NATURE OF DISCHARGE REPORT

Portable Damage Control Drain Pump Wet Exhaust

1.0 INTRODUCTION

The National Defense Authorization Act of 1996 amended Section 312 of the Federal Water Pollution Control Act (also known as the Clean Water Act (CWA)) to require that the Secretary of Defense and the Administrator of the Environmental Protection Agency (EPA) develop uniform national discharge standards (UNDS) for vessels of the Armed Forces for "...discharges, other than sewage, incidental to normal operation of a vessel of the Armed Forces, ..." [Section 312(n)(1)]. UNDS is being developed in three phases. The first phase (which this report supports), will determine which discharges will be required to be controlled by marine pollution control devices (MPCDs)—either equipment or management practices. The second phase will develop MPCD performance standards. The final phase will determine the design, construction, installation, and use of MPCDs.

A nature of discharge (NOD) report has been prepared for each of the discharges that has been identified as a candidate for regulation under UNDS. The NOD reports were developed based on information obtained from the technical community within the Navy and other branches of the Armed Forces with vessels potentially subject to UNDS, from information available in existing technical reports and documentation, and, when required, from data obtained from discharge samples that were collected under the UNDS program.

The purpose of the NOD report is to describe the discharge in detail, including the system that produces the discharge, the equipment involved, the constituents released to the environment, and the current practice, if any, to prevent or minimize environmental effects. Where existing process information is insufficient to characterize the discharge, the NOD report provides the results of additional sampling or other data gathered on the discharge. Based on the above information, the NOD report describes how the estimated constituent concentrations and mass loading to the environment were determined. Finally, the NOD report assesses the potential for environmental effect. The NOD report contains sections on: Discharge Description, Discharge Characteristics, Nature of Discharge Analysis, Conclusions, and Data Sources and References.

2.0 DISCHARGE DESCRIPTION

This section describes the Portable Damage Control (DC) Drain Pump Wet Exhaust discharge and includes information on: the equipment that is used and its operation (Section 2.1), general description of the constituents of the discharge (Section 2.2), and the vessels that produce this discharge (Section 2.3).

2.1 Equipment Description and Operation [1]

Portable, engine-driven pumps are used to provide fire fighting water in the unlikely event that it is unavailable from the ship's installed fire pumps because of damage, loss of electrical power, or other reasons. These pumps may also be used in an emergency to directly dewater (drain) flooded compartments which have no installed drainage system. They can also be used to provide driving water for portable eductors that dewater flooded spaces as well. The two models of engine-driven pumps which produce this discharge are the P-250 and the P-100. A portion of the sea water output from the P-250 portable damage control pump is directed to cool the engine. A small portion of the cooling water is also injected into the engine exhaust to cool and quiet the exhaust. This cooling water (called wet exhaust), containing some of the burned and unburned exhaust constituents, is discharged to receiving waters. Although the engine which drives the P-100 pump is air-cooled, and no water is injected into the engine exhaust of this pump, a small amount of water contacts the engine exhaust during pump priming only. This water is also considered part of this discharge and is characterized in this report.

Typical operations involving portable damage control drain pump wet exhaust discharge include monthly planned maintenance system (PMS) activities and emergency situations such as fire and flooding.

2.1.1 Wet Exhaust (P-250). The P-250 MOD 1 pump (Figure 1) operates at 250 gallons per minute (gpm) and is driven by a 35-horsepower (HP*)*, two-cylinder, water-cooled, two-stroke per cycle, spark-ignition, vertical-shaft engine. It is fueled by gasoline and lubricated by oil that is injected into the gasoline via a small injection pump. A later modification of the P-250, the P-250 MOD 2 pump was similar to the P-250 MOD 1 model, but the engine was modified to run on JP-5, a kerosene-based fuel. All P-250 MOD 2 pumps have been removed from service because of reliability, maintainability and availability issues.[1,2]

2.1.2 Discharge from pump priming. In the Navy, Army, and MSC fleets, the remaining P-250 MOD 1 pumps are currently being replaced by P-100 portable damage control pumps (Figure 2). The P-100 differs significantly from the P-250 pump models in that the P-100 has no wet exhaust discharge. The P-100 is smaller, rated at 100 gpm at 95 pounds per square inch (psi). It is driven by a one-cylinder, air-cooled, four-stroke per cycle, diesel engine with a

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[1] This discharge was formerly called "Emergency Fire Pump Wet Exhaust". References and other materials related to this discharge can be found in the files under that title. These pumps are more properly called fire pumps, since they were designed for fire fighting; however, they can be used for dewatering ("drainage") as well. The title of this discharge was changed to make it clear that there are in fact two separate discharges from these equipments. The main discharge of sea water from these pumps is covered in a separate NOD titled "Portable Damage Control Drain Pump Discharges".

