AESO Report No. 2-87
April, 1987

CHARACTERIZATION OF PARTICULATE EMISSIONS FROM THE J79-GE-15A ENGINE McCLELLAN AIR FORCE BASE, CALIFORNIA

Prepared by

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EXECUTIVE SUMMARY

Visual emissions have long been a concern of both private industry and government installations. Private industry control their visual emissions by various means such as electrostatic precipitators, fabric filtration systems and in some cases simple mechanical collection systems. These systems work because of the steady state operational procedures of most private industry facilities. This problem of visual emissions take on a whole new meaning when associated with gas turbine engine test cells. Operating procedures associated with these test cells seldom remain steady state, because of the operating procedures of test cells the previous mentioned control equipment are impractical and ineffective.

In recent years the armed services have been evaluating the use of fuel additives to reduce the visual emissions from problem engines, and to bring the test cells into regulatory compliance.

This study evaluated the use of two fuel additives on the Air Force J79-GE-15A engine in the test cell at McClellan Air Force Base, California. The two additives were Ferrocene and Cerium.

Engineering evaluations of the effects of the additives on the engine performance were performed. These results are not presented in this report. Final evaluations are carried out by the Air Logistics Centers' engine managers.

Visible emissions changes from the fuel additive were recorded. Both additives lowered visible smoke to or below a Ringlemann 1 or twenty percent opacity.

Additional studies on particle size distribution and particulate mass of the engine exhaust were performed and reported in this study.

Table S-1 summarizes the results of the visible emission changes with the use of fuel additives. Figure S-1 summarizes the major effect of the fuel additives in the particulate size distribution of the engine exhaust. No changes in mass emissions were detected.

TABLE S-1: EXECUTIVE SUMMARY, VISIBLE EMISSIONS
J79-GE-15A, McCLELLAN AFB, CALIFORNIA

POWER SETTING	ADDITIVE	RINGLEMANN #
Idle	None	1.00
75% rpm	None	1.00
85% rpm	None	2.25
92% rpm	None	2.25
Military	None	2.75
85% rpm	Ferrocene	1.25
92% rpm	Ferrocene	1.00
Military	Ferrocene	1.00
85% rpm	Cerium	1.00
92% rpm	Cerium	1.00
Military	Cerium	1.00

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SECTION I

INTRODUCTION

This report presents the results of a comprehensive test program to evaluate the feasibility of using fuel additives to control the visual emissions from the exhaust of J79-GE-15A gas turbine engines in the J79 test cell located at McClellan Air Force Base, California. This program was funded through Tyndall Air Force Base to the Aircraft Environmental Support Office, Naval Aviation Depot, North Island, San Diego, California.

The objective of the program was to evaluate the overall performance of two fuel additives commonly known as Ferrocene and Cerium in controlling the visual emissions generated from the J79-GE-15A gas turbine engine. Based on the performance of these additives as smoke suppressants and with the results generated by a complete engine tear down inspection, an engineering evaluation on the use of additives water during normal test cell operation can be made. This final use determination will be made by the Air Logistics Center's engine managers at Tinker Air Force Base and is not a part of this report.

This program consist of three phases: 1) Visual observation of exhaust smoke, 2) Measurement of the combustion aerosol as a function of particle size distribution, and 3) Measurement of the combustion aerosol as a function of mass. Measurement were made on the gas turbine engine exhaust with and without the use of the two additives. Similar programs have been conducted on test cells at Naval Aviation Depot, North Island[1,2] and Naval Air Station Miramar[3]. These past programs provide the reference for the test program used at McClellan Air Force Base. This program was executed from 11 Agust through 30 August 1986.

Detailed information of the additives, test equipment, tests performed, techniques, methods, circumstances, calculations, problems encountered, results obtained, and conclusions are presented in the sections which follow. All raw data and other field information are present in the Appendices.

SECTION II

MATERIALS AND METHODS

A. ADDITIVE INJECTION SYSTEM

Fuel additives are mixed into the engine fuel line through an additive injection system (Figure 1). A positive displacement pump is used to pull the additive from standard 55 gallon storage drums and push it through various flow control devices before injecting it into the fuel line. An in-line filter is placed before the pump to remove impurities from the additives.

Directly downstream of the pump outlet (positive pressure) a bypass line tees off and returns any excess additive to the nagative side of the pump. This return bypass line allows the pump to operate efficiently at a constant and fairly high flow rate without oversupplying additive to the system. A valve in this line allows fine control of additive flow rate. Further downstream of the return bypass a cross-tee fitting is placed in the main additive line. As the additive flows through this fitting it pressurizes an expansion chamber which serves as a surge suppressor for the system. This helps the additive flow at a constant rate into the fuel line without pulsations caused by the mechanical action of the pump. Above the surge suppressor is a stand-pipe with an attached valve. this valve is used to bleed trapped air bubbles from the additive. To avoid waste a small diameter line carries any vented additive/air mix back to the storage drum for later use.

To monitor system pressure the fuel additive then flows through a main flow control valve and pressure gauge. This valve is used to regulate the volume of additive injected into the fuel line. In actual operation all of the control valves work in conjuntion with each other and adjustments to one valves will affect the flow characteristics of the others. It is extremely important to remember that the additive pressure must be higher than the fuel line pressure or no additive will be mixed with the fuel.

After leaving the pumping sytem the additive next passes through a flow monitoring station. It first flows through a sensor which measures the actual volume of additive being injected and this information is displayed on an attached digital readout. It then passes through a rotometer for visual confirmation of the additive flow rate. Finally, the additive flows through an in-line check valve to insure that no fuel flows through the additive system.

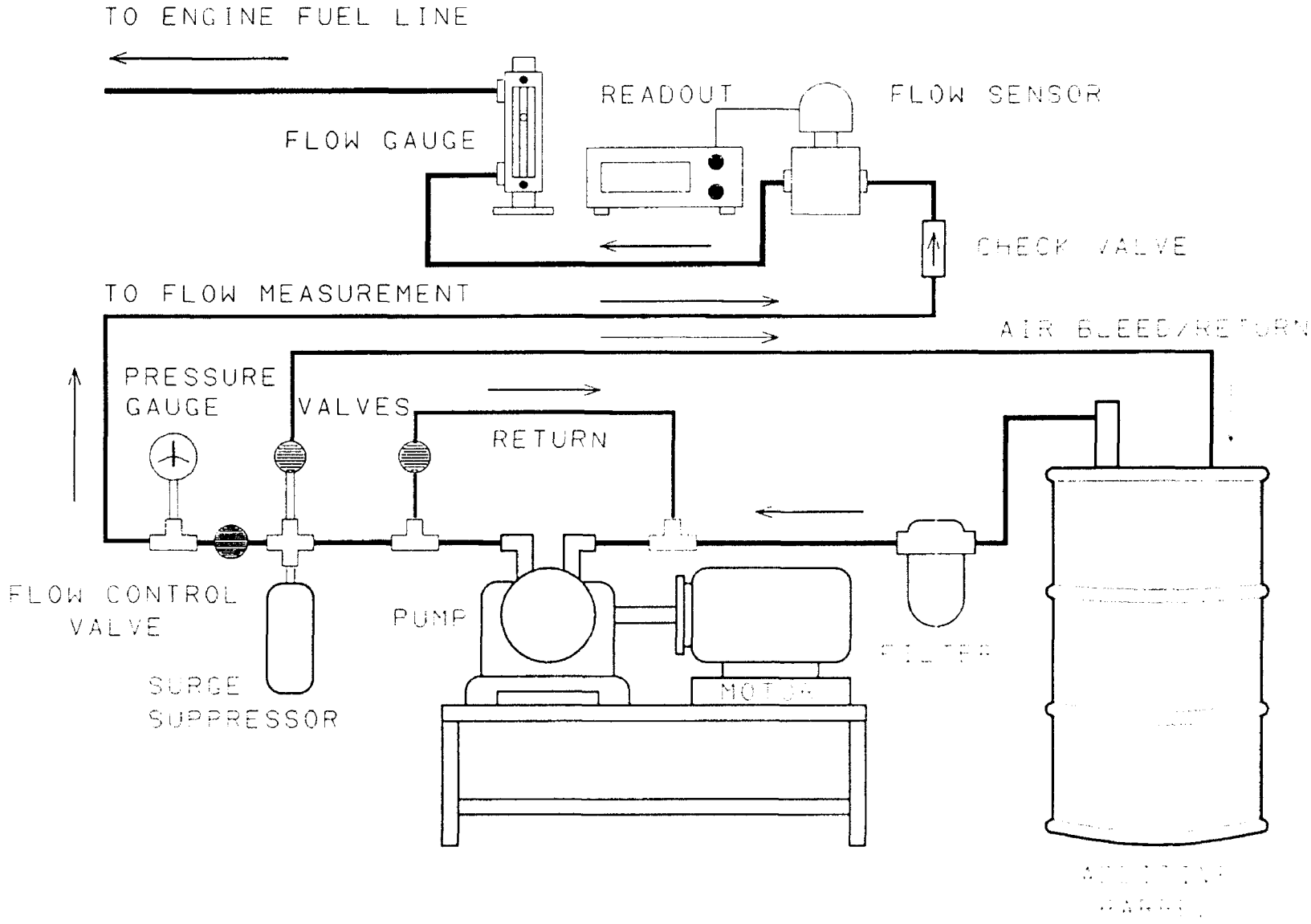

FIGURE 1. Fuel Additive Injection System.

The additive is physically injected through a tee-fitting plumbed into the fuel line. The injection port should be reasonably close to the engine to reduce the time lag between additive flow adjustments and test system response. At this injection port a three-way valve allows the line to be bleed of any entrapped air which may have entered the lines during installation.

All flow sensors and rotometers were calibrated for Cerium and Ferrocene prior to testing. Flow readings were further checked by comparing indicated use with actual measurements of additive loss from the storage drums.

B. AEROSOL TEST EQUIPMENT

Similar instrumentation was used to measure aerosols at both test locations; engine exhaust plane and test cell exhaust stack exit. The primary piece of equipment used to determine submicron particle size distributions was the TSI Model 3030 Electrical Aerosol Analyzer (EAA). The EAA consists of two independent packages; the analyzer unit itself and control section which regulates sampling parameters. Additionally, a vacuum pump is used to pull sample through the system. Because this instrument was originally designed to sample low concentration ambient air streams it was necessary to dilute the engine exhaust stream prior to analysis by the EAA. Special dilution systems were designed and contructed for this purpose. To make a visual record of our test results the output of the EAA was connected to a strip chart recorder. This arrangement gave us "pictures" of the voltage changes measured by the EAA as it cycled through its various particle size measurement ranges. A diagram of the aerosol sampling system can be found in Figure 2.

1. Aerosol Analyzer

The EAA is a size distribution measuring instrument designed to operate on particles in the submicron range. It analyzes the electrical mobility of an aerosol by measuring its voltage. Once the voltage is known particle size can be calculated.

Aerosol is drawn through the EAA by a vacuum pump and passes through a flow meter and control valve prior to entering the aerosol charger. In the charger the particles are exposed to unipolar positive ions and become electrically charged. The charged aerosol then enters the mobility analyzer around a core of clean laminar air while an electrometer current sensor measures the total current of the flow. In the analyzer various sized particles are

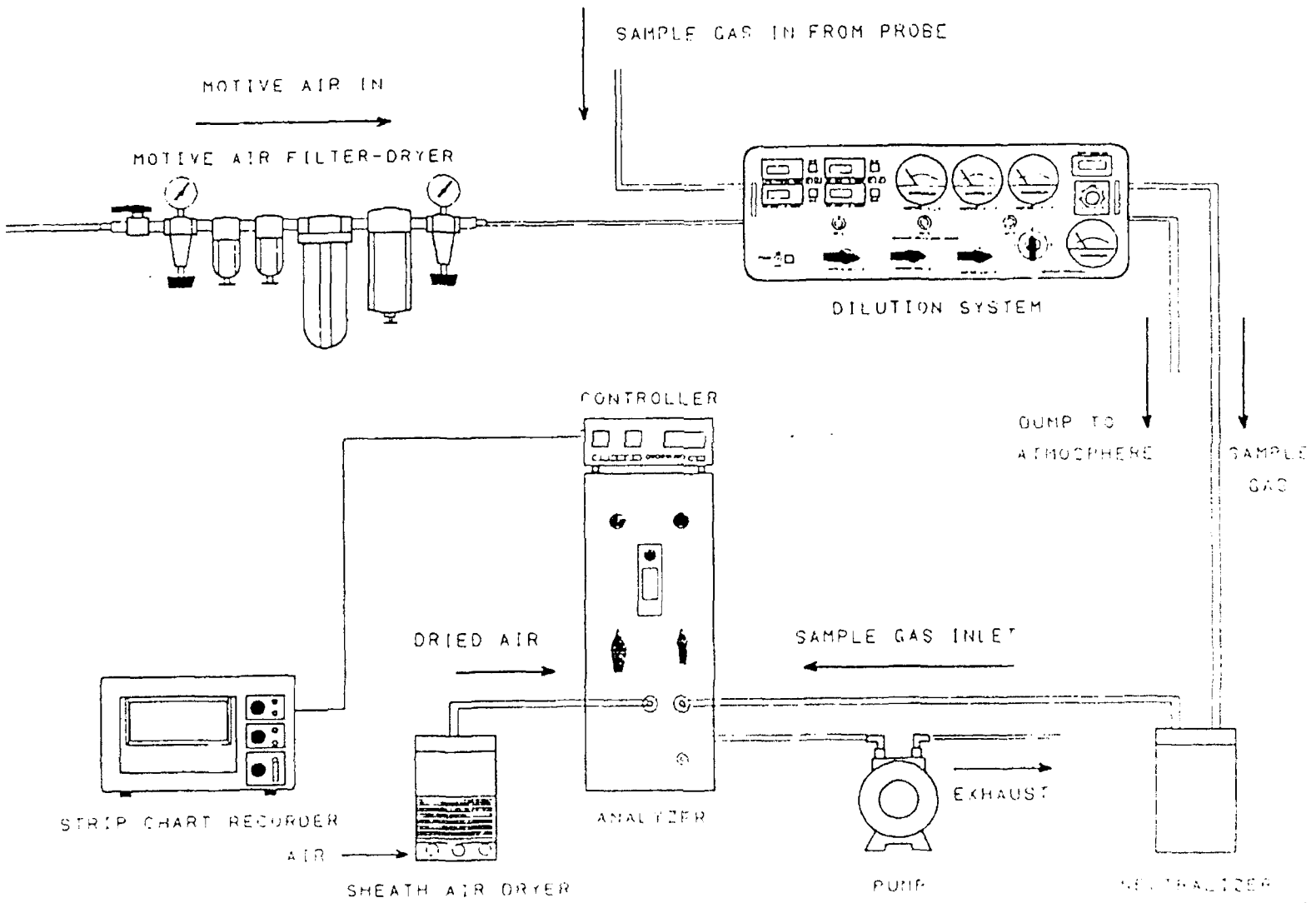

Figure 2. Aerosol Analysis System

precipitated as specific voltages are applied to a central electrode. By charging this electrode with a known voltage, particles within a specific size and mobility regime are precipitated and their charge neutralized. The electrometer current sensor then measures the remaining current of the aerosol flow and a corresponding voltage reading is displayed on the control box. By progressively increasing the voltage input to the central electrode and measuring the resulting charges on the aerosol a particle size distribution of the sample gas stream can be determined.

A complete sequence consists of eleven (11) voltage steps with a perris distribution from 0.0032 to 1.0 micrometers but channels 1 and 2 (particle diameters 0.0032 and 0.0056 micrometers) are often eliminated to minimize the effect of noise distortion. A nine step sequence (particle diameters 0.01 to 1.0 micrometers) requires slightly more than a minute to complete and this typically allows numerous sampling sequences to be performed during the course of a test. During this test program channels 1 and 2 were not used.

2. Dilution System

The EAA was originally designed to sample the relatively low aerosol concentrations found in ambient air. Because of the significantly higher concentrations present in the engine exhaust gas it was necessary to dilute the samples prior to analysis. To accomplish this a fine particle dilution system (Figure 3) was employed at each test site to reduce aerosol concentrations to levels compatible with the measurement capabilities of the EAA. These dilution systems were commissioned by the Aircraft Environmental Support Office (AESO), Naval Aviation Depot, North Island, San Diego, CA. The first was developed by Denver Research Institute, Denver, Colorado. Both systems operate on the same principle.

Both diluters are a dynamic three stage system which use clean, dry compressed air (motive air) with the sample gas stream. Dilution of the gas stream occurs as the motive air induces sample flow through each of the three calibrated orifices. The orifice restricts the flow and controls the rate at which the source aerosol is aspirated. It also functions as a metering device by allowing only a portion of the flow through to the next stage of the system.

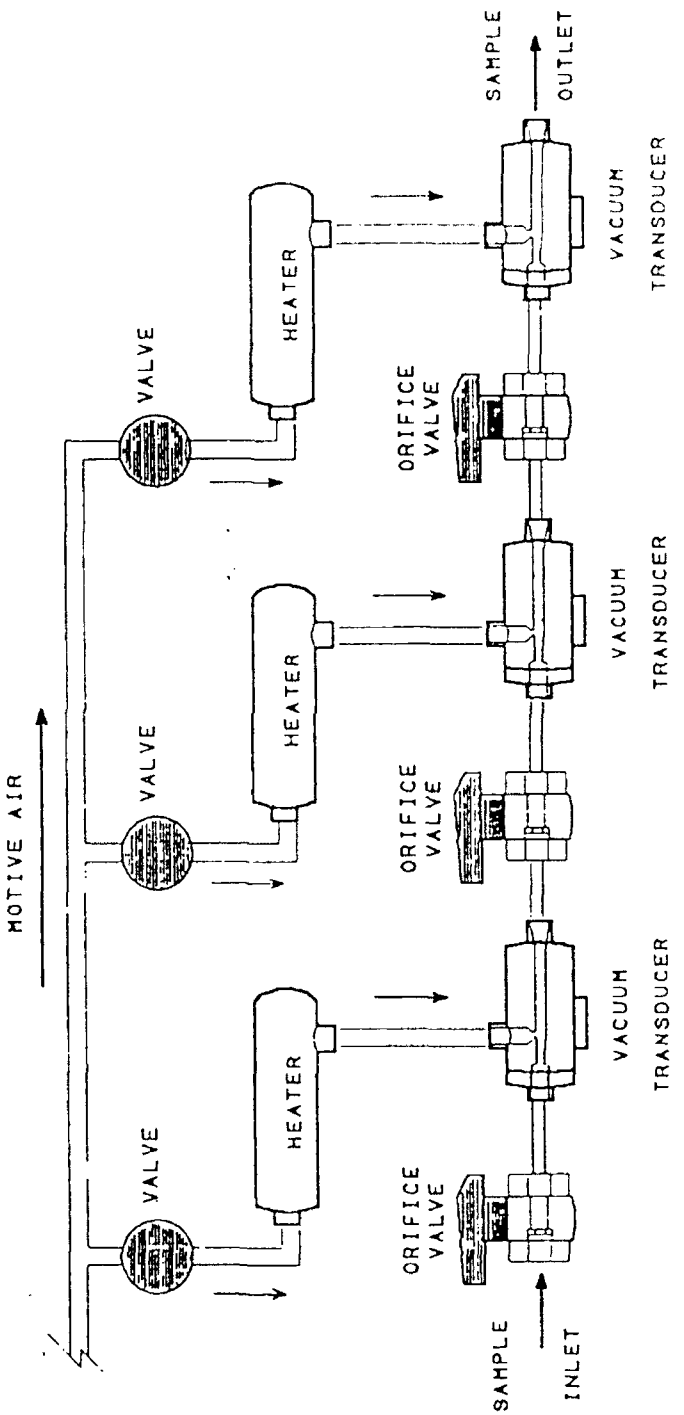

Figure 3. Dilution Flow Diagram

The compressed air used for dilution is dried and filtered prior to entering the diluter by the system shown in Figure 2. It consists of two regulators to control motive air flow, two different grade particle filters, a silica gel drying chamber and a coalescing filter. The pre-regulator controls the compressed air pressure from the plant source while the post-regulator controls the motive air pressure to the dilution system. The two particle filters are extremely effective when used together and operate at nearly 100% efficiency. The silica gel absorbs any remaining moisture is separated from the air stream in the coalescing filter.

The motive air flowing through the aspirators (vacuum transducers) produces a partial vacuum on the aerosol stream which induces flow through the restricting orifices. The design of the transducers causes the motive air to enter at a right angle to the aerosol stream and insures complete mixing of the two streams. The orifice at each stage can be removed completely or replaced with an assortment of other calibrated orifices to allow varying amount of sample flow through the next ensuing stage. Excess diluted sample gas is simply dumped to atmosphere.

The flow characteristics of the transducers are such that the flow of motive air is linearly proportional to the pressure of the compressed air entering the system and inversely proportional to the square root of the sample gas temperature. The diluter allows measurement of the pressure drop across each orifice, the static pressure at each orifice and the temperature preceeding each orifice. From this information flow rate can be determined.

For each stage the dilution is calculated by the following formula.

$$\text{Stage Dilution} = \frac{\text{Aerosol Flow + Motive Air Flow}}{\text{Aerosol Flow}}$$

Total dilution of the aerosol stream is calculated by the following formula.

$$\text{Total Dilution} = (\text{Stage 1 dilution}) \times (\text{Stage 2 dilution}) \times (\text{Stage 3 dilution})$$

For a given temperature and pressure a smaller orifice will decrease aspirator suction on the aerosol stream resulting

in an increase in the dilution ratio for that stage.

Because some gas streams may contain moisture the dilution system also has capability of heating the motive air prior to its entering the vacuum transducers. The motive air stream is split to flow through independent pass-through style heaters at each stage of the system. These heaters are controlled by set-point temperature controllers and can be adjusted externally and independently to allow complete temperature control of the motive air/sample stream flow. Feedback to the controllers comes from permanently located thermocouple sensors at each stage. Although the exhaust gas from the jet engine is extremely low in moisture the heaters were used to guarantee that no moisture biased our test results.

Following the final stage dilution the aerosol passes through a neutralizing residence chamber prior to entering the EAA. This chamber contains two strips of 500 microcurie polonium 210 alpha emitters to ensure sampling of uncharged particles. It is designed to provide one minute of residence time at the desired flow rate of four (4) liters per minute and also smooths pulsations in the sample flow to the EAA.

Control of the final dilution rate can be accomplished in a number of ways. Primary among these are controlling orifice size and motive air flow at each stage of the system. In every case we attempted to adjust our dilution ratios to a level corresponding to a measured reading of between four (4) and eight (8) volts when monitoring channel 3 on the EAA. Once the dilution ratios were adjusted for a given set of test parameters (i.e. engine power setting or fuel/additive mix) these settings were repeatable on future tests at similar parameters. These settings were recorded prior to each test on a "dilution worksheet".

3. Strip Chart Recorder

At each test location a strip chart recorder was connected to the output of the EAA control box. On the chart paper is recorded a "picture" of the voltages being measured as the EAA cycles through its channels (Figure 4).

Although the EAA can operate without the use of a strip chart recorder there are a number of advantages to using

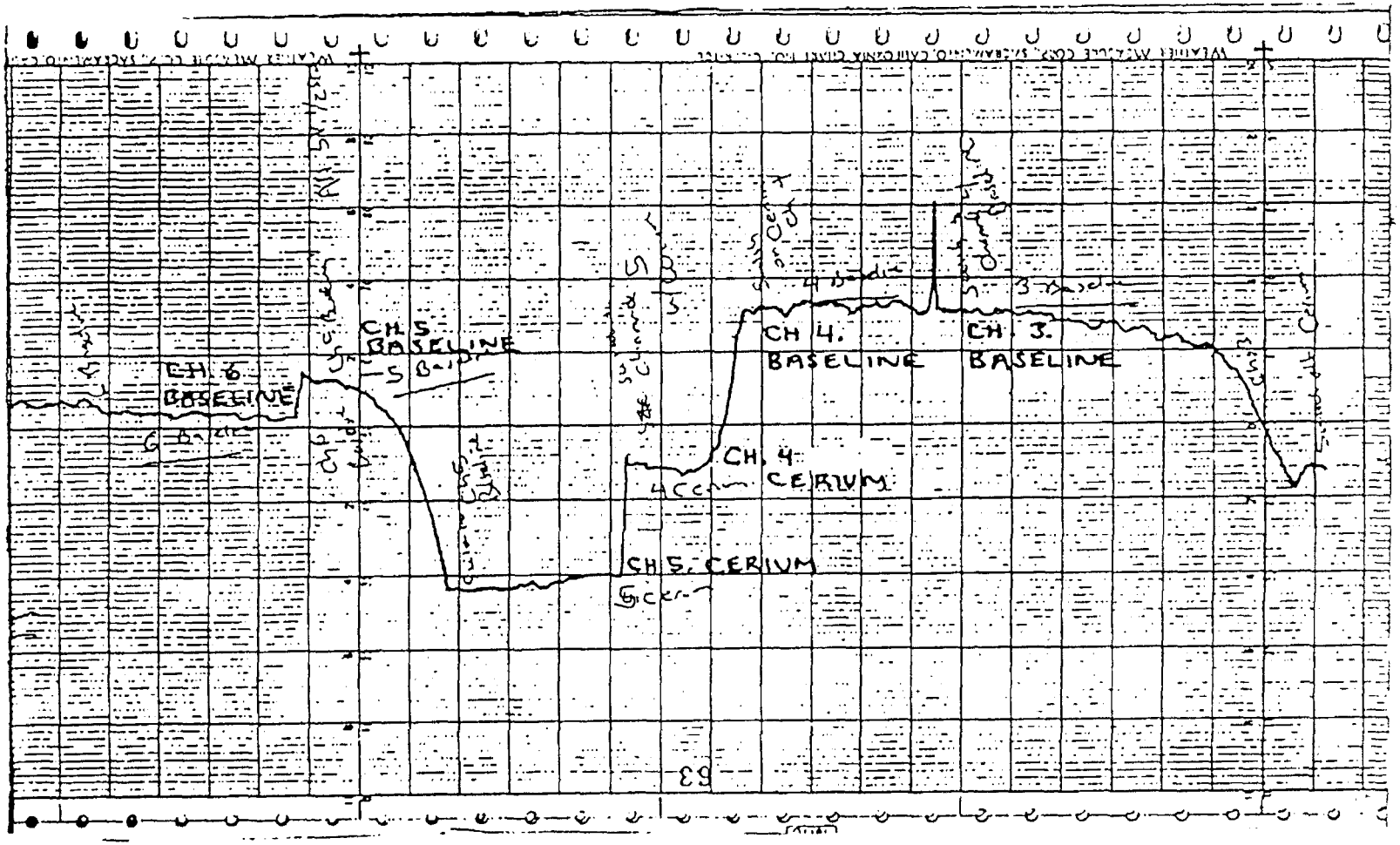

Figure 4. EAA Voltage Output – Strip Chart

a recording device when performing aerosol measurement and size distribution studies with the EAA. Primary among these advantages is the creation of a hard copy of all collected data for back-up support and reference. The strip chart recorder provides the user with a permanent record of not only all data generated by the EAA, but also serves as a log book on which to record any and all pertinent information about testing procedures, equipment parameters and source conditions. By creating a permanent record of test data and conditions the operator has created a reference tool that may serve a number of purposes including quality control assurance, data safety insurance and data support requirements.

This hard copy record also allows the user to visibly monitor the entire data collection system for changes in source parameters or testing conditions. By closely observing the chart patterns as they emerge it is possible to see trends develop that may require corrective action. Such actions may involve EAA or diluter system adjustments, test procedure modifications or sample collection equipment repair.

Field experience using the strip chart recorder has indicated that voltage changes in the first two EAA channels may be studied using this technique.

4. Probe and Sampling System

The sampling probe used for behind the engine testing was a specially designed two stage system (Figure 6). The first stage, or nozzle section of this probe, was a fabricated section of 3/8 inch O.D. stainless steel tubing approximately 3 feet in length. In appearance it is very similar to one-half of an S-type Pitot (Figure 6). The machined end was formed and milled to create a smooth intake flume for the exhaust gases to enter. This helps limit possible impaction of the larger particles by avoiding abrupt angular changes in the sample stream flow.

The second stage of the probe was designed to control the quantity of sample gas pulled as well as its velocity. Since the probe intake is directly in the exhaust stream of the engine the sample gas velocity can be extremely high. This velocity should be reduced until there is only a slight positive pressure at the dilution system inlet. Additionally, far more sample enters the probe than is

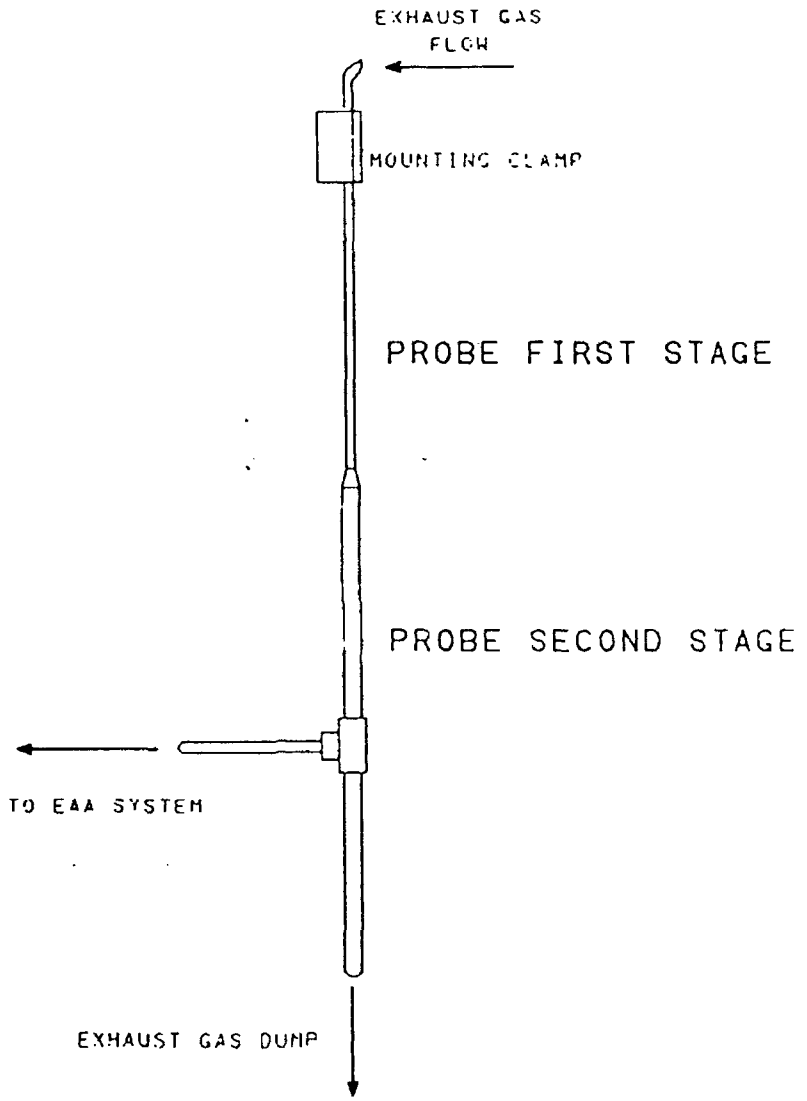

Figure 5. Aerosol Sampling Probe

p12

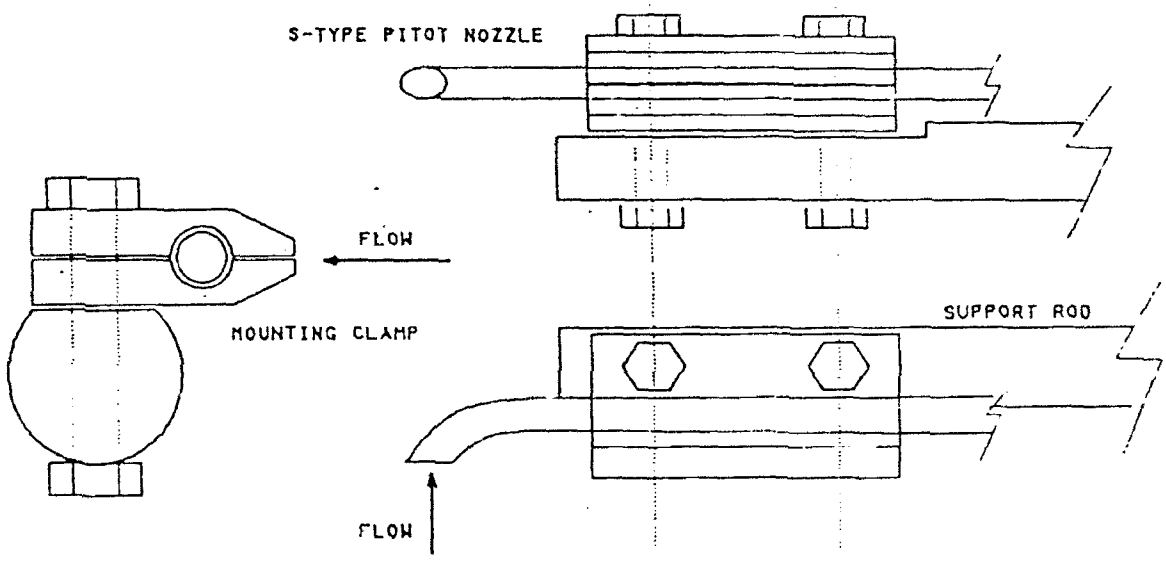

Figure 6. Probe Nozzle and Mounting Clamp

necessary for analysis by the EAA and the total quantity of sample should be reduced. Both of these requirements should be met without creating back pressure on the system.

The second stage of our probe accomplishes these goals by a combination of three control methods. First, exhaust gas velocity is slowed by a pressure drop as the gas stream enters the second stage of the probe. The second stage is made of larger diameter tubing than the first stage, and the pressure drop occurs as the gas expands to fill this greater volume. Second, the sample gas is pulled, through an inline tee-fitting, at an angle 90 degrees to the main exhaust gas flow in the probe. This allows both the sample gas velocity and volume to be controlled by the EAA system and not by the engine exhaust gas pressure. It also helps reduce the potential for particle impaction which could occur due to shape bends or other physical obstructions in the sample line. Finally, the remaining gas stream is simply dumped to atmosphere to eliminate excess positive pressure on the system.

At the exhaust stack outlet a nozzle similar to that used behind the engine was fastened approximately 12 inches above the exhaust plane of the test cell. Because the exhaust gas velocity was substantially reduced by the time it exited the stack it was unnecessary to use the pressure reducing second stage as we did behind the engine.

To mount the sampling probe behind the engine we developed a clamping device (Figure 7) which was bolted directly to the engine test stand. This device allowed the probe to be positioned at any point across the diameter of the exhaust gas stream and at any distance (between zero inches and 36 inches) behind the engine. For all of our tests throughout this program the probe was centered in the exhaust gas stream and located 12 inches behind the engine outlet.

No special clamping system was required to fasten the probe above the exhaust tube at the stack outlet. Hose clamps were used to simply hold the nozzle firmly against a steel rod spanning 12 inches above the exhaust tube.

