollution from nonroad engines also occurs as fuel evaporation when gasoline vapors are forced out of the fuel tank (for instance, during refueling) or when gasoline spills and evaporates.

Particulate matter is an exhaust product primarily from diesel-fueled vehicles. These microscopic airborne particles damage the respiratory system and contribute to the smoke and odor associated with diesel exhaust.

Nitrogen oxides (NOx) result from subjecting nitrogen and oxygen in the air to the high temperature and high pressure conditions in an internal combustion engine. Nitrogen oxides react with hydrocarbons in the atmosphere to form ground-level ozone. They also contribute to acid rain.

Carbon monoxide (CO) is a colorless, odorless, poisonous gas that results from incomplete fuel combustion.

Carbon dioxide (CO_2) is the ultimate product from burning carbon-based fuel including gasoline. Carbon dioxide does not directly impair human health, but it is a "greenhouse gas" that contributes to the potential for global warming. As engine fuel economy declines, carbon dioxide emissions increase.

CARB Regulations

In addition to the EPA regulations, the CARB has developed regulations in accordance to the California Clean Air Plan. CARB Tier II regulations are currently more stringent than EPA regulations for both handheld engines under 65 cc and nonhandheld engines and will continue to be more stringent until 2003.

Starting in 2003, the EPA handheld standards will be more stringent than the CARB standards, depending on engine displacement. Proposed Tier III CARB regulations however are more stringent than the EPA regulations after 2005. These drafted regulations are scheduled for CARB action in December 2002.

Pumps with engine displacement of 40 cc or greater are exempt from CARB emission requirements. Chain saws over 45 cc are limited to Federal EPA control. CARB has authority over all handheld engines, except those established as farm and construction engines. CARB regulations and a preemption list appear on the CARB Web site http://www.carb.ca.gov. Click on Off-Road Mobile Source Emission Reduction Program, Small Off-Road Engines and Equipment Less Than 25 Horsepower, and formal regulatory documents page.

EPA Regulations

EPA Phase I emission standards, referenced in 40 CFR Parts 9 and 90 of July 3, 1995, have been in effect since production model year 1997. (The most recent version of the EPA emissions regulations is found in 40CFR90 of July 7, 2000.) The EPA estimates that Phase I regulations will reduce hydrocarbon pollution from engines by an average 33 percent, compared to hydrocarbons released by unregulated engines.

EPA Phase II emission standards, which are more stringent than Phase I standards, are expected to further reduce the hydrocarbons and reduce oxides of nitrogen by an additional 59 percent beyond the reduction resulting from the current Phase I standards. EPA Phase II also changes engine classes and adds a required useful life period determination. The Phase II standards are scheduled for phasing in between 2001 and 2007. The first year of Phase II is similar to Phase I except for additional durability testing. In the second year and in subsequent years for particular models up to 6 years, the emission standards become increasingly stringent. See table 1 for emission by engine displacement and classification.

EPA Phase I nonhandheld engine classes:
Class I—engines less than 225 cc in displacement; or

Class II—engines greater than or equal to 225 cc in displacement.

Engines powering equipment defined as handheld:
Class III—engines less than 20 cc in displacement; or

Class IV—engines equal to or greater than 20 cc and less than 50 cc in displacement; or

Class V—engines equal to or greater than 50 cc in displacement.

Table 1–EPA and CARB emission regulations.

Class⇓/MY⇒	2000	2001	2002	2003	2004	2005	2006	2007
CARB - California Air Resources Board – Tier 2 No handheld / nonhandheld definitions								
0 to 65 cc Classes III, IV, and V	72 g/kW-h CO = 536 ⇒	⇐	⇐	⇐	⇐	⇐	⇐	⇐
65 to < 225cc Class I	Special agreement engines	Special agreement engines	All horizontal 16.1g/kW-hr CO = 467 ⇒	⇐	⇐	⇐	all vertical	⇐
≥ 225cc Class II	B&S and Tecumseh TE engines	Same as 2000	all engines 12.0 g/kW-hr CO = 467 ⇒	⇐	⇐	⇐	⇐	⇐
EPA – Environmental Protection Agency – Phase 2 Nonhandheld classes 1, 1A, 1B, & 2 Handheld classes 3, 4, & 5								
< 20cc Handheld Class III	Phase I	Phase I	238 g/kW-hr CO = 805 ⇒	175 g/kW-hr (2003)	113 g/kW-hr	50 g/kW-hr	50 g/kW-hr	50 g/kW-hr
20 to < 50cc HH Class IV			196 g/kW-hr CO = 805 ⇒	148 g/kW-hr (2003)	99 g/kW-hr	50 g/kW-hr	50 g/kW-hr	50 g/kW-hr
≥ 50cc HH Class V			Phase I	Phase I	143 g/kW-hr CO = 603 ⇒	119 g/kW-hr	96 g/kW-hr	72 g/kW-hr
0 < 66cc Class IA	Phase I	50 g/kW-hr CO = 610 ⇒	⇐	⇐	⇐	⇐	⇐	⇐
66 < 100cc Class IB	Phase I	40 g/kW-hr CO = 610 ⇒	⇐	⇐	⇐	⇐	⇐	⇐
100 < 225 cc Class I	Phase I	⇐	⇐	August new designs 16.1 g/kW-hr CO = 610 ⇒	⇐ new	⇐new	⇐new	August all engines 16.1 g/kW-hr
≥ 225 cc Class II	Phase I	18 g/kW-hr CO = 610 ⇒ fi	16.6 g/kW-hr	15.0 g/kW-hr	13.6 g/kW-hr	12.1 g/kW-hr	⇐	⇐

Standard shown is HC + NOx or CO in grams/kilowatt-hour. California regulation is written in grams/horsepower-hour; those values have been translated to kilowatt for easy comparison with the EPA regulation.

The EPA definition of handheld remains similar in Phase II to the original in Phase I, but Classes I-A and I-B have been added for non-handheld engines of smaller displacement. Meanwhile California has dropped the handheld/nonhandheld distinction and uses a simpler displacement split between classes.

EPA Phase II describes two new engine classes: classes I-A and I-B, in addition to classes I and II defined in Phase I. Engine classes are specified by engine displacement and by the type of equipment the engine powers—either handheld or nonhandheld. Each of the seven Phase II engine classes has a unique set of emission standards.

The EPA anticipates that implementation of Phase II standards will generate significant reductions in emissions from the seven classes of engines with small increases in cost. It estimates the average price increase for handheld equipment to be $20 for Class III, $23 for Class IV, and $56 for Class V engines. (See the March 2000 EPA fact sheet, "Final Phase 2 Standards for Small Spark-Ignition Handheld Engines," EPA420-F-00-007.) Engine manufacturers, however, have stated that the actual cost will be significantly higher than the EPA estimates.

Certification is accomplished by full emissions testing at 0 hours and again at the hours required for the chosen category for the useful life period: for example, 300 hours. To be certified the engine must be in compliance during both tests because emissions change in relation to an engine's wear life, sometimes significantly. It is not unusual for a 2-cycle engine to meet the standards at 0 hours and then fail at 20 hours of use.

EPA Phase II nonhandheld engine classes are as follows:

Class I-A—engines less than 66 cc in engine displace ment; or

Class I-B—engines greater than or equal to 66 cc but less than 100 cc displacement; or

Class I—engines greater than or equal to 100 cc but less than 225 cc displacement; or

Class II—engines greater than or equal to 225 cc in displacement.

EPA Phase II handheld engine classes are as follows:

Class III—engines less than 20 cc in displacement; or

Class IV—engines equal to or greater than 20 cc and less than 50 cc in displacement; or

Class V—engines equal to or greater than 50 cc in displacement.