horizontal shaft. The engine exhaust pipe is a double-walled, insulated, corrugated steel tube. No water is injected into the exhaust nor is the exhaust discharged into receiving waters.[3]

The P-100 pump is equipped with a unique exhaust-powered primer. (Priming of the P-250 pump is accomplished with a hand-operated pump; the P-250 does not have an exhaust-powered primer.) In priming the P-100 pump, the main engine exhaust port is blocked by the exhaust primer valve, forcing the engine exhaust to flow through the priming jet. The priming jet evacuates the air from the pump casing and suction hose, causing water to rise in the suction hose and fill the pump casing. Priming is completed when water begins discharging from the priming jet. When priming is complete, the primer shut off valve is adjusted to stop the water flow.[4] Up to 1/2 liter of exhaust-contaminated water may be discharged during pump priming. During a typical priming event, the liquid discharge is just sufficient to puddle on the deck, and is wiped up with rags.

2.2 Releases to the Environment

This discharge consists of water injected as a cooling stream into the exhaust system of P-250 portable damage control pump internal combustion engines. Exhaust constituents generated during the operation of the internal combustion engines can be transferred to the engine's water cooling stream and discharged as wet exhaust. Wet exhaust discharges are continuously routed overboard during pump operation, typically via an exhaust hose. The purpose of the exhaust hose is to route the engine exhaust products from the vessel interior spaces to the weather so that personnel are not overcome by the exhaust fumes. For maintenance and any familiarization training that may be performed on ships, the common practice is to connect the exhaust hose so that the discharge goes directly overboard.

In addition, this discharge consists of less than 1/2 liter of water containing trace amounts of exhaust which may be released during a P-100 priming event.

2.3 Vessels Producing the Discharge

There are 906 portable damage control pumps which produce this discharge on Navy vessels.[1,5] The Military Sealift Command (MSC) has 137 of these pumps on their vessels.[2,5] The Coast Guard (USCG) has 370 pumps, which are all P-250's.[5,6] There are 66 pumps which produce this discharge aboard U.S. Army (USA) watercraft.[7,8] There are no pumps which produce this discharge aboard U.S. Air Force watercraft.[9] Pumps within the fleets are as follows:[1,2,3,7]

	P-250 MOD 1	P-100	Total by Service
Navy	70	836	906
MSC	0	137	137
USCG	370	0	370
Army	60	6	66
Totals	500	979	1479

The Navy is completely converting to P-100 pumps, and it is estimated that all P-250's in Navy service will be replaced by P-100's by the end of 1998. The Army has also begun to replace P-250's with P-100's, but a timetable for complete conversion has not yet been developed.

3.0 DISCHARGE CHARACTERISTICS

This section contains qualitative and quantitative information that characterizes the discharge. Section 3.1 describes where the discharge occurs with respect to harbors and near-shore areas, Section 3.2 describes the rate of the discharge, Section 3.3 lists the constituents in the discharge, and Section 3.4 gives the concentrations of the constituents in the discharge.

3.1 Locality

Wet exhaust discharges from portable damage control drain pumps occur during maintenance activities. Maintenance activities can be initiated while in port or at sea. For purposes of this analysis, it has been assumed that all discharges occur within 12 nautical miles (n.m.).

3.2 Rate

The P-250 pump discharges wet exhaust at 2 gpm. As previously stated in Section 2.1, the P-100 pump has no wet exhaust, but may produce up to 1/2 liter of exhaust-contaminated water during pump priming.

Using standard maintenance schedules, pump inventory data, and established pump wet exhaust discharge rates, discharge volume estimates were calculated as shown in Table 1. During monthly maintenance activities, the Navy runs pumps for approximately 10 minutes, and during annual maintenance checks for about 15 minutes. The annual check is done concurrently with a monthly check.[10] The Army and MSC follow the Navy's maintenance procedures. The USCG currently runs its pumps for 30 minutes per month, but the maintenance procedures are expected to be modified to require only a 15 minute run time per month.[11,12]

The calculation for the annual wet exhaust flow rate of 298,900 gallons per year from P-250 MOD 1 pumps is shown below:

Annual wet exhaust flow rate = (per minute wet exhaust flow rate (gal/min)) (operating time (minutes/year/pump)) (number of pumps)

For P-250 MOD 1 Pumps:

1. Wet exhaust flow = 2 gallons/minute

2. Operating time

Navy and Army pump monthly maintenance checks = (10 min/month) (11 months) = 110 min/yr/pump
Navy and Army pump annual maintenance check = 15 min/yr/pump
Navy and Army pump total operating time = (110 min/yr/pump) + (15 minutes/yr/pump) = 125 minutes/yr/pump

USCG pump monthly checks = (30 minutes/month) (12 months) = 360 minutes/yr/pump

3. Number of pumps

Navy and Army vessels = 130 pumps
USCG vessels = 370 pumps

4. Annual wet exhaust flow rate

for Navy/Army = (2 gal/min) (125 min/yr/pump) (130 pumps) = 32,500 gal/yr
for USCG = (2 gal/min) (360 min/yr/pump) (370 pumps) = 266,400 gal/yr
for Navy/Army/USCG = 32,500 gal/yr + 266,400 gal/yr = 298,900 gal/yr

3.3 Constituents

The constituents of this discharge are fuel (gasoline or diesel), lubricants, or their combustion exhaust gases. Typical constituents of exhaust gases from small diesel or gasoline-fueled engines include both organic and inorganic substances. Most of the substances that originate from the fuel are combustion products. However, some fuel passes through the engine unburned along with combustion products in the exhaust gases.[13]

Inorganic substances in portable damage control pump engine exhaust gases include combustion products such as carbon dioxide (CO_2), carbon monoxide (CO), oxides of nitrogen (NO_x), oxides of sulfur (SO_x), and metals. The specific substances and their concentrations depend on a number of factors, including the composition of the fuel, engine temperature, engine use, and engine condition.

P-250 MOD 1: Engine wet exhausts contain oil and grease. The concentrations are affected by the composition of the fuel, any additives used, and the efficiency of the engine. In 1992, sampling was conducted by the Navy for metals in portable damage control pump wet exhaust and the results are shown in Table 2. The metals analyses were only conducted on the P-250 MOD 2 unit, which has since been removed from service; however, since P-250 MOD 1 and MOD 2 pumps and cooling systems are of similar construction, the metals for both types of engine exhausts are expected to be comparable. Chromium, cadmium, copper, lead, nickel, silver, and zinc were all detected in the wet exhaust.[14] All of these metals are priority pollutants. As mentioned in Section 2.1, the P-250 MOD 1 pump is a two-stroke per cycle, spark ignition gasoline powered engine. These types of engines are known to release high levels of gaseous hydrocarbons (HC) relative to other engine types such as diesel or four-stroke per cycle engines. The primary component of the HC in air exhaust which may impact water quality is volatile organic compounds (VOCs).[15]

While there is not a large body of information available on the impact of engine exhaust on water, some studies have been done. A study in 1995 measured the rate of introduction of VOCs into water during the operation of a gasoline powered two-stroke engine. In this test, an outboard engine was operated in an enclosed tank and the increase in VOCs such as benzene was measured. The results were given in terms of mg of compound/10 min of operation (e.g. 2800 mg benzene/10 min.). Therefore, the number was a bulk measurement of the rate of accumulation of the compound in the water. The study reported that the VOC compounds introduced into the water were almost exclusively aromatic hydrocarbons. In most cases, other types of hydrocarbons were not found. The amount of VOCs introduced into the water on a power basis (grams/horse power-hr) was equivalent to approximately 10% of the total HC emitted in the air exhaust. The VOC compounds measured in the 1995 study and the rate of introduction are shown in Table 3.[15]

The compounds listed in Table 3 are expected to be similar to that of the P-250 MOD 1 engine exhaust since both the test engine and the P-250 engine are two-stroke cycle, gasoline powered engines. Of the compounds listed in Table 3, benzene, toluene, ethylbenzene, and naphthalene are priority pollutants. None of the compounds are bioaccumulators.

3.4 Concentrations

P-250 MOD 1: Oil and grease concentrations in the exhaust from P-250 MOD 1 portable damage control pump wet exhaust is shown in Table 4. These concentrations were taken from laboratory analytical data provided by Naval Surface Warfare Center Carderock Division (NSWCCD).[14] The analyses were performed in April 1992 for oil and grease.

Concentrations of metals in portable damage control pump wet exhaust are shown in Table 2. Metals analyses were only conducted for the P-250 MOD 2,[14] which has since been removed from service; however, it is expected that the concentrations of metals in the P-250 MOD 1 unit will be comparable due to the similarity of the exhaust systems.