The sample lines used to bring engine exhaust gas from the probes to the dilution systems were length of 3/8 inch O.D. teflon tubing approximately twenty feet long. This line was insulated with foam pipe wrap to keep the sample gas

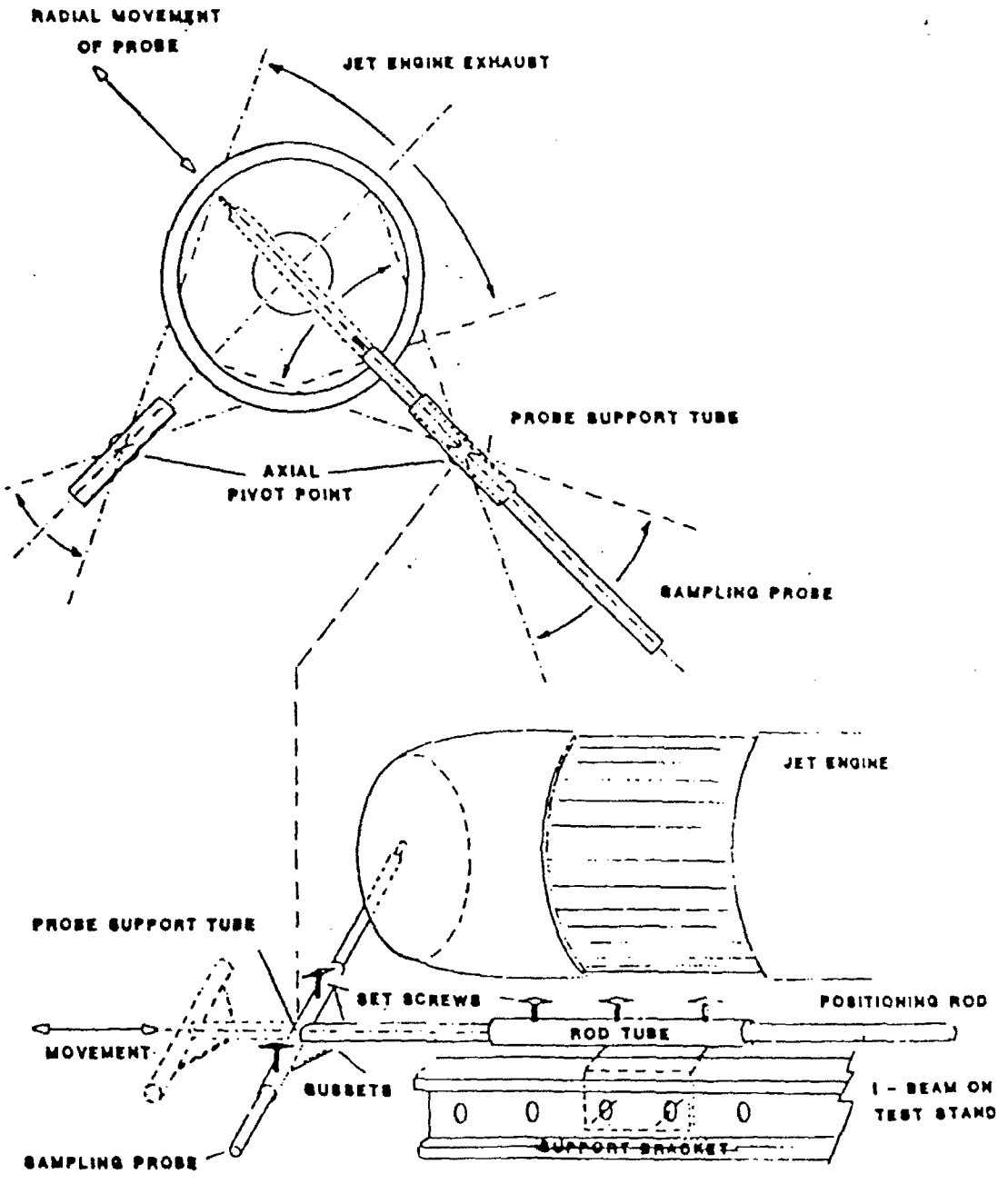

Figure 7. Probe Mounting Assembly

temperature from being cooled by air flow in the test cell or by wind at the stack outlet. Because the moisture content of the engine exhaust is low, and the exhaust gas temperatures were high, it was unnecessary to heat the sample gas prior to its entering the dilution system. No condensation was seen in any section of the sample line during our tests.

C. AEROSOL DATA ANALYSIS

All of the data collected during the aerosol test program was input into an IBM personal computer. The method of data reduction is based on original work by Twomey and further verified by Kapadia[5]. Data reduction software for Apple II computers was modified further by TSI, Inc. York Research Consultants was commissioned by the Aircraft Environmental Support office to convert this software for use on IBM Computers and to further enhance its capabilities. All basic methodology remains the work of Twomey and Kapadia.

The raw voltages for each sample run were entered into data files and the program calculated results for both individual sample runs and average sample runs. It also allowed us to regenerate "Final Averages" of the data. These are normalized averages of the test averages and make it possible to reduce data from a number of tests with identical parameters (i.e. additive, engine rpm) to a single result.

Using a Grapher program, graphs of the best averages were produced for all three data groups; concentration, surface area and volume. On each graph baseline data at a specific engine power condition was plotted against additive data at the same condition. This allowed us to graphically show any shifting of particle characteristics due to the presence of additives in the fuel. These garphs were produced in both percentage and probability formats for a more complete presentation of the data.

D. MASS MEASUREMENTS

EPA Method 5 collection of exhaust gas for mass measurement was performed at a single point location at the top of the exhaust stack. Treatment of samples and data reduction were carried out as specified in Method 5. All results are presented in Volume II of this study.

E. EXHAUST STREAM SAMPLING AND VISIBLE EMISSIONS

During the weeks from 11 August through 29 August 1986, a series of particle size measurements and visible emission readings were

TABLE 1. FERROCENE TEST PROTOCOL
McCLELLAN AFB, J79-GE-15A, S/N 434557

DATE	POWER SETTING	FUEL ADDITIVE	BEHIND ENGINE # EAA SAMPLES	BEHIND ENGINE DATA FILES	TOP OF STACK # EAA SAMPLES	TOP OF STACK DATA FILES
8/13/86	85%	None	10	00.1	N/A	N/A
	85%	None	10	00.2	N/A	N/A
8/14/86	Military	None	15	00.3	15	10.1
	75%	None	15	00.4	15	10.2
	85%	None	15	00.5	15	10.4
	92%	None	15	00.6	15	10.3
8/15/86	Military	Yes	13	00.7	15	10.6
	92%	Yes	5[a]	00.8	15	10.7
	Military	Yes	15	00.9	15	10.8
	92%	Yes	15	01.0	N/A	N/A
	85%	Yes	15	01.1	15	10.5
	85%	Yes	15	01.2	15	10.9
8/18/86	85%	Yes	15	01.4	14	11.0
	92%	Yes	15	01.5	15	11.1
	Military	Yes	15	01.6	15	11.2
8/19/86	92%	Yes	15	01.7	15	11.3
	Military	Yes	15	01.8	15	11.4
	85%	None	15	01.9	26	11.5 & 11.6
	Military	None	13	02.0	15	11.7
	92%	None	15	02.1	15	11.8

8/20-22/86 Tear down and engine inspection

a) Sample taken not included in summary. Ferrocene being adjusted during run.

b) Data File numbers correspond to computer data files.

NOTE: Fuel used was usually JP5/4 mix. Sometime only JP4.

TABLE 2. CERIUM TEST PROTOCOL
McCLELLAN AFB, J79-GE-15A, S/N 440201

DATE	POWER SETTING	FUEL ADDITIVE	BEHIND ENGINE # EAA SAMPLES	BEHIND ENGINE DATA FILES	TOP OF STACK # EAA SAMPLES	TOP OF STACK DATA FILES
8/20/86	85%	None	15	02.2	15	12.1
	92%	None	15	02.3	15	12.0
	Military	None	15	02.4	15	11.9
	85%	None	15	02.5	15	12.2
8/21/86	85%	Yes	10	02.6	15	12.3
	85%	Yes	15	02.7	7	12.4
8/22/86	Military	None	20	02.8	15	12.5
	Military	Yes	15	02.9	20	12.6A,B
	92%	Yes	15	03.0	15	12.7
	92%	Yes	15	03.1	15	12.8
	Military	Yes	15	03.2	15	12.9
8/25/86	Ambient three	sample line	5	03.3	N/A	N/A
	85%	Yes	15	03.4	15	13.0
	92%	Yes	15	03.5	15	13.1
	Military	Yes	15	03.6	15	13.2
	85%	Yes	15	03.7	15	13.3
	Military	Yes	15	03.8	15	13.4
	92%	Yes	15	03.9	15	13.5
	Military	Yes	15	04.0	15	13.6
8/26/86	85%	None	15	04.1	15	13.7
	Idle	None	6	04.2	N/A	N/A
	92%	None	15	04.3	15	13.8
	85%	None	15	04.4	15	13.9
	Military	None	15	04.5	15	14.0
	92%	None	15	04.6	15	14.1
	Military	None	15	04.7	15	14.2

taken on the exhaust of two J79-GE-15A gas turbine engines. Tables 1 and 2 are master reference summary of these tests. The measurements were taken at varying power settings from idle through military power. Sample were extracted at two locations; twelve inches from the exhaust plane of the engine and the exit plane of the test cell exhaust stack. Visible emissions were recorded by certified smoke readers. Measurement were made with the engines running under normal conditions or baseline -- i.e. using only regular jet fuel and with the Cerium and Ferrocene fuel additives being used of the higher power settings. The jet fuel used was usually a mix of JP-5 and JP-4 with JP-5 comprising over 95% of mixture. Occassionally only JP-4 used. Tables 3 and 4 summarizes the results of the additive tests.

The samples were analyzed using two TSI Model 3030 Electrical Aerosol Analyzers (EAA) interfaced with two dilution systems. The dilution systems allows the process streams containing high concentrations of particles to be analyzed by instruments designed for low concentrations.

Daily operations began with several minutes of engine warm up followed by EAA flow rate adjustments. Ion current and screen bias voltage of the charger were checked and adjusted when required. Following EAA checkout, the dilution system flow rates were checked and any adjustments made. Calculations were made to determine proper dilution ratios to present an acceptable particle concentrations to the EAA.

At the completion of sampling equipment checkout, a test schedule was developed for that day. Once the engines were started a stablization period was observed before samples were collected. Radio communication between the two sampling locations insured simultaneous sample collection. During each run care was taken to keep current readings on the EAA in an acceptable range to allow minimum dilution rate changes during the days' testing. All data was hand recorded and a strip chart hardcopy was taken for backup. For this test program a minimum of fifteen (15) individual cycles were made on the EAA per run. In some cases this number was not reached due to time limitations or engine problems.

At the conclusion of the days testing all data collected was input into a computer for data interpretation at a later date.

Initial baseline tests were conducted on the engines to establish a control prior to additive injection. Baseline simply reders to running the engine at a power setting using jet fuel without any additive. These baseline tests were conducted on a routine basis throughout the program, at all power settings established

TABLE 3. SUMMARY OF TESTS - BEHIND ENGINE
McCLELLAN AFB, J79-GE-15A

S/N 434557

POWER SETTING	# RUNS	BASELINE RUNS[a]	FERROCENE RUNS
75% RPM	1	1	0
85% RPM	7	4(3,1)	3
92% RPM	5	2(1,1)	3
Military	6	2(1,1)	4

S/N 440201

POWER SETTING	# RUNS	BASELINE RUNS	FERROCENE RUNS
85% RPM	8	4(2,2)	4
92% RPM	7	3(1,2)	4
Military	8	4(2,2)	4
Idle	1	1	

a. Numbers in parenthesis represent baseline runs before and after fuel additive runs.

TABLE 4. SUMMARY OF TESTS - TOP OF STACK
McCLELLAN AFB, J79-GE-15A

S/N 434557

POWER SETTING	# RUNS	BASELINE RUNS[a]	FERROCENE RUNS
85% RPM	4	2( )	2
92% RPM	5	2(1,1)	3
Military	5	2(1,1)	3

S/N 440201

POWER SETTING	# RUNS	BASELINE RUNS	FERROCENE RUNS
85% RPM	5	2	3
92% RPM	5	2(1,1)	3
Military	5	2	3

for evaluation. All additive flow rates were determined by visually observing the exhaust plume and adjusting additive flow for the lowest Ringlemann Number. The flow rate was allowed to stablize to insure complete mixing of the fuel and additive. Visual observations were taken throughout the program.

F. FUEL ADDITIVES

1. Ferrocene

The ferrocene used was obtained from Arapahoe Chemicals in Boulder, Colorado. Ferrocene is $C_{10}H_{10}Fe$, molecular weight 186.03 and known as dicyclopentadienyliron. 30.02% of the molecule is iron. The solution was purchased as a 10% by weight ferrocene in coal tar naphtha solvent. The color in solution is a deep orange.

2. Cerium (III) Octoate

This Cerium solution, trade name 125 Cerium Hex-CEM was purchased from Mooney Chemicals, Inc., Cleveland, Ohio. The solution is about 65% Cerium Octoate by weight in a naphtha solvent. the Cerium atom represents about 12% by weight of the solution. The color in solution is a deep orange.

SECTION III
RESULTS AND DISCUSSION

The results of the test program have been summarized and presented in the figures and summary data sheets that follow (Figures 8 through 79).

Each section contains the averages results from three engine power settings; Military, 92% rpm and 85% rpm. Both baseline and fuel additive results are shown. The averaged data summaries follow each set of graphics. Graphics are drawn using number concentration, surface areas and volumes. Probability representation at these variables are also included.

The graphic representation of the aerosol size distribution clearly shows the effect of the fuel additives on the aerodynamic properties of the gas turbine engine exhaust aerosol. The data used to present the size distribution information is the normalized average of all values for that specific power setting and additive conditions stated on the graphs.

The two ways chosen to present the size distribution information were percent frequency of mid-point diameter distribution and cumulative mass distribution percent. Cumulative mass distributions are obtained by plotting the cumulative fraction (or percent) of particles smaller than the mid-point diameter. Using this plot the size distributions can be characterized by the mass median diameter. The median diameter is the diameter above and below which half of the particulate mass lies. It can be determined from these plots by reading the diameter corresponding to the 50% cumulative mass point. By using the cumulative size distribution plot it is possible to compare two different distributions through the median diameter.

Although measurements were taken at a range of power settings, the results at military power are of greatest interest in terms of visible emission. Table 5 and 6 present the Ringlemann Number, additive flow, and run duration for each of the power settings for Ferrocene and Cerium respectively. The improvement in visible emission attributed to the fuel additives can easily be seen. Both additives lowered the visible emissions to a Ringlemann one or less. The Cerium appeared to work better than the Ferrocene but the mechanisms by which fuel additives work is unknown and only a superficial evaluation is presently possible. This decrease in Ringlemann Number is graphically shown by the shift to a smaller

TABLE 5. FERROCENE TEST PROTOCOL
McCLELLAN AFB, J79-GE-15A, S/N 434557

DATE	POWER SETTING	RUN DURATION (MINUTES)	ADDITIVE FLOW RATE (GPM)[a]	RINGLEMANN NUMBER
8/13/86	85% RPM	60	0.30	1.5-1.75
	90% RPM		None	2.75
	Military	45	0.12	1.25
8/14/86	Military		None	2.75
	85% RPM		None	2.75
8/15/86	85% RPM	62	0.36	1.50-1.75
	Military	21	0.24	1.50
	92% RPM	32	0.20	1.50-1.75
	Military	33	0.24	1.00-1.25
	85% RPM	62	0.30	1.25
8/18/86	85% RPM	23	None	2.25
	85% RPM	72	0.30	1.25
	92% RPM	34	0.20	1.00-1.25
	Military	36	0.24	0.75-1.00
8/19/86	92% RPM	33	0.20	1.00
	Military	33	0.24	1.00
	85% RPM	70	None	Not Taken
	Military	75	None	2.50
	Military	35	None	2.50
	92% RPM	32	None	2.25

a) GPM equals gallons per minute.

TABLE 6. CERIUM TEST PROTOCOL
McCLELLAN AFB, J79-GE-15A, S/N 440201

DATE	POWER SETTING	RUN DURATION (MINUTES)	ADDITIVE FLOW RATE (GPM)[a]	RINGLEMANN NUMBER
8/20/86	85% RPM	70	None	1.50-1.75
	92% RPM	36	None	2.25-2.50
	Military	34	None	2.50-2.75
	85% RPM	Not Taken	None	2.25
8/21/86	85%	165	0.11	0.50-0.75
8/22/86	Military	48	None	2.50-2.75
	Military	57	0.09	0.50
	92%	51	0.08	0.75
	92%	31	0.08	0.50
	Military	49	0.09	0.50
8/25/86	85%	56	0.10	0.25-0.50
	92%	51	0.08	0.50
	Military	31	0.09	0.00-0.50
	85%	26	0.10	0.00-0.50
	Military	45	0.10	0.25
	92%	33	0.05	0.25-0.50
	Military	25	0.04	0.50-0.75
8/26/86	85%	34	None	Not Taken
	92%	33	None	Not Taken
	85%	34	None	Not Taken

a) GPM equals gallons per minute.

mean particle diameter when either Ferrocene or Cerium is used and that the greater shifts occur at the higher power settings (Figure 8 and 44).

The median particle diameter at military power measured behind the engine shifted from 0.071 to 0.044 micrometers when Ferrocene was added. When Cerium was added, a much more dramatic shift occurred. The mean particle diameter shifted from 0.063 to 0.029 micrometers. Previous investigations showed no change in the mass emissions when Ferrocene was used[2]. The results in the Volume II of this study substantiate that finding and indicate similar results for Cerium. A much more definitive study, howerver would be required before any conclusions could be drawn regarding mass emissions with Cerium.

This test program proved highly successful in meeting the designed objectives. No major problems were experienced, and all equipment performed up to all expectations.

Previous studies have verified the high concentrations of submicron particles contained in the exhaust of jet engines. The results of this study also indicate a high concentration of submicron particles across the entire power range of the engine.

Although this study does not contain the results of the engine performance evaluations, engine performance is the prime importance in any additive tests. Preliminary results, howerver, showed no engine degradation with the use of Cerium. Ferrocene has previously been shown to cause no performance problems.

Another conclusion generated by the test program is the similarity of the particle size distribution measured at the stack outlet and the measurements collected behind the engine. This similarity suggests that little if any aggromeratation of the aerosol took place. By demonstrating this similarity it should be noted that if future test programs do not allow sampling directly behind the engine, reliable and accurate measurements of the exhaust aerosol can be taken at the exhaust exit of a test cell.

SECTION IV

REFERENCES

1. Aircraft Environmental Support office Report No. 110-XX-86, "F404-GE-400 Particle Size Measurement Program, Jet Engine Test Cell # 3, Naval Air Station, Lemore, California", February 1986.

2. Aircraft Environmental Support Office Report No. 110-01-81, "Particulate Emissions Test Program, Jet Engine Test Cell 19, Building 397, Naval Air Rework Facility North Island, San Diego, California", October 1981.

3. Aircraft Environmental Support Office Report No. 110-01-82, "Particulate Emissions Test Program, Turbofan Jet Engine Test Cell facility, Cell A, Building 545, Naval Air Station Miramar, San Diego, California", 1982.

4. Twomey, S. Comparison of Constrained Linear Inversion and an Iterative Non-Linear Algorithm Applied to the Indirect Estimation of Particle Size Distributions, Journal of Computation Physics 13: 188-200, 1975.

5. Kapadia, A. Ph.D. Thesis, Mechanical Engineering Department, University of Minnesota, Minneapolis, MN, 1979.

CONTENTS OF SECTION:

NUMBER CONCENTRATION GRAPHICS
OF
PERCENT FREQUENCY VS MID-POINT DIAMETER
&
CUMULATION MASS DISTRIBUTION VS MID-POINT DIAMETER

1. Graphics

Baseline	Ferrocene Additive
Military	Military
92% RPM	92% RPM
85% RPM	85% RPM

2. All averaged summary data sheets.

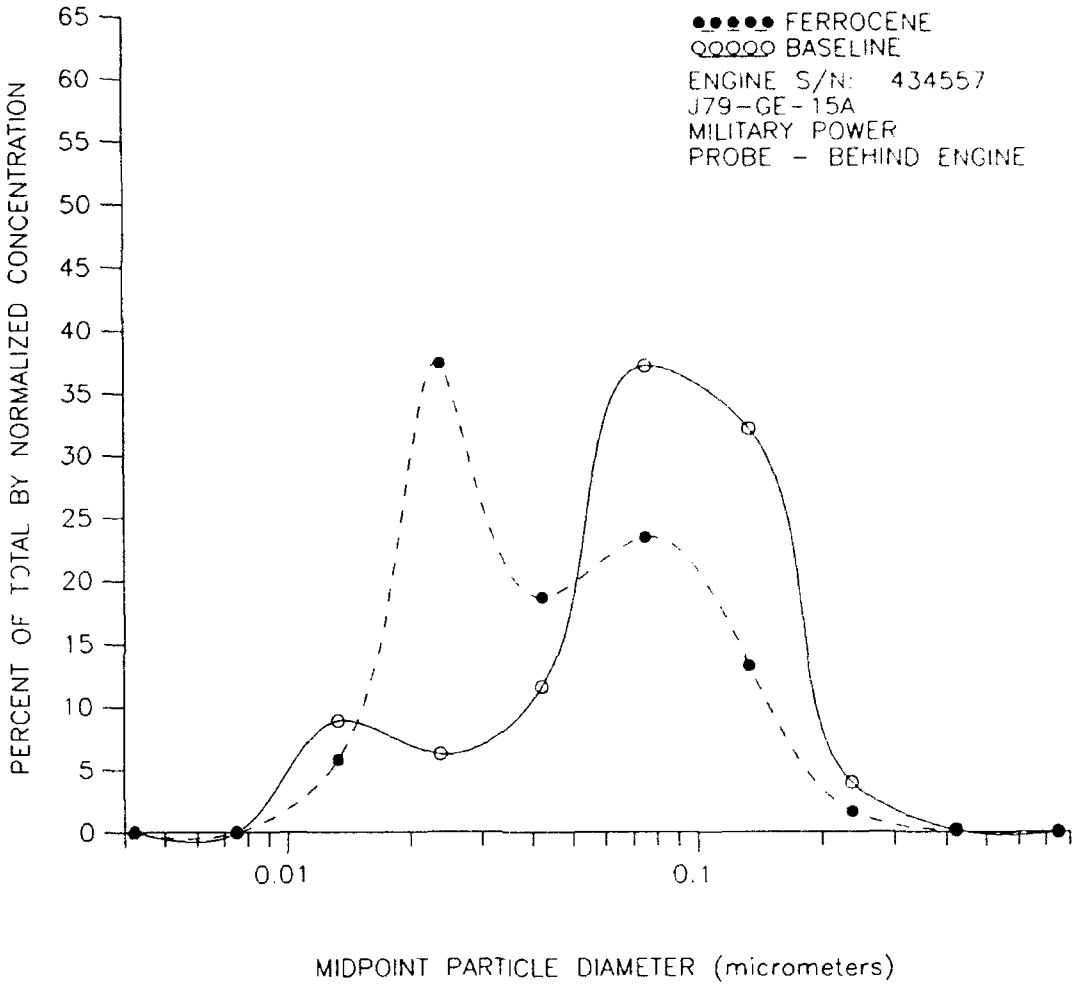

Figure 8. Particle Diameter vs Percent of Total by Normalized Concentration.

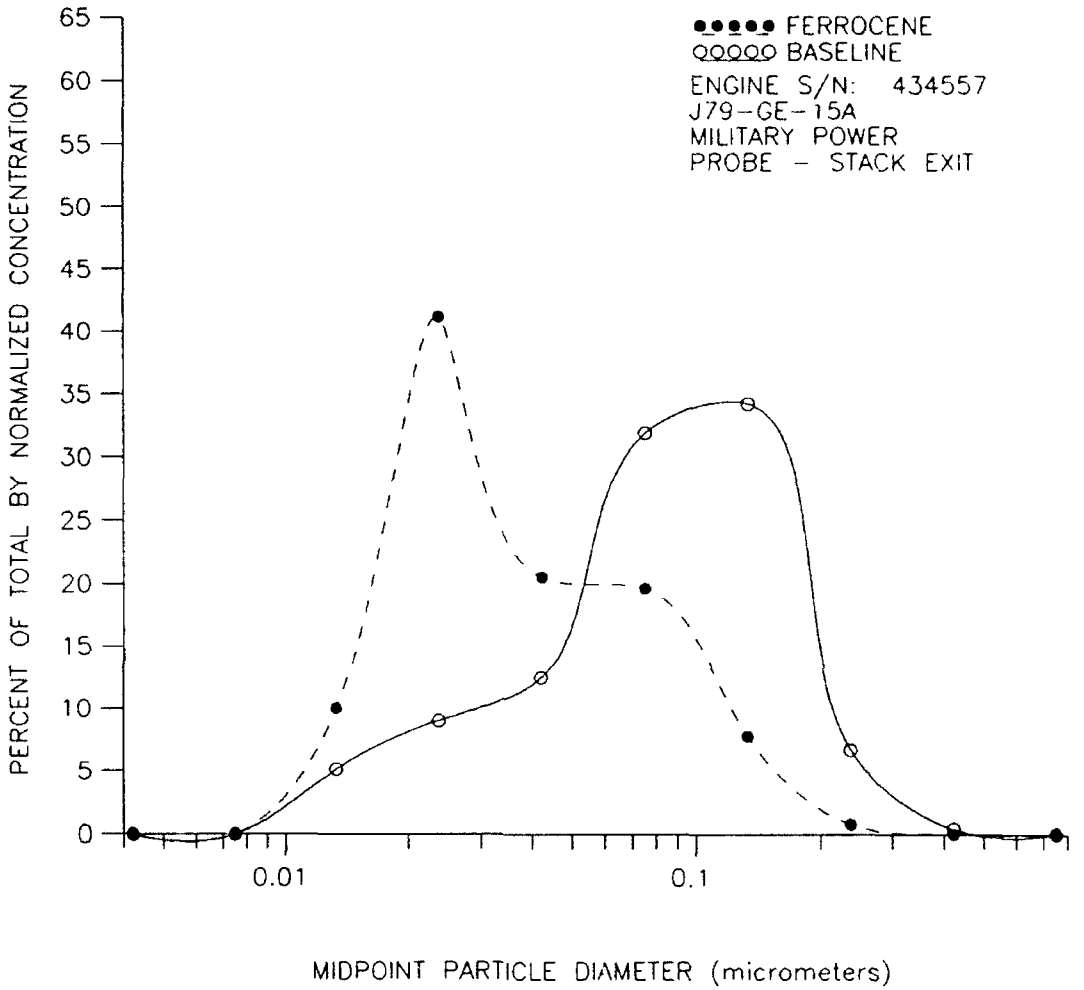

Figure 9. Particle Diameter vs Percent of Total by Normalized Concentration.

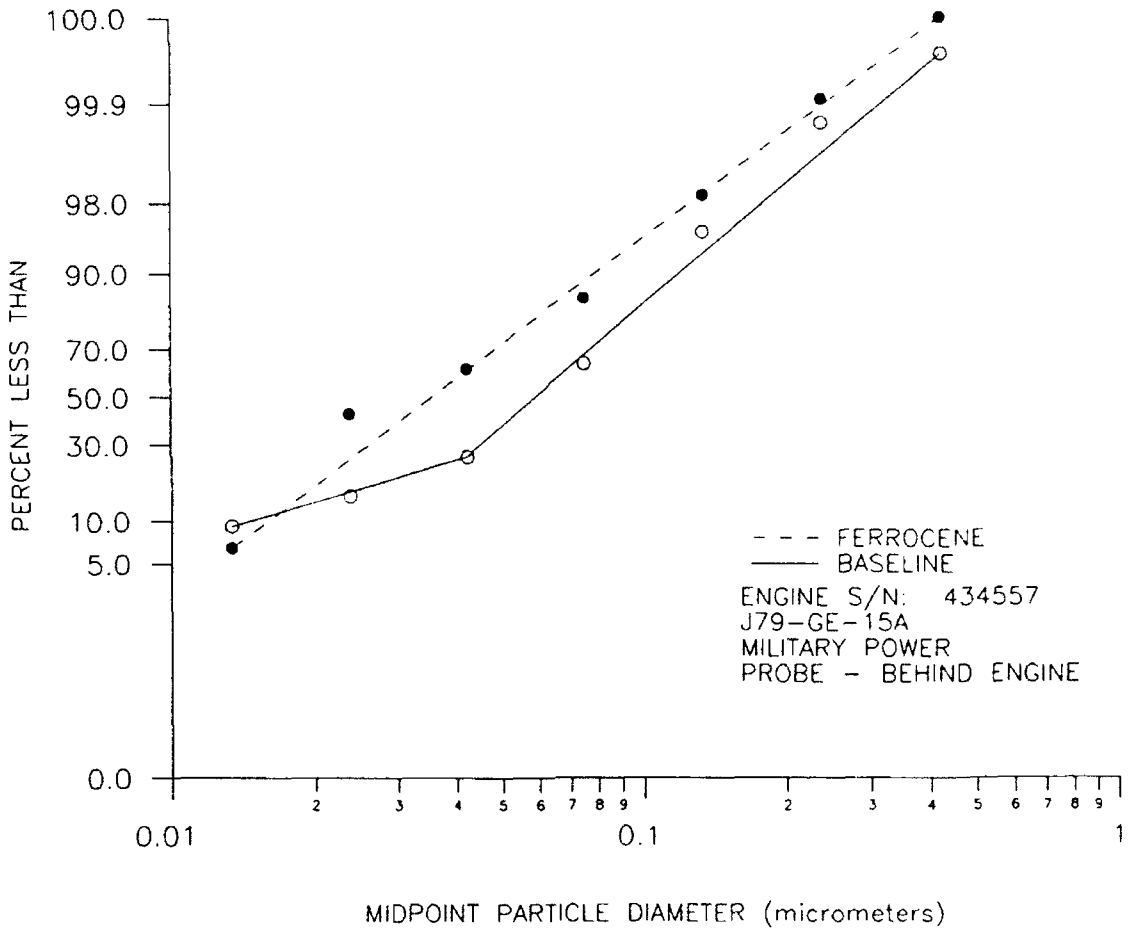

Figure 10. Cumulative Mass Distribution by Number Concentration.

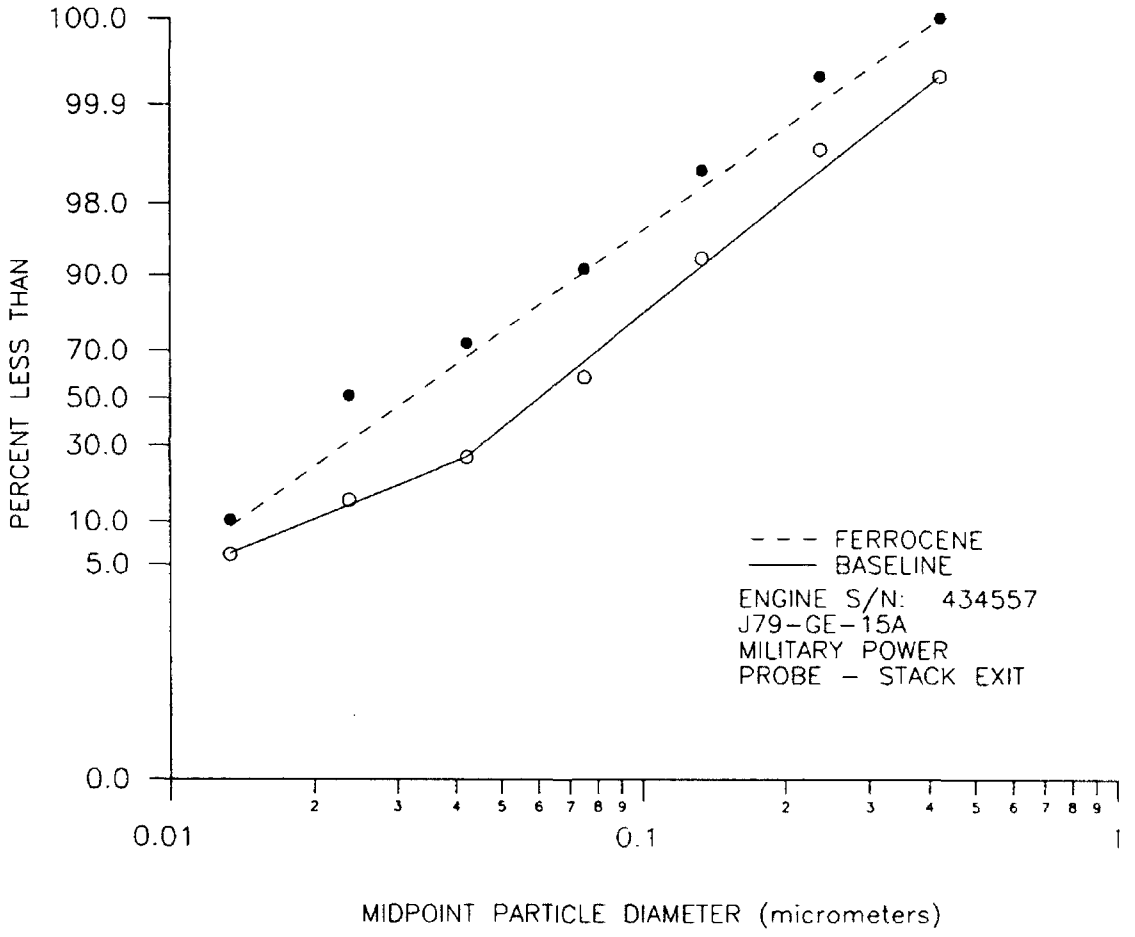

Figure 11. Cumulative Mass Distribution by Number Concentration.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - MILITARY - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 2

FILES INCLUDED:
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----------FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	95844.562	137.95	8.88	8.88
2.371375E-02	67482.289	56.01	6.25	15.13
4.216968E-01	125022.195	58.47	11.59	26.72
7.498948E-01	400245.590	62.23	37.09	63.81
0.1333522	346055.940	33.51	32.07	95.88
0.2371376	42456.066	14.82	3.93	99.81
0.4216968	1945.356	10.41	0.18	99.99
0.7498948	101.727	28.50	0.01	100.00

TOTAL = 269788.44

MEAN-DIA = 7.070429E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - MILITARY - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 2

FILES INCLUDED:
A:D9MAC-10.1 A:D9MAC-11.7

----------FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	39014.621	2073.85	5.12	5.12
2.371375E-02	68771.258	2284.50	9.03	14.15
4.216968E-01	95445.930	1085.93	12.53	26.67
7.498948E-01	243265.203	560.42	31.93	58.60
0.1333522	260969.469	214.87	34.25	92.86
0.2371376	51044.324	136.82	6.70	99.56
0.4216968	3161.406	135.10	0.41	99.97
0.7498948	220.940	211.95	0.03	100.00

TOTAL = 190473.30

MEAN-DIA = 7.632671E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - MILITARY - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
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A:D9MAC-01.8

----------FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	72538.727	146.13	5.77	5.77
2.371375E-02	469383.340	21.72	37.32	43.08
4.216968E-01	234445.797	40.59	18.64	61.72
7.498948E-01	293973.470	64.93	23.37	85.09
0.1333522	166561.672	47.42	13.24	98.33
0.2371376	19938.762	25.49	1.59	99.92
0.4216968	966.095	14.95	0.08	100.00
0.7498948	56.071	34.79	0.00	100.00

TOTAL = 314466.00

MEAN-DIA = 0.0436741 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - MILITARY - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
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A:D9MAC-11.4

---FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	151659.859	348.90	10.03	10.03
2.371375E-02	622008.810	153.74	41.14	51.17
4.216968E-01	310491.090	218.59	20.54	71.71
7.498948E-01	296995.530	288.39	19.64	91.35
0.1333522	118257.719	375.59	7.82	99.18
0.2371376	11961.712	593.08	0.79	99.97
0.4216968	483.802	1063.15	0.03	100.00
0.7498948	24.011	1939.36	0.00	100.00

TOTAL = 377970.62

MEAN-DIA = 3.685399E-02 MICROMETERS

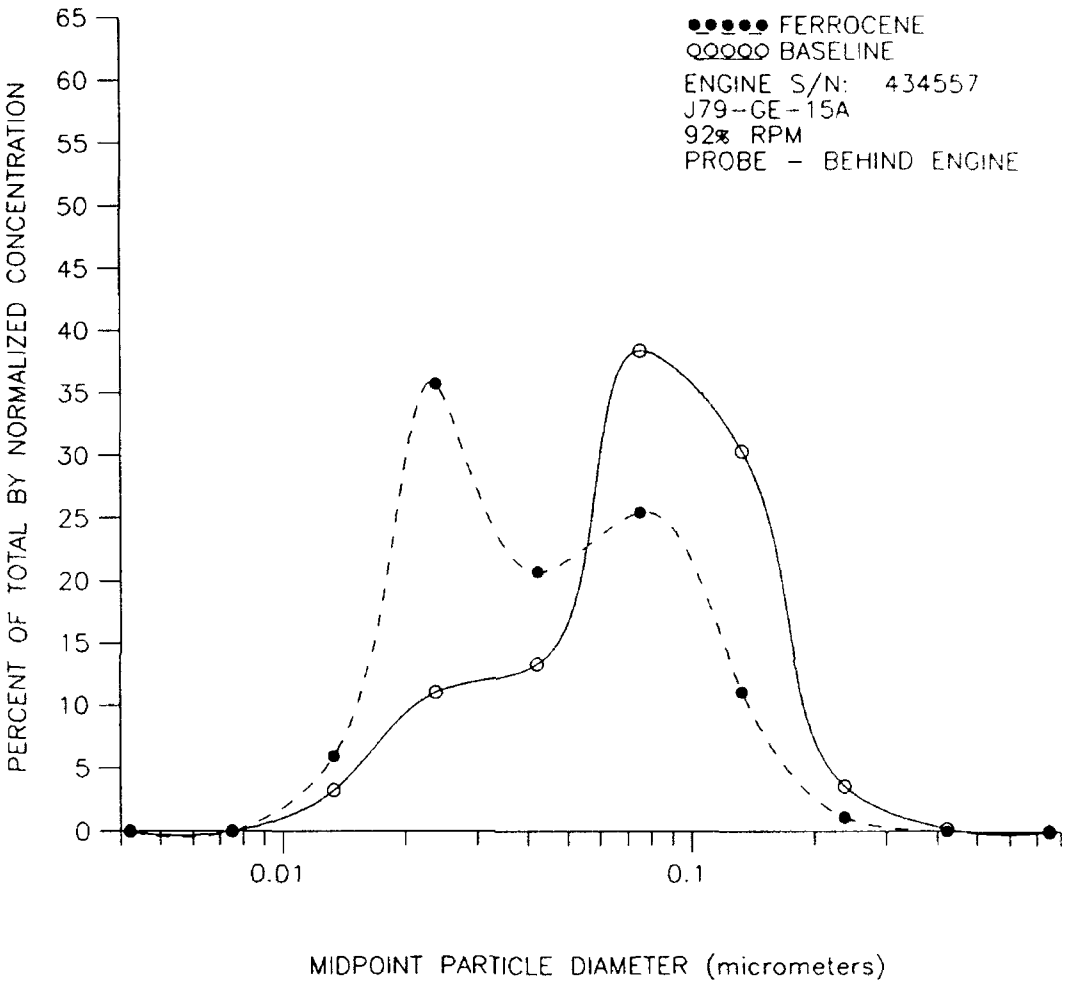

Figure 12. Particle Diameter vs Percent of Total by Normalized Concentration.