EPA Phase II Useful Life Periods

EPA Phase II requires manufacturers to declare the applicable useful life category for each engine family at the time of certification as described in 40CFR90.105. Such shall be the category, which most closely approximates the expected useful lives of the equipment into which the engines are anticipated to be installed as determined by the engine manufacturer.

EPA and CARB Emission-Compliant Pumps

A full range of engines is commercially available for all classes of pumps meeting the EPA and CARB regulations. An engine that currently meets the lower requirements of later years provides an air quality advantage, and perhaps a sales advantage to the equipment manufacturer. For instance, all Honda general purpose engines sold in North America have been certified to the lowest emission level required in EPA Phase II regulations, or if different, at the emission level in the final phase-in year. Honda Class II GX340 and GX390 engines, designated as EPA Class II engines with an engine displacement greater than 225 cc, meet the CO 12.1 g requirement of 2005, beginning with the 2001 engine model year. Pump manufacturers have developed new lines of pump configurations to meet the emission standards, using low emission engines.

The next step, and as currently required by EPA and CARB regulations, is for pump manufacturers to provide only EPA- and CARB-compliant engines for pumps. To this end, manufacturers are phasing out several pump lines in the next 2 years, as indicated in appendix A.

The EPA has allowed small pumps as a category that by careful definition certify to the standard of the less-stringent handheld regulation. In 2002 that standard is 196 g of HC + NOx or CO. By contrast, the Honda engines in this category are certified below 50 g, which is the handheld requirement for 2005.

Briggs & Stratton (B&S) confirms that all engines sold by B&S in the United States are EPA and CARB compliant through model year 2002. In addition, the Vanguard Model 3504 engine used in the BB4 class pumps is EPA Phase II compliant for class II engines for 2005 and later model years, which is the lowest standard in the Phase II regulation for Class II engines. The Vanguard Model 3504 engine meets the CARB regulations for Tier II standards applicable to 2006 and later model years.

The SDTDC has studied engines typically procured for fire suppression regarding compliance with EPA and CARB standards. Appendix A provides detailed information regarding these new pumps and current pumps. All pump performance information was provided by the manufacturer and does not imply testing or endorsement of pump performance by SDTDC laboratories. (See the EPA Web site for other pumps not listed here. The EPA Web site for the downloadable certification files is located at www.epa.gov/otaq/certdata.htm.)

The SDTDC collected information from manufacturers regarding when an engine meets a future-year emission requirement. This information is provided in tables 2 to 4 for pumps and table 5 for chain saws.

See table 2 and appendix A for minilightweight pump comparison, table 3 and appendix A for lightweight pump class comparison, and table 4 and appendix A for the large class pump comparison.

Table 2–Minilightweight centrifugal portable pump comparison (less than 30 lb)

Pump Model	Engine Model	Engine EPA-Certified through year	Dry Weight (lb)	Suction (in)	Discharge (in)	Number (cycles)	Power (hp)	Displacement (cc)	Oil/ fuel (mix)
Shindaiwa GP450	Shindaiwa	No	17.2	1-1/2	1-1/2	2	2.3	44	50:1
Wildfire Mini-Mark	Robin ECO4ER	No	14.3	1-1/2 NPSH	1-1/2 NPSH	2	2	40.2	25:1
Wildfire LAP	Honda	2005	13.5	1-1/2 NPSH	1-1/2 NPSH	4	1.5	31	NA
Wildfire Mini-Striker	Honda GXH50	2005	20	1-1/2 NPSH	1-1/2 NPSH	4	2.5	49	NA
Mercedes Textiles Wick 70-4H	Honda GX31	2005	16.8	1-1/2 NPSH	1-1/2 NPSH	4	1.5	31	NA
Mercedes Textiles Wick 100	Solo	2001	16.8	1-1/2 NPSH	1-1/2 NPSH	2	2.3	40	24:1
Mercedes Textiles Wick 100-4H	Honda GXH50	2005	20.2	1-1/2 NPSH	1-1/2 NPSH	4	2.5	49	NA

Table 3–Lightweight centrifugal pump (31 to 60 lb)

Pump Model	Engine Model	Engine EPA-Certified through year	No. of Cycles	Power (hp)	cc (in)	Dry weight (lb)	Suction (in)	Discharge (in)
Wildfire Mark-3	Rotax	No	2	8.5	185	55	1-1/2 9NH	1-1/2 9NH
Mercedes Textiles Wick 250	Motorpower	No	2	8	134	31	1-1/2 9NH	1-1/2 9NH
Mercedes Textiles Wick 375	Solo	No	2	10	210	53.5	1-1/2 9NH	1-1/2 9NH

Table 4–BB4 Class pump comparison (greater than 60 lb) Note: The Mallory, Wildfire, and Mercedes BB4 are not on the lightweight pump Qualified Products List at this time.

Pump Model	Engine Model	Engine EPA-Certified through year	Dry Weight (lb)	Suction (in)	Dis-charge (in)	No. (cycles)	Power (hp)	Displacement (cc)
Mercedes Wick F200-13H	Honda GX-390	2005	117	2 NPSH	1-1/2 NPSH	4	13	389
Mercedes BN4200-13H	Honda GX-390	2005	123	2 NPSH	1-1/2 NPSH	4	13	389
Wildfire Striker II	Honda GX340K1	2005	119	2 NPSH	1-1/2 NPSH	4	11	337
Mallory MM 4	B&S Twin V Vanguard	2005	143	2 NPSH	1-1/2 NPSH	4	18	690
Mallory M88	Kohler	No	130	1-1/2 9NH	1-1/2 9NH	2	8	305
Mallory M88	Honda	2005	130	1-1/2 9NH	1-1/2 9NH	4	9	270
Wildfire Ultra-striker	Honda GX390K1	2005	126	2 NPSH	1-1/2 NPSH	4	14/13	389
Wildfire BB4	B&S Twin V Vanguard	2005	143	2 NPSH	1-1/2 NPSH	4	18	694
Wildfire BB4 (in development)	Honda	2005	*	2 NPSH	1-1/2 NPSH	4	20	*
Mercedes Textiles Wick BN4200	B&S Twin V Vanguard	2005	137	2 NPSH	1-1/2 NPSH	4	18	694
Mercedes Textiles BN4200 –18H	Honda	2005	140	2 NPSH	1-1/2 NPSH	4	18	614

* In development

EPA- and CARB-Compliant Chain Saws

Chain saws used in wildland firefighting are classified as handheld equipment. Class III saws that are less than 20 cc typically are not used in wildland firefighting. Most chain saws are classified into class IV, with 20 to 49 cc. Some of the larger saws are in class V, with more than 50 cc engine displacement.

The EPA divides engines into classes based on whether they are handheld or nonhandheld and on engine displacement. Classes I, I-A, I-B, and II are for nonhandheld equipment, while classes III, IV, and V are for handheld equipment.

EPA Phase II standards become effective in model year 2002 for engines in classes III and IV and model year 2004 for engines in class V. The new rules will make it difficult for chain saw compliance because of the unique operating characteristics of the saws.

The EPA requires that engine manufacturers label all engines that are EPA compliant; or if the engine label is not readily visible, the manufacturer should indicate compliance on the piece of equipment itself. Because California requires that all emission-compliant engines have an emission conformity label on the engine for engines sold in the State, some engine labels cite compliance with both the EPA and CARB. (For a list of EPA and CARB-certified engines used in chain saws for 2001, see table 5.)

Table 5–EPA/CARB-certified engines used in chain saws in wildland firefighting. All engines are air cooled.