The 1995 study measured the VOC accumulation in water from the exhaust of a 10 hp (7.3 kW) engine. Because the P 250 MOD 1 engine is a 35 hp (26 kW) engine, the results are not directly transferable to this larger engine. However, one pertinent observation was reported in this study which permits the results to be “scaled” for a different engine. This observation was that the concentration of VOC in the water was related primarily to the level of HC emissions in the exhaust. The higher the level of HC emissions in the engine exhaust, the higher the level of VOC found in the water.[15] This indicates that if the level of total HC emissions for a different engine can be estimated, the VOC introduction rates for the compounds given in the 1995 study can reasonably be adjusted by comparing the total HC emission rates.

In general, two-stroke cycle engines do not use fuel efficiently since a substantial portion of unburned fuel and oil can be pushed out with the exhaust gases during scavenging. According to EPA, two-stroke technology can result in wasting more than 25-35% of the fuel consumed.[13] However, the results presented in the 1995 study indicate that the percentages may be even higher for smaller engines.

In the 1995 study, the highest normalized HC emissions rates for the 7.3 kW (10 hp) and 15 kW (20 hp) engines tested were 267 g/kW-hr and 172 g/kW-hr respectively.[15] Multiplying these normalized emission rates by their respective engine sizes yields a total HC emissions rate of 1949 and 2580 grams per hour. For typical outboard engines, the fuel consumption rates for these two engines sizes are approximately 4199 and 7110 g/hr.[16] Based upon these figures, the ratio of HC emissions to fuel consumption for each engine can be estimated to be 0.46 for the 10 hp engine and 0.36 for the 20 hp engine.

Based on operational experience, the fuel consumption rate for the 35 hp P-250 MOD 1 pump is approximately 3.0 gallons per hour. Using a specific gravity (s.g.) for gasoline of 0.73, fuel consumption rate of the P-250 MOD 1 pump is approximately:

Fuel consumption = (3.0 gallons/hour)(8.34 lbs water/gallon)(0.73 s.g.) = 18.26 lbs/hr, or 8286 grams/hour

Since the P-250 MOD 1 is a larger engine (35 hp), it can be assumed that one-third of this fuel is wasted and released as HC in the exhaust.[13] Therefore, the HC emissions rate to the air can be estimated as 2762 grams/hour. Using this number, the ratio of HC emissions was calculated as shown below:

Total HC emissions rate - 10 hp engine (7.3 kW): (267 g/kW-hr)(7.3 kW) = 1949 grams/hour
P-250 MOD 1 Emissions rate based on fuel consumption: (8286 g/hr)/3 = 2762 g/hr
Emissions ratio = 2762/1949 =1.418

If it is assumed that there is a direct relationship between the HC emissions rate and the VOC introduction rate, the rates of VOC introduction measured in the 1995 study can be multiplied by the hydrocarbon emissions ratio. Using this approach, Table 5 provides the estimated VOC introduction rates for the portable damage control drain pump wet exhaust. An example calculation for benzene is provided below:

Benzene introduction rate for a 7.3 kW engine is 2800 mg/ 10 min (from 1995 study)
Hydrocarbon emissions ratio for a 26 kW engine equals 1.418 (from above calculation)
Benzene introduction rate for a 26 kW engine equals (1.418)(2800 mg/10 min) = 3970 mg/10 min

To estimate the concentration of the constituents in the wet exhaust, the flow rate must be assumed. From Section 3.2, the approximate wet exhaust flow rate is 2 gpm. A rough approximation of the constituent concentrations can be made if it is assumed that all the VOC introduced into the water is transferred into the wet exhaust. These concentrations are shown in Table 6. A sample calculation is presented below:

Wet Exhaust Flow rate: 2 gpm
Benzene introduction rate: 3970 mg/10 min
Concentration = (3970 mg/10 min)(1 min/2 gal)(1 gal/3.7854 L) = 52.4 mg/L

This approach is limited by several differences between conditions of the laboratory study and the actual portable damage control pump wet exhaust discharge. These limitations are listed below:

- The 1995 study was conducted on a typical outboard engine where the entire engine cooling water flow is discharged through the engine exhaust pipe. For the portable damage control drain pump, a much smaller amount of water is injected into the exhaust hose. Therefore, mixing of the exhaust gases with water is not as complete in the P-250 MOD 1 wet exhaust.

- The length of the exhaust hose is approximately 10 feet, allowing limited contact time between the water and the exhaust.

- The 1995 study was performed on a fixed volume of water. During testing, the temperature increased from 8.8 °C to 13.5 °C (48-56 °F). This was considered to be ambient water temperature for central Europe.[17] However, in many United States ports, ambient water temperature may be up to 10 °C higher. After injection, the temperature of the wet exhaust will be higher still. As a general rule, the solubility of a VOC in water will decrease threefold for every 10 °C temperature rise.[18] Therefore, the actual VOC concentrations may be as much as nine times less than estimated due to temperature effects.