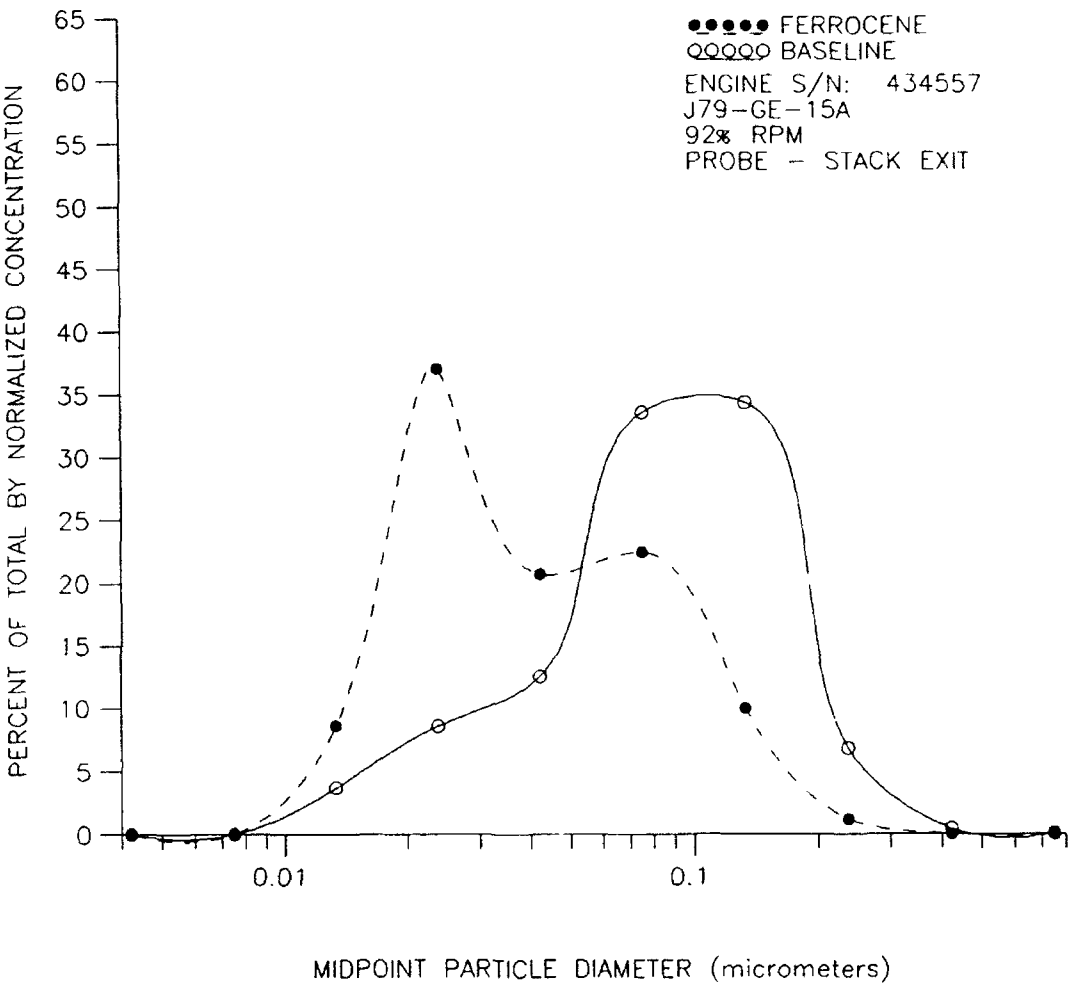

Figure 13. Particle Diameter vs Percent of Total by Normalized Concentration.

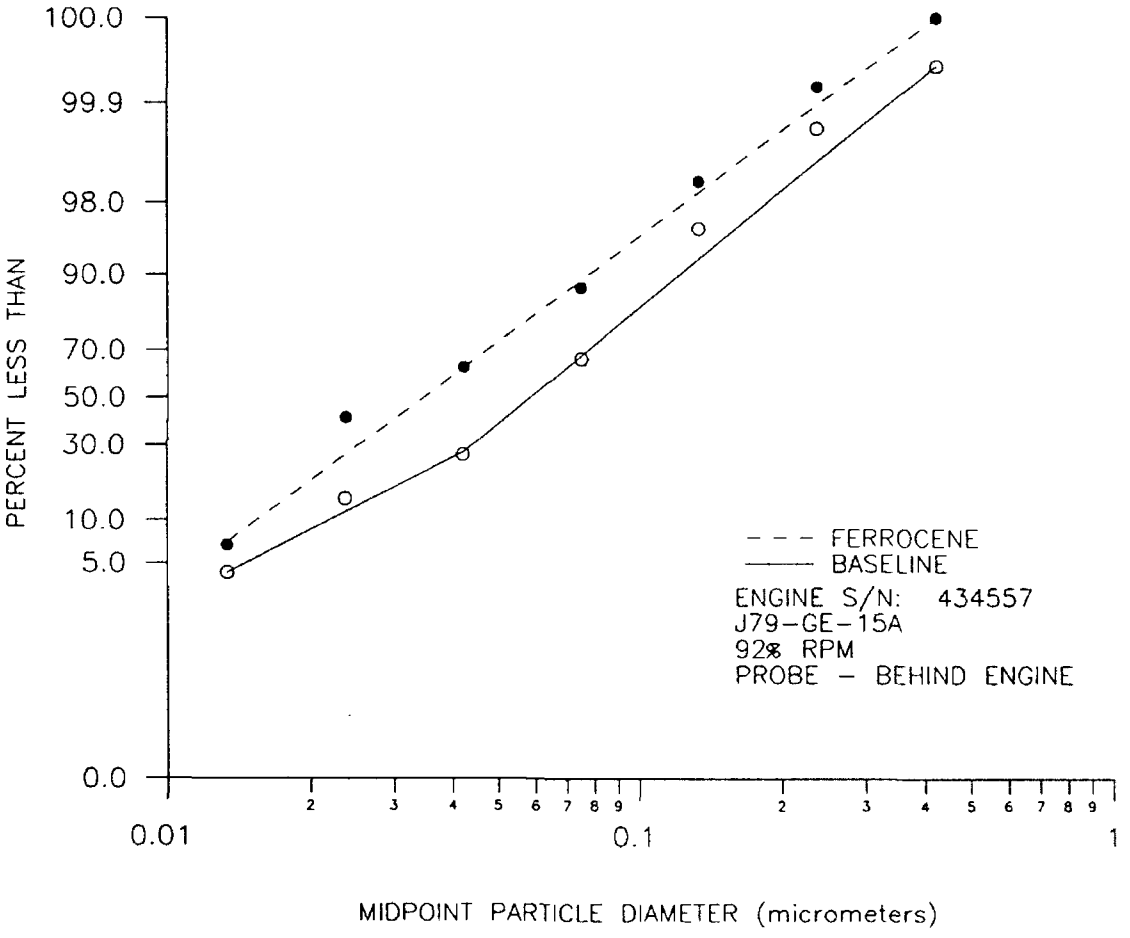

Figure 14. Cumulative Mass Distribution by Number Concentration.

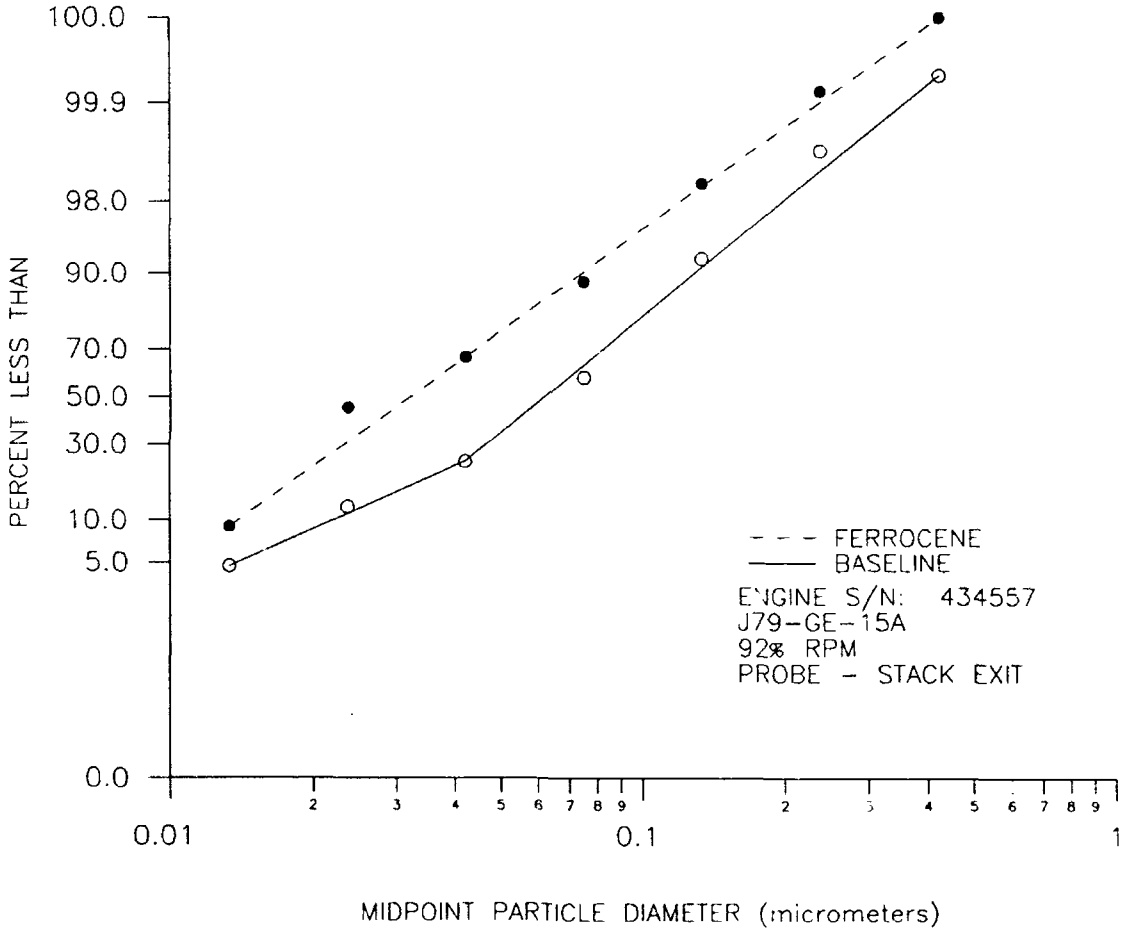

Figure 15. Cumulative Mass Distribution by Number Concentration.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 92% RPM - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 2

FILES INCLUDED:
A:D9MAC-00.6 A:D9MAC-02.1

----------FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	40054.984	594.15	3.22	3.22
2.371375E-02	137118.766	176.56	11.03	14.25
4.216968E-01	165372.906	126.55	13.30	27.55
7.498948E-01	477165.500	102.79	38.38	65.92
0.1333522	376695.530	51.65	30.30	96.22
0.2371376	44180.230	29.36	3.55	99.77
0.4216968	2632.590	16.34	0.21	99.98
0.7498948	200.132	26.58	0.02	100.00

TOTAL = 310855.16

MEAN-DIA = 0.0720618 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 92% RPM - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 2

FILES INCLUDED:
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----------FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	31069.035	2829.21	3.67	3.67
2.371375E-02	72588.516	2246.93	8.57	12.24
4.216968E-01	106161.453	1053.28	12.53	24.77
7.498948E-01	284379.810	545.17	33.57	58.34
0.1333522	290983.660	271.18	34.35	92.69
0.2371376	57828.316	218.42	6.83	99.52
0.4216968	3825.241	247.75	0.45	99.97
0.7498948	276.943	318.35	0.03	100.00

TOTAL = 211778.25

MEAN-DIA = 7.889319E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 92% - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 3

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----------FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	78509.328	230.41	5.93	5.93
2.371375E-02	472351.780	54.28	35.71	41.64
4.216968E-01	273908.720	79.43	20.71	62.35
7.498948E-01	336270.500	114.35	25.42	87.77
0.1333522	146453.080	95.47	11.07	98.84
0.2371376	14646.080	61.74	1.11	99.95
0.4216968	680.633	44.95	0.05	100.00
0.7498948	35.888	107.02	0.00	100.00

TOTAL = 330714.16

MEAN-DIA = 4.303441E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 92% - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
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----------FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	109522.547	575.47	8.59	8.59
2.371375E-02	471855.190	256.34	37.02	45.61
4.216968E-01	263783.880	319.15	20.70	66.31
7.498948E-01	285975.120	387.56	22.44	88.75
0.1333522	127527.023	449.92	10.01	98.75
0.2371376	15107.714	605.07	1.19	99.94
0.4216968	748.251	892.17	0.06	100.00
0.7498948	44.452	1374.85	0.00	100.00

TOTAL = 318641.03

MEAN-DIA = 4.028323E-02 MICROMETERS

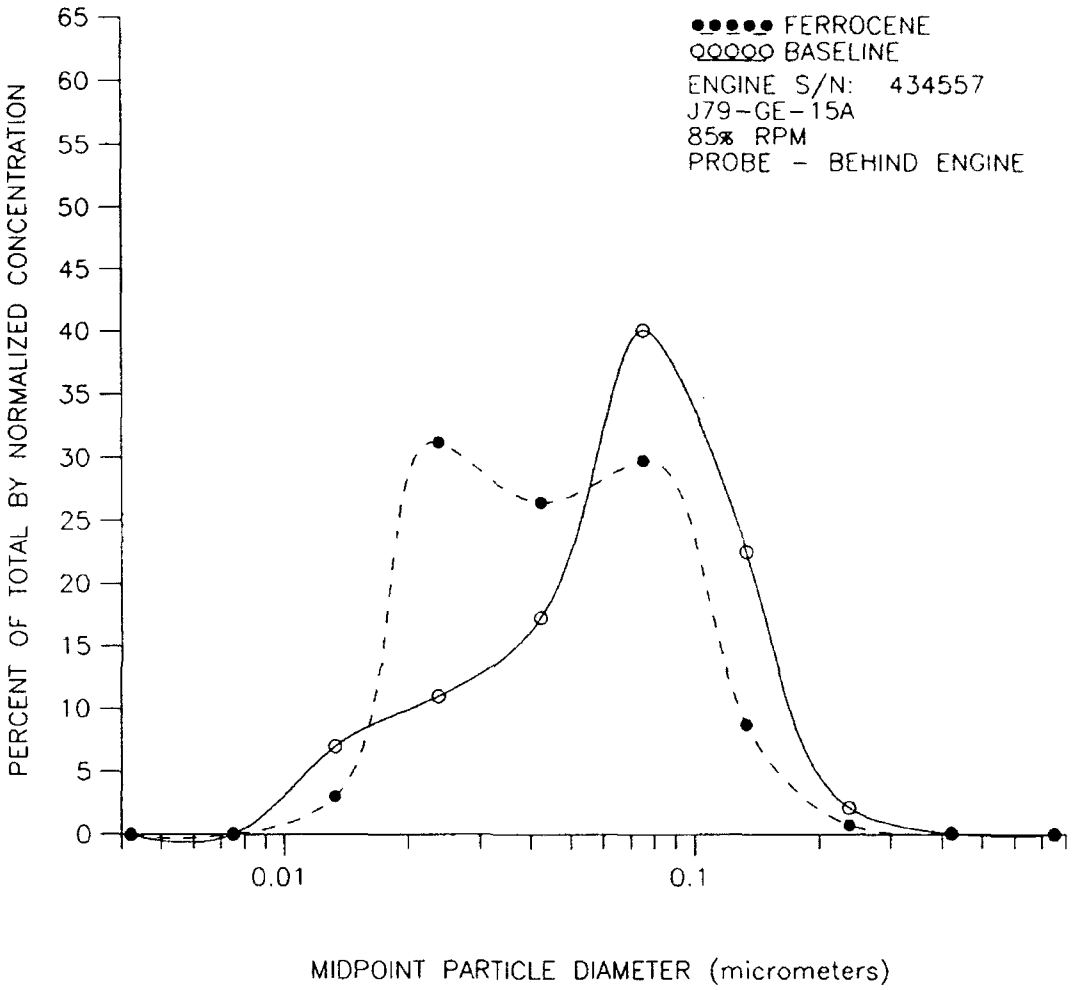

Figure 16. Particle Diameter vs Percent of Total by Normalized Concentration.

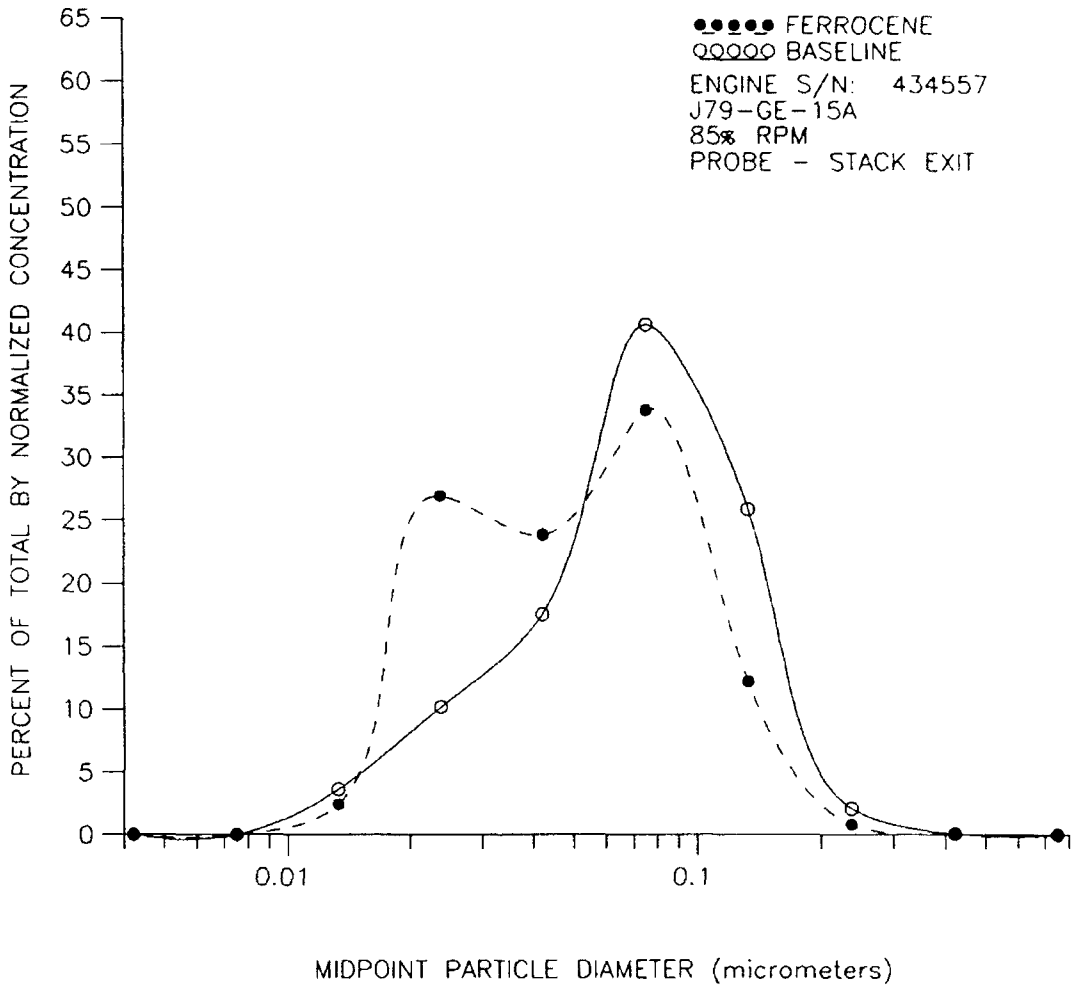

Figure 17. Particle Diameter vs Percent of Total by Normalized Concentration.

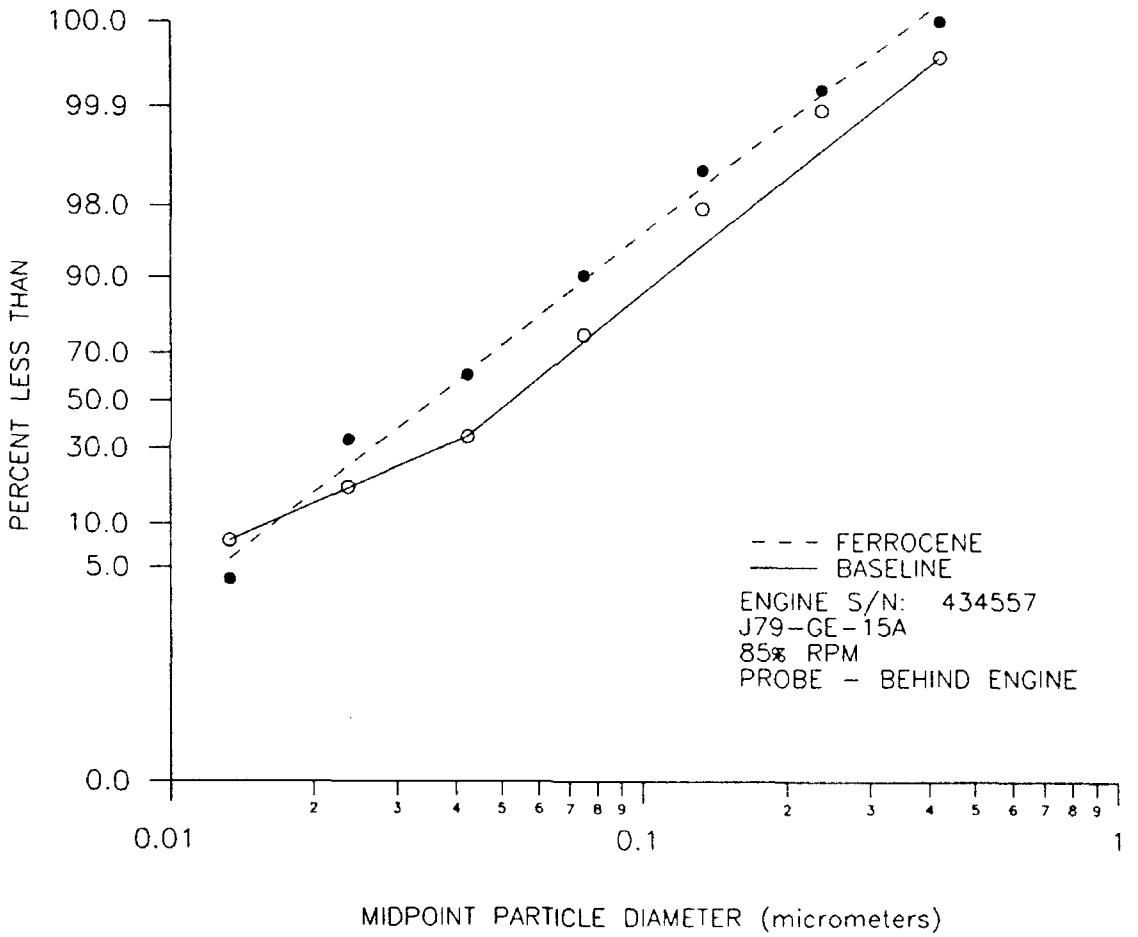

Figure 18. Cumulative Mass Distribution by Number Concentration.

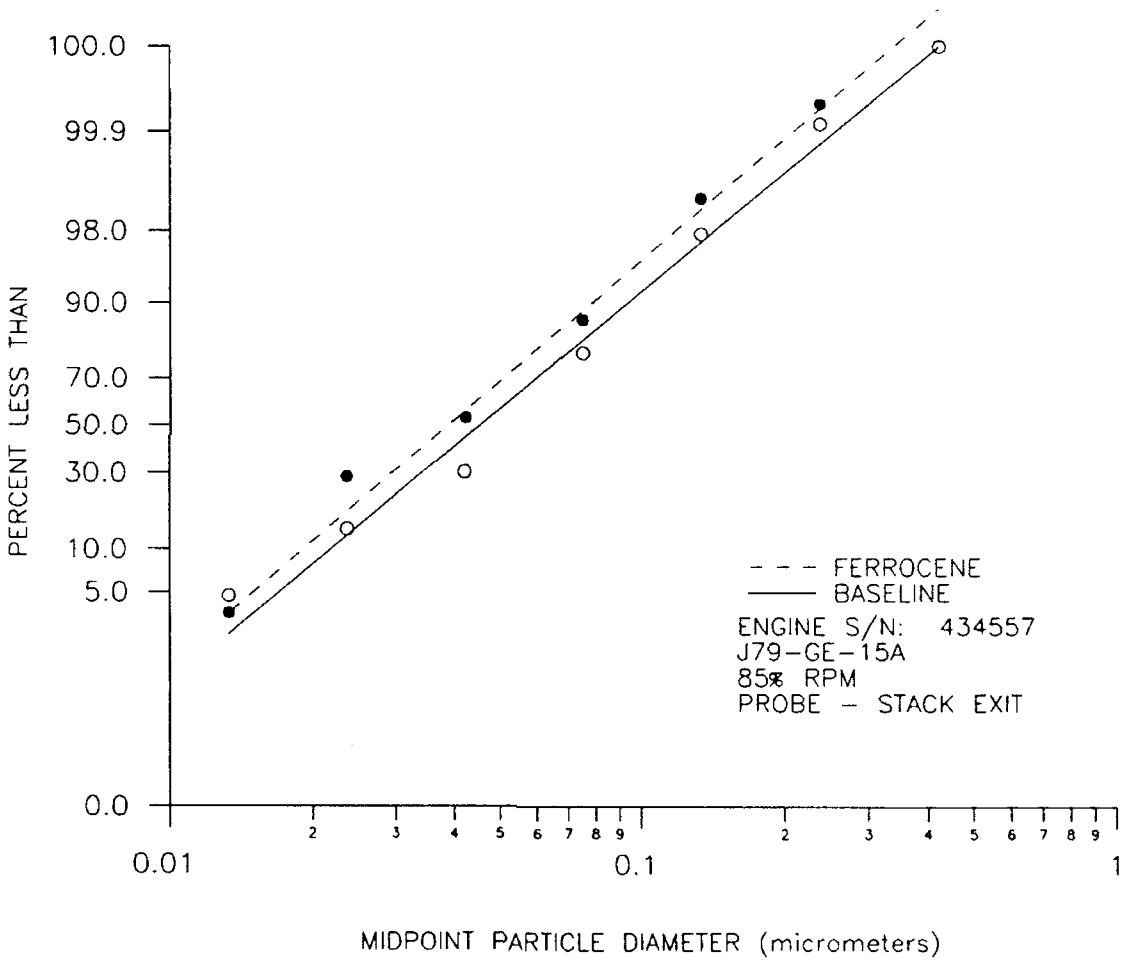

Figure 19. Cumulative Mass Distribution by Number Concentration.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 85% RPM - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-00.1 A:D9MAC-00.2 A:D9MAC-00.5
A:D9MAC-01.9

----------FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	87856.859	182.30	7.00	7.00
2.371375E-02	137610.484	154.60	10.96	17.95
4.216968E-01	216414.594	89.97	17.23	35.19
7.498948E-01	503175.380	80.93	40.07	75.26
0.1333522	282845.440	50.75	22.52	97.78
0.2371376	26536.725	33.82	2.11	99.89
0.4216968	1250.379	38.10	0.10	99.99
0.7498948	70.866	60.85	0.01	100.00

TOTAL = 313940.19

MEAN-DIA = 0.0619913 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 85% RPM - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-10.4 A:D9MAC-11.5 A:D9MAC-11.6

----------FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	41394.980	1384.22	3.64	3.64
2.371375E-02	115857.125	937.70	10.20	13.85
4.216968E-01	199041.812	372.08	17.52	31.37
7.498948E-01	461084.780	223.01	40.60	71.97
0.1333522	293772.120	163.75	25.87	97.83
0.2371376	23775.328	275.72	2.09	99.93
0.4216968	801.794	581.12	0.07	100.00
0.7498948	38.981	1158.70	0.00	100.00

TOTAL = 283941.72

MEAN-DIA = 6.738192E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 85% RPM - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-01.1 A:D9MAC-01.2 A:D9MAC-01.4

----------FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	46962.707	498.30	3.01	3.01
2.371375E-02	486525.030	62.49	31.18	34.19
4.216968E-01	412935.440	74.40	26.46	60.65
7.498948E-01	464715.560	134.98	29.78	90.43
0.1333522	136669.234	146.68	8.76	99.19
0.2371376	11880.165	118.64	0.76	99.95
0.4216968	671.954	119.29	0.04	100.00
0.7498948	61.378	142.06	0.00	100.00

TOTAL = 390105.34

MEAN-DIA = 0.0453357E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 85% RPM - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-10.5 A:D9MAC-10.9 A:D9MAC-11.0

----------FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	31237.029	1881.07	2.44	2.44
2.371375E-02	344434.250	323.27	26.92	29.36
4.216968E-01	304699.190	251.92	23.81	53.17
7.498948E-01	431964.620	249.65	33.76	86.92
0.1333522	156587.000	348.16	12.24	99.16
0.2371376	10349.297	829.50	0.81	99.97
0.4216968	397.141	1611.25	0.03	100.00
0.7498948	26.076	2288.62	0.00	100.00

TOTAL = 319923.66

MEAN-DIA = 4.982853E-02 MICROMETERS

CONTENTS OF SECTION:

SURFACE AREA GRAPHICS
OF
PERCENT FREQUENCY VS MID-POINT DIAMETER
&
CUMULATION MASS DISTRIBUTION VS MID-POINT DIAMETER

1. Graphics

Baseline	Ferrocene Additive
Military	Military
92% RPM	92% RPM
85% RPM	85% RPM

2. All averaged summary data sheets.

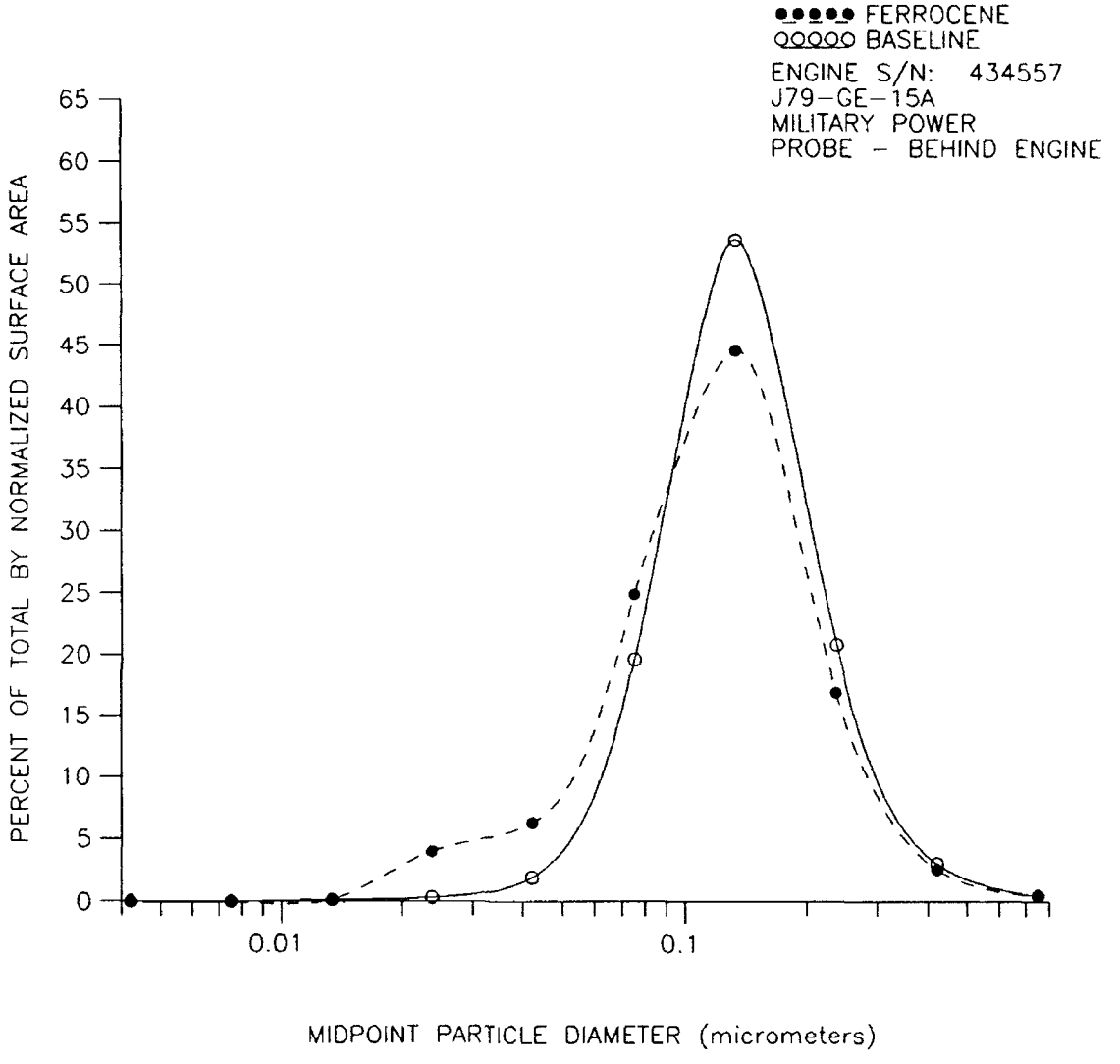

Figure 20. Particle Diameter vs Percent of Total by Normalized Surface Area.

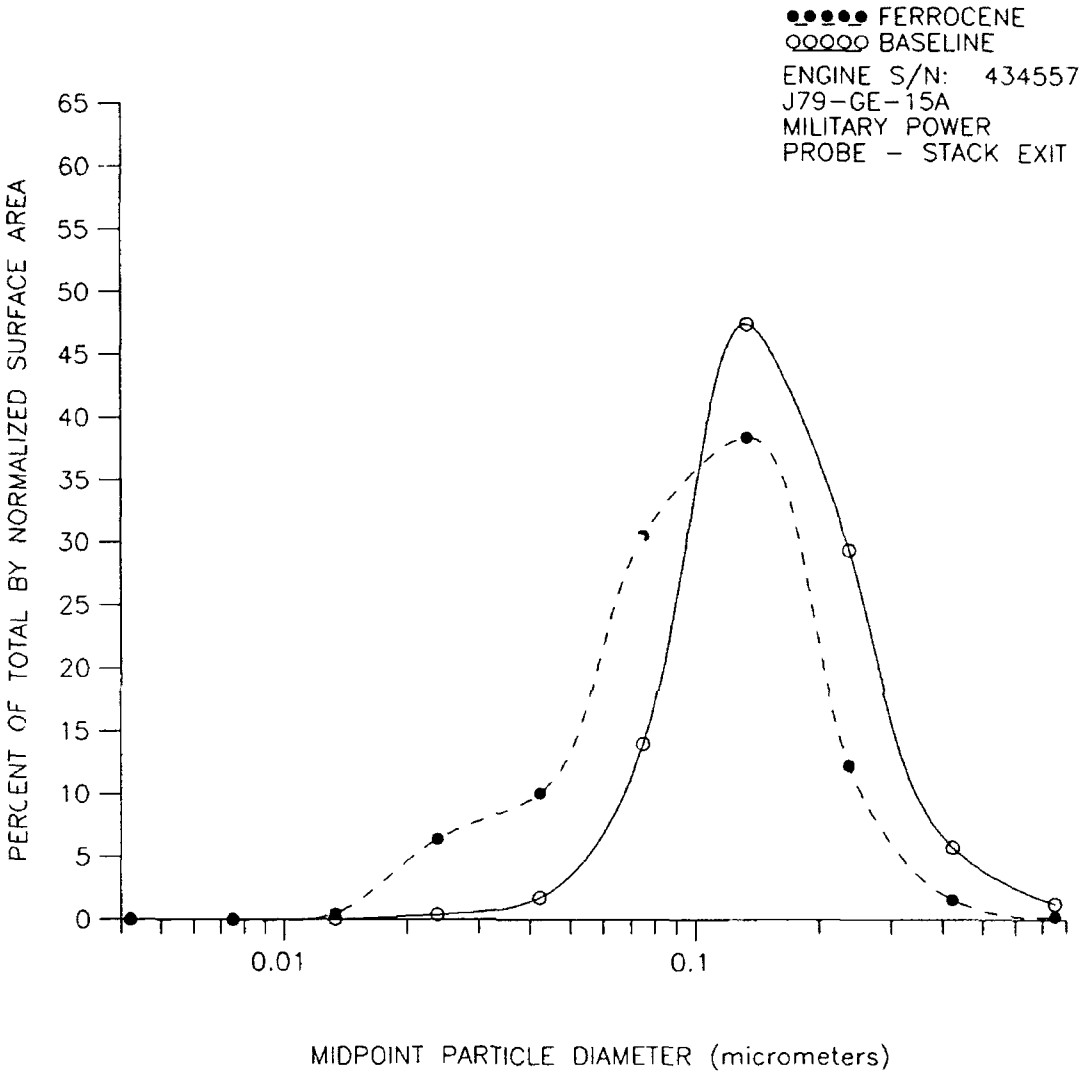

Figure 21. Particle Diameter vs Percent of Total by Normalized Surface Area.