Brand	Model	Displacement (cc)	Engine family	EPA-Certified through year	Power(kW)	Rated speed
Husqvarna	136	36	1PWES.0404CS	2002	1.3 kW	8,000
	141	40				
Jonsered	2036	36				
	2040	40				
Poulan	2250	36	1PWES.0424CS	2002	1.42 kW	8,000
	2450	36				
	2150	36				
	2050	36				
	2075	36				
	1950	36				
	2175	36				
	2025	36				
Craftsman	358.350370	36				
	358.350440	36				
	358.350460	36				
Poulan	2550	42				
	2375	42				
	2350	42				
Craftsman	358.350380	42				
	358.350480	42				
Poulan Pro	220	42	1PWES.0464CS	2003	1.68 kW	9,000
	260	42				
Poulan	2900	46				
	2750	46				
	2775	46				
Craftsman	358.35020	46				
Poulan Pro	295	46				
Poulan	3450	54	1PWES.0605CS	2003	2.4 kW	9,000
Poulan Pro	330	54				
Poulan	3750	60				
Poulan Pro	380	60				
Poulan	Patriot 1900LE	42	1PWES.0424CA	2003	1.34 kW	9,000
	1950LE	42				
	2050LE	42				
	2075LE	42				
	2150LE	42				
	2175LE	42				
	2375LE	42				
Craftsman	358.35054	42				
	358.35056	42				
	358.35057	42				
	358.35059	42				
Poulan	2550LE	42	1PWES.0424CB	2003	1.34 kW	9,000
Poulan Pro	260LE	42				
Craftsman	358.35058	42				
Husqvarna	136 Low Emission	36	1PWES.036CB	2003	1.34 kW	9,000
ANDREAS STIHL	1A8XS.0354RD	35	1A8XS.0354RD	2001	2.199 bhp	9,000
ANDREAS STIHL	1A8XS.0354RD		1A8XS.0354RD	2001	2.199 bhp	9,000

ANDREAS STIHL	1A8XS.0474RA	46.5	1A8XS.0474RA	2001	1.904 bhp	7,500
ANDREAS STIHL	1A8XS.0474RA		1A8XS.0474RA	2001	1.904 bhp	7,500
ANDREAS STIHL	1A8XS.0494RA	48.7	1A8XS.0494RA	2001	2.29 kW	9,000
ANDREAS STIHL	1A8XS.0494RA		1A8XS.0494RA	2001	2.29 kW	9,000
ANDREAS STIHL	1A8XS.0494RA		1A8XS.0494RA	2001	2.29 kW	9,000
Echo/Kioritz Inc.	1EHXS.0494RB	49.3	1EHXS.0494RB	2001	2.24 kW	8,500
Echo/Kioritz Inc.	1EHXS.0494RB		1EHXS.0494RB	2001	2.24 kW	8,500
John Deere	1H2XS.0384RA	38	1H2XS.0384RA	2001	2.1 bhp	9,000
John Deere	1H2XS.0454RA	45	1H2XS.0454RA	2001	2.64 bhp	9,000
McCulloch Corp.	1MHXS.0384AA	37.7	YMHXS.0384AA	2001	1.12 kW	8,000
McCulloch Corp.	1MHXS.0384AA		YMHXS.0384AA	2001	1.12 kW	8,000
Shindaiwa	1SWXS.029403	28.5	YSWXS.029403	2001	1.6 hp	9,000
Shindaiwa	1SWXS.036404	35.5	YSWXS.036404	2001	1.7 bhp	7,500
Shindaiwa	1SWXS.036404		YSWXS.036404	2001	1.7 bhp	7,500
Shindaiwa	1SWXS.038405	37.7	YSWXS.038405	2001	2.2 hp	9,000
Shindaiwa	1SWXS.038405		YSWXS.038405	2001	2.2 hp	9,000
Shindaiwa	1SWXS.048413	47.9	WSWXS.048413	2001	2.2 hp	9,500
Shindaiwa	1SWXS.048413		WSWXS.048413	2001	2.2 kW	9,500
Shin-Daiwa Kogyo	1SWXS.074515	73.5	XSWXS.074515	2003	4.8 hp	9,000

Future EPA and CARB Certification Information
The published list of EPA emission-certified engines by model year appears on the Web at http://www.epa.gov/oms/equip-ld.htm The downloadable certification files are at http://www.epa.gov/otaq/certdata.htm and can be accessed by using Excel or FileMaker Pro software. The database is updated quarterly.

For further information regarding EPA compliance of engines, contact Joe Hresko or John Guy at the EPA Certification Department by e-mail at hresko.joe@epamail.epa.gov; or by phone at 202–564–9275 or guy.john@epamail.epa.gov, or by phone at 202–564–9276.

Replacement Parts and Repair

Manufacturers typically will continue to provide replacement parts for 7 to 10 years in support of engines out of production and are using some of the same parts for new product lines. For example, in 1997, Shindaiwa ceased production of the GP45 but continues to use many of the same parts in the new Shindaiwa GP450. (See appendix B.) This information is useful to service GP45 pumps already in the national cache system. New or rebuilt parts can be used as long as they are the same configuration material and heat treatment as the original part. Replacement parts used in pumps and chain saws may not be manufactured by that specific industry. For example, a local automotive supply store may be able to supply bearings, point's condenser, etc, identical to the original equipment manufacturer. Matching parts lists are available for some of the wildland pumps. (See the publication "Manitoba's Alternate Parts Program for Medium Pumps," published by the Canadian Interagency Forest Fire Center.)

Older equipment that was produced before emission regulations took effect is not required to be retrofitted with emissions equipment when brought in for servicing.

Tampering with an Emission-Certified Engine
Tampering with an emission-certified engine may reduce the life span and performance of the engine. Tampering, which is against the law and subject to a civil penalty/fine, includes the following:

- Knowingly disabling an emission control component of a certified saw,
- Adjusting the fuel or exhaust system,
- Changing the engine's performance so it no longer meets the engine specifications,
- Improperly venting crankcase emissions,
- Installing a replacement part of a different configuration, or
- Adding a part that was not originally certified with the engine.

Some manufacturers have equipped engines with special caps or plugs that limit or prevent adjusting the fuel mixture or engine timing. Removal of these special plugs and adjustments beyond the manufacturers' specified limits is considered tampering.

In servicing an engine that has been tampered with, the EPA encourages repair technicians to restore the engine to the original certified configuration. This is required only if the repair is specific to the tampered with component/ system.

Impact of Emission Regulations

EPA and CARB air emission regulations have pushed engine manufacturers to optimize current engine design to develop new product lines, and to support procurement of fire equipment for wildland fire suppression activities. Engines are available in each class of pump and chain saw to meet EPA and CARB 2001 emission requirements. Not all pumps, however, are driven by EPA and CARB emission-compliant engines, as indicated in tables 2, 3, and 4. All chain saw/engine combinations listed in table 5 have been certified to the indicated year of compliance. Within the next 2 years, the pump industry may be limited to only emission-compliant engines on pumps in the commercial marketplace.

To meet more stringent emission requirements, more engine manufacturers have developed or are in the process of certifying new engines for the years 2002 and beyond. The EPA estimates an increase in cost of at least $20 to $52 for each engine to implement these new regulations. Manufacturers estimate an increase in cost up to two to four times the EPA estimate, or $80 to $200 per engine.

Because chain saw engine manufacturers continue to invest resources in developing emission technology that incorporates current and scheduled future emission requirements into the core product line, limited resources are available to invest in new engine technology, such as a commercially available 4-cycle chain saw. The technology of the 4-cycle engine is important to emission reduction. Two-cycle engines are lightweight, basic in design, inexpensive to produce, powerful, and can reach high engine speeds but they have much higher emissions and smoky exhaust, as compared to 4-cycle engines. Such pollutants occur when some of the air/fuel intake mixture of the 2-cycle engine is expelled during the exhaust cycle and combustion of oil, since oil is mixed with fuel to lubricate the crankshaft, cylinder walls, and connecting rod assembly. Consequently, designing a 2-cycle engine to meet the more stringent emission requirements is a great challenge. New engine technology has focused more on lightweight, miniaturized 4-cycle engines, or "mini" 4-cycle engines, for smaller displacement chain saws and pumps.