P-100: The P-100 does not have a wet exhaust discharge. It does release less than 1/2 liter of water containing trace amounts of exhaust during pump priming. This discharge usually puddles on the deck and is wiped up with rags. P-100 priming discharge is expected to contain less than 5 milligrams per liter (mg/L) of oil and grease.[5]

4.0 NATURE OF DISCHARGE ANALYSIS

Based on the discharge characteristics presented in Section 3.0, the nature of the discharge and its potential impact on the environment can be evaluated. The estimated mass loadings are presented in Section 4.1. In Section 4.2, the concentrations of discharge constituents after release to the environment are estimated and compared with the water quality criteria. In Section 4.3, the potential for the transfer of non-indigenous species is discussed.

4.1 Mass Loadings

Using the annual flow volumes shown in Table 1, annual mass loadings of constituents to receiving waters from USCG, MSC, Navy, and Army fleets were estimated. A sample annual mass loading calculation for benzene from P-250 MOD 1 pumps follows:

Mass loading (kg/yr) = (total flow rate (gal/yr))(concentration (mg/L))(3.785 L/gal)(10^{-6} kg/mg)
Mass loading = (298,900 gal/yr)(52.4 mg/L)(3.785 L/gal)(10^{-6} kg/mg)
Mass loading = 59.3 kilograms per year (kg/yr)

For estimating mass loadings, the metals concentration for the P-250 MOD 1 wet exhaust and the P-250 MOD 2 wet exhaust were assumed to be the same. Annual mass loadings for each type of portable damage control pump are presented in Table 7. The table shows that the greatest mass loadings are estimated to be toluene and xylene isomers, both of which are over 200 pounds yearly. However, even for toluene, which is the greatest single component, the discharge per event for a MOD 1 pump is only 0.08 pound based on a 30 minute operating period.

4.2 Environmental Concentrations

A comparison of maximum estimated constituent concentrations in the P-250 MOD 1 pump wet exhaust with water quality criteria (WQC) is presented in Table 8. This table indicates that the discharge is expected to exceed the criteria for five constituents. In addition, one of three analyses of P-250 MOD 1 discharge indicate that the Florida WQC for oil and grease was exceeded.

Environmental concentrations of the constituents in Table 8 will not be significant for several reasons. The discharge from each of the 500 P-250 pumps occurs separately at different discharge locations. On average, each P-250 pump discharges less than 0.3 pounds of pollutants per discharge event. The duration of each discharge event is short, averaging less than 30 minutes. These three factors allow the pollutants to dissipate quickly.

4.3 Potential for Introducing Non-indigenous Species

Portable damage control pump wet exhaust does not involve the transport of sea water. Therefore, it is unlikely that the pumps could introduce foreign species into receiving waters.

5.0 CONCLUSION

Wet exhaust from portable damage control pumps has a low potential for causing an adverse environmental effect because mass loadings of benzene, toluene, ethylbenzene, naphthalene, oils, and greases are not significant, although the discharge concentrations of these constituents are expected to exceed water quality criteria. Additionally, environmental concentrations of the above constituents are not expected to exceed water quality criteria because they are expected to dissipate quickly because the mass loadings per discharge event are small and the discharge locations are dispersed fleetwide.

6.0 DATA SOURCES AND REFERENCES

To characterize this discharge, information from various sources was obtained. Process information, equipment specifications, and projected equipment inventories were used to estimate the rate of discharge. Based on this estimate and on the reported concentrations of oil and grease constituents, the concentrations of the oil and grease constituents in the environment resulting from this discharge were then estimated. Table 9 shows the sources of data used to develop this NOD report.