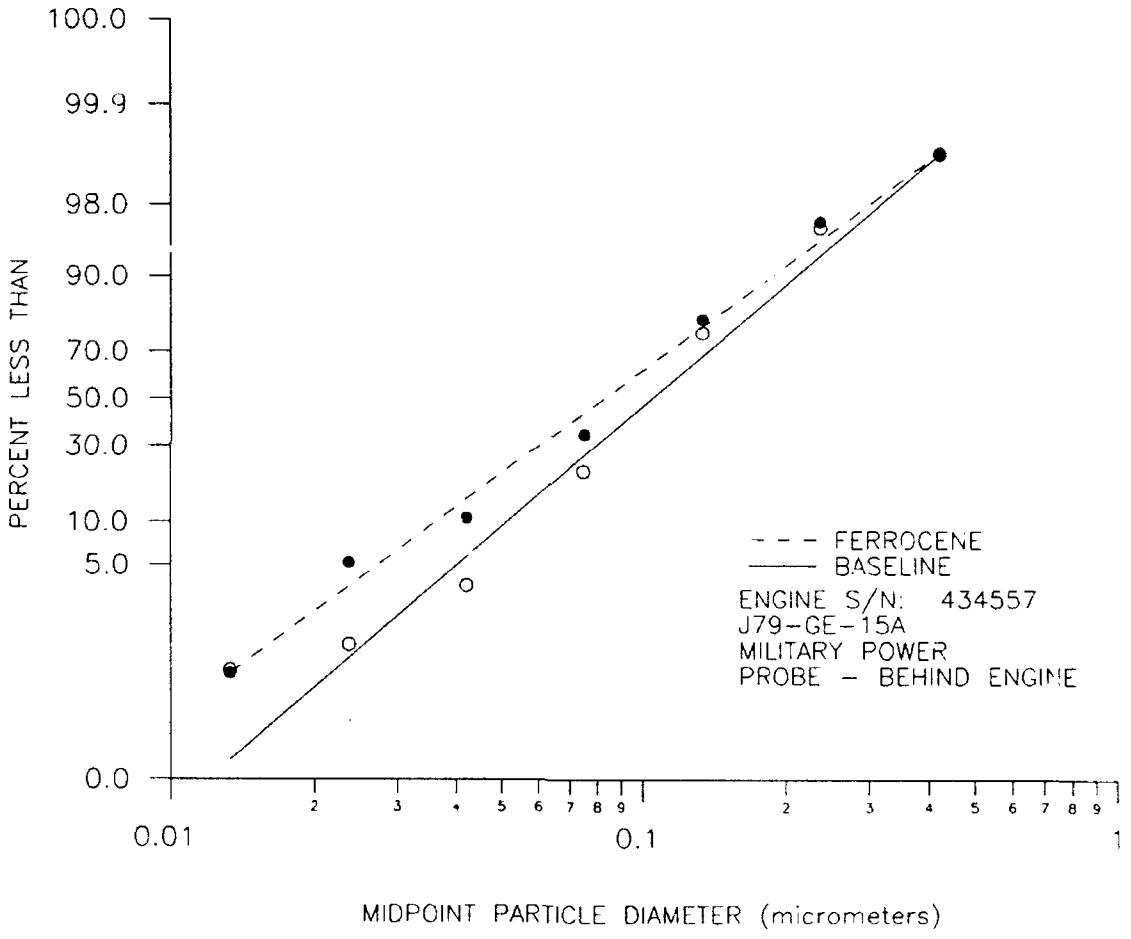

Figure 22. Cumulative Mass Distribution by Surface Area.

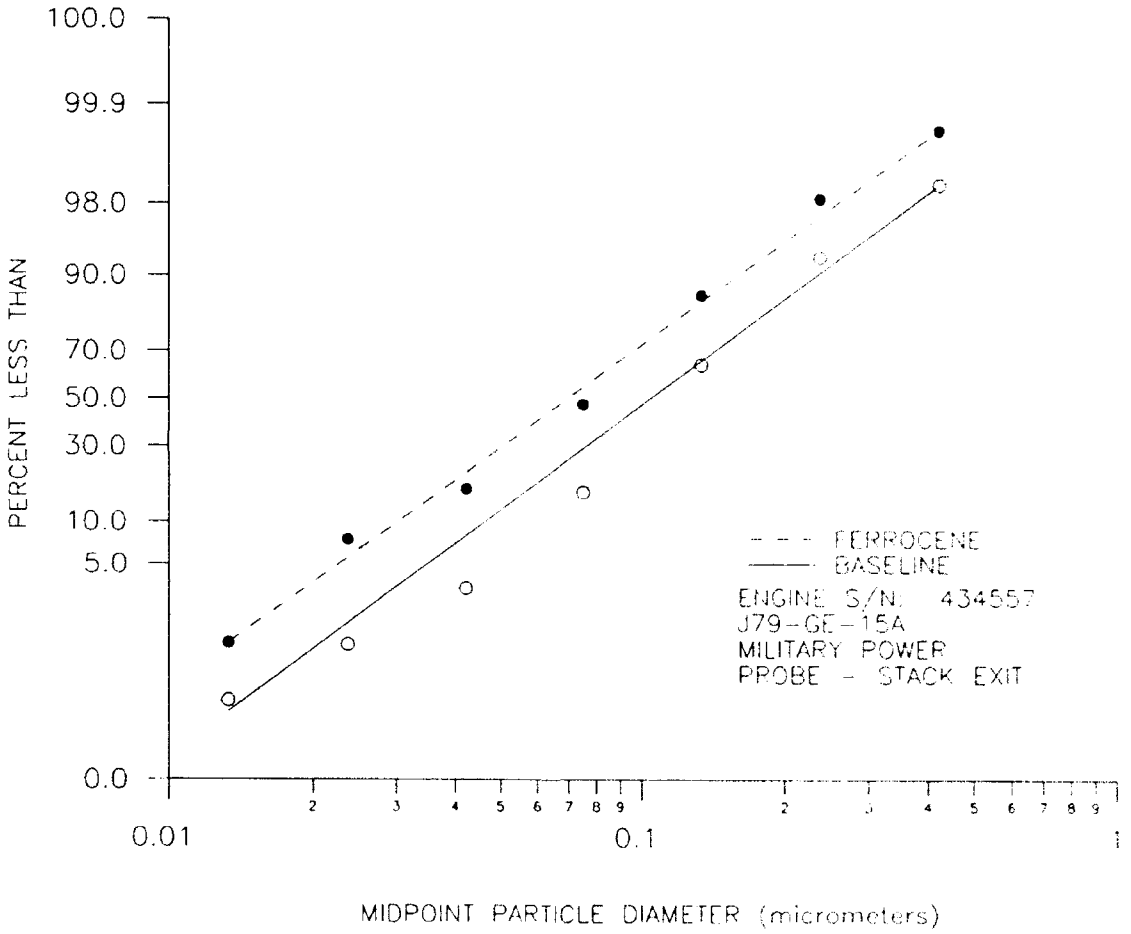

Figure 23. Cumulative Mass Distribution by Surface Area.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - MILITARY - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 2

FILES INCLUDED:
A:D9MAC-00.3 A:D9MAC-02.0

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	53.544	137.95	0.15	0.15
2.371375E-02	119.216	56.01	0.33	0.48
4.216968E-01	698.446	58.47	1.94	2.42
7.498948E-01	7070.866	62.23	19.62	22.04
0.1333522	19332.678	33.51	53.64	75.68
0.2371376	7500.422	14.82	20.81	96.49
0.4216968	1086.788	10.41	3.02	99.50
0.7498948	179.714	28.50	0.50	100.00

TOTAL = 9010.419

MEAN-DIA = 0.1358753 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - MILITARY - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 2

FILES INCLUDED:
A:D9MAC-10.1 A:D9MAC-11.7

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	21.796	2073.85	0.07	0.07
2.371375E-02	121.493	2284.50	0.40	0.47
4.216968E-01	533.216	1085.93	1.74	2.20
7.498948E-01	4297.599	560.42	13.99	16.19
0.1333522	14579.263	214.87	47.45	63.63
0.2371376	9017.650	136.82	29.35	92.98
0.4216968	1766.144	135.10	5.75	98.98
0.7498948	390.319	211.95	1.27	100.00

TOTAL = 7681.871

MEAN-DIA = 0.1546384 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - MILITARY - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-00.7 A:D9MAC-00.9 A:D9MAC-01.6
A:D9MAC-01.8

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	40.524	146.13	0.19	0.19
2.371375E-02	829.227	21.72	3.98	4.17
4.216968E-01	1309.750	40.59	6.29	10.46
7.498948E-01	5193.429	64.93	24.92	35.38
0.1333522	9305.097	47.42	44.65	80.03
0.2371376	3522.445	25.49	16.9[illegible]	96.93
0.4216968	539.716	14.95	2.59	99.52
0.7498948	99.056	34.79	0.48	100.00

TOTAL = 5209.811

MEAN-DIA = 0.1143551 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - MILITARY - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-10.6 A:D9MAC-10.8 A:D9MAC-11.2
A:D9MAC-11.4

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	84.726	348.90	0.49	0.49
2.371375E-02	1098.860	153.74	6.39	6.88
4.216968E-01	1734.583	218.59	10.09	16.97
7.498948E-01	5246.816	288.39	30.51	47.48
0.1333522	6606.558	375.59	38.42	85.89
0.2371376	2113.194	593.08	12.29	98.18
0.4216968	270.280	1063.15	1.57	99.75
0.7498948	42.419	1939.36	0.25	100.00
TOTAL =	4299.359			

MEAN-DIA = 9.679972 MICROMETERS

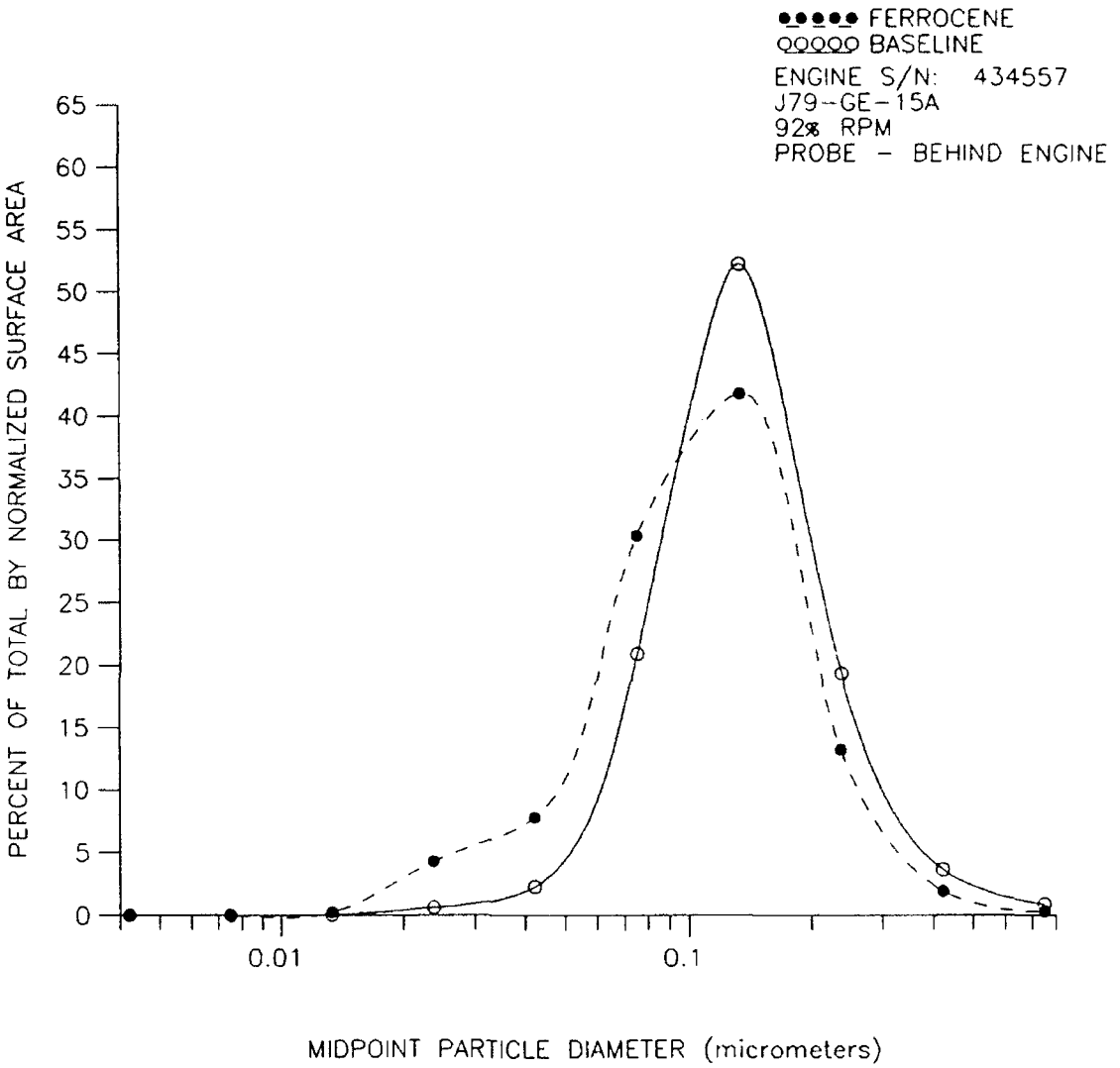

Figure 24. Particle Diameter vs Percent of Total by Normalized Surface Area.

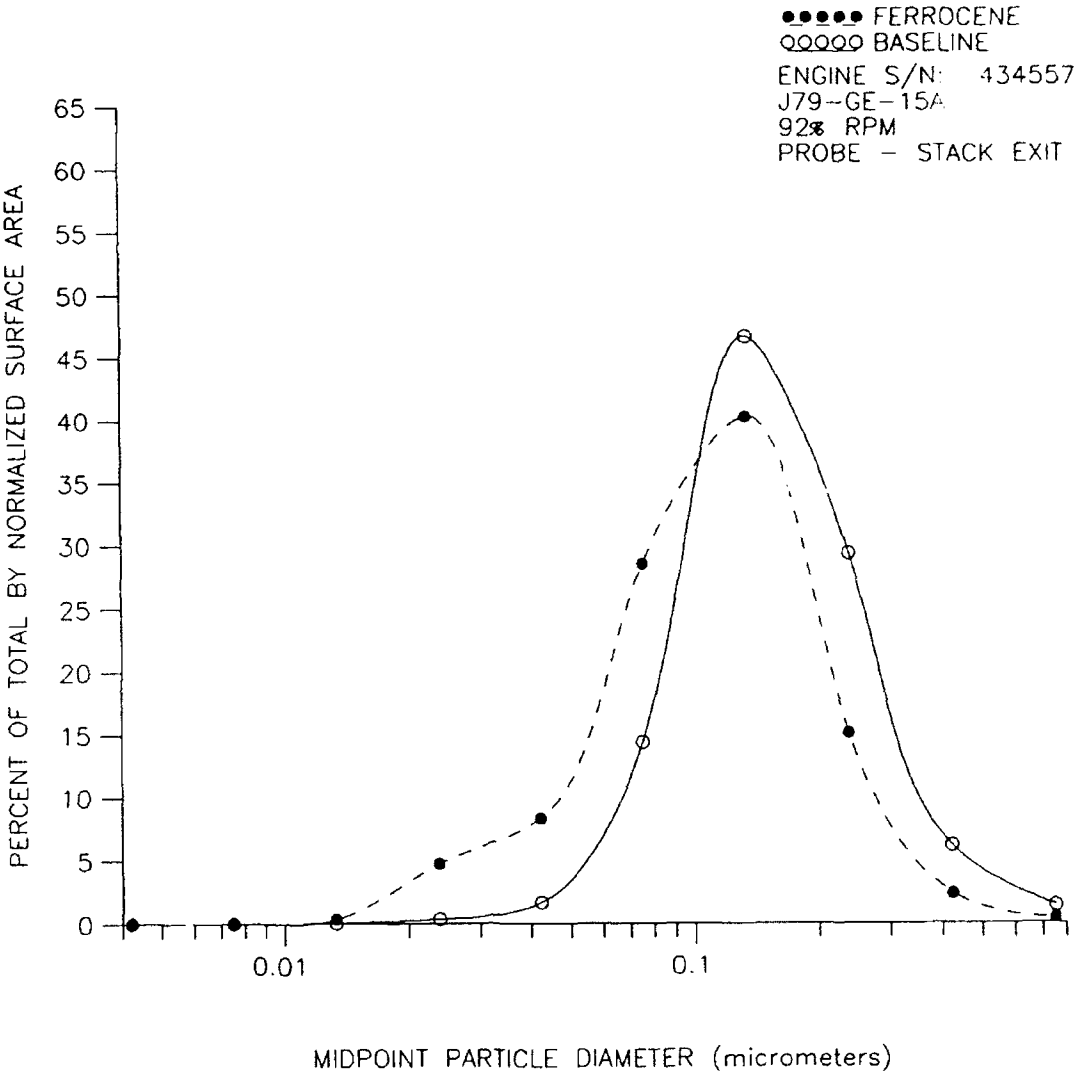

Figure 25. Particle Diameter vs Percent of Total by Normalized Surface Area.

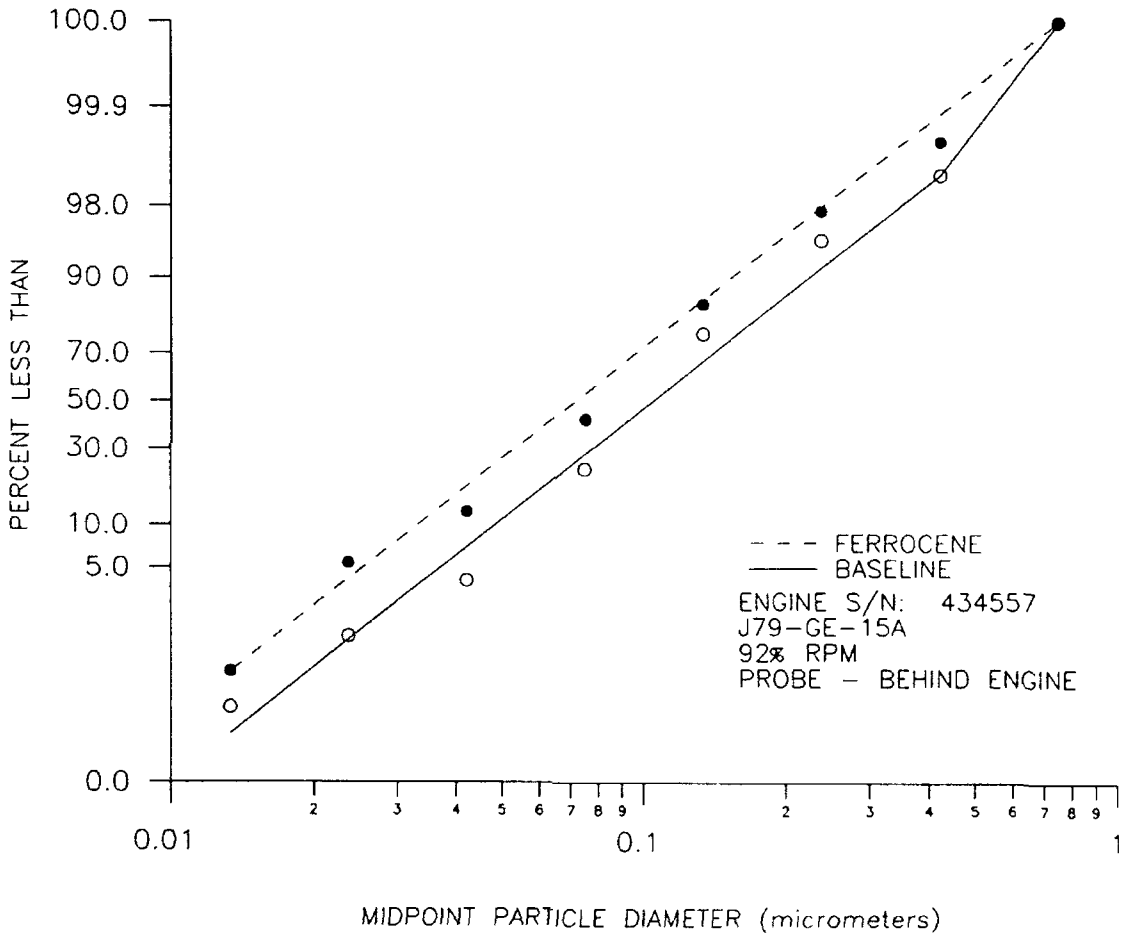

Figure 26. Cumulative Mass Distribution by Surface Area.

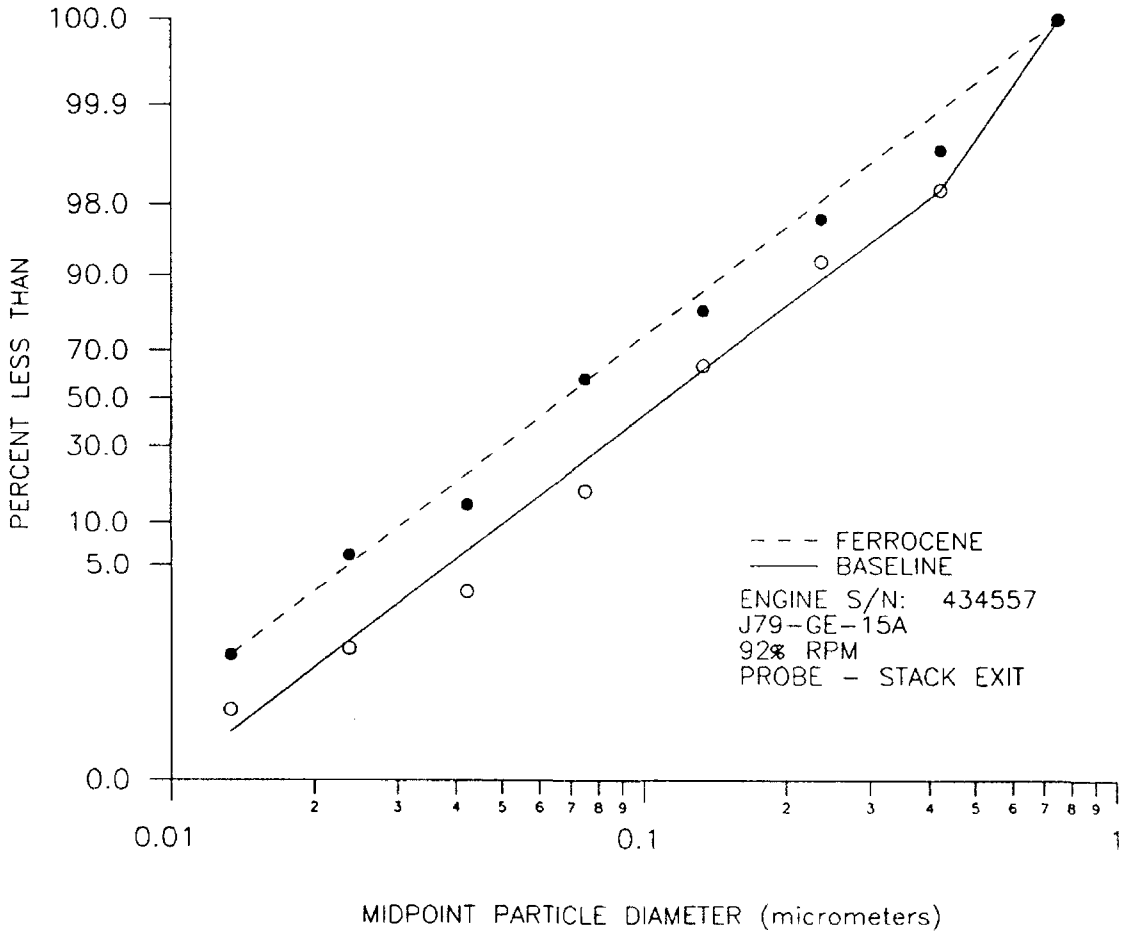

Figure 27. Cumulative Mass Distribution by Surface Area.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 92% RPM - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 2

FILES INCLUDED:
A:D9MAC-00.6 A:D9MAC-02.1

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	22.377	594.15	0.06	0.06
2.371375E-02	242.238	176.56	0.60	0.66
4.216968E-01	923.869	126.55	2.29	2.95
7.498948E-01	8429.755	102.79	20.92	23.87
0.1333522	21044.385	51.65	52.23	76.10
0.2371376	7805.017	29.36	19.37	95.47
0.4216968	1470.717	16.34	3.65	99.12
0.7498948	353.559	26.58	0.88	100.00

TOTAL = 10072.980

MEAN-DIA = 0.1347184 MICROMETERS

FINAL AVERAGF COMPUTATIONS - EAA DATA FILES

STACK - 92% RPM - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 2

FILES INCLUDED:
A:D9MAC-10.3 A:D9MAC-11.8

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	17.357	2829.21	0.05	0.05
2.371375E-02	128.237	2246.93	0.37	0.42
4.216968E-01	593.079	1053.28	1.70	2.12
7.498948E-01	5023.943	545.17	14.41	16.53
0.1333522	16256.025	271.18	46.63	63.16
0.2371376	10216.131	218.42	29.31	92.47
0.4216968	2137.000	247.75	6.13	98.60
0.7498948	489.256	318.35	1.40	100.00

TOTAL = 8715.257

MEAN-DIA = 0.1554706 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 92% - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-01.0 A:D9MAC-01.5 A:D9MAC-01.7

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	43.860	230.41	0.22	0.22
2.371375E-02	834.471	54.28	4.27	4.49
4.216968E-01	1530.213	79.43	7.82	12.31
7.498948E-01	5940.660	114.35	30.37	42.68
0.1333522	8181.754	95.47	41.82	84.51
0.2371376	2587.423	61.74	13.23	97.73
0.4216968	380.241	44.95	1.94	99.68
0.7498948	63.401	107.02	0.32	100.00

TOTAL = 4890.505

MEAN-DIA = 0.1049419 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 92% RPM - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-10.7 A:D9MAC-11.1 A:D9MAC-11.3

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	61.186	575.47	0.35	0.35
2.371375E-02	833.594	256.34	4.71	5.05
4.216968E-01	1473.649	319.15	8.32	13.37
7.498948E-01	5052.127	387.56	28.53	41.90
0.1333522	7124.396	449.92	40.23	82.13
0.2371376	2668.976	605.07	15.07	97.20
0.4216968	418.017	892.17	2.36	99.56
0.7498948	78.531	1374.85	0.44	100.00

TOTAL = 4427.619

MEAN-DIA = 0.1062007 MICROMETERS

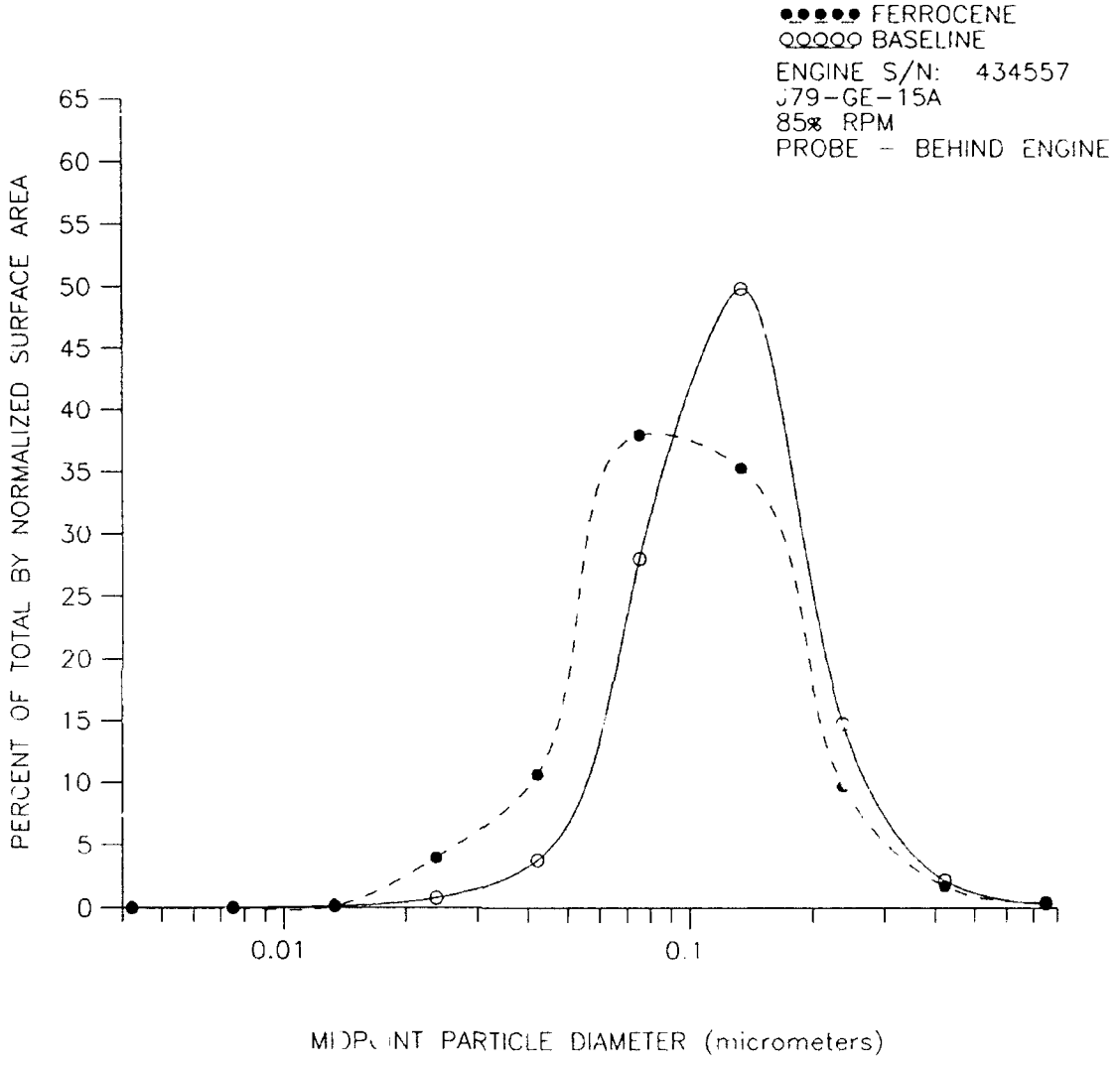

Figure 28. Particle Diameter vs Percent of Total by Normalized Surface Area.

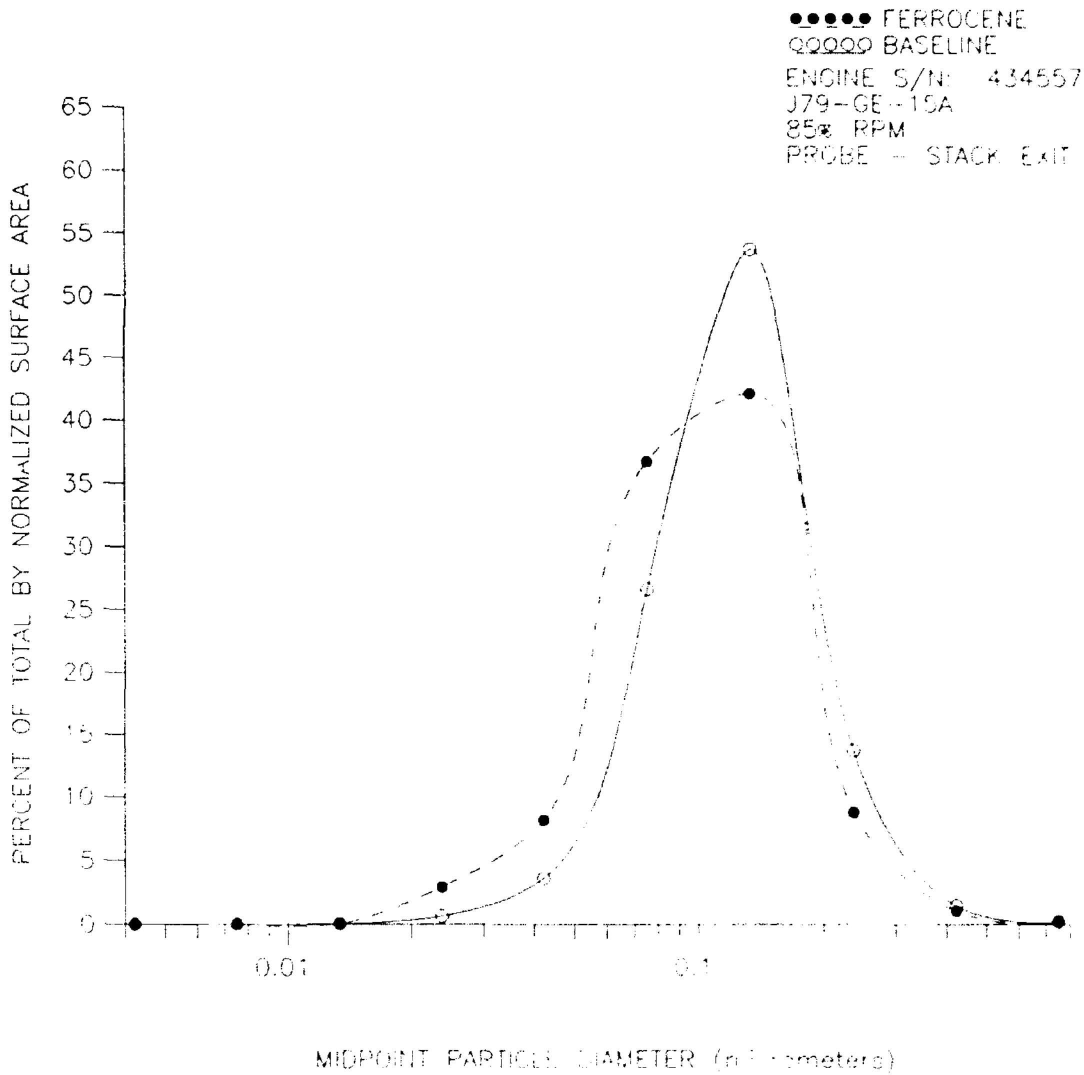

FIGURE [illegible]. Particle [illegible] Data by [illegible] Area

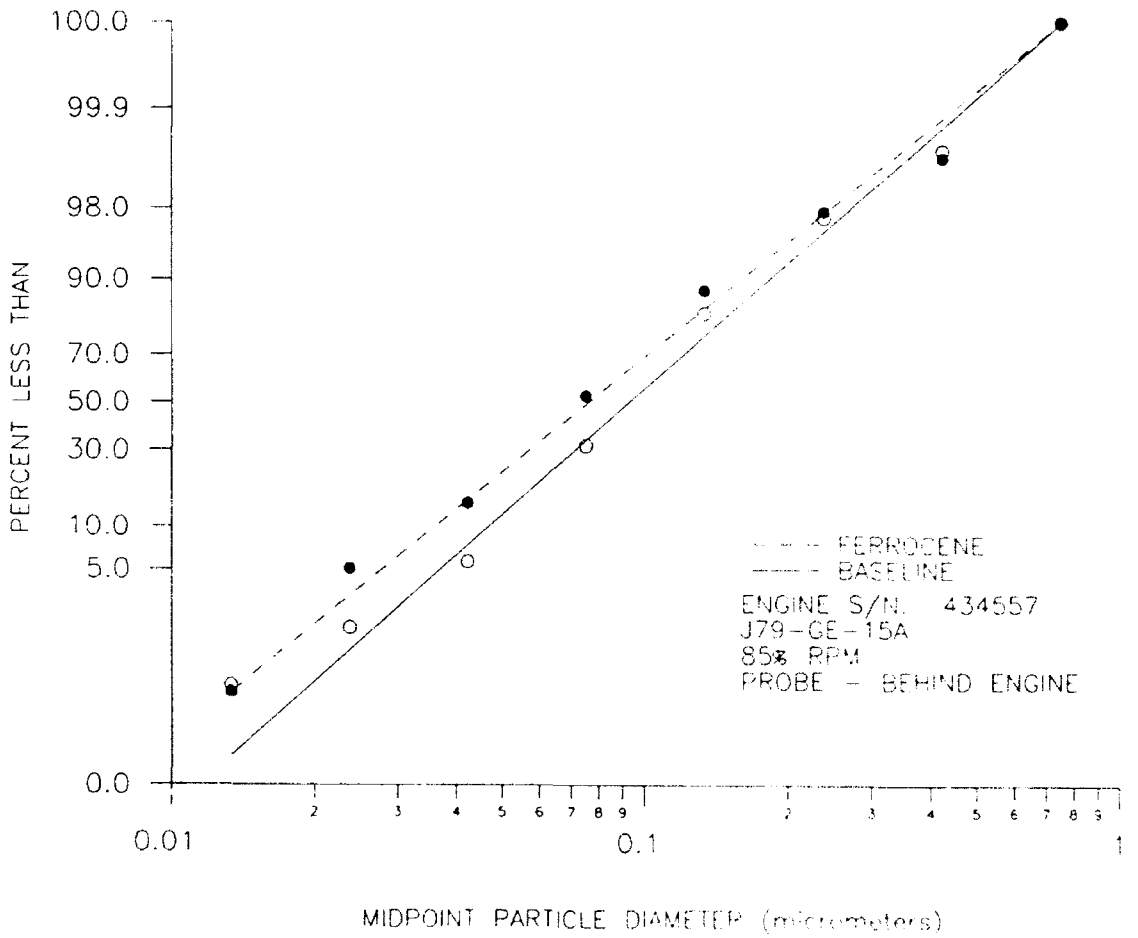

Figure 30. Cumulative Mass Distributions by Surface Area

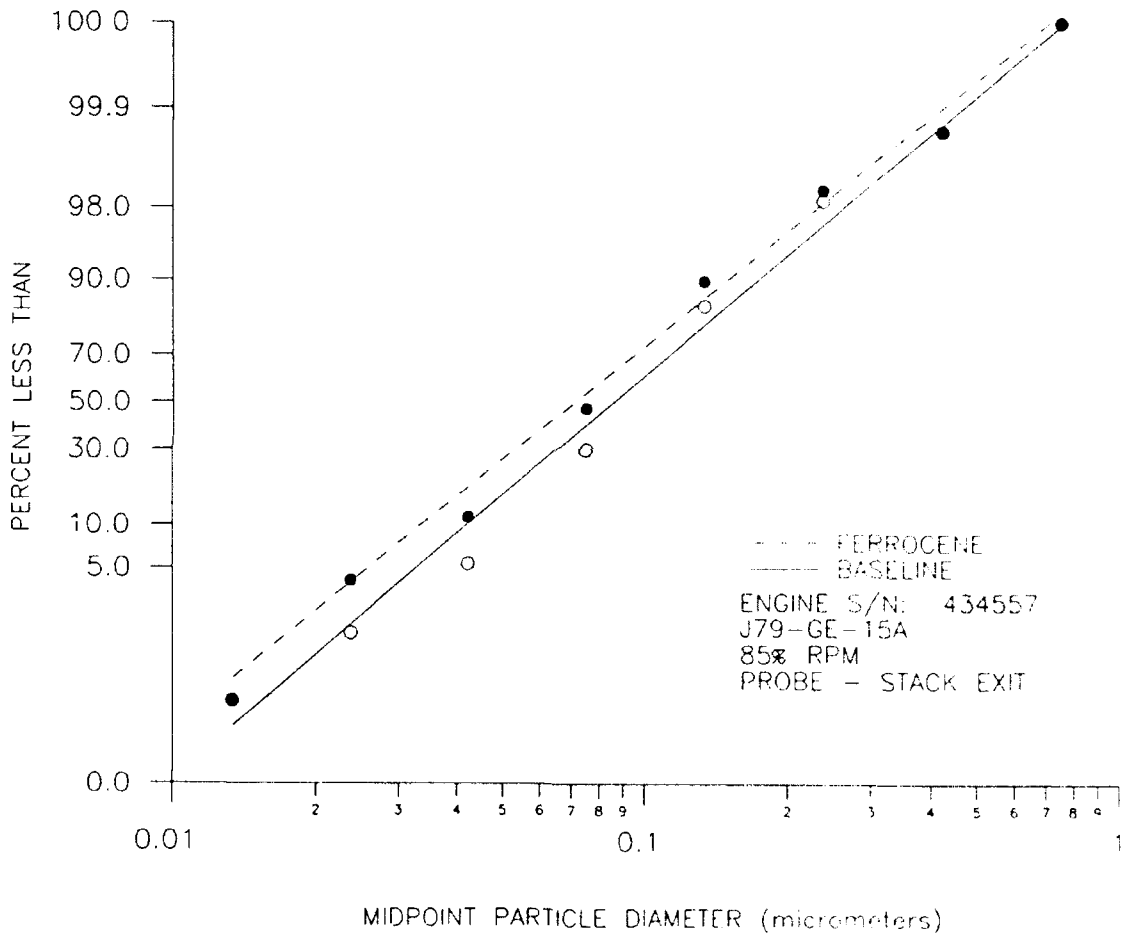

Figure 31. Cumulative Mass Distribution by Surface Area.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 85% RPM - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-00.1 A:D9MAC-00.2 A:D9MAC-00.5
A:D9MAC-01.9