Some chain saw manufacturers allocate resources only to class engines with the highest sales volume and plan to cease production on other engines. A prominent chain saw manufacturer expects to cease production of its Class III engines in 2003 and of its Class V engines in 2004. The company will maintain production of Class IV engines of 20 to 49 cc. Consequently, fewer product lines will be available for the consumer to choose from and sales competition will decrease.

The EPA essentially restricts manufacturers to production in the model year indicated, but allows for distribution of current inventory, regardless of the year manufactured. Provisions within the regulations prevent manufacturers from "stockpiling" inventory before ceasing production of a product line. Consequently, the consumer will be able to buy new chain saws or pumps certified to a prior year, but in limited quantity.

EPA and CARB have an "average banking and trading" emissions program in which a manufacturer is given "credits" for producing cleaner-than-required engines. Manufacturers can trade these credits for permission to produce engines that do not meet the current regulations. In this way, the EPA continues to realize an overall improvement in air quality while providing incentive to the manufacturer. The current ratio for converting credits is approximately eight clean engines to one out-of-compliance engine. Each year the ratio of clean engines will increase, with fewer out-of-compliance engines sold under the credit program. The banking and trading program, which the EPA and CARB closely monitor, allows the consumer to buy a limited number of out-of-compliance pumps or saws.

For further information, please contact the SDTDC fire program by e-mail at mailroom:wo_sdtdc@fs.fed.us or by phone at 909–599–1267.

Appendix A

Manufacturer Provided Information on Pumps Listed in Tables 4, 5.

All pump performance information was provided by the manufacturer and does not imply testing or endorsement of pump performance by SDTDC laboratories. (See the EPA Web site for other pumps not listed here.) The EPA Web site for the downloadable certification files is located at www.epa.gov/otaq/certdata.htm

Wildfire Lightning Attack Pump (LAP) pump

- 1.5 hp, 31cc displacement, Honda engine
- EPA Class IV, handheld
- Engine EPA/CARB-compliant through 2005
- 4-cycle, air-cooled engine
- Diaphragm carburetor
- Recoil starter
- Transitorized magneto ignition
- Suction/discharge: 1-1/2 in NPSH
- Pump dimensions: Length: 11 in; Width: 10 in; Height: 12 in; Weight: 13.5 lb
- Oil capacity: 0.11 qt
- Shutoff at 80 psi, free flow at 46 gpm
- Noise level measurement according to 5100-274c, method 4.7.5; the average sound level measured was 72dB, with a highest point at 74dB.
- USDA Forest Service-approved spark arrester, rubber protection caps
- Foam and retardant solutions pumping capability
- Service manual
- Fuel tank capacity of 0.17 US gal; fuel consumption of 0.1 US gal/h

Optional Equipment

- Thread protector
- Helicopter package on special order
- Repair tool kits. See figures A1 and A2.

Tyco-Ansul Inc. DBA Wildfire Tyco-Wildfire
www.wildfire-equipment.com,
Phone: 800–426–5207, Fax: 819–849–0320

Figure A1–LAP pump configuration.

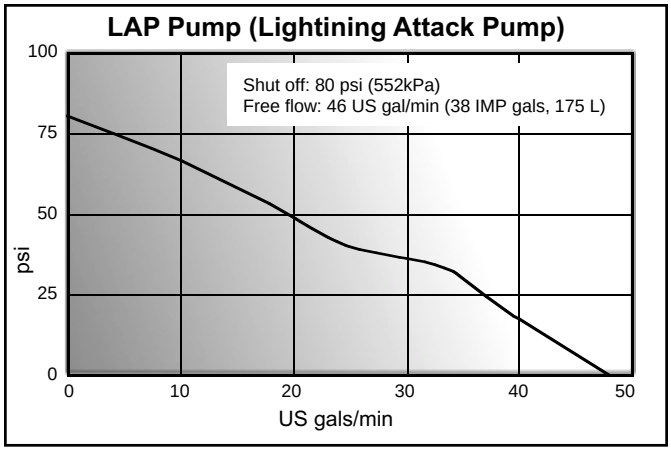

Figure A2–LAP pump performance curve.

Mercedes Textiles Wick-70-4H

- 1.5 hp, 31 cc engine displacement, Honda GX-31 engine
- EPA Class IV, handheld, centrifugal pump
- Engine EPA/CARB compliant through 2005
- 4-stroke engine
- Single-stage aluminum impeller
- Clutch for free idling and warmup
- Weight: 16.75 lb. See figure A3.

Figure A3–Wick-70-4H pump configuration.

Mercedes Textiles
16633 Hymus Blvd., Kirkland, Quebec, Canada H9H 4R9
http://www.mercedestextiles.com, Phone: 514–697–0817, Fax: 514–697–5297

Wildfire Mini-Mark II
According to Wildfire, the Mini-Mark II will be phased out by December 2002. Wildfire suggests that if pressure and flow are key, replace the Mini-Mark II with the Mini-Striker. Wildfire suggests using the LAP pump when backpacking or when having an external fuel tank is critical.

- 2 hp, 40.2 cc engine
- EPA Class IV, handheld, Robin ECO4ER engine, centrifugal pump
- Engine not EPA or CARB compliant
- 2-cycle, air-cooled engine

- Recoil starter pointless electronic ignition
- Integral 1.1 L fuel tank
- 25:1 fuel mix, diaphragm carburetor
- Fuel consumption: 0.24 gal/h, Integral 1.1 L fuel tank, 25:1 fuel mix,
- Corrosion-resistant, horizontal single-stage, volute type centrifugal pump with foam and retardant solutions pumping capability
- Anodized aluminum body and a USDA Forest Service approved spark-arresting muffler
- Pump dimensions: Length: 12.3 in; Width: 11.3 in; Height: 14.1 in; Weight: 14.3 lb
- Suction/discharge: 1-1/2 in NPSH
- Price: $725
- Shutoff at 73 psi, free flow at 64 gpm
- Rubber thread protection caps

Optional equipment

- Hand primer B-5980
- Thread protector 1-1/2 in NPSH A-2161
- Foot valve and strainer A-7012
- Lightweight 8-ft suction hose MK-150-8
- Quick-connect fuel connection A-7013
- Fuel line 12-401B with handle quick-connect R-712
- Fuel air transport tank FA-552
- Hours meter MTR-1000
- Pump testing kit A-2388
- Helicopter package on special order
- Service manual. See figures A4 and A5.

Figure A4–Mini-Mark II pump configuration.

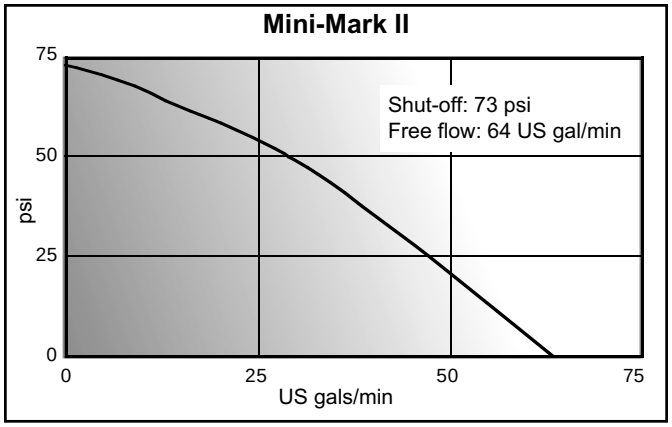

Figure A5–Mini-Mark II pump performance curve.