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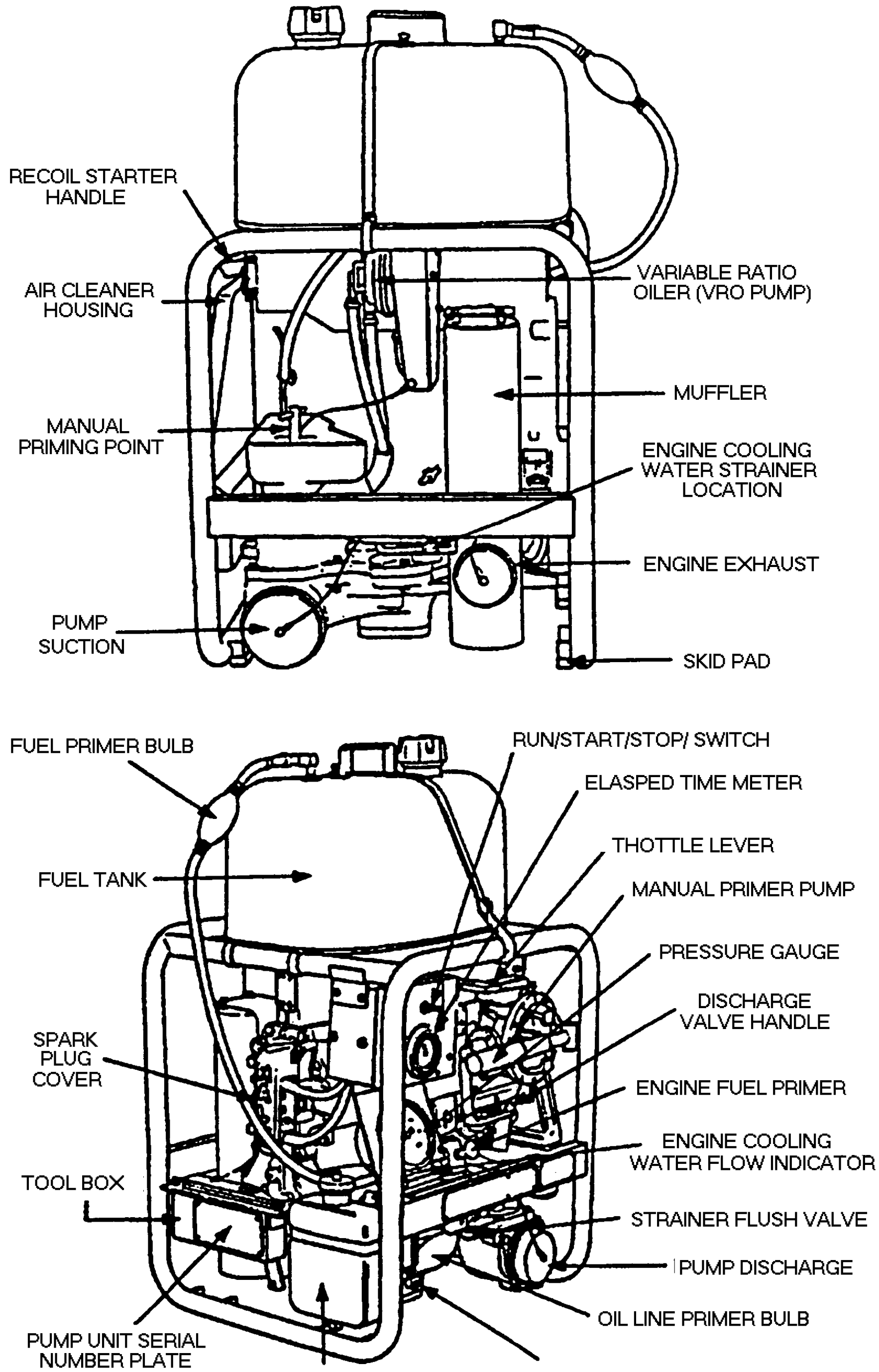