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	49.082	182.30	0.15	0.15
2.371375E-02	243.107	154.60	0.77	0.92
4.216968E-01	1209.017	89.97	3.81	4.74
7.498948E-01	8889.254	80.93	28.04	32.77
0.1333522	15801.379	50.75	49.84	82.61
0.2371376	4688.061	33.82	14.79	97.40
0.4216968	698.534	38.10	2.20	99.61
0.7498948	125.194	60.85	0.39	100.00
TOTAL =	7925.908			

MEAN-DIA = 0.1200835 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 85% RPM - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-10.4 A:D9MAC-11.5 A:D9MAC-11.6

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	23.126	1384.22	0.08	0.08
2.371375E-02	204.677	937.70	0.67	0.74
4.216968E-01	1111.963	372.08	3.63	4.38
7.498948E-01	8145.670	223.01	26.61	30.98
0.1333522	16411.809	163.75	53.61	84.59
0.2371376	4200.225	275.72	13.72	98.31
0.4216968	447.929	581.12	1.46	99.78
0.7498948	68.866	1159.70	0.22	100.00
TOTAL =	7653.566			

MEAN-DIA = 0.1196337 MICROMETERS

FINAL AVERAGE COMPUTATIONS - .'AA DATA FILES

BEHIND ENGINE - 85% - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-01.1 A:D9MAC-01.2 A:D9MAC-01.4

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	26.236	498.30	0.12	0.12
2.371375E-02	859.510	62.49	3.98	4.10
4.216968E-01	2306.896	74.40	10.67	14.77
7.498948E-01	8209.813	134.98	37.97	52.74
0.1333522	7635.133	146.68	35.31	88.05
0.2371376	2098.787	118.64	9.71	97.76
0.4216968	375.392	119.29	1.74	99.50
0.7498948	108.432	142.06	0.50	100.00
TOTAL =	5405.050			

MEAN-DIA = 9.602846E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 85% RPM - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-10.5 A:D9MAC-10.9 A:D9MAC-11.0

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	17.451	1881.07	0.08	0.08
2.371375E-02	608.488	323.27	2.92	3.01
4.216968E-01	1702.225	251.92	8.18	11.19
7.498948E-01	7631.223	249.65	36.68	47.87
0.1333522	8747.856	348.16	42.05	89.92
0.2371376	1828.339	829.50	8.79	98.71
0.4216968	221.866	1611.25	1.07	99.78
0.7498948	46.067	2288.62	0.22	100.00
TOTAL =	5200.878			

MEAN-DIA = 9.967157E-02 MICROMETERS

CONTENTS OF SECTION:

VOLUME GRAPHICS
OF
PERCENT FREQUENCY VS MID-POINT DIAMETER
&
CUMULATION MASS DISTRIBUTION VS MID-POINT DIAMETER

1. Graphics

Baseline	Ferrocene Additive
Military	Military
92% RPM	92% RPM
85% RPM	85% RPM

2. All averaged summary data sheets.

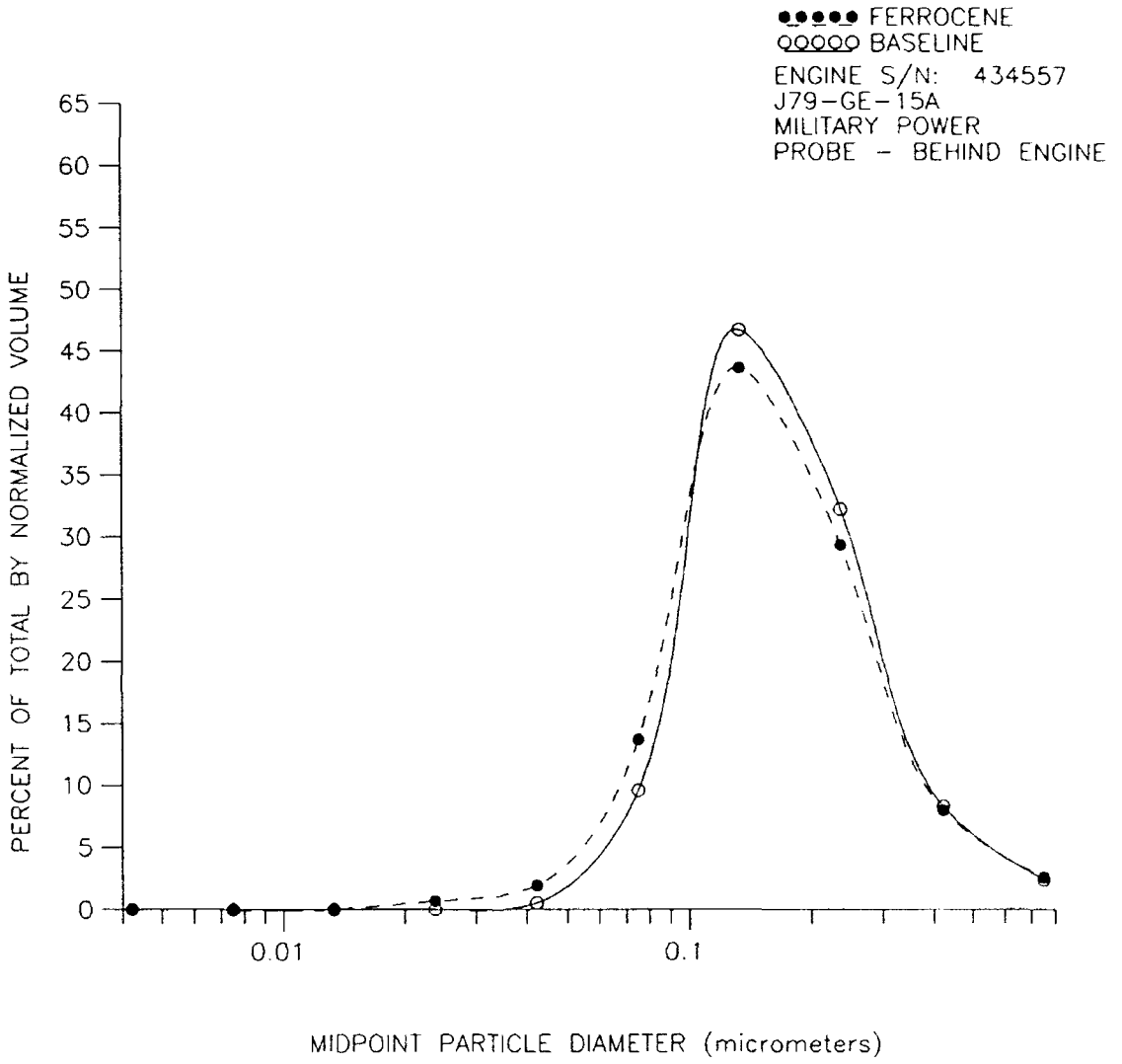

FIGURE 32. Particle Diameter vs Percent of Total by Normalized Volume.

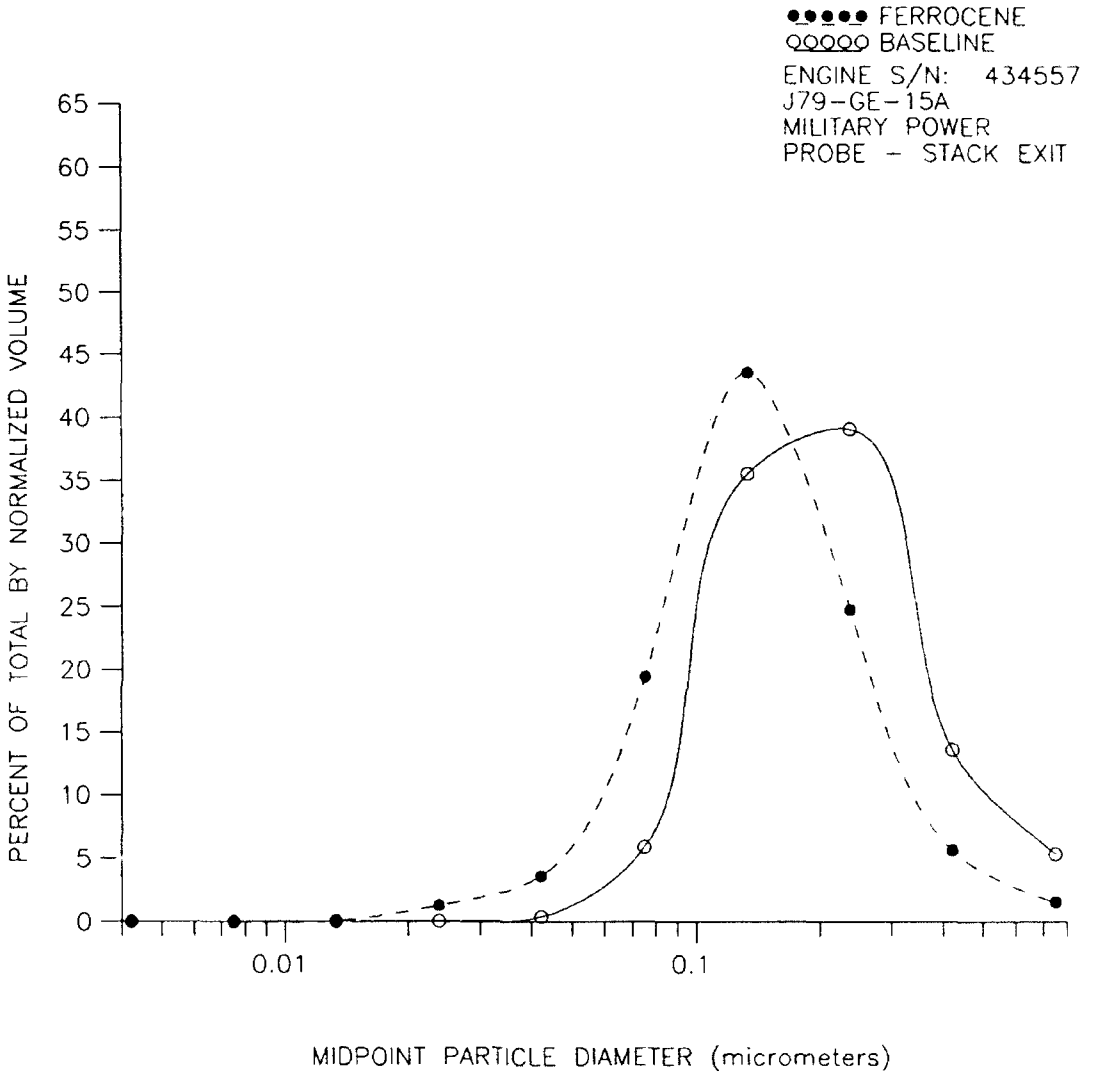

FIGURE 33. Particle Diameter vs Percent of Total by Normalized Volume.

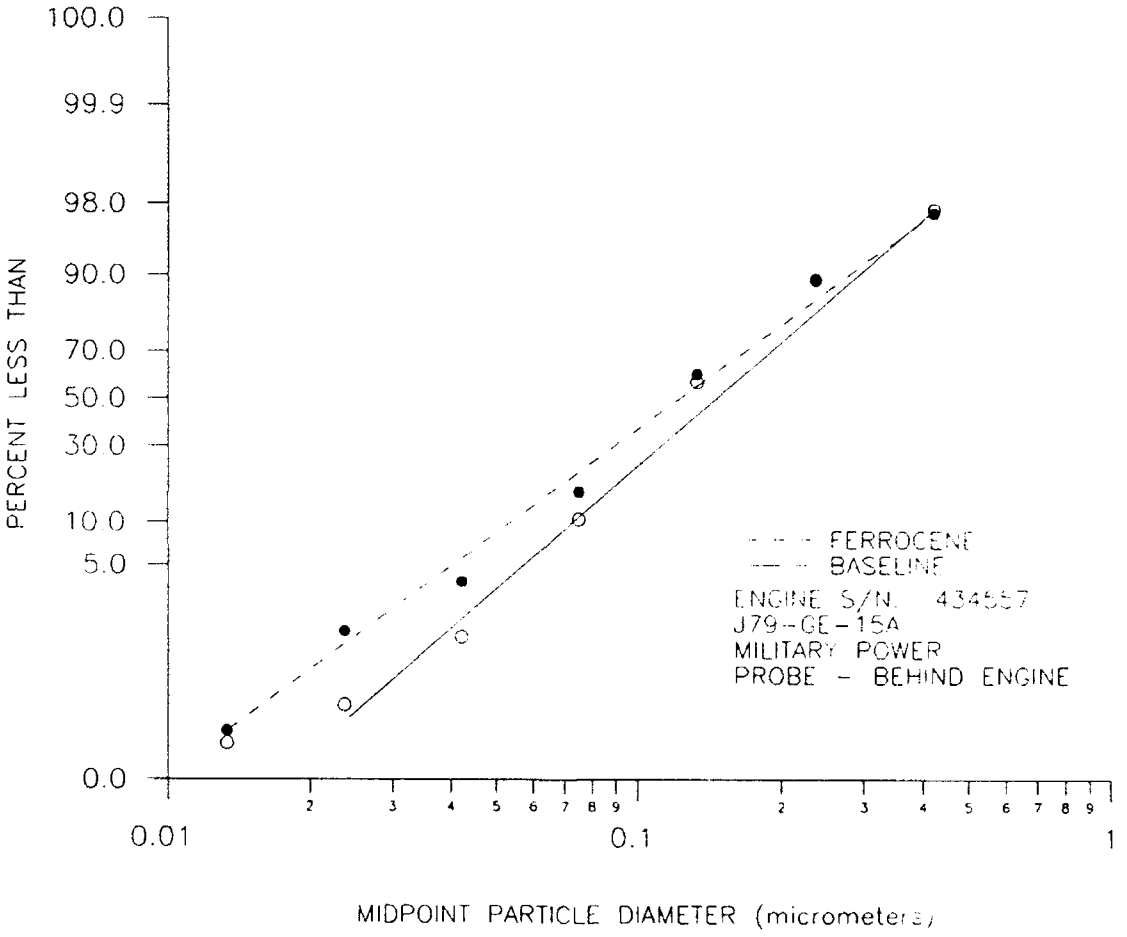

Figure 34. Cumulative Mass Distribution by Volume.

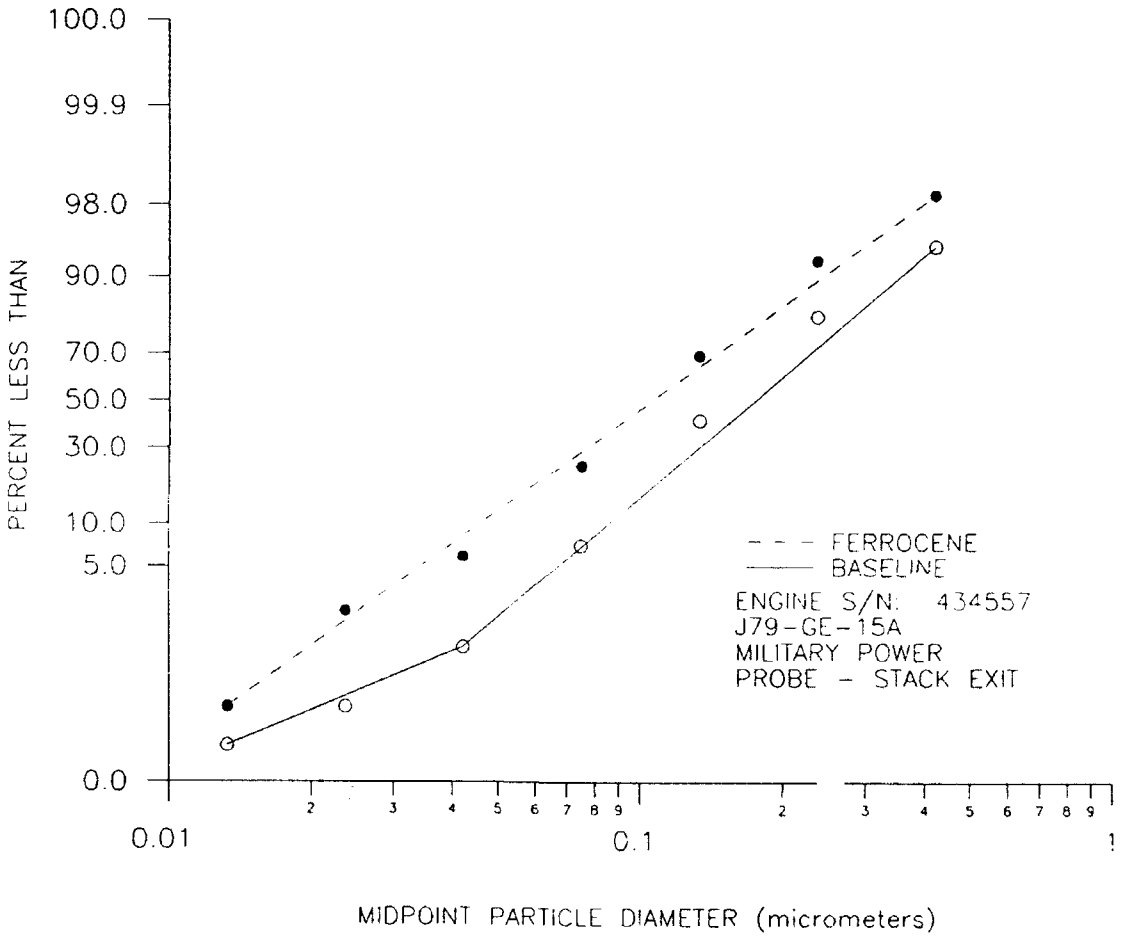

Figure 35. Cumulative Mass Distribution by Volume.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - MILITARY - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 2

FILES INCLUDED:
A:D9MAC-00.3 A:D9MAC-02.0

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.119	137.95	0.01	0.01
2.371375E-02	0.471	56.01	0.05	0.06
4.216968E-01	4.909	58.47	0.53	0.60
7.498948E-01	88.373	62.23	9.62	10.22
0.1333522	429.676	33.51	46.76	56.98
0.2371376	296.439	14.82	32.26	89.24
0.4216968	76.383	10.41	8.31	97.56
0.7498948	22.461	28.50	2.44	100.00
TOTAL =	229.708			

MEAN-DIA = 0.1731112 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - MILITARY - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 2

FILES INCLUDED:
A:D9MAC-10.1 A:D9MAC-11.7

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.048	2073.85	0.01	0.01
2.371375E-02	0.480	2284.50	0.05	0.06
4.216968E-01	3.748	1085.93	0.41	0.47
7.498948E-01	53.712	560.42	5.89	6.36
0.1333522	324.029	214.87	35.56	41.92
0.2371376	356.404	136.82	39.11	81.03
0.4216968	124.130	135.10	13.62	94.65
0.7498948	48.783	211.95	5.35	100.00
TOTAL =	227.834			

MEAN-DIA = 0.2059592 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - MILITARY - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-00.7 A:D9MAC-00.9 A:D9MAC-01.6
A:D9MAC-01.8

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.090	146.13	0.02	0.02
2.371375E-02	3.277	21.72	0.69	0.71
4.216968E-01	9.205	40.59	1.94	2.65
7.498948E-01	64.909	64.93	13.70	16.35
0.1333522	206.809	47.42	43.65	60.00
0.2371376	139.217	25.49	29.38	89.38
0.4216968	37.933	14.95	8.01	97.39
0.7498948	12.380	34.79	2.61	100.00
TOTAL =	118.455			

MEAN-DIA = 0.1617115 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - MILITARY - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-10.6 A:D9MAC-10.8 A:D9MAC-11.2
A:D9MAC-11.4

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.188	348.90	0.06	0.06
2.371375E-02	4.343	153.74	1.29	1.34
4.216968E-01	12.191	218.59	3.62	4.96
7.498948E-01	65.576	288.39	19.46	24.42
0.1333522	146.833	375.59	43.58	68.00
0.2371376	83.520	593.08	24.79	92.79
0.4216968	18.996	1063.15	5.64	98.43
0.7498948	5.302	1939.36	1.57	100.00
TOTAL =	84.237			

MEAN-DIA = 0.1412493 MICROMETERS

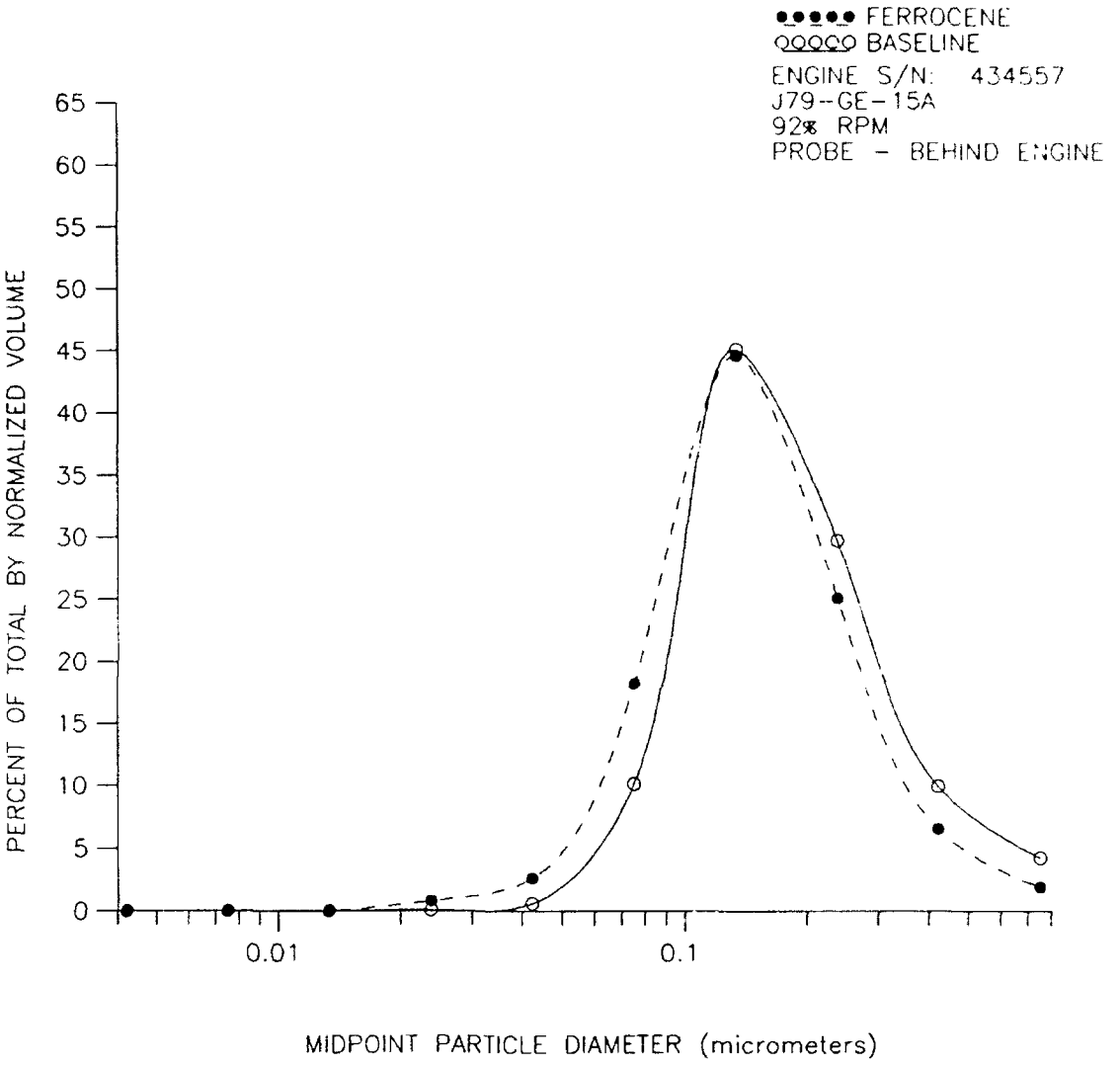

FIGURE 36. Particle Diameter vs Percent of Total by Normalized Volume.

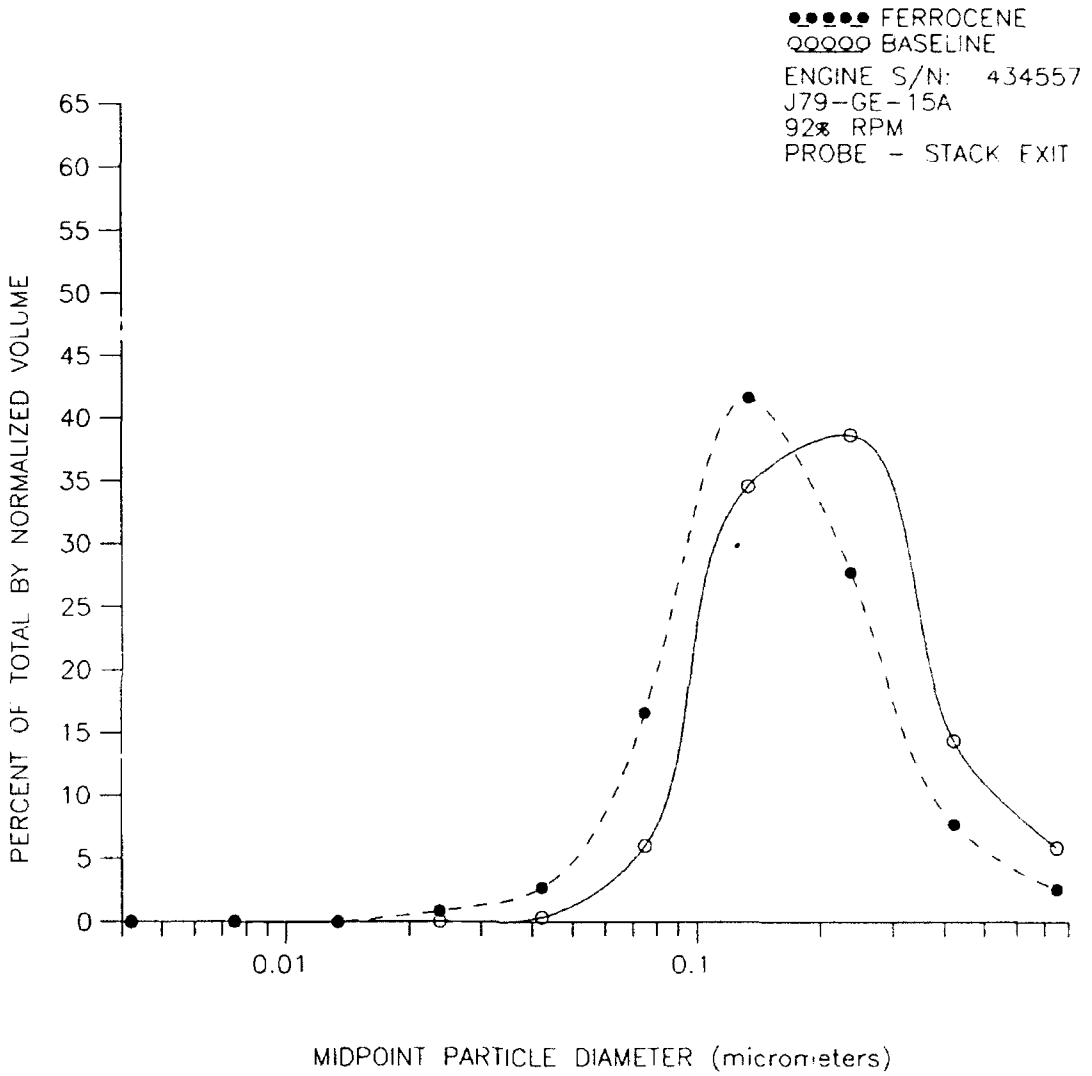

FIGURE 37. Particle Diameter vs Percent of Total by Normalized Volume.

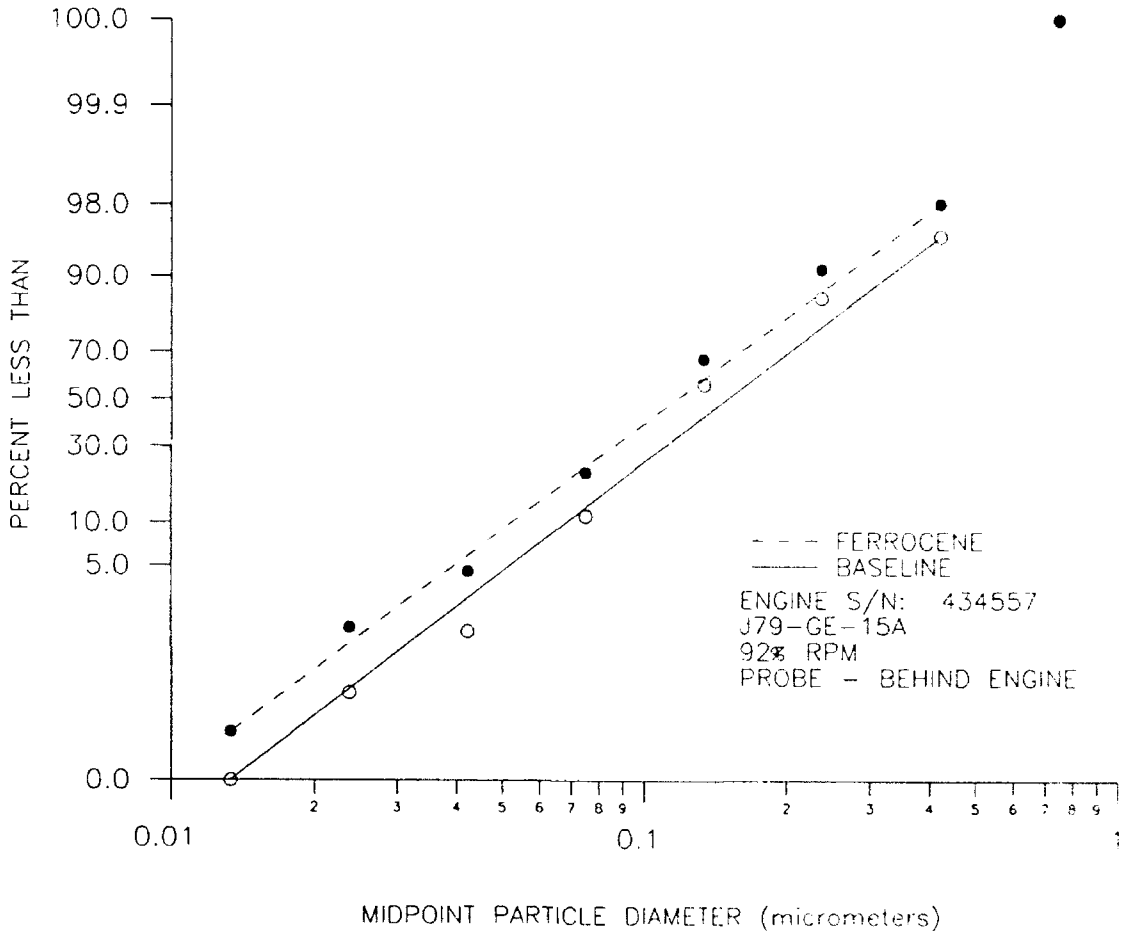

Figure 38. Cumulative Mass Distribution by Volume.