Mercedes Textiles Wickman-100

- 2.3 hp, 40 cc
- EPA Class IV handheld, Solo engine, centrifugal,
- 2 cycle engine
- Engine EPA compliant for 2001
- 24:1 fuel mixture
- Pump dimensions: Length: 13.0 in; Width: 11.0 in; Height: 10.5 in; Weight: 16.9 lb
- Suction/discharge: 1-1/2 in NPSH
- Manufactured with nikasil-treated cylinder walls
- Horizontal, single-stage pump, with a detachable end
- Cost: $999

Standard features

- Built-in fuel tank and primer and a compact muffler
- Clutch drive, 10 ft suction hose, foot valve, and manual primer
- The clutch drive system automatically shuts off water flow while idling

Optional equipment

- Remote fuel tank connection kit $38. See figures A6 and A7.

Figure A6–Wickman-100 pump configuration.

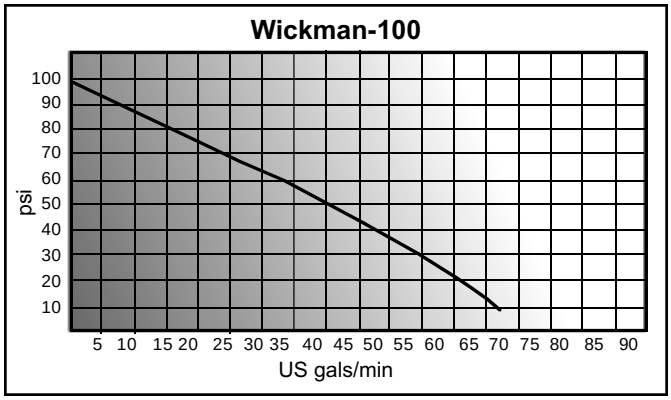

Figure A7–Wickman-100 performance curve.

Shindaiwa GP450
Shindaiwa discontinued the GP25 in 1996 and GP45 in 1997 in response to the EPA Phase I emission regulations that went into effect in September 1997.

Shindaiwa has a replacement pump and engine, the GP450, with 2.3 hp. This pump is comparable to the GP45. In fact, many of the GP450 parts are interchangeable with the GP45 and GP25. Shindaiwa will market the GP450 internationally only where EPA regulations are not in effect. The manufacturer states that the GP450 engine is essentially the same as that of the GP45. However, the pump assembly is different. See appendix B for replacement parts for the GP45.

Shindaiwa GP450
- Engine- 2.3 hp, 44 cc
- EPA Class IV, handheld
- Engine not EPA or CARB compliant
- 2-cycle engine
- Fuel Mixture 50:1
- Max. suction head 26-1/4 ft
  Max. psi 48-52

Shindaiwa Inc.
Tualatin, OR 97062
www.shindaiwa.com
Phone: 503–692–3070 Fax: 503– 692–6696

Mercedes Textiles Wick-100-4H
- 2.5 hp @7,000 rpm engine, 49 cc engine displacement
- EPA Class IV, handheld
- Engine EPA/CARB compliant to 2005
- 4-stroke, air-cooled
- Transistorized magneto ignition
- Mechanical valve lifters
- Single-stage detachable pump
- Centrifugal clutch
- Lightweight, corrosion-resistant anodized pump parts
- Stainless steel shaft
- Overspeed governor protection
- Suction/discharge: 1-1/2 in NPSH
- Weight: 20.2 lb
- 15° maximum operating angle
- Integral fuel tank 0.32 gal See figures A8 and A9.


Figure A8–Wick-100-4H pump configuration.

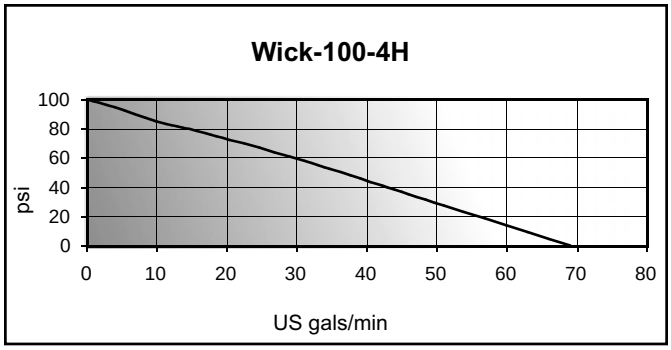

Figure A9–Wick-100-4H pump performance curve.

Wildfire Mini-Striker
- 2.5 hp at 8,000 rpm, 49 cc engine displacement
- EPA Class IV, handheld, centrifugal pump
- Engine EPA/CARB-compliant to year 2005
- Honda GXH50 engine
- 4-cycle, air-cooled, engine
- Recoil starter, transistorized magneto ignition
- Oil capacity: 0.26 qt
- Fuel consumption: 0.24 gal; 0.32 gal integral fuel tank; no mixed fuel
- Pump dimensions: Length: 12 in; Width: 10 in; Height: 15 in; Weight: 20 lb
- Suction/discharge: 1.5 in NPSH
- Price: $795

Standard features- Foam and retardant solutions pumping capability.

Optional equipment

- Hand primer B-5980 Foot valve and strainer A-7012
- Lightweight 8-ft suction hose MK-150-8
- Thread protector 1-1/2 in NPSH A-216
- Ball check valve A-6935
- Pressure gauge A-2392-600
- Hours meter MTR-1000
- Pump testing kit A-2388
- Service manual
- Figure A10 and A11

Figure A10–Mini-Striker pump configuration.

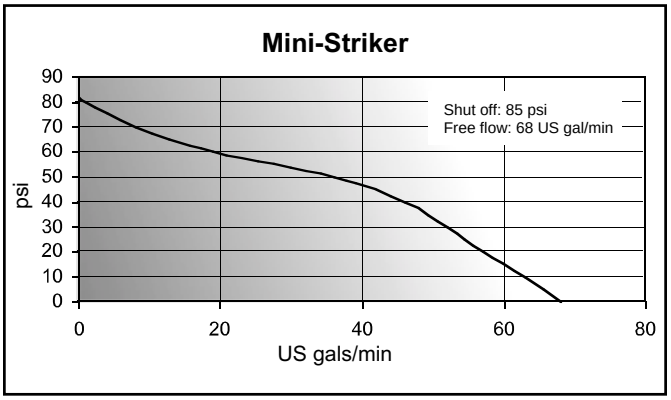

Figure A11–Mini-Striker pump performance curve.

Wildfire Mark 26 - Out of production since 1997. Wildfire is investigating EPA/CARB-compliant replacement engine.

- 5 hp Rotax
- EPA class I, nonhandheld
- 2-cycle engine
- 2-stage centrifugal pump head
- Weight: 40 lb
- Hand primer

Mercedes Textiles Wick-250

- 8 hp, 134 cc engine displacement
- EPA Class I, U.S. Motorpower engine
- Engine not EPA/CARB-compliant
- 2-cycle, air-cooled engine
- Pump dimensions: Length: 15.3 in; Width: 13.0 in; Height: 12 in; Weight: 31 lb
- 24:1 fuel mixture
- Suction: 2 in NPSH, discharge: 1-1/2 in NPSH
- Auto reset high-speed cutout

Optional equipment

- USDA Forest Service approved spark arrester. Figures A12 and A13

Figure A12–Wick-250 pump configuration.