Figure 1. P-250 MOD 1 Portable Gasoline Engine Driven Centrifugal Fire Pump

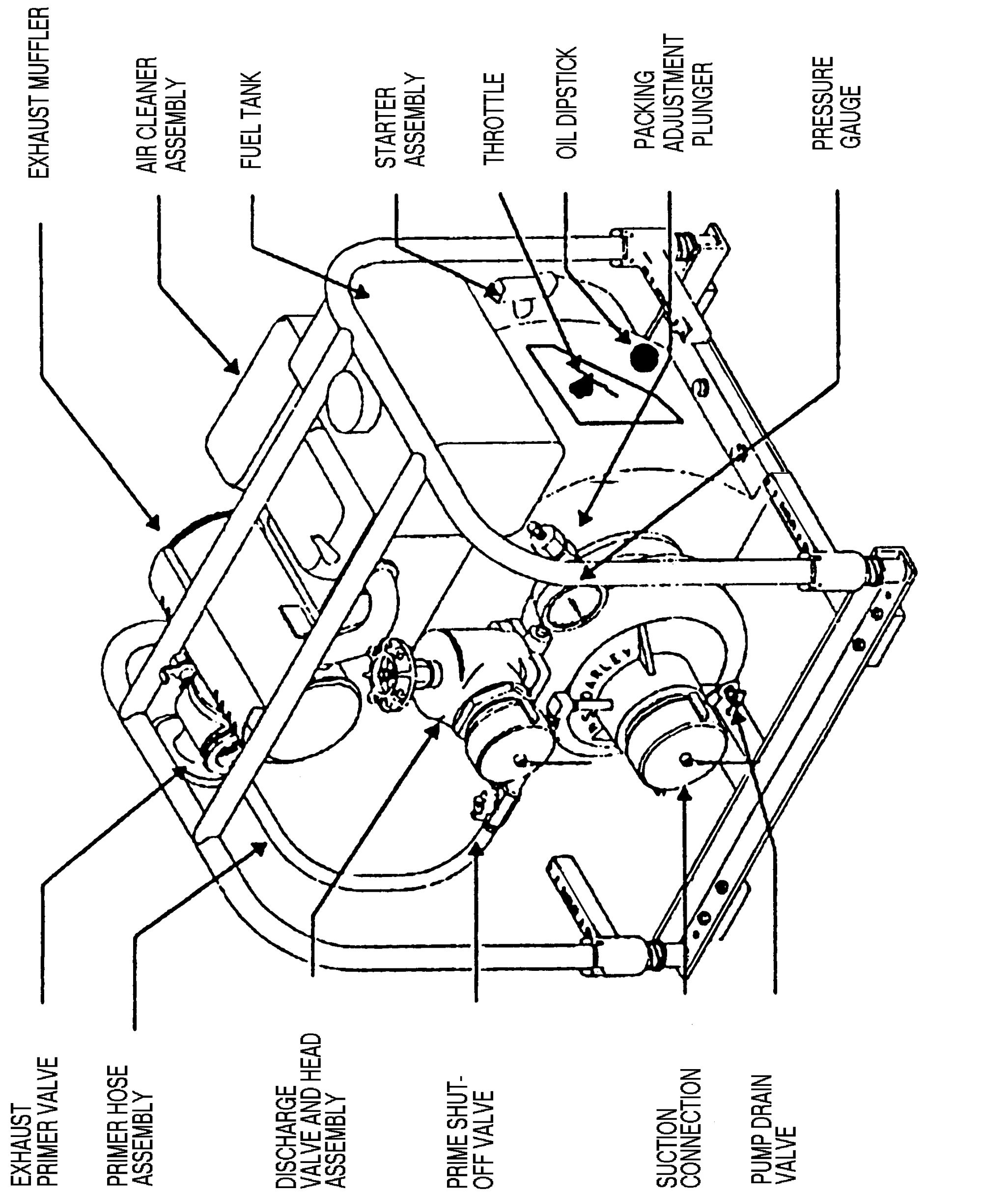

Figure 2. P-100 Portable Diesel Engine Driven Centrifugal Pump

Table 1. Cumulative Wet Exhaust Discharge

Pump Model	Exhaust Flow (Gallons/Year)
P-250 MOD 1	298,900
P-100	1,546 [a]
TOTAL:	300,446

[a] - From pump priming

Table 2. P-250 Metals Analyses[14, b]

Constituent	Concentration (ppm)
Cadmium	<0.001
Total Chromium	0.08
Copper	0.23
Lead	0.85
Nickel	0.21
Silver	0.01
Zinc	3.90

[b] - Data taken in 1992 from P-250 Mod 2 pumps. Although the Mod 2 pump is no longer in service, the exhaust and cooling systems are identical to that of the Mod 1 pump; therefore this data should be representative of the Mod 1 pump.

Table 3. Wet Exhaust Constituents Emitted from Two-Stroke Gasoline Outboard Engines[15]

Compound	Amount in Wet Exhaust from Two-Stroke Outboard Engines (mg /10 min.)
Benzene	2800
Toluene	8500
Ethylbenzene	2000
p/m-Xylene	6900
o-Xylene	3600
3/4-Ethyltoluene	3400
2-Ethyltoluene	1200
Indane	840
Indene	270
Naphthalene	1400
2-Methylnaphthalene	930
1-Methylnaphthalene	350
Formaldehyde	970

Table 4. Laboratory Analyses of Exhaust Effluent Oil and Grease Analyses[14]

Pump Model	Oil & Grease Concentration (ppm)*
P-250 MOD 1 Sample 2A	less than 5
P-250 MOD 1 Sample 2B	less than 5
P-250 MOD 1 Sample 2C	6

* parts per million (ppm)

Table 5. Estimated Wet Exhaust Constituents from P-250 MOD 1 Portable DC Drain Pump Engine

Compound	Amount in Wet Exhaust from Two-Stroke Outboard Engines (mg / 10 min.)
Benzene	3,970
Toluene	12,054
Ethylbenzene	2,836
p/m-Xylene	9,784
o-Xylene	5,104
3/4-Ethyltoluene	4,822
2-Ethyltoluene	1,702
Indane	1,192
Indene	382
Naphthalene	1,986
2-Methylnaphthalene	1,318
1-Methylnaphthalene	496
Formaldehyde	1,376