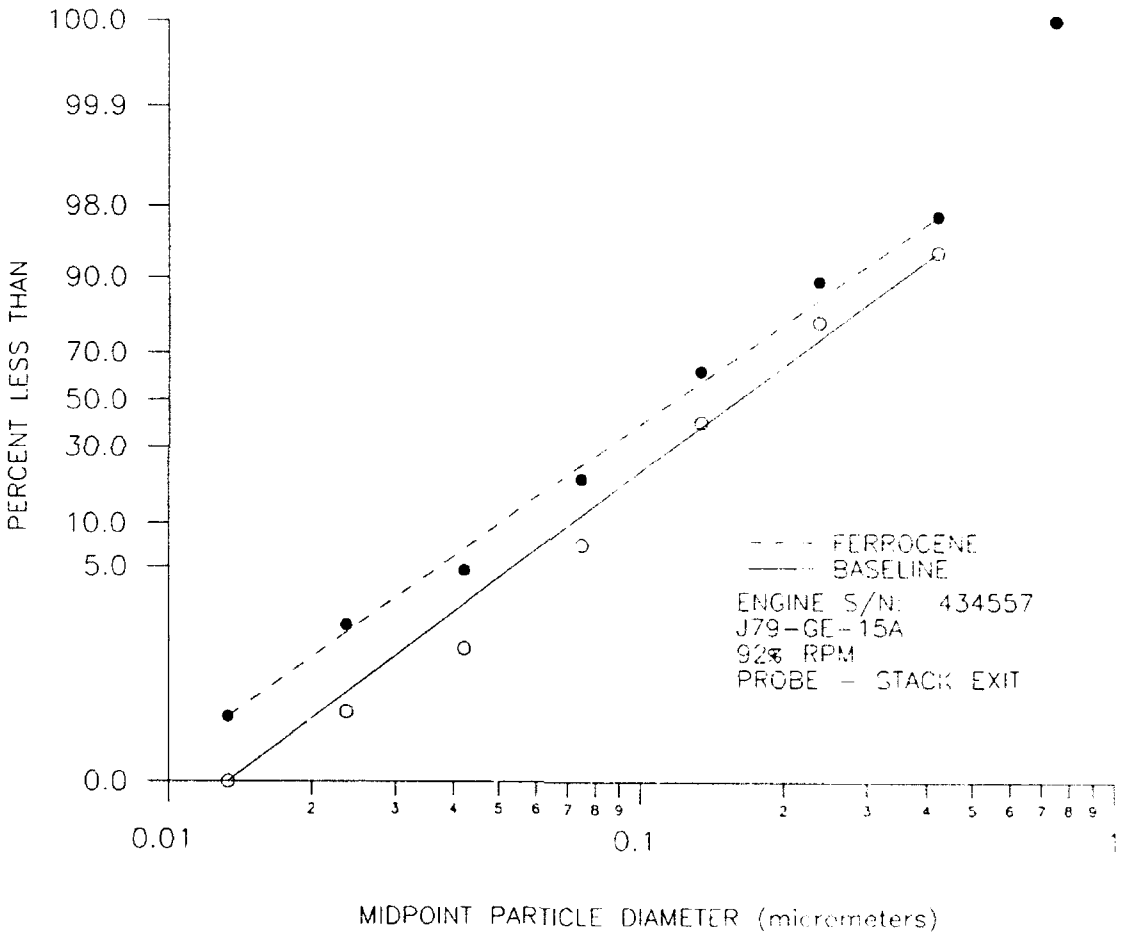

Figure 39. Cumulative Mass Distribution by Volume.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 92% RPM - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 2

FILES INCLUDED:
A:D9MAC-00.6 A:D9MAC-02.1

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.050	594.15	0.00	0.00
2.371375E-02	0.957	176.56	0.09	0.10
4.216968E-01	6.493	126.55	0.63	0.72
7.498948E-01	105.357	102.79	10.16	10.89
0.1333522	467.719	51.65	45.12	56.01
0.2371376	308.477	29.36	29.76	85.77
0.4216968	103.366	16.34	9.97	95.74
0.7498948	44.189	26.58	4.26	100.00
TOTAL =	259.152			

MEAN-DIA = 0.1786254 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 92% RPM - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 2

FILES INCLUDED:
A:D9MAC-10.3 A:D9MAC-11.8

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.039	2829.21	0.00	0.00
2.371375E-02	0.507	2246.93	0.05	0.05
4.216968E-01	4.168	1053.28	0.40	0.45
7.498948E-01	62.790	545.17	6.01	6.47
0.1333522	361.296	271.18	34.61	41.08
0.2371376	403.771	218.42	38.68	79.75
0.4216968	150.194	247.75	14.39	94.14
0.7498948	61.148	318.35	5.86	100.00
TOTAL =	260.979			

MEAN-DIA = 0.2089932 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 92% RPM - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-01.0 A:D9MAC-01.5 A:D9MAC-01.7

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.097	230.41	0.02	0.02
2.371375E-02	3.298	54.28	0.81	0.83
4.216968E-01	10.755	79.43	2.64	3.48
7.498948E-01	74.248	114.35	18.24	21.71
0.1333522	181.842	95.47	44.66	66.37
0.2371376	102.263	61.74	25.12	91.49
0.4216968	26.724	44.95	6.56	98.05
0.7498948	7.924	107.02	1.95	100.00
TOTAL =	101.788			

MEAN-DIA = 0.1479433 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 92% RPM - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-10.7 A:D9MAC-11.1 A:D9MAC-11.3

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.136	575.47	0.04	0.04
2.371375E-02	3.295	256.34	0.87	0.90
4.216968E-01	10.357	319.15	2.73	3.63
7.498948E-01	63.143	387.56	16.62	20.25
0.1333522	158.342	449.92	41.67	61.92
0.2371376	105.486	605.07	27.76	89.68
0.4216968	29.379	892.17	7.73	97.42
0.7498948	9.815	1374.85	2.58	100.00
TOTAL =	94.988			

MEAN-DIA = 0.1550266 MICROMETERS

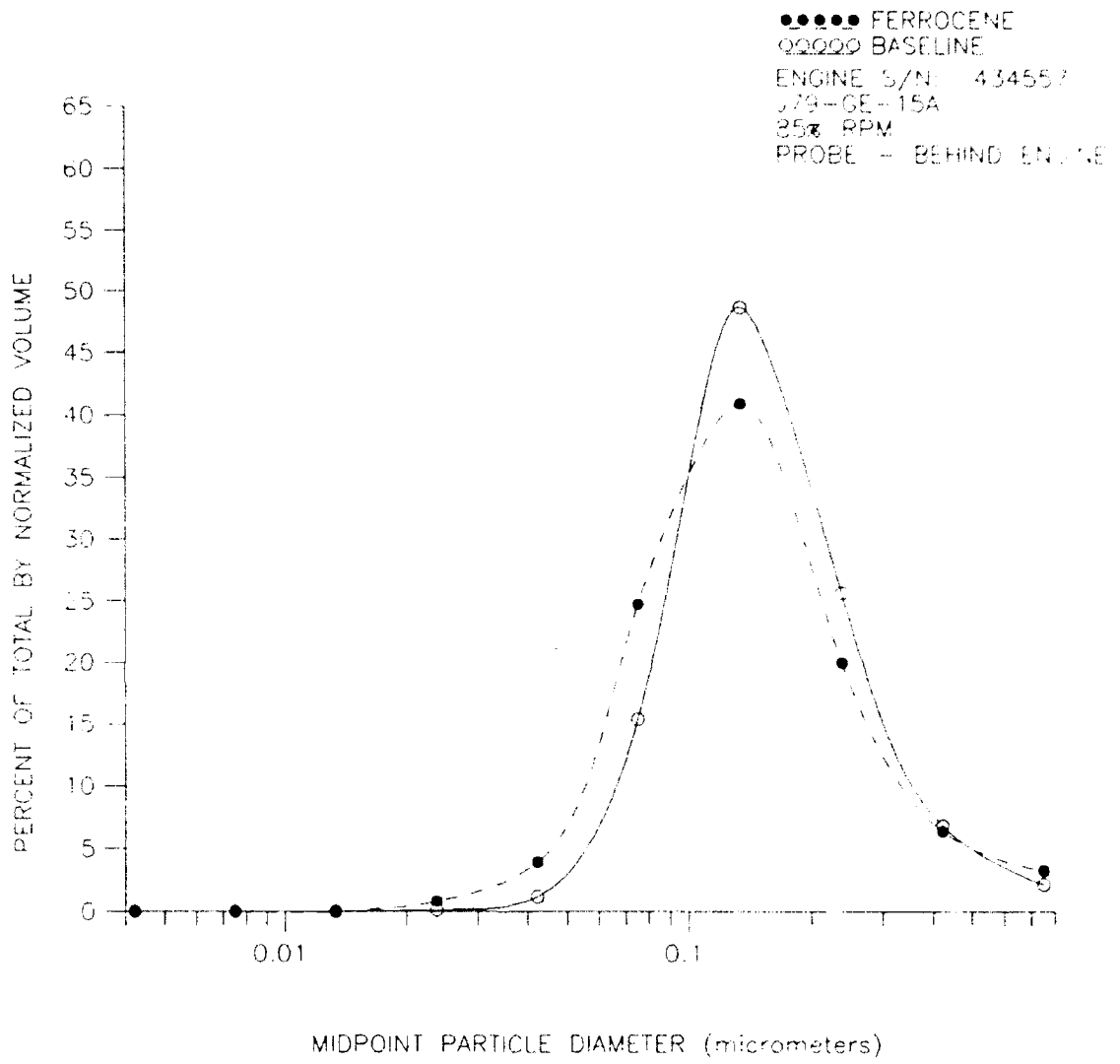

FIGURE 40. Particle Diameter vs Percent of Total by Normalized Volume.

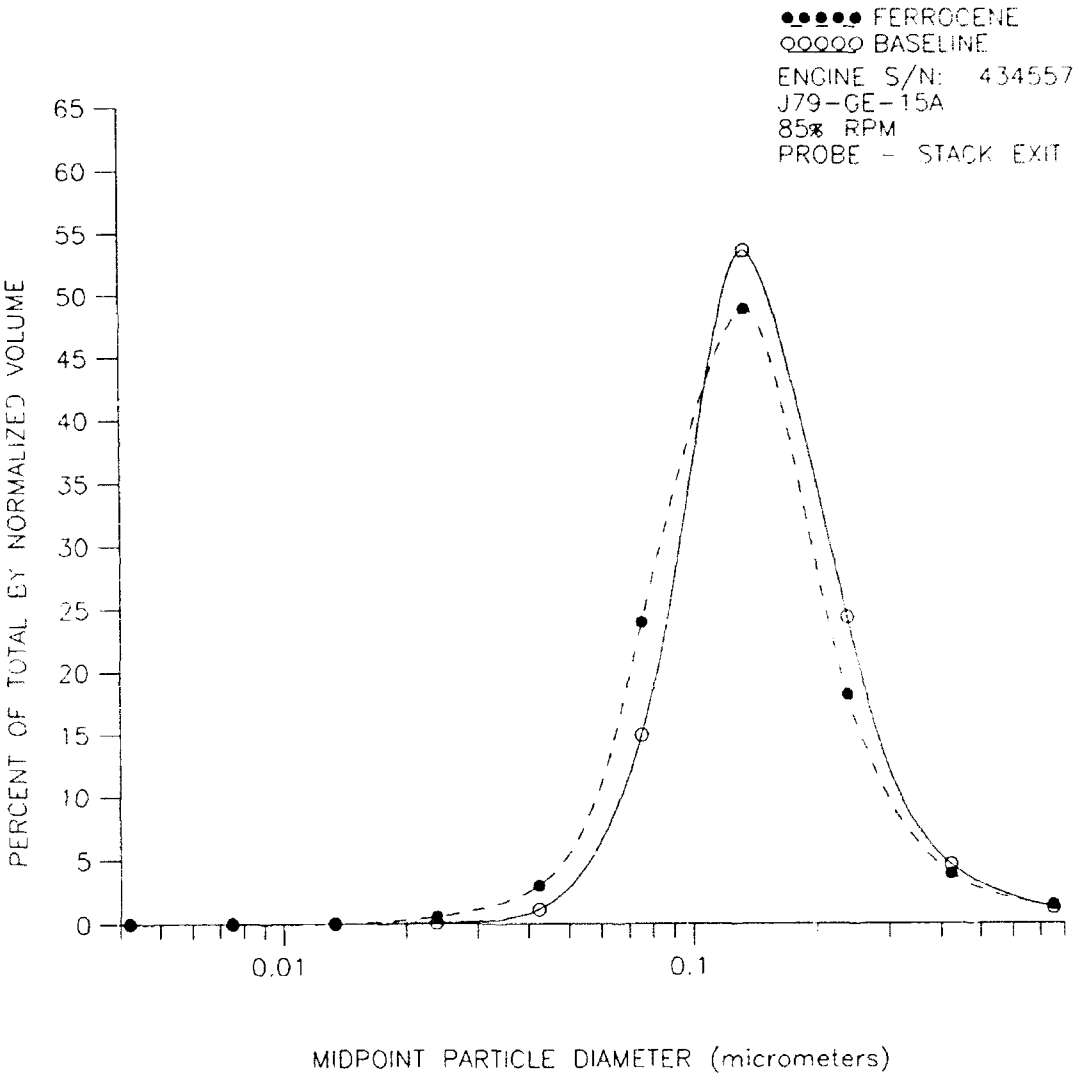

FIGURE 41. Particle Diameter vs Percent of Total by Normalized Volume.

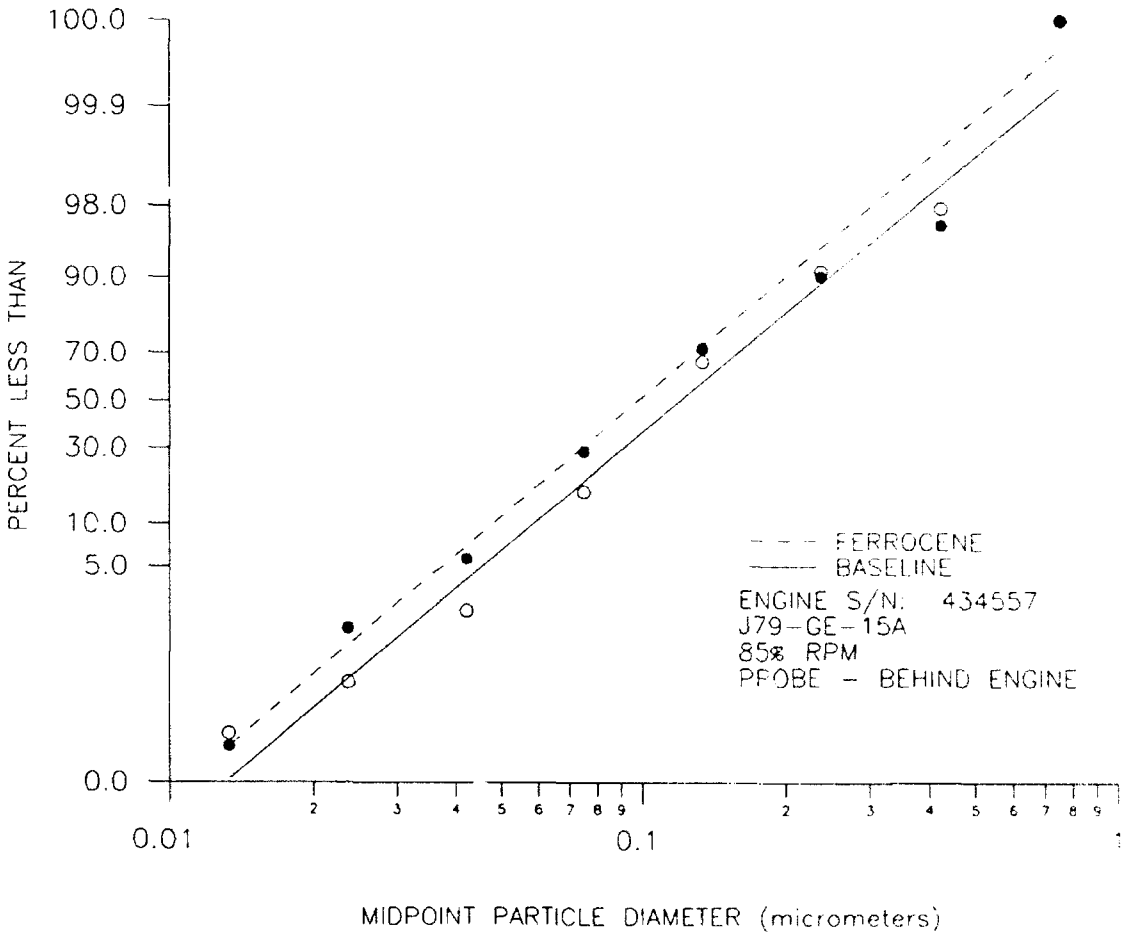

Figure 42. Cumulative Mass Distribution by Volume.

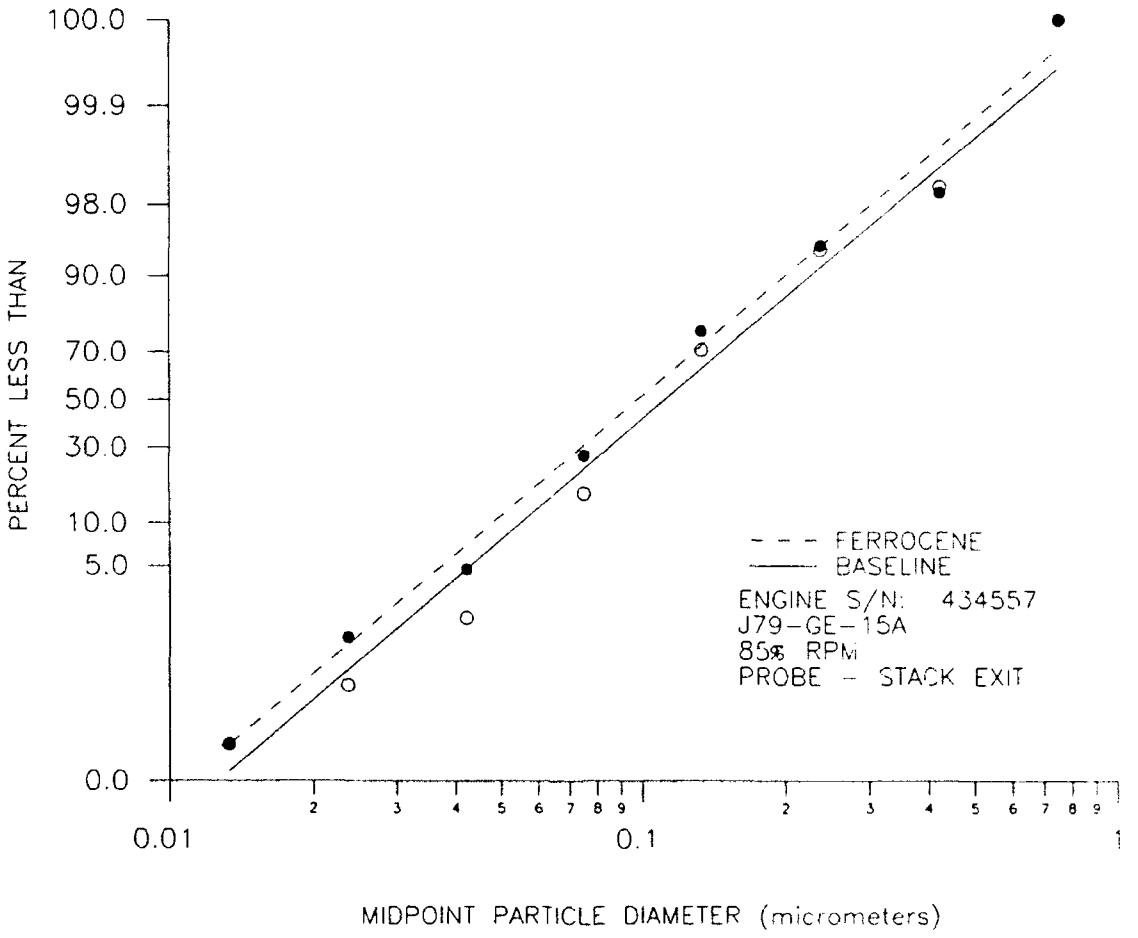

Figure 43. Cumulative Mass Distribution by Volume.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 85% RPM - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-00.1 A:D9MAC-00.2 A:D9MAC-00.5
A:D9MAC-01.9

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.109	182.30	0.02	0.02
2.371375E-02	0.961	154.60	0.13	0.15
4.216968E-01	8.497	89.97	1.18	1.33
7.498948E-01	111.100	80.93	15.39	16.72
0.1333522	351.192	50.75	48.65	65.36
0.2371376	185.286	33.82	25.67	91.03
0.4216968	49.095	38.10	6.80	97.83
0.7498948	15.647	60.85	2.17	100.00
TOTAL =	180.472			

MEAN-DIA = 0.1562853 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 85% RPM - BASELINE FOR FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-10.4 A:D9MAC-11.5 A:D9MAC-11.6

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.051	1384.22	0.01	0.01
2.371375E-02	0.809	937.70	0.12	0.13
4.216968E-01	7.815	372.08	1.15	1.27
7.498948E-01	101.807	223.01	14.94	16.22
0.1333522	364.759	163.75	53.54	69.75
0.2371376	166.005	275.72	24.36	94.12
0.4216968	31.482	581.12	4.62	98.74
0.7498948	8.607	1159.70	1.26	100.00
TOTAL =	170.334			

MEAN-DIA = 0.1494283 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 85% RPM - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-01.1 A:D9MAC-01.2 A:D9MAC-01.4

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.058	498.30	0.01	0.01
2.371375E-02	3.397	62.49	0.82	0.83
4.216968E-01	16.214	74.40	3.91	4.74
7.498948E-01	102.608	134.98	24.73	29.47
0.1333522	169.694	146.68	40.90	70.38
0.2371376	82.950	118.64	19.99	90.37
0.4216968	26.384	119.29	6.36	96.73
0.7498948	13.552	142.06	3.27	100.00
TOTAL =	103.714			

MEAN-DIA = 0.139197 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 85% RPM - FERROCENE - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-10.5 A:D9MAC-10.9 A:D9MAC-11.0

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.039	1881.07	0.01	0.01
2.371375E-02	2.405	323.27	0.61	0.61
4.216968E-01	11.964	251.92	3.01	3.62
7.498948E-01	95.377	249.65	23.97	27.60
0.1333522	194.424	348.16	48.87	76.47
0.2371376	72.261	829.50	18.16	94.63
0.4216968	15.593	1611.25	3.92	98.55
0.7498948	5.758	2288.62	1.45	100.00
TOTAL =	99.455			

MEAN-DIA = 0.1322083 MICROMETERS

CONTENTS OF SECTION:

NUMBER CONCENTRATION GRAPHICS
OF
PERCENT FREQUENCY VS MID-POINT DIAMETER
&
CUMULATION MASS DISTRIBUTION VS MID-POINT DIAMETER

1. Graphics

Baseline	Cerium Additive
Military	Military
92% RPM	92% RPM
85% RPM	85% RPM

2. All averaged summary data sheets.

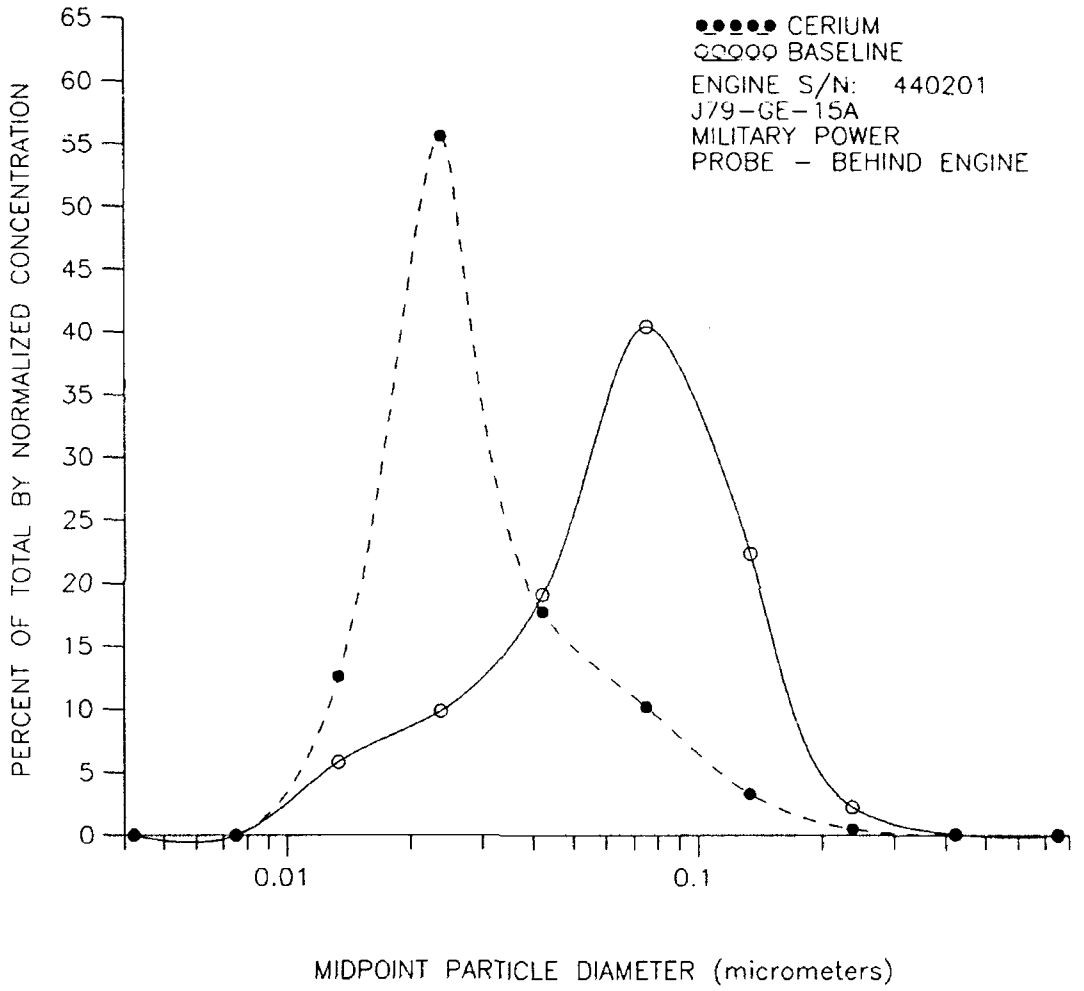

Figure 44. Particle Diameter vs Percent of Total by Normalized Concentration.

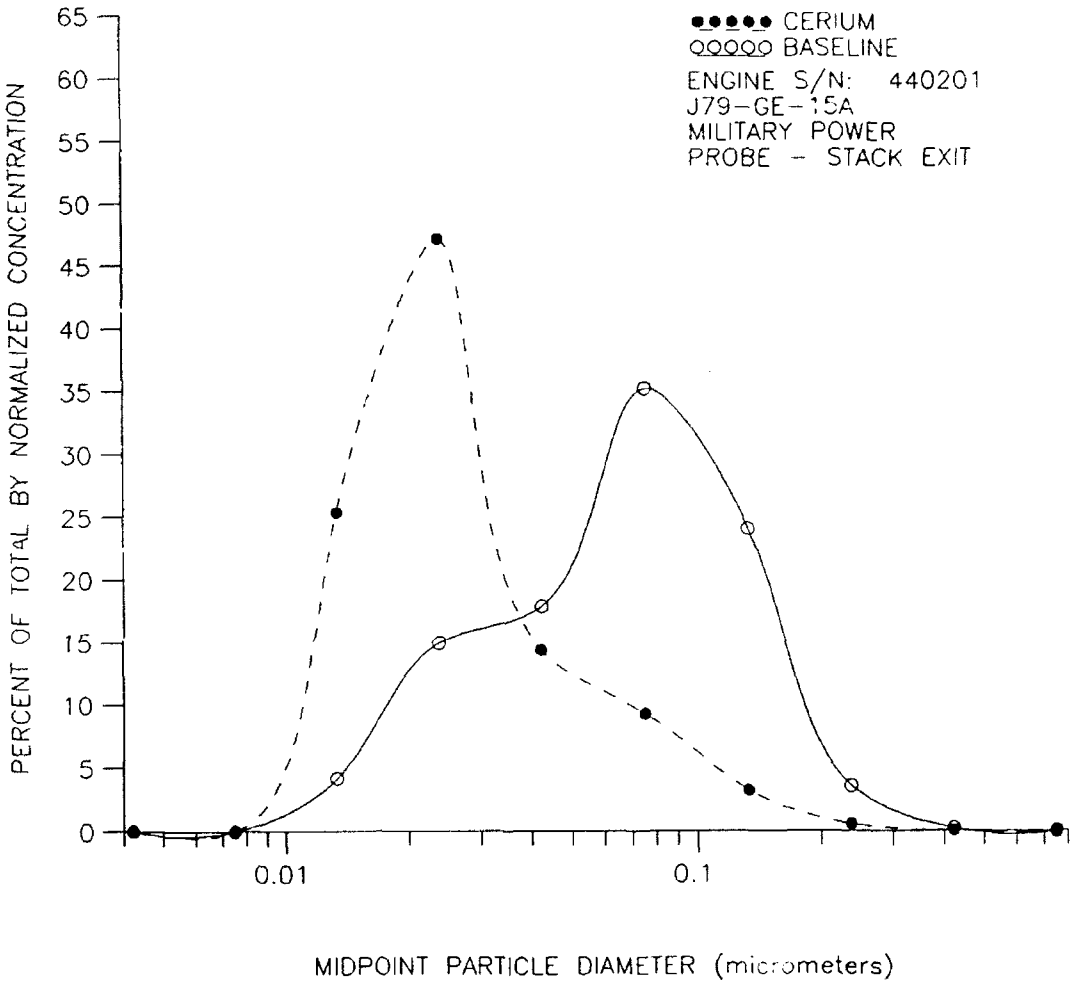

Figure 45. Particle Diameter vs Percent of Total by Normalized Concentration.

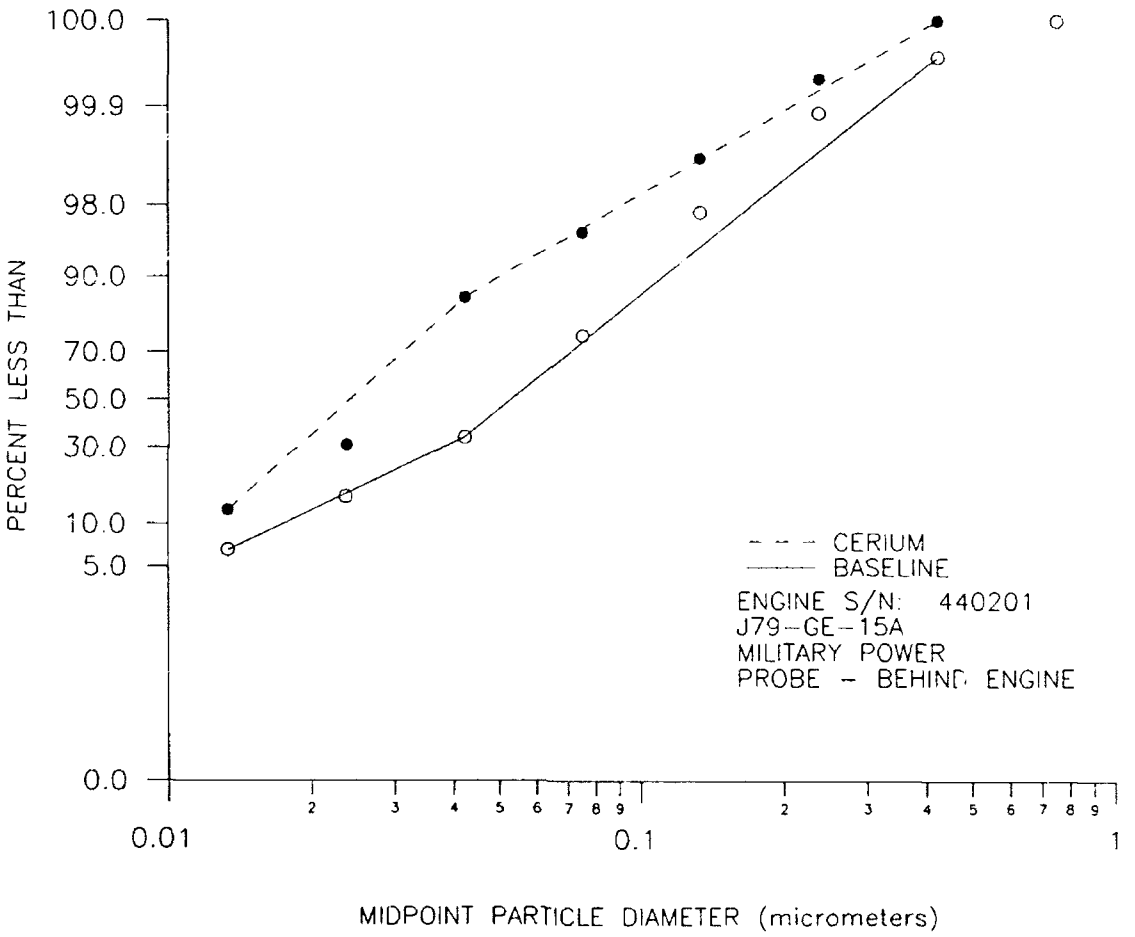

Figure 46. Cumulative Mass Distribution by Number Concentration.