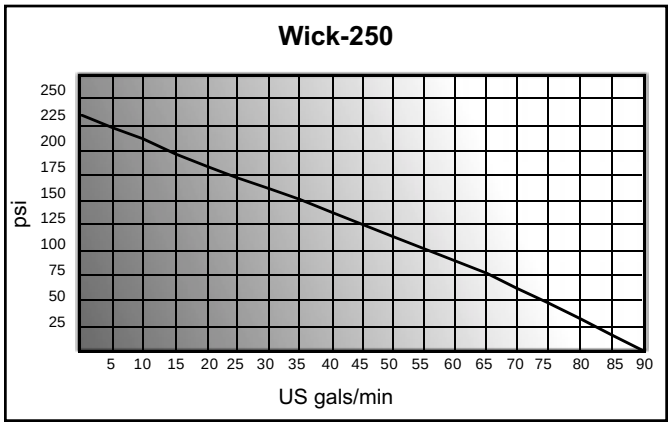

Figure A13–Wick-250 pump performance curve.

Mercedes Textiles Wick-375

This portable pump is not listed on the 5100-274c lightweight pump Qualified Products List at this time.

- 10 hp, 210 cc engine displacement
- EPA class I Solo engine,
- Engine not EPA or CARB compliant
- 2-cycle engine
- 24:1 fuel mixture
- Pump dimensions: Length: 22.75 in; Width: 14.25 in; Height: 14 in; Weight: 53.5 lb
- Suction: 2 in NPSH; discharge: 1-1/2 in NPSH
- Mercury style fuel quick-connect

Standard features

- 4-stage detachable pump end
- Reliable stainless steel pump attaching clamp
- Detachable rewind starter for emergency rope start
- Electronic automatic reset “loss of prime” cut-out switch (patent pending)

Optional equipment

- USDA Forest Service approved spark arrester
- Heat shield. See figures A14 and A15.

Figure A14–Mini-Striker pump configuration.

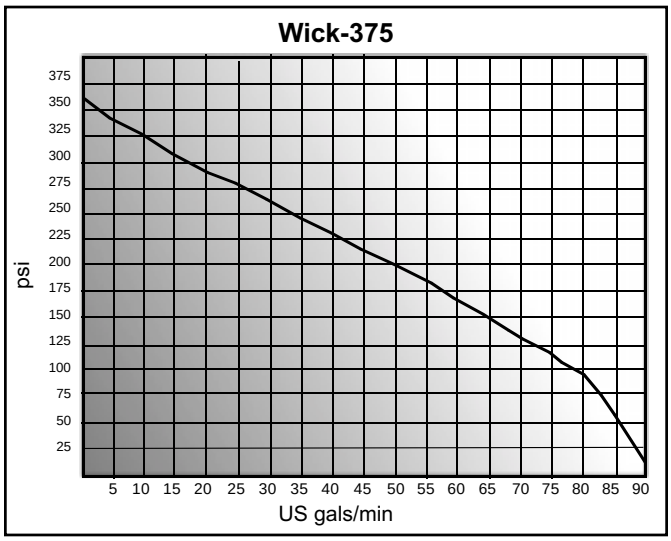

Figure A15–Mini-Striker pump performance curve.

Wildfire Mark 3

This pump is listed on the 5100-274c lightweight pump Qualified Products List.

- 10 hp, 185cc engine displacement
- EPA Class I, Rotax engine
- Engine not EPA/CARB-compliant (the manufacturer is looking for suitable replacement engine)
- 2-cycle air cooled engine
- Pump dimensions: Length: 23 in; Width: 12 in; Height: 16-1/4 in; Weight: 55 lb
- Suction: 2 in NPSH; discharge: 1-1/2 in NPSH

Standard features

- Fuel air transport tank FA-552
- Fuel line 12-401B with handle quick-connect R-712
- Quick-connect fuel connection
- Operating tool kit R-900
- Rubber protection caps
- Foam and retardant solutions pumping capability
- Operating manual

Optional equipment

- B-2 pump end
- Hand primer B-5980
- Thread protector 2 in NPSH A-2688; thread protector 1-1/2 in NPSH A-2161
- Ball check valve A-6935
- Pressure gauge A-2392-600
- Hours meter MTR-1000
- Backboard C-7404. Deluxe backpack PF-2122
- Pump unit antivibration base B-5889
- Noise reducer R-4000
- Pump testing kit A-2388
- Repair tool kits R-952, R-900
- Service manual. See figure A16.

Figure A16–Mark 3 pump configuration.

Wildfire Striker II

- 11 hp, 337 cc engine displacement
- EPA Class II, nonhandheld Honda GX340K1 engine
- Engine EPA/CARB compliant to 2005
- 4-cycle
- Oil capacity: 1.16 qt
- Fuel consumption: 0.93 gal/h
- Pump dimensions: Length: 29 in; Width: 17 in; Height: 19 in; Weight: 119 lb

- Suction: 2 in NPSH; Discharge:1-1/2 in NPSH
- Pump end utilizes many interchangeable parts with Mark-3, BB-4, and Ultra-Striker pumps
- Governor system for over-speed protection

Optional equipment

- Battery and cable kit B-7459
- Painted steel carry frame with vinyl grips B-7272; painted extended steel carry frame with vinyl grips B-7232
- Electric priming pump B-7498; hand-pump priming system
- Thread protector 2 in NPSH A-2688; thread protector 1-1/2 in NPSH A-2161
- Hours meter with tachometer MTR-1000
- Repair tool kit A-2355. See figures A17 and A18.

Figure A17–Striker II pump configuration.

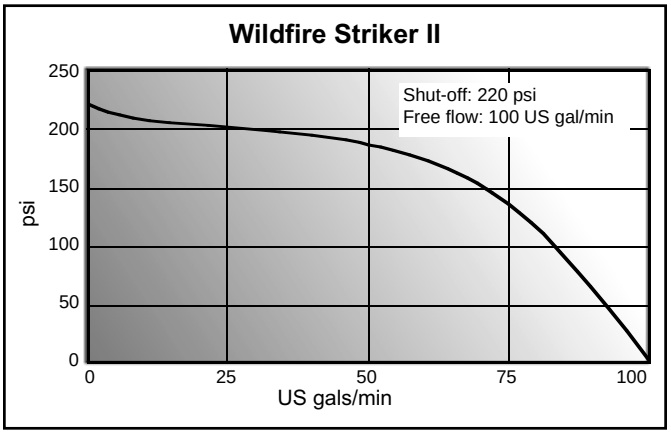

Figure A18–Striker II pump performance curve.

Mercedes Textiles- Wick-N4200-13H

- 13 hp, Honda GX390 engine
- EPA class nonhandheld
- Engine EPA/CARB-compliant through 2005
- 4-stroke, air cooled
- 1.7 gal fuel tank
- 4-stage detachable with integral bearings
- Suction: 2-in NPSH; Discharge: 1-1/2-in NPSH
- Manual priming pump
- Pressure gage
- Weight: 123 lb. See figures A19 and A20.

Figure A19–Wick BN4200-13H pump configuration.

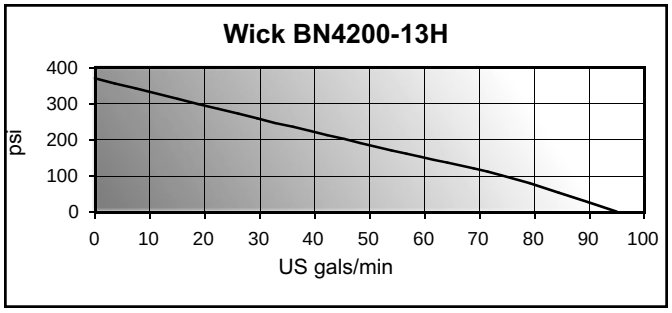

Figure A20–Wick BN4200-13H performance curve.