Table 6. Estimated Concentrations of P-250 MOD 1 Portable DC Drain Pump Exhaust Constituents

Compound	Estimated concentration in two-stroke engine wet exhaust (mg/L)
Benzene	52.4
Toluene	159.2
Ethylbenzene	37.4
p/m-Xylene	129.2
o-Xylene	67.4
3/4-Ethyltoluene	63.6
2-Ethyltoluene	22.4
Indane	15.8
Indene	5.0
Naphthalene	26.2
2-Methylnaphthalene	17.4
1-Methylnaphthalene	6.6
Formaldehyde	18.2

Table 7. Estimated Maximum Annual Mass Loadings

Constituent	Concentration (mg/L)	Mass Loading (kg/yr)	Mass Loading (lbs/yr)
P-250 MOD 1 – Annual Flow Rate 298,900 gallons per year			
Benzene	52.4	59.3	131
Toluene	159.2	180	397
Ethylbenzene	37.4	42.3	93.3
p/m-Xylene	129.2	146	322
o-Xylene	67.4	76.3	168
3/4-Ethyltoluene	63.6	72.0	159
2-Ethyltoluene	22.4	25.3	55.9
Indane	15.8	17.9	39.4
Indene	5.0	5.66	12.5
Naphthalene	26.2	29.6	65.4
2-Methylnaphthalene	17.4	19.7	43.4
1-Methylnaphthalene	6.6	7.5	16.5
Formaldehyde	18.2	20.6	45.4
Oil and Grease	6	6.79	15.0
Cadmium*	<0.001	0	0
Total Chromium*	0.08	0.09	0.2
Copper*	0.23	0.26	0.574
Lead*	0.85	0.962	2.12
Nickel*	0.21	0.238	0.524
Silver*	0.01	0.0113	0.0249
Zinc*	3.90	4.41	9.73
P-100 – Annual Flow Rate 1,546 gallons per year			
Oil and Grease	5	0.029	0.065

* - Data taken in 1992 from P-250 Mod 2 pumps. Although the Mod 2 pump is no longer in service, the exhaust and cooling systems are identical to that of the Mod 1 pump; therefore this data should be representative of the Mod 1 pump.

Table 8. Comparison of Environmental Concentrations and Water Quality Criteria (mg/L)
P-250 MOD 1

Constituent	Estimated Concentrations	Federal Acute WQC	Most Stringent State Acute WQC
Benzene*	52.4	none	0.07128 (FL)
Toluene*	159.2	none	2.1(HI)
Ethylbenzene*	37.4	none	0.14(HI)
Naphthalene*	26.2	none	0.78(HI)
Oil & Grease	6*	visible sheen[a] / 15[b]	5 (FL)
Copper	0.23	0.0024	0.0024 (CT, MS)
Lead	0.85	0.21	0.0056 (FL, GA)
Nickel	0.21	0.074	0.0083 (FL, GA)
Silver	0.01	0.0019	0.0012 (WA)
Zinc	3.9	0.09	0.0846 (WA)

Notes:
Refer to federal criteria promulgated by EPA in its National Toxics Rule, 40 CFR 131.36 (57 FR 60848; Dec. 22, 1992 and 60 FR 22230; May 4, 1995)
Where historical data were not reported as dissolved or total, the metals concentrations were compared to the most stringent (dissolved or total) state water quality criteria.

* Highest of three separate samples. Remaining samples were <5 ppm.

CT = Connecticut
FL = Florida
GA = Georgia
HI = Hawaii
MS = Mississippi
WA = Washington

[a] *Discharge of Oil*, 40 CFR 110, defines a prohibited discharge of oil as any discharge sufficient to cause a sheen on receiving waters.

[b] *International Convention for the Prevention of Pollution from Ships* (MARPOL 73/78). MARPOL 73/78 as implemented by the *Act to Prevent Pollution from Ships* (APPS)

Table 9. Data Sources

	Data Source			
NOD Section	**Reported**	**Sampling**	**Estimated**	**Equipment Expert**
2.1 Equipment Description and Operation	X			X
2.2 Releases to the Environment	X			X
2.3 Vessels Producing the Discharge	UNDS Database			X
3.1 Locality	X			X
3.2 Rate	X			X
3.3 Constituents	X	X	X	X
3.4 Concentrations	X	X		
4.1 Mass Loadings			X	
4.2 Environmental Concentrations			X	
4.3 Potential for Introducing Non-Indigenous Species			X	X