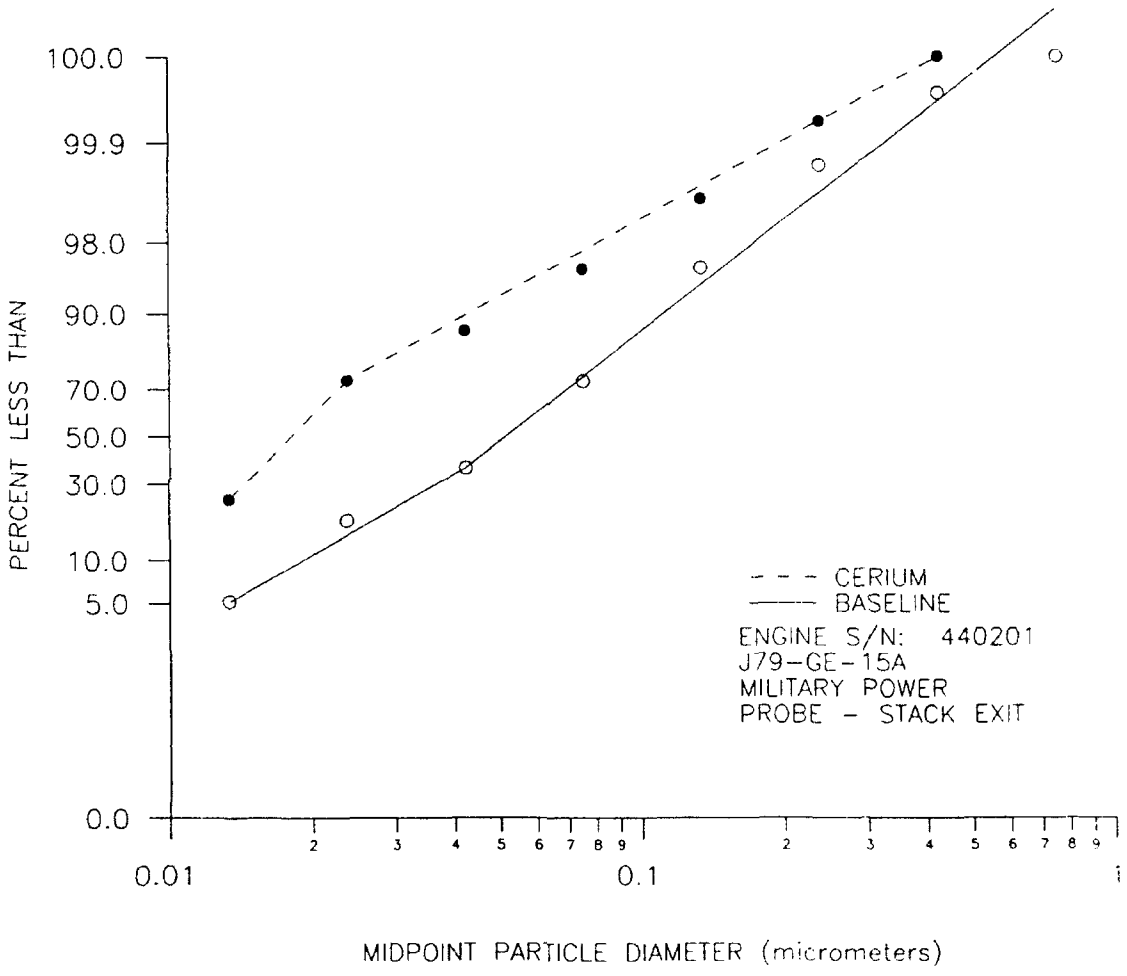

Figure 47. Cumulative Mass Distribution by Number Concentration.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - MILITARY - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-02.4 A:D9MAC-02.8 A:D9MAC-04.5
A:D9MAC-04.7

----------FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	72812.539	284.31	5.83	5.83
2.371375E-02	123084.406	207.74	9.86	15.70
4.216968E-01	238659.141	105.28	19.12	34.82
7.498948E-01	504633.910	96.73	40.44	75.26
0.1333522	279098.030	64.08	22.36	97.62
0.2371376	28261.908	54.66	2.26	99.88
0.4216968	1342.861	69.74	0.11	99.99
0.7498948	109.976	105.86	0.01	100.00

TOTAL = 312000.72

MEAN-DIA = 6.342332E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - MILITARY - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-11.9 A:D9MAC-14.0 A:D9MAC-14.2

----------FINAL AVERAGED NORMALIZED CONCENTRATION ---------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	51323.383	1391.48	4.16	4.16
2.371375E-02	184255.141	734.77	14.93	19.09
4.216968E-01	220444.531	446.62	17.87	36.96
7.498948E-01	434590.840	292.10	35.22	72.19
0.1333522	296546.220	216.81	24.04	96.22
0.2371376	43997.977	230.90	3.57	99.79
0.4216968	2477.279	300.81	0.20	99.99
0.7498948	151.226	440.39	0.01	100.00

TOTAL = 308446.62

MEAN-DIA = 6.368107E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - MILITARY - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 5

FILES INCLUDED:
A:D9MAC-02.9 A:D9MAC-03.2 A:D9MAC-03.6
A:D9MAC-03.8 A:D9MAC-04.0

----------FINAL AVERAGED NORMALIZED CONCENRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	238729.766	101.97	12.60	12.60
2.371375E-02	1053069.120	46.49	55.56	68.16
4.216968E-01	336102.280	102.19	17.73	85.89
7.498948E-01	193797.422	252.63	10.22	96.12
0.1333522	63361.133	251.46	3.34	99.46
0.2371376	9674.417	144.38	0.51	99.97
0.4216968	560.108	151.24	0.03	100.00
0.7498948	35.399	313.71	0.00	100.00

TOTAL = 473832.44

MEAN-DIA = 2.948108E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - MILITARY - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 7

FILES INCLUDED:

A:D9MAC-12.6 A:D9MAC-12.6A A:D9MAC-12.6B
A:D9MAC-12.9 A:D9MAC-13.2 A:D9MAC-13.4
A:D9MAC-13.6

----------FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	935188.310	87.81	25.37	25.37
2.371375E-02	1737008.000	96.11	47.12	72.49
4.216968E-01	530820.940	168.66	14.40	86.89
7.498948E-01	342537.190	260.78	9.29	96.19
0.1333522	118330.602	332.48	3.21	99.40
0.2371376	20647.557	329.18	0.56	99.96
0.4216968	1463.706	360.62	0.04	100.00
0.7498948	87.749	487.01	0.00	100.00

TOTAL = 921520.88

MEAN-DIA = 2.656125E-02 MICROMETERS

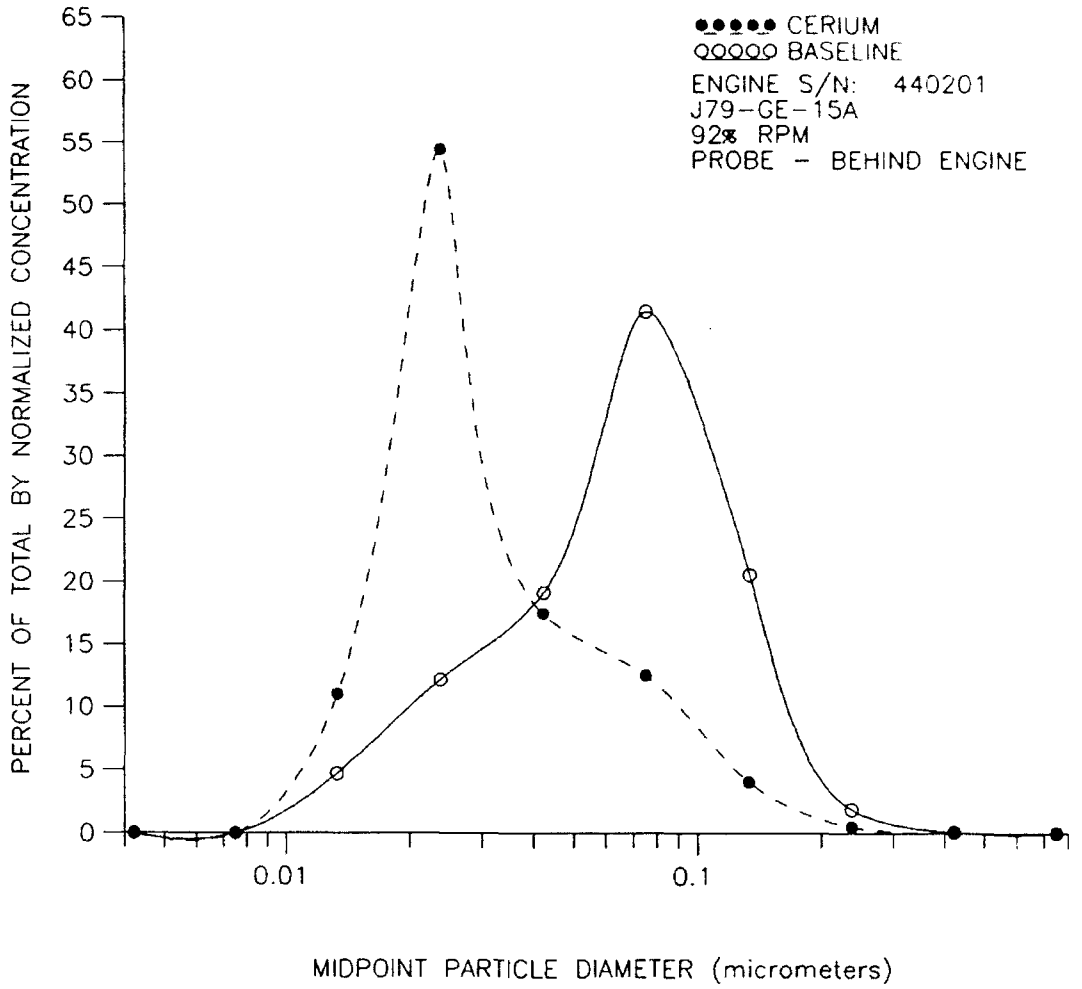

Figure 48. Particle Diameter vs Percent of Total by Normalized Concentration.

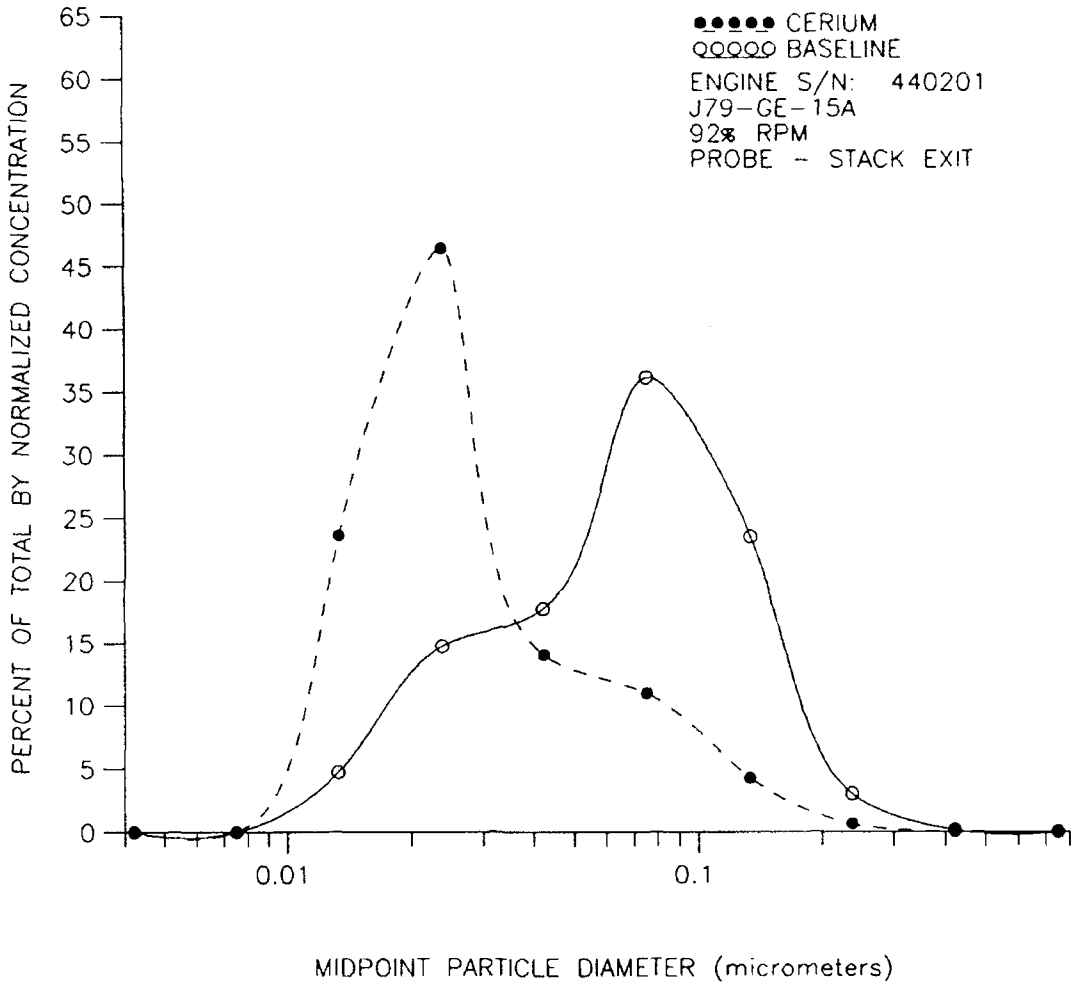

Figure 49. Particle Diameter vs Percent of Total by Normalized Concentration.

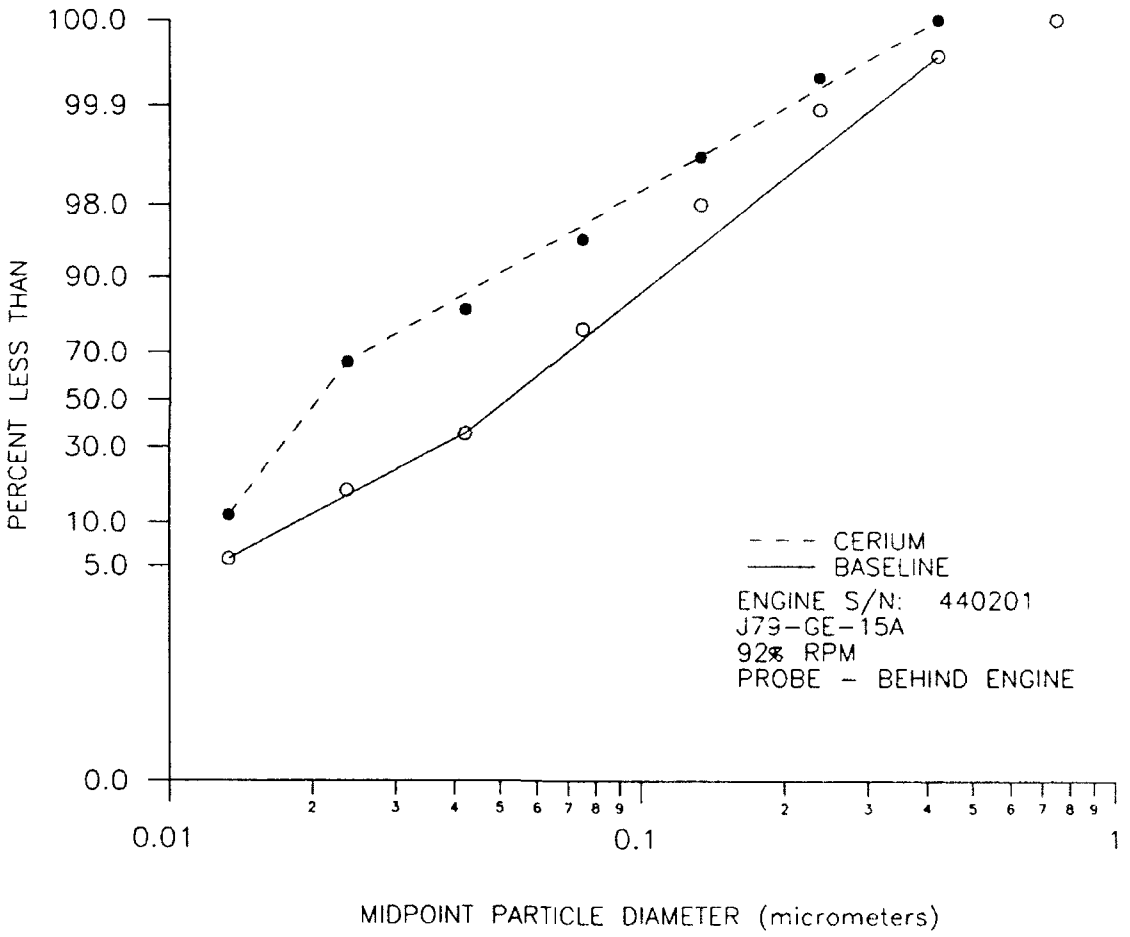

Figure 50. Cumulative Mass Distribution by Number Concentration.

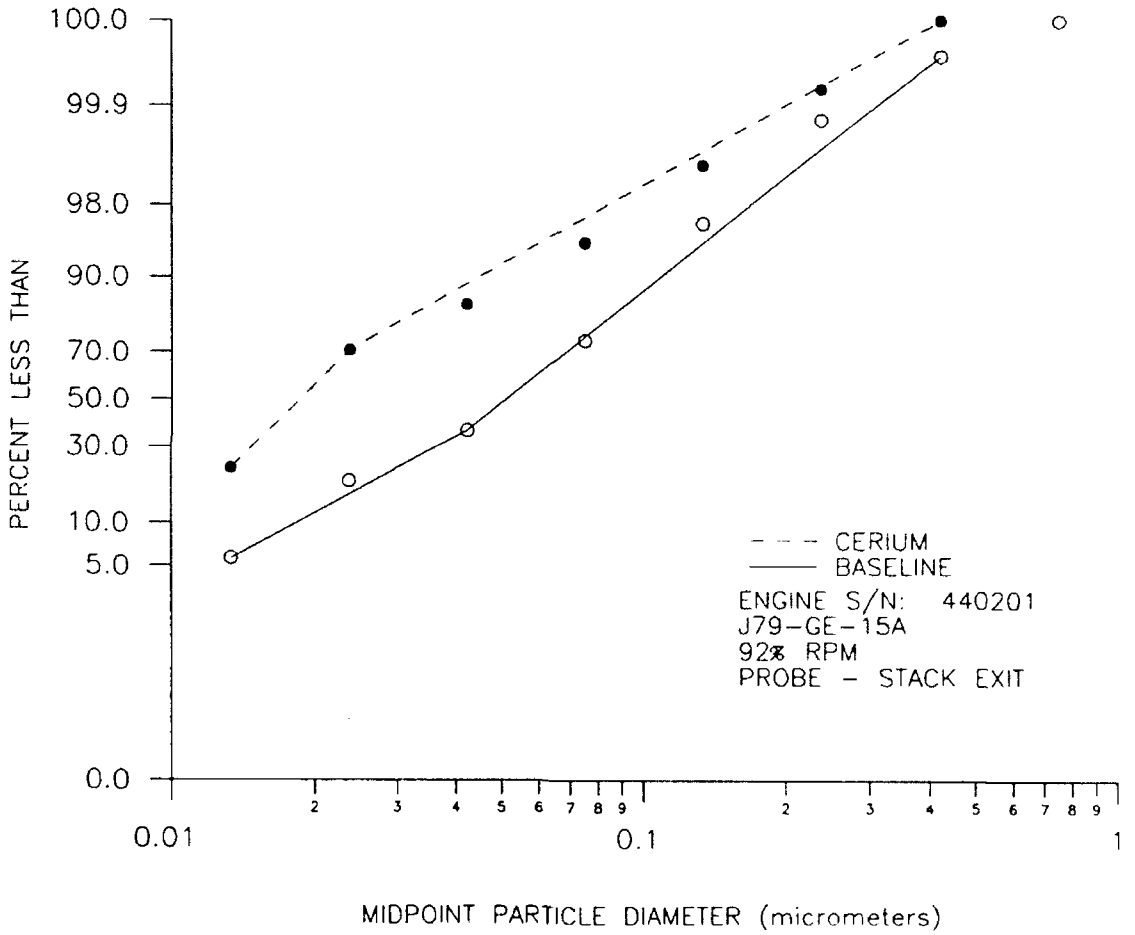

Figure 51. Cumulative Mass Distribution by Number Concentration.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 92% RPM - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-02.3 A:D9MAC-04.3 A:D9MAC-04.6

----------FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	56212.109	799.91	4.70	4.70
2.371375E-02	145555.734	599.07	12.16	16.86
4.216968E-01	228960.359	262.95	19.14	36.00
7.498948E-01	496038.530	175.53	41.46	77.45
0.1333522	245865.953	139.96	20.55	98.00
0.2371376	22613.619	146.65	1.89	99.89
0.4216968	1177.050	150.25	0.10	99.99
0.7498948	104.970	224.61	0.01	100.00

TOTAL = 299132.09

MEAN-DIA = 6.205106E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 92% RPM - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-12.0 A:D9MAC-13.8 A:D9MAC-14.1

----------FINAL AVERAGED NORMALIZED CONCENTRATION ---------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	58285.484	1259.45	4.72	4.72
2.371375E-02	182116.953	784.77	14.76	19.48
4.216968E-01	218902.719	484.39	17.74	37.22
7.498948E-01	445559.810	310.29	36.11	73.33
0.1333522	289922.530	233.40	23.49	96.82
0.2371376	37324.477	287.84	3.02	99.84
0.4216968	1828.569	435.54	0.15	99.99
0.7498948	102.375	687.10	0.01	100.00

TOTAL = 308510.72

MEAN-DIA = 6.258826E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 92% RPM - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-03.0 A:D9MAC-03.1 A:D9MAC-03.5
A:D9MAC-03.9

----------FINAL AVERAGED NORMALIZED CONCENRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	204188.453	197.88	11.03	11.03
2.371375E-02	1006019.880	77.62	54.37	65.40
4.216968E-01	323234.660	159.01	17.47	82.87
7.498948E-01	232056.578	291.17	12.54	95.41
0.1333522	74863.664	352.93	4.05	99.46
0.2371376	9415.903	273.75	0.51	99.97
0.4216968	589.057	236.16	0.03	100.00
0.7498948	50.946	367.58	0.00	100.00

TOTAL = 462604.78

MEAN-DIA = 3.087869E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 92% RPM - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-12.7 A:D9MAC-12.8 A:D9MAC-13.1
A:D9MAC-13.5

----------FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	807768.810	105.04	23.56	23.56
2.371375E-02	1591031.250	115.84	46.41	69.98
4.216968E-01	482500.880	255.16	14.08	84.05
7.498948E-01	376080.440	380.73	10.97	95.02
0.1333522	146601.844	429.04	4.28	99.30
0.2371376	22519.963	469.15	0.66	99.95
0.4216968	1452.625	560.28	0.04	100.00
0.7498948	91.242	756.17	0.00	100.00

TOTAL = 857011.75

MEAN-DIA = 0.0278834 MICROMETERS

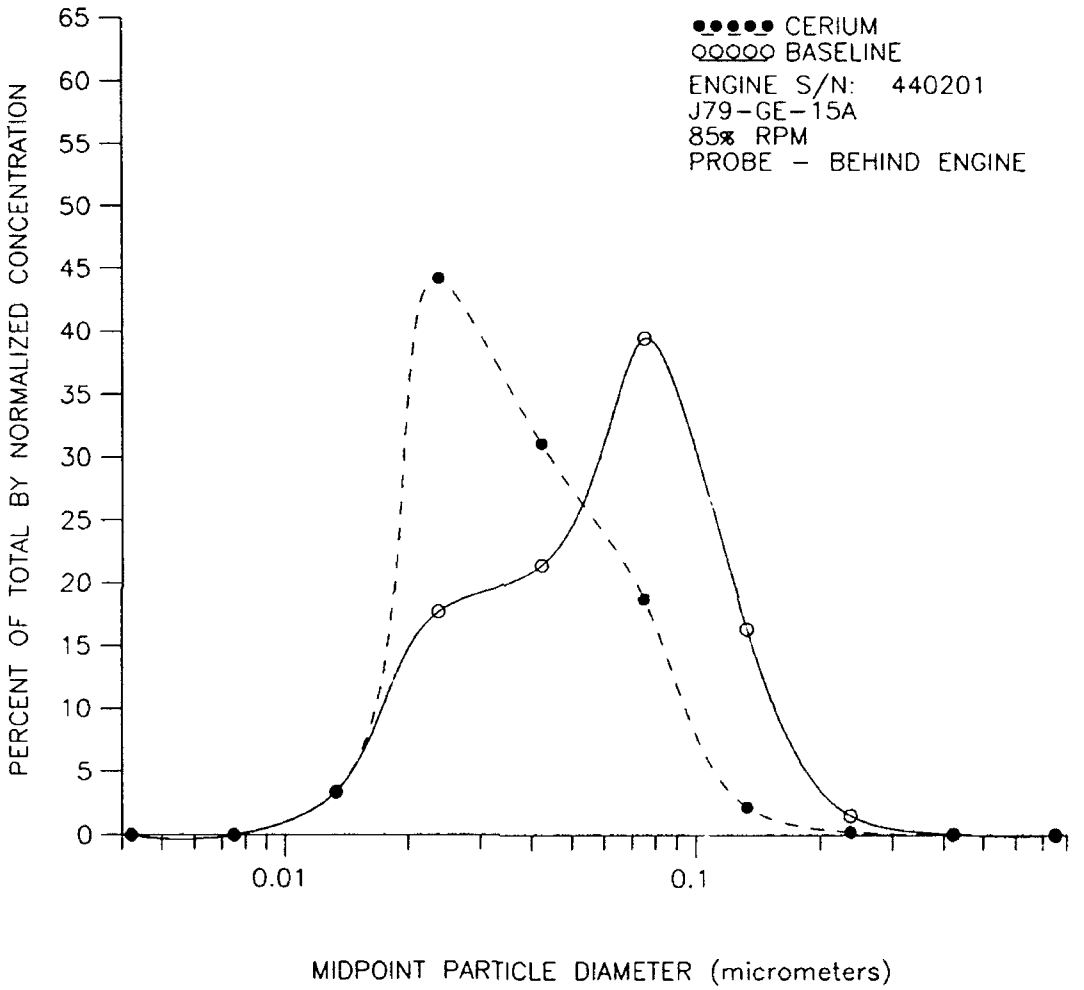

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Figure 52. Particle Diameter vs Percent of Total by Normalized Concentration.

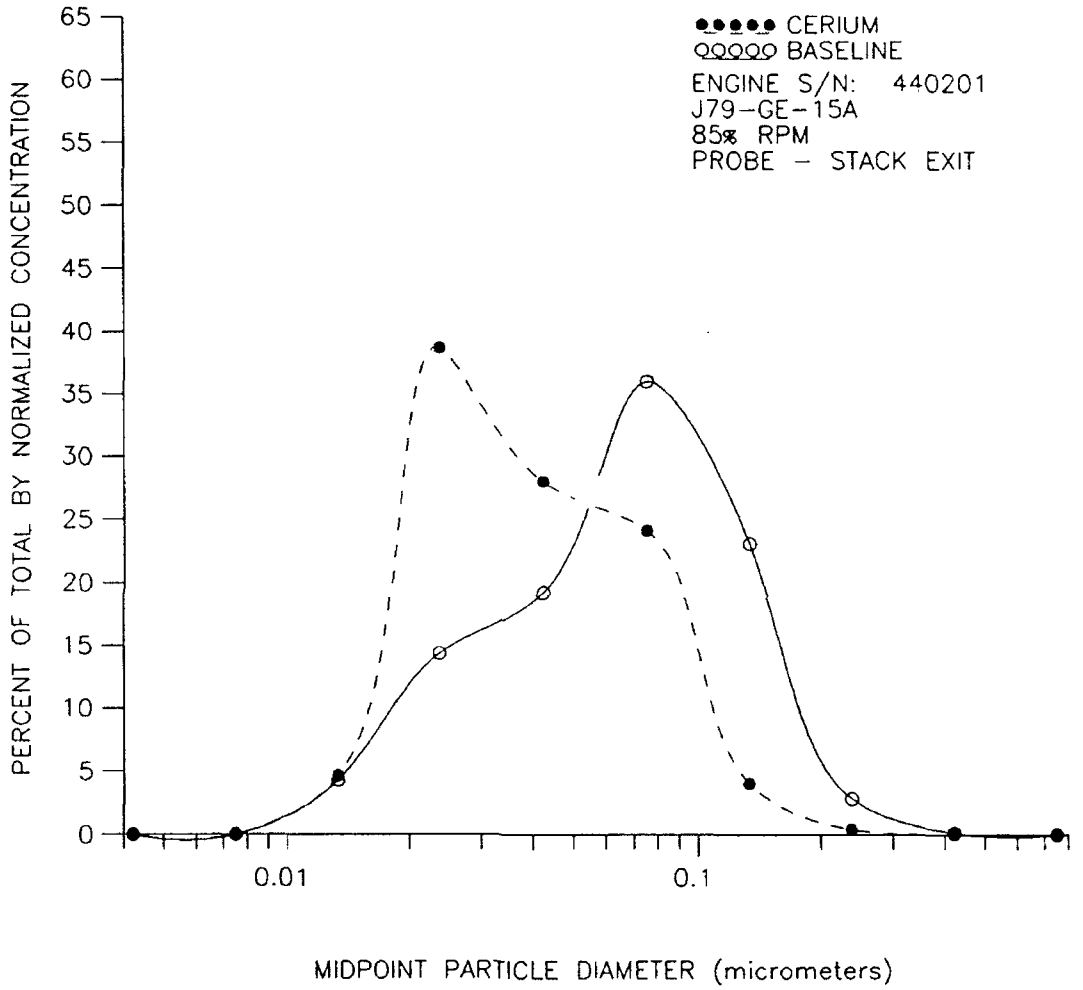

Figure 53. Particle Diameter vs Percent of Total by Normalized Concentration.

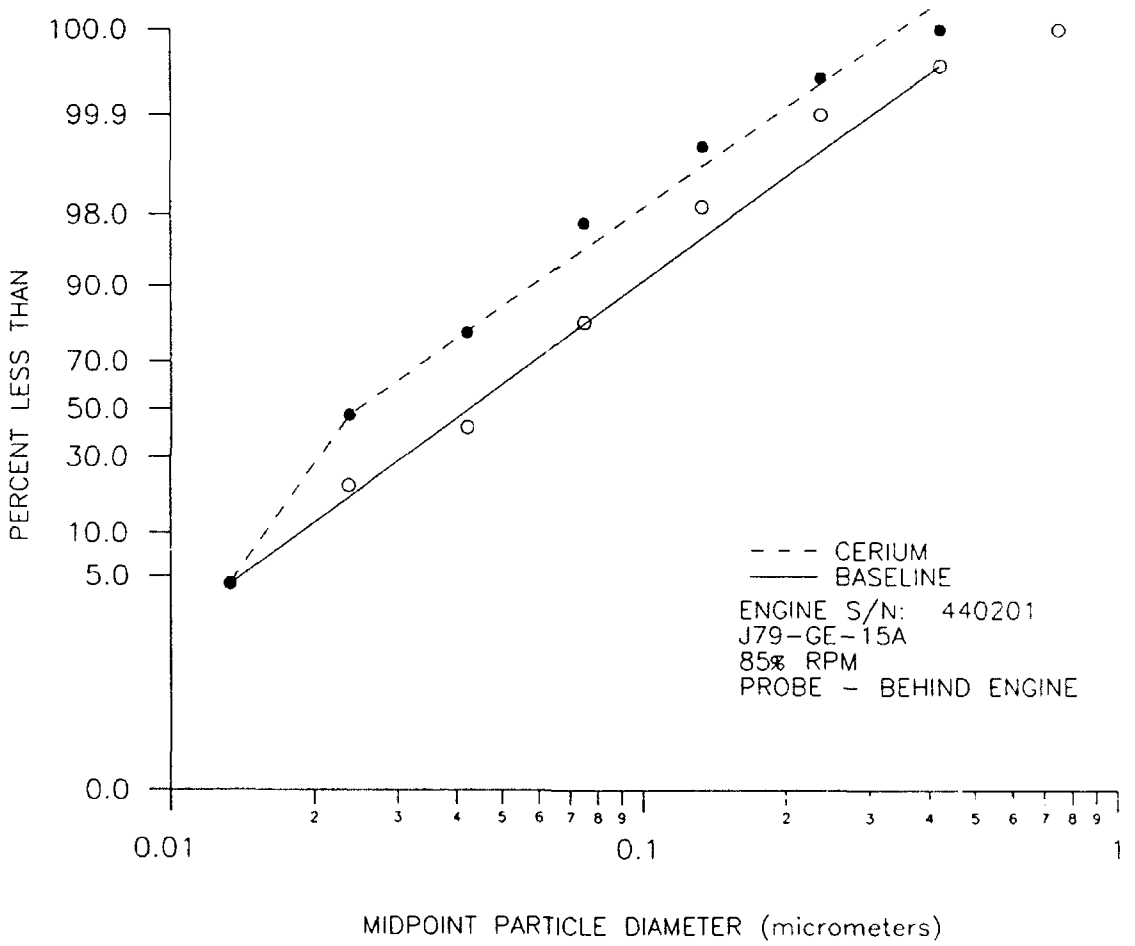

Figure 54. Cumulative Mass Distribution by Number Concentration.

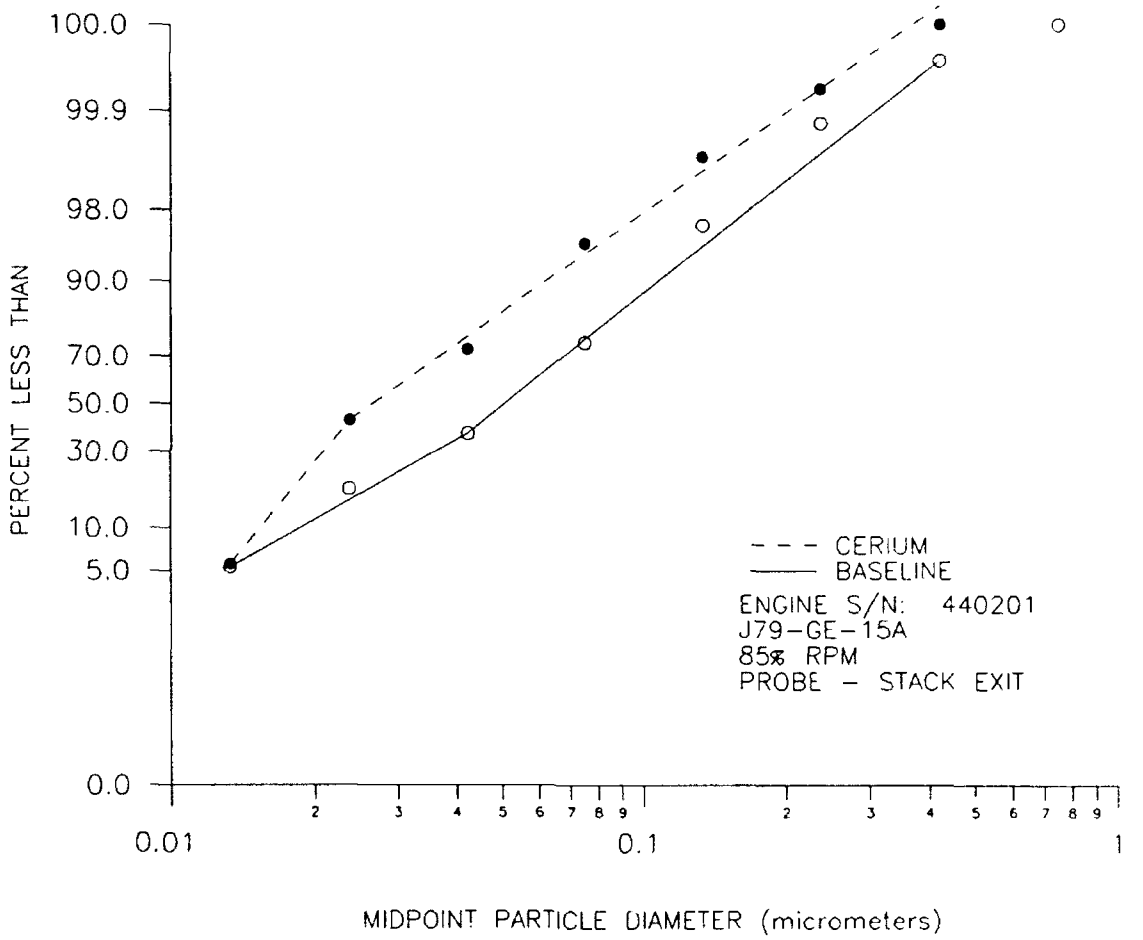

Figure 55. Cumulative Mass Distribution by Number Concentration.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 85% RPM - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-02.5 A:D9MAC-04.1 A:D9MAC-04.4

----------FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	34965.070	1196.22	3.39	3.39
2.371375E-02	182404.266	463.43	17.69	21.09
4.216968E-01	220748.000	266.70	21.41	42.50
7.498948E-01	407001.340	205.19	39.48	81.98
0.1333522	168803.672	175.83	16.37	98.35
0.2371376	15914.643	175.45	1.54	99.90
0.4216968	964.313	173.89	0.09	99.99
0.7498948	92.343	213.88	0.01	100.00

TOTAL = 257723.42

MEAN-DIA = 5.714873E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 85% RPM - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 5

FILES INCLUDED:
A:D9MAC-12.1 A:D9MAC-12.2 A:D9MAC-12.5
A:D9MAC-13.7 A:D9MAC-13.9

----------FINAL AVERAGED NORMALIZED CONCENTRATION ---------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	481282.785	943.45	4.34	4.34
2.371375E-02	159389.781	591.80	14.37	18.71
4.216968E-01	213019.859	344.01	19.20	37.91
7.498948E-01	399390.340	241.03	36.00	73.91
0.1333522	256020.906	178.98	23.08	96.99
0.2371376	31699.906	233.92	2.86	99.85
0.4216968	1599.059	346.98	0.14	99.99
0.7498948	85.601	557.70	0.01	100.00

TOTAL = 277347.06

MEAN-DIA = 6.247774E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 85% RPM - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-02.6 A:D9MAC-02.7 A:D9MAC-03.4
A:D9MAC-03.7

----------FINAL AVERAGED NORMALIZED CONCENRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	76280.578	290.12	3.46	3.46
2.371375E-02	975433.250	32.27	44.19	47.64
4.216968E-01	686765.190	46.98	31.11	78.75
7.498948E-01	413480.720	140.25	18.73	97.49
0.1333522	49101.715	387.35	2.22	99.71
0.2371376	5914.381	275.99	0.27	99.98
0.4216968	466.256	212.54	0.02	100.00
0.7498948	35.182	370.92	0.00	100.00

TOTAL = 551869.31

MEAN-DIA = 3.609465E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 85% RPM - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-12.3 A:D9MAC-12.4 A:D9MAC-13.0
A:D9MAC-13.3

----------FINAL AVERAGED NORMALIZED CONCENTRATION ----------

MID-PT-DIA	AVERAGE DN/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	102127.203	586.32	4.66	4.66
2.371375E-02	847935.060	170.93	38.69	43.35
4.216968E-01	613877.750	179.73	28.01	71.36
7.498948E-01	528367.310	258.80	24.11	95.47
0.1333522	89144.445	664.80	4.07	99.54
0.2371376	9226.988	1026.01	0.42	99.96
0.4216968	765.068	946.43	0.03	100.00
0.7498948	59.190	1060.25	0.00	100.00

TOTAL = 547875.75

MEAN-DIA = 3.882608E-02 MICROMETERS

CONTENTS OF SECTION:

SURFACE AREA GRAPHICS
OF
PERCENT FREQUENCY VS MID-POINT DIAMETER
&
CUMULATION MASS DISTRIBUTION VS MID-POINT DIAMETER

1. Graphics

Baseline	Cerium Additive
Military	Military
92% RPM	92% RPM
85% RPM	85% RPM

2. All averaged summary data sheets.

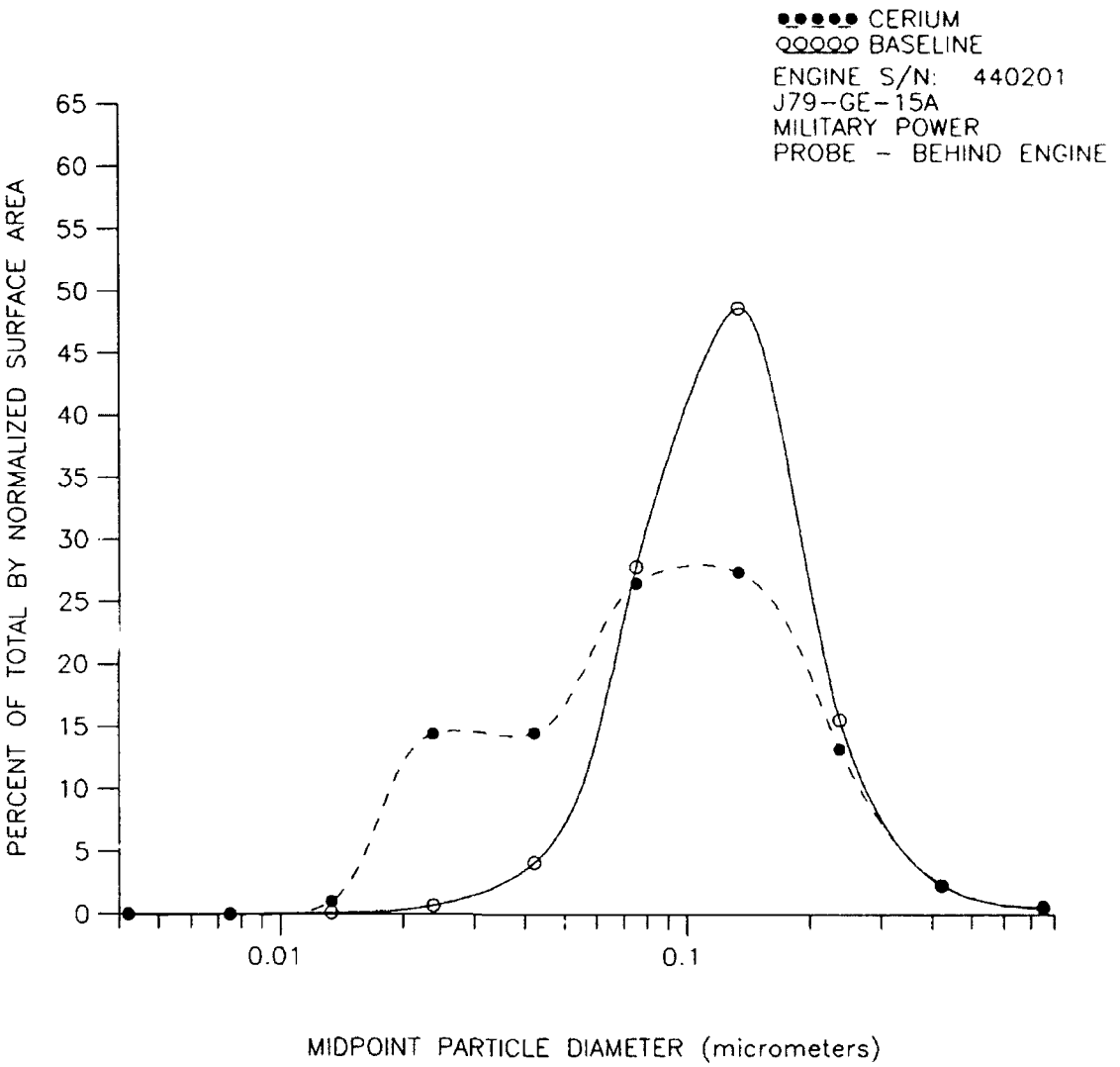

Figure 56. Particle Diameter vs Percent of Total by Normalized Surface Area.