Mercedes Textiles Wick F200-13H

- 13 hp Honda GX-390 engine
- EPA Class II nonhandheld
- Engine EPA/CARB-compliant through 2005
- 4-stroke, air-cooled
- Integral 1.7 gal fuel tank
- 2-stage detachable with integral bearings
- Suction: 2 in NPSH
- Discharge: 1-1/2 in NPSH
- Manual priming pump
- Pressure gauge
- Weight: 117 lb. See figures A21 and A22.

Figure A21–Wick F200-13H.

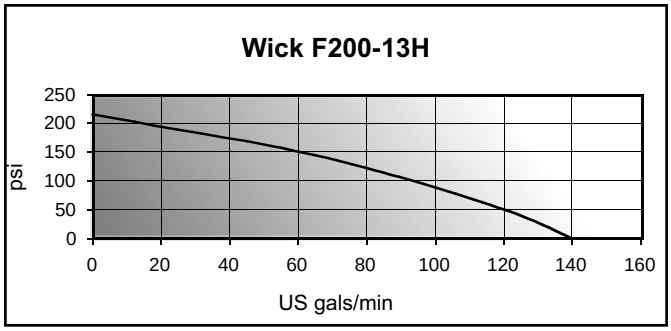

Figure A22–Wick F200-13H pump performance curve.

Wildfire Ultra-Striker

- 13 hp, 389 cc engine displacement
- EPA Class II nonhandheld, Honda GX390K1 engine
- Engine EPA/CARB-compliant to year 2005
- 4-cycle engine
- Pump dimensions: Length: 29 in; Width: 17 in; Height: 19 in; Weight: 126 lb
- Suction: 2 in NPSH; Discharge: 1 _ in NPSH
- Provides many interchangeable parts with the MARK-3 and BB-4
- 18-16, detachable 3-stage centrifugal pump end
- Quick-release pump clamp
- Lightweight aluminum alloy pump parts
- Anodized pump parts for corrosion resistance
- Stainless steel shaft mechanical rotary seal
- Governor system for overspeed protection
- Rubber protection caps
- Service manual
- Foam and retardant solutions pumping capability

Optional equipment

- Battery and cable kit B-745
- Painted steel carry frame with vinyl grips B-7272; painted extended steel carry frame with vinyl grips B-723
- Electric priming pump B-7498; hand-pump priming system
- Thread protector 2 in NPSH A-2688; thread protector 1-1/2 in NPSH A-216
- Hours meter with tachometer MTR-1000
- Repair tool kit A-2355. See figures A23 and A24.

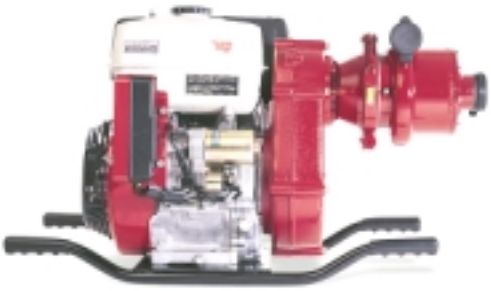

Figure A23–Ultra-Striker pump configuration.

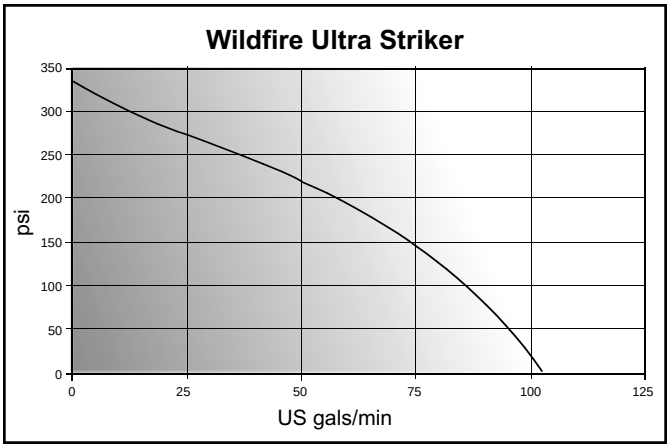

Figure A24–Ultra-Striker pump performance curve

Mercedes Textiles Wick-BN4200

- 18 hp, Briggs & Stratton Vanguard “V Twin” E1 engine
- EPA class II, nonhandheld
- Engine EPA/CARB-compliant to 2005
- Weight: 137 lb (62 kg)
- Suction: 2 in NPSH; Discharge: 1-1/2 in NPSH
- 4-stroke, air-cooled. See figures A25 and A26.

Figure A25–Wick BN4200 pump configuration.

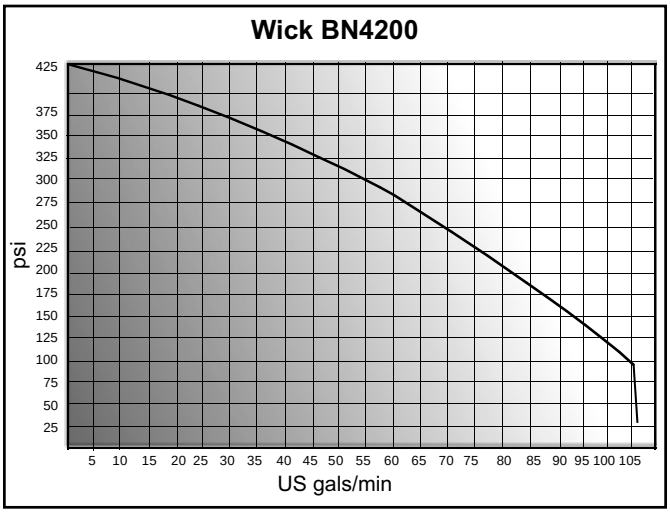

Figure A26–Wick BN4200 performance curve.

Wildfire BB4

- 18 hp Briggs and Stratton Vanguard “V Twin” E1 engine
- EPA Class II, nonhandheld
- Engine EPA/CARB compliant to 2005
- 4 cycle, air-cooled engine
- Electric with backup recoil starter
- Oil capacity: 1.75 qt
- Fuel consumption: 1.8 US gal/h; 1.5 gal fuel tank
- Pump dimensions: Length: 34 in; Width: 19-1/4 in; Height: 19 in; Weight: 143 lb
- Suction: 2 in NPSH; Discharge: 1-1/2 in NPSH
- Belt driven speed increaser

Optional equipment

- Thread protector 1-1/2 in NPSH A-2161
- Ball check valve A-6935
- Pressure gauge A-2392-600
- Hours meter MTR-1000
- Control panel A-7198
- Repair tool kit A-2356
- Battery kit B-7225
- Service manual Briggs & Stratton Model Vanguard engine Manual reel (available on slip on) F-4559-3M
- REELTEX Forestry fire hose (available on slip on). See figures A27 and A28.

Figure A27–BB4 pump configuration.

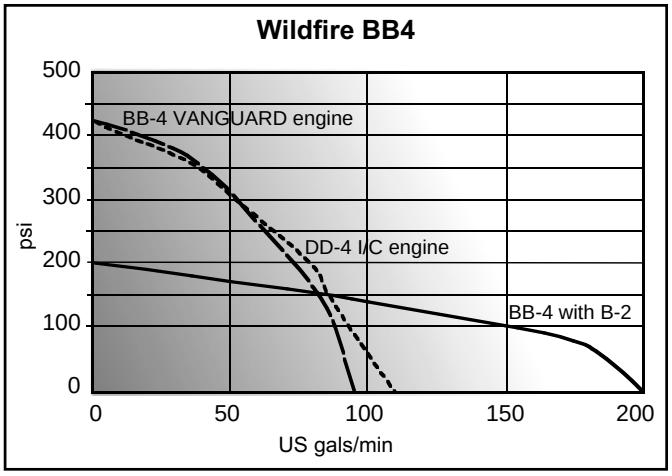

Figure A28–BB4 pump performance curve.

Mercedes Textiles Wick- B4200-18H

- 18 hp Honda engine
- EPA Class II, nonhandheld
- EPA/CARB-compliant to 2005
- Weight: 140 lb
- Suction: 2 in NPSH; Discharge: 1-1/2 in NPSH
- 4-stroke, air-cooled engine

Mallory M88 with Kohler Engine

- 8 hp Kohler engine, 305 cc engine displacement
- EPA class II, nonhandheld
- Engine EPA/CARB-compliant through year 2002
- 4-cycle, air-cooled engine
- Max 60 gpm
- Electric with backup recoil starter
- Suction: 2 in NPSH; Discharge: 1-1/2 in NPSH
- Belt-driven speed increaser
- Pump dimensions: Length: 27 in; Width: 22 in; Height: 18 in; Weight: 130 lb

Mallory Company
www.malloryco.com
Phone: 800–426–6830 Fax: 360–577–4244

Mallory M88 with Honda Engine

- 9 hp Honda engine, 270 cc engine displacement
- EPA Class II, nonhandheld
- Engine EPA/CARB-compliant to 2005
- 4-cycle, air-cooled engine
- Electric with backup recoil starter
- Suction: 2 in NPSH; Discharge: 1-1/2 in NPSH
- Belt driven speed increaser
- Pump dimensions: Length: 27 in; Width: 22 in; Height 18 in; Weight: 130 lb

Mallory MM11 with Honda Engine

- 13 hp Honda engine, 289 cc engine displacement
- EPA class II, nonhandheld
- Engine EPA/CARB-compliant 2005
- 4 cycle, air-cooled engine
- Single stage pump
- Weight: 120 lb
- Electric with backup recoil starter
- Suction: 2 in NPSH, Discharge: 1-1/2 in NPSH
- Belt driven speed increaser

Mallory MM4 with B&S Engine

- 18 hp Briggs & Stratton Vanguard “V Twin” E1 engine
- EPA Class 2 nonhandheld
- Engine EPA/CARB-compliant to 2005
- 4 cycle, air-cooled engine
- Weight: 137 lb
- Electric with backup recoil starter
- Oil capacity: 1.75 qt
- Fuel consumption: 1.8 US gal/h; 1.5 gal fuel tank,
- 4-stage pump dimensions: Length: 34 in; Width: 19-1/4 in; Height: 19 in; Weight: 143 lb
- Suction: 2 in NPSH; Discharge: 1-1/2 in NPSH
- Belt driven speed increaser

Mallory MM4 with Honda Engine

- 18 hp Honda engine, 614 cc engine displacement
- EPA class II, nonhandheld
- Engine EPA/CARB-compliant to 2005
- 4-cycle, air-cooled engine
- Electric with backup recoil starter
- 4-stage pump dimensions
- Suction: 2 in NPSH; Discharge: 1-1/2 in NPSH
- Belt driven speed increaser

Mallory M90 with B&S Engine

- 18 hp Briggs and Stratton Vanguard “V Twin” E1 engine
- EPA Class II, nonhandheld
- Engine EPA/CARB-compliant through 2005
- 4-cycle, air-cooled engine
- Single stage pump
- Electric with backup recoil starter
- Suction: 2 in NPSH; Discharge: 1-1/2 in NPSH
- Belt driven speed increaser

Mallory M90 with Kohler Engine

- 20 hp Kohler Magnum engine, 624 cc engine displacement
- EPA Class II, nonhandheld
- Engine EPA/CARB-compliant through year 2007
- 4-cycle, air-cooled engine
- Single stage pump
- Electric with backup recoil starter
- Suction: 2 in NPSH; Discharge: 1-1/2 in NPSH
- Belt driven speed increaser

Mallory M90 with Honda Engine

- 20 hp Honda engine, 614 cc engine displacement
- EPA Class II, non-handheld
- Engine EPA/CARB-compliant to 2005
- 4-cycle, air-cooled engine
- Single stage pump
- Electric with backup recoil starter
- Suction: 2 in NPSH; Discharge: 1-1/2 in NPSH
- Belt driven speed increaser

Appendix B

Shindaiwa GP45 and GP450 Mini-Lightweight Pump Part Interchangeability

The following Shindaiwa GP450 parts are interchangeable between the GP450 and GP45.

Cylinder:	Crank Case Assembly:
70000-15140 arrester gasket	20000-21140 crank case dowel pin
11206-04080 screw PM SPW	
Piston:	**Rotor:**
20021-41341 thrust washer	01600-10251 rotor spring washer
Recoil Starter Sub Assembly:	
20000-75130 recoil starter ratchet	20000-75150 friction plate
20000-75160 friction spring	20000-75170 friction plate screw
20020-75180 rope	20010-75190 starter knob
20000-75220 return spring	70000-75230 starter pulley
20000-76210 starter pulley nut	11022-04160 bolt SPW
20020-76110 starter gasket	
Carburetor Assembly:	
20000-81910 stay	20000-81310 slow stop screw
20000-81710 cleaner body	20010-81550 drain gasket
20000-81740 filter	20000-81730 air cleaner screw
20000-81760 air cleaner seal	20010-81760 net B
20000-81790 cleaner cover screw	20000-81770 cleaner cover
Fuel tank:	
20010-85201 fuel cap assembly	20010-85301 fuel cock assembly
20003-86130 cushion	
Special Tool:	
22900-91180 plug wrench	
Puller Assembly:	
22100-96121 lever center bolt	20000-96130 lever bolt
20000-96140 lever bolt	20000-96411 rotor spanner
20021-96420 stopper	20021-96611 puller
20021-96621 boss bolt	20021-96630 puller guide pin

The following GP450 parts are not interchangeable with the GP45:

Cylinder:	Crank Case Assembly:
72905-15100 muffler comp	70062-21000 crank case assembly
	20124-31110 fan cover
Piston:	**Rotor:**
20021-41112 piston	02403-03100 key
20021-41311 piston pin	22011-11411 switch
22152-41231 snap ring	20124-72520 bracket
	20124-58110 pump shaft
Carburetor Assembly:	**Fuel tank:**
20124-81000 carburetor assembly	20043-85410 fuel pipe
20124-81020 carburetor sub assembly	20124-86110 tank bracket
20124-81180 throttle valve	
20124-81210 jet needle	
20124-81230 needle jet	
19404-00008 label choke	

Casing:	
403-001 casing	401-017 packing
401-002 packing	401-018 house coupling
501-014 bolt	403-019 bend
403-004 casing cover	403-020 packing
501-005 bolt	501-012 plug
501-006 seal packing	501-022 packing
501-007 spring washer	501-021 plug
501-008 washer	401-032 house band
405-009 impeller	405-033 strainer
401-010 mechanical seal	405-036 base
405-011 inner casing	401-038 cushion
403-012 packing	405-030 handle
401-013 valve case	401-037 tapping screw
403-014 tapping bolt	1001-024 spring nut
401-015 check valve	501-024 flange nut
401-016 house joint	405-034 bolt

Puller Assembly:	Special Tool:
20000-96104 puller assembly	70110-91100 tool set
20000-96114 lever	19639-01100 poly bag
20022-96210 air gap gauge	
20021-96601 puller assembly	
20000-96631 guide pin	
20035-96630 guide pin	

Approximate English/Metric Conversion Factors for Units Used in this Document

To Change	To	Multiply by
feet	meters	0.305
gallons	liters	3.785
gallons/minute	liters/second	0.063
grams	ounces	0.035
horsepower	watts	745.7
inches	millimeters	25.4
pounds	kilograms	0.454
quarts	liters	0.946