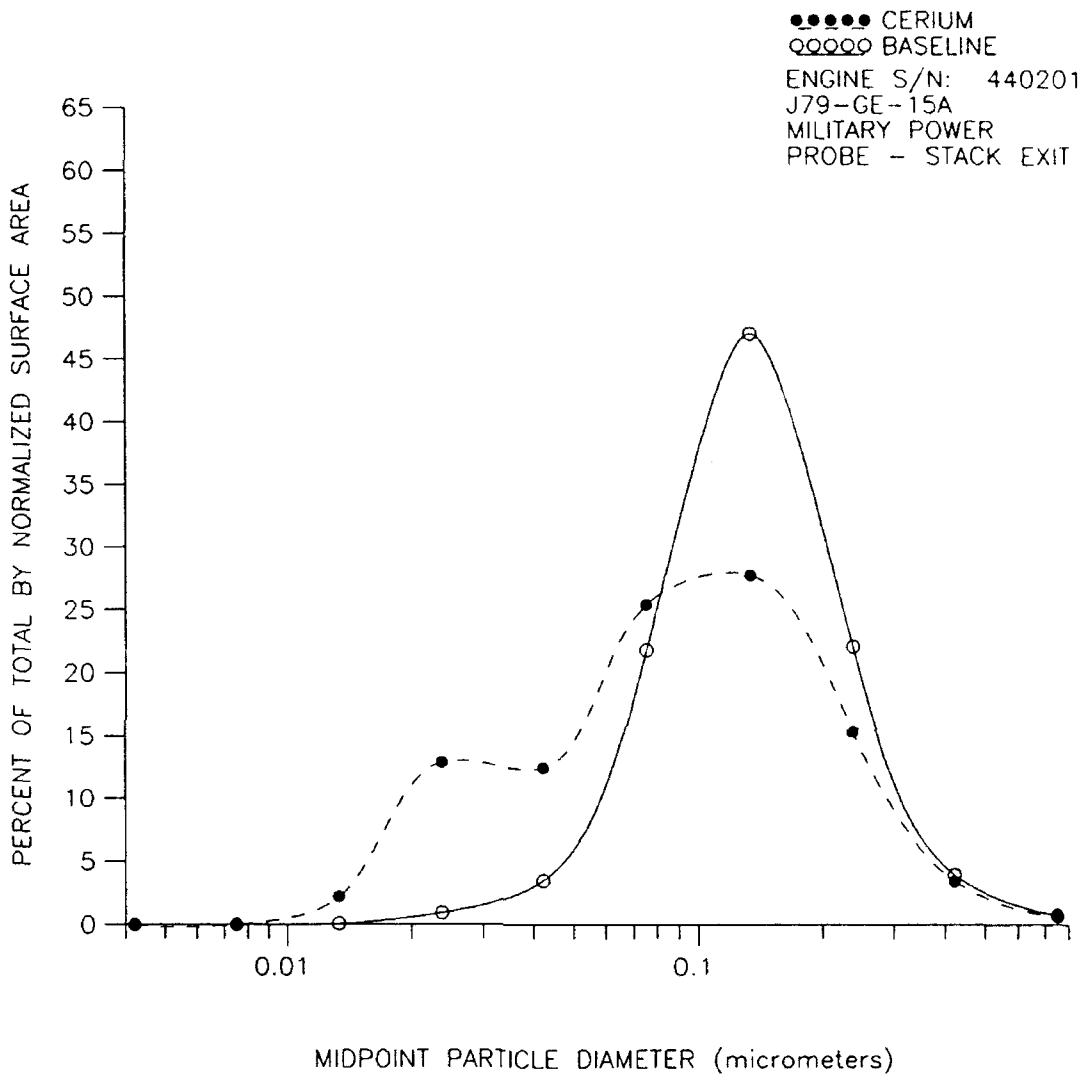

Figure 57. Particle Diameter vs Percent of Total by Normalized Surface Area.

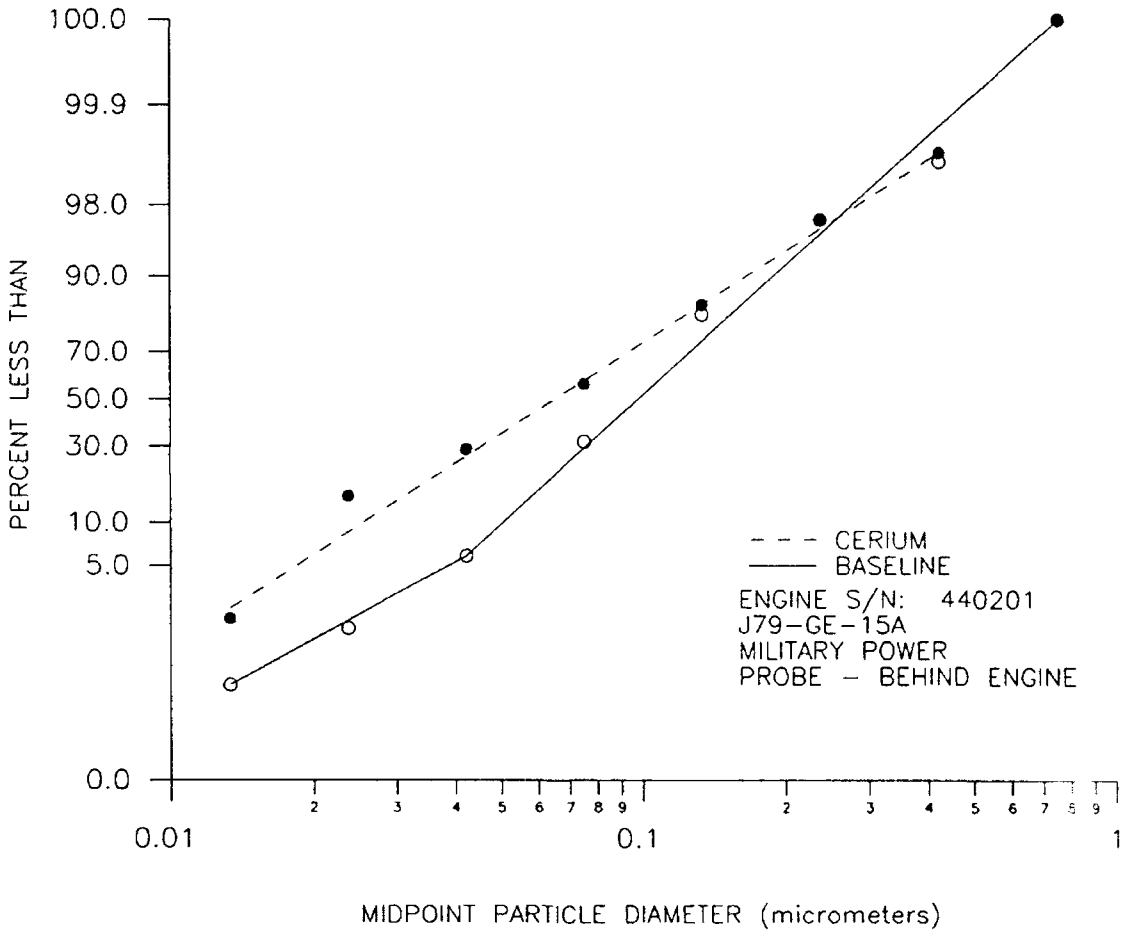

Figure 58. Cumulative Mass Distribution by Surface Area.

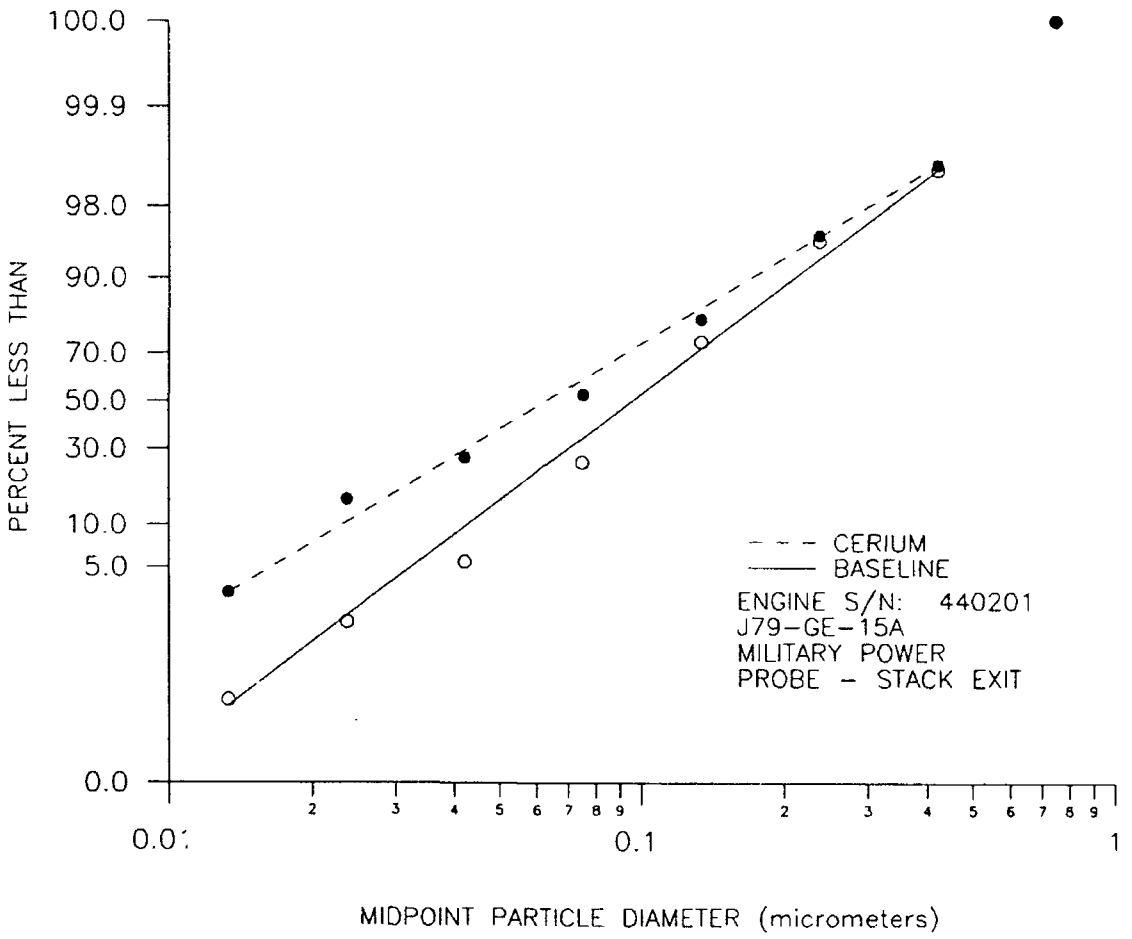

Figure 59. Cumulative Mass Distribution by Surface Area.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - MILITARY - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-02.4 A:D9MAC-02.8 A:D9MAC-04.5
A:D9MAC-04.7

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	40.677	284.31	0.13	0.13
2.371375E-02	217.445	207.74	0.68	0.81
4.216968E-01	1333.288	105.28	4.16	4.97
7.498948E-01	8915.022	96.73	27.83	32.80
0.1333522	15592.031	64.08	48.67	81.47
0.2371376	4992.837	54.66	15.59	97.05
0.4216968	750.200	69.74	2.34	99.39
0.7498948	194.288	105.86	0.61	100.00

TOTAL = 8008.947

MEAN-DIA = 0.1211937 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - MILITARY - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-11.9 A:D9MAC-14.0 A:D9MAC-14.2

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	28.672	1391.48	0.08	0.08
2.371375E-02	325.511	734.77	0.92	1.00
4.216968E-01	1231.530	446.62	3.49	4.50
7.498948E-01	7677.620	292.10	21.78	26.28
0.1333522	16566.785	216.81	46.99	73.27
0.2371376	7772.821	230.90	22.05	95.32
0.4216968	1383.951	300.81	3.93	99.24
0.7498948	267.161	440.39	0.76	100.00

TOTAL = 8813.514

MEAN-DIA = 0.1335927 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - MILITARY - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 5

FILES INCLUDED:

A:D9MAC-02.9 A:D9MAC-03.2 A:D9MAC-03.6
A:D9MAC-03.8 A:D9MAC-04.0

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	133.368	101.97	1.03	1.03
2.371375E-02	1860.384	46.49	14.40	15.43
4.216968E-01	1877.662	102.19	14.53	29.97
7.498948E-01	3423.686	252.63	26.50	56.47
0.1333522	3539.719	251.46	27.40	83.86
0.2371376	1709.113	144.38	13.23	97.09
0.4216968	312.908	151.24	2.42	99.52
0.7498948	62.538	313.71	0.48	100.00

TOTAL = 3229.845

MEAN-DIA = 8.252227E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - MILITARY - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 7

FILES INCLUDED:

A:D9MAC-12.6 A:D9MAC-12.6A A:D9MAC-12.6B
A:D9MAC-12.9 A:D9MAC-13.2 A:D9MAC-13.4
A:D9MAC-13.6

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	522.450	87.81	2.19	2.19
2.371375E-02	3068.652	96.11	12.87	15.06
4.216968E-01	2965.472	168.66	12.44	27.50
7.498948E-01	6051.370	260.78	25.38	52.89
0.1333522	6610.632	332.48	27.73	80.62
0.2371376	3647.662	329.18	15.30	95.92
0.4216968	817.711	360.62	3.43	99.35
0.7498948	155.020	487.01	0.65	100.00

TOTAL = 5959.742

MEAN-DIA = 8.732998E-02 MICROMETERS

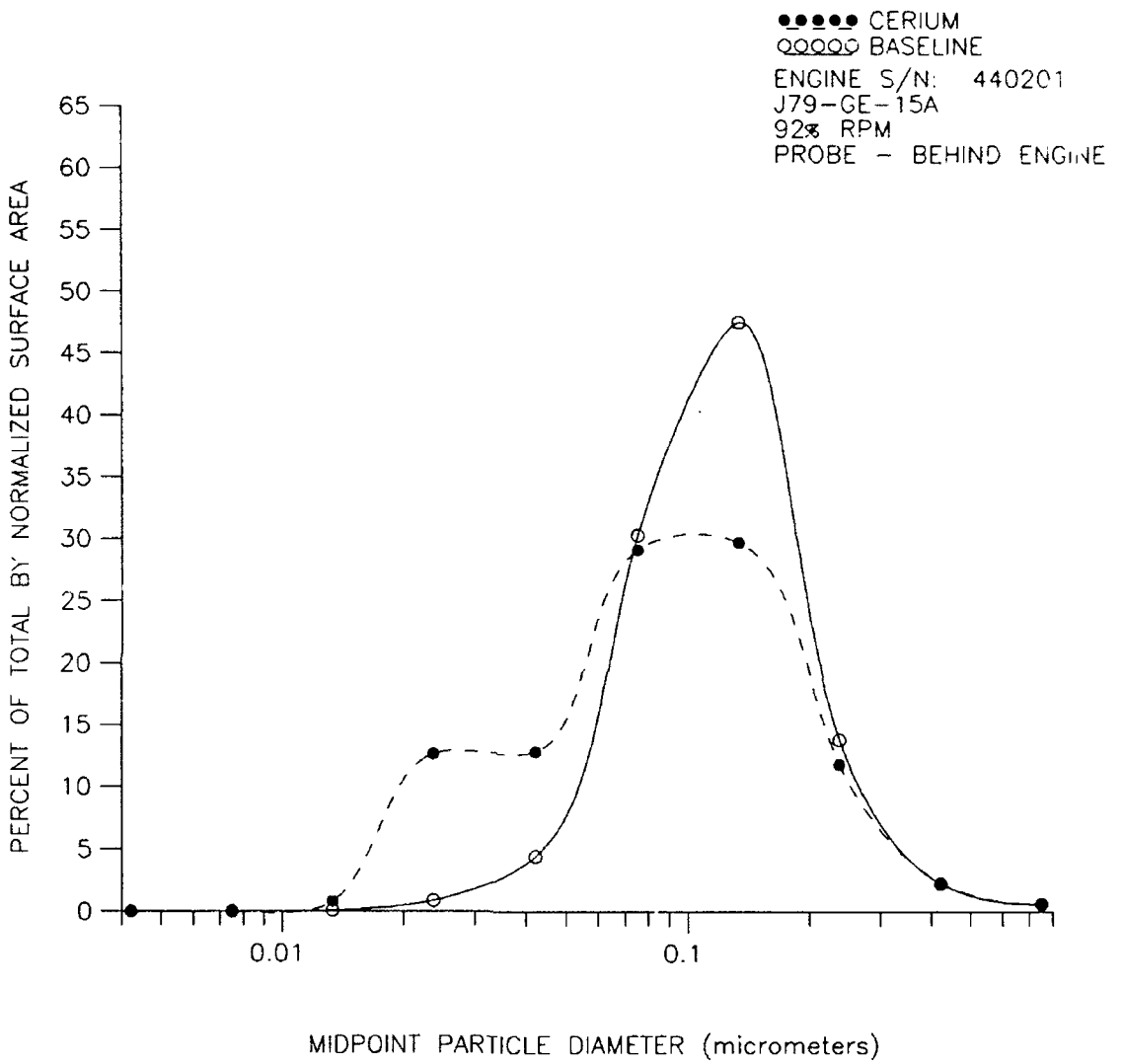

Figure 60. Particle Diameter vs Percent of Total by Normalized Surface Area.

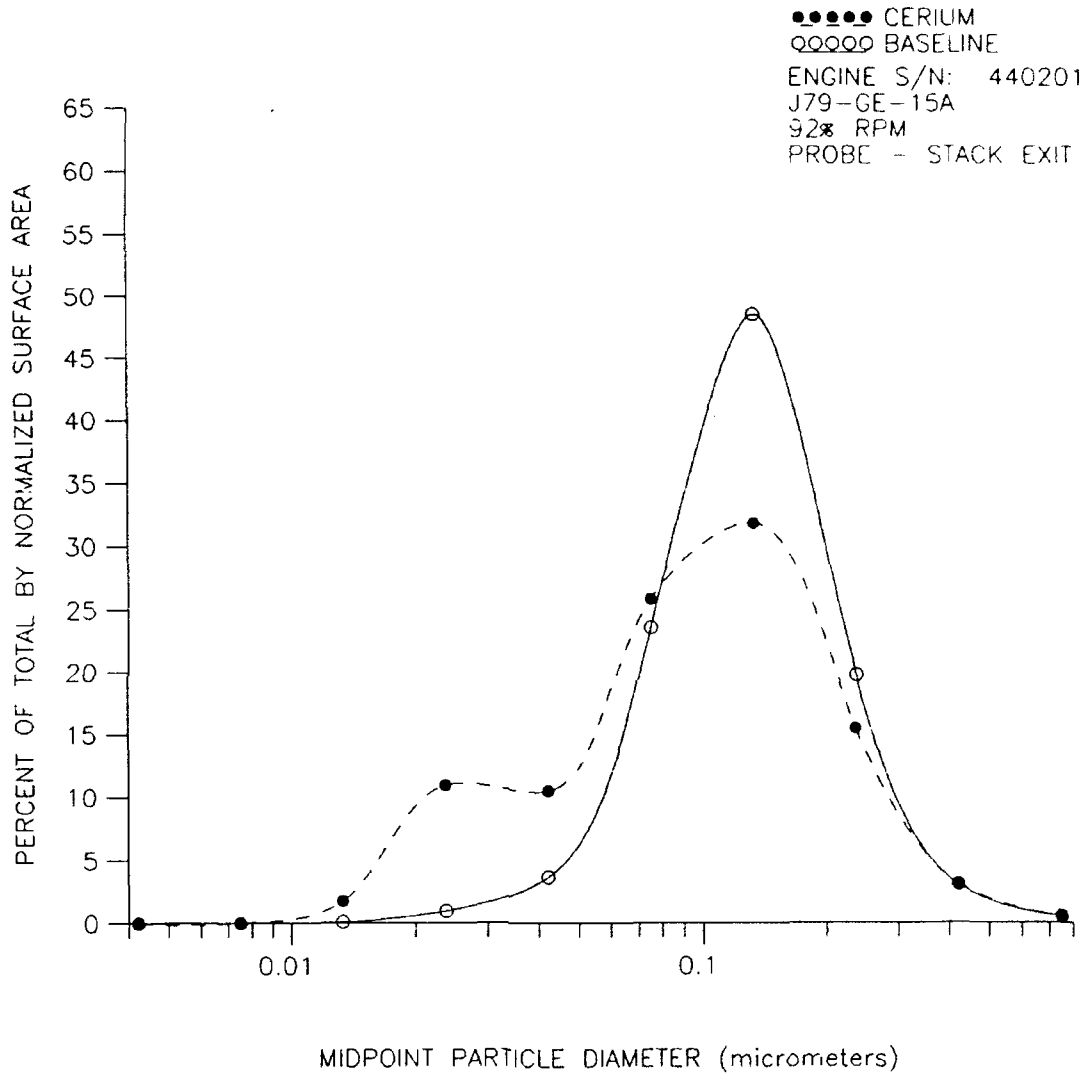

Figure 61. Particle Diameter vs Percent of Total by Normalized Surface Area.

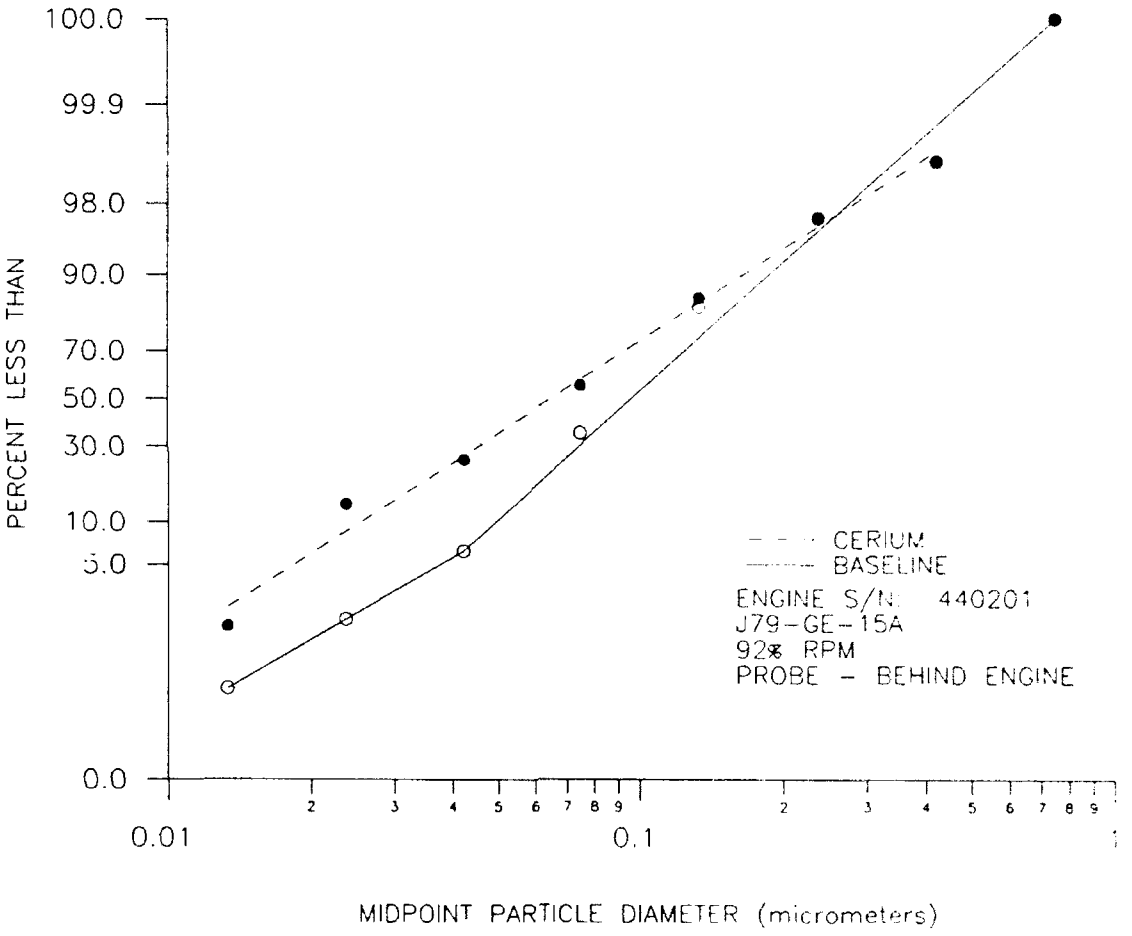

Figure 62 Cumulative Mass Distribution by Surface Area.

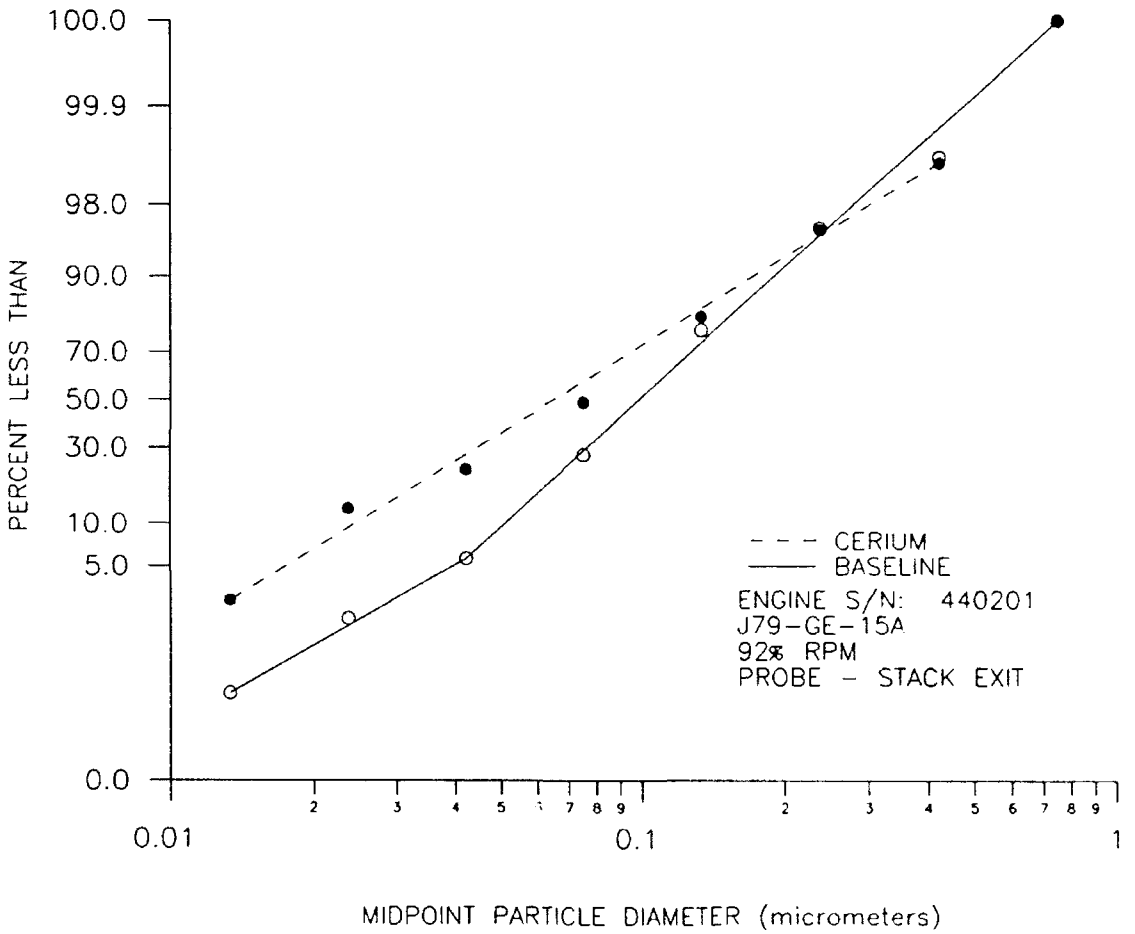

Figure 63. Cumulative Mass Distribution by Surface Area.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 92% RPM - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-02.3 A:D9MAC-04.3 A:D9MAC-04.6

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	31.403	799.91	0.11	0.11
2.371375E-02	257.143	599.07	0.89	1.00
4.216968E-01	1279.105	262.95	4.43	5.42
7.498948E-01	8763.174	175.53	30.32	35.74
0.1333522	13735.497	139.96	47.52	83.26
0.2371376	3994.992	146.65	13.82	97.08
0.4216968	657.568	150.25	2.27	99.36
0.7498948	185.444	224.61	0.64	100.00

TOTAL = 7226.082

MEAN-DIA = 0.1175062 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 92% RPM - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-12.0 A:D9MAC-13.8 A:D9MAC-14.1

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	32.562	1259.45	0.10	0.10
2.371375E-02	321.733	784.77	0.96	1.06
4.216968E-01	1222.917	484.39	3.66	4.72
7.498948E-01	7871.399	310.29	23.54	28.25
0.1333522	16196.750	233.40	48.43	76.69
0.2371376	6593.859	287.84	19.72	96.40
0.4216968	1021.544	435.54	3.05	99.46
0.7498948	180.859	687.10	0.54	100.00
TOTAL =	8360.405			

MEAN-DIA = 0.1283234 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 92% - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-03.0 A:D9MAC-03.1 A:D9MAC-03.5
A:D9MAC-03.9

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	114.071	197.88	0.81	0.81
2.371375E-02	1777.265	77.62	12.64	13.45
4.216968E-01	1805.776	159.01	12.84	26.29
7.498948E-01	4099.585	291.17	29.15	55.45
0.1333522	4182.317	352.93	29.74	85.19
0.2371376	1663.443	273.75	11.83	97.02
0.4216968	329.081	236.16	2.34	99.36
0.7498948	90.003	367.58	0.64	100.00
TOTAL =	3515.386			

MEAN-DIA = 0.0853246 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 92% RPM - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-12.7 A:D9MAC-12.8 A:D9MAC-13.1
A:D9MAC-13.5

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	451.266	105.04	1.75	1.75
2.371375E-02	2810.765	115.84	10.92	12.67
4.216968E-01	2695.528	255.16	10.47	23.14
7.498948E-01	6643.956	380.73	25.81	48.95
0.1333522	8190.026	429.04	31.81	80.77
0.2371376	3978.448	469.15	15.45	96.22
0.4216968	811.521	560.28	3.15	99.37
0.7498948	161.191	756.17	0.63	100.00
TOTAL =	6435.675			

MEAN-DIA = 9.285334E-02 MICROMETERS

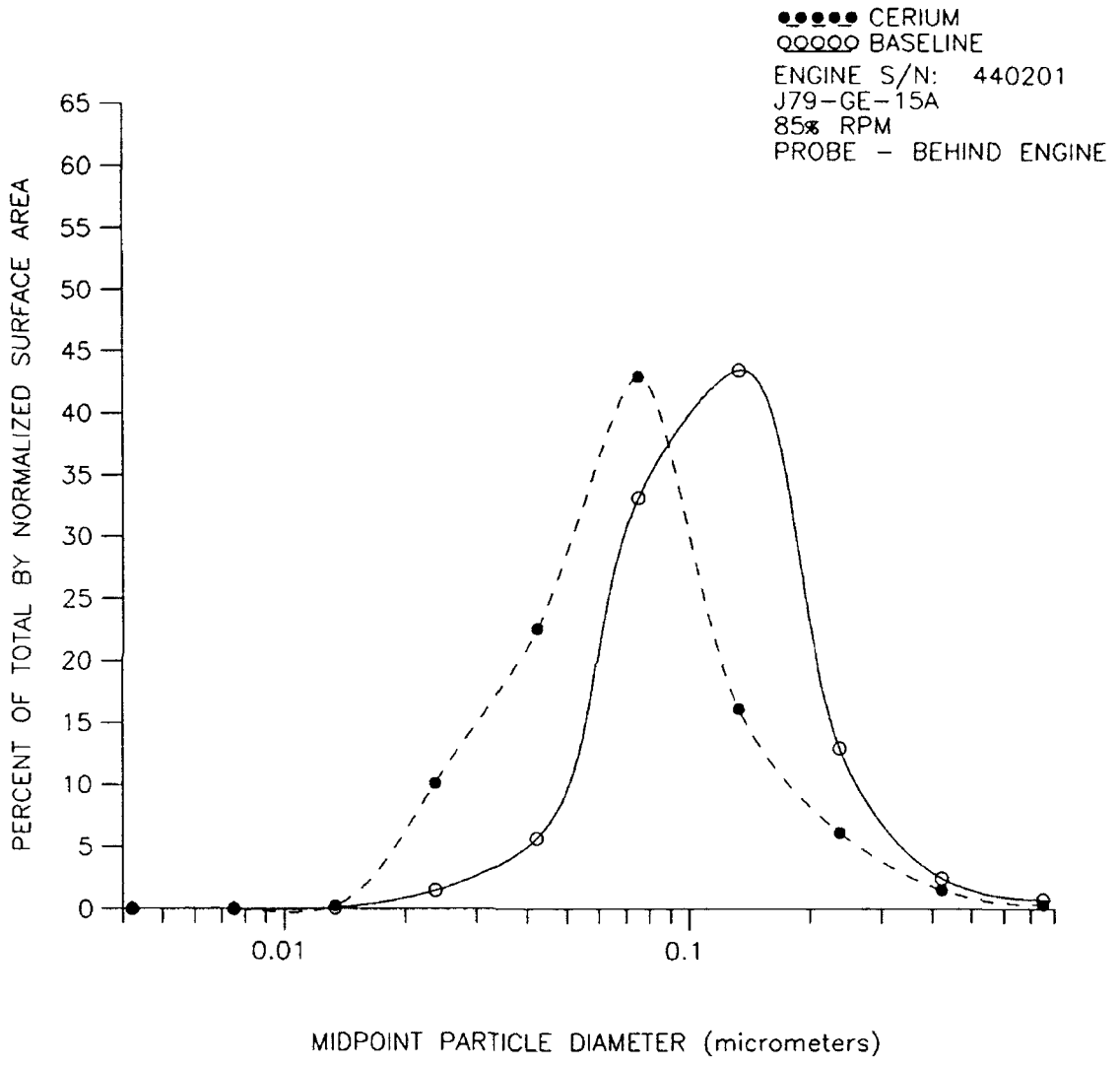

Figure 64. Particle Diameter vs Percent of Total by Normalized Surface Area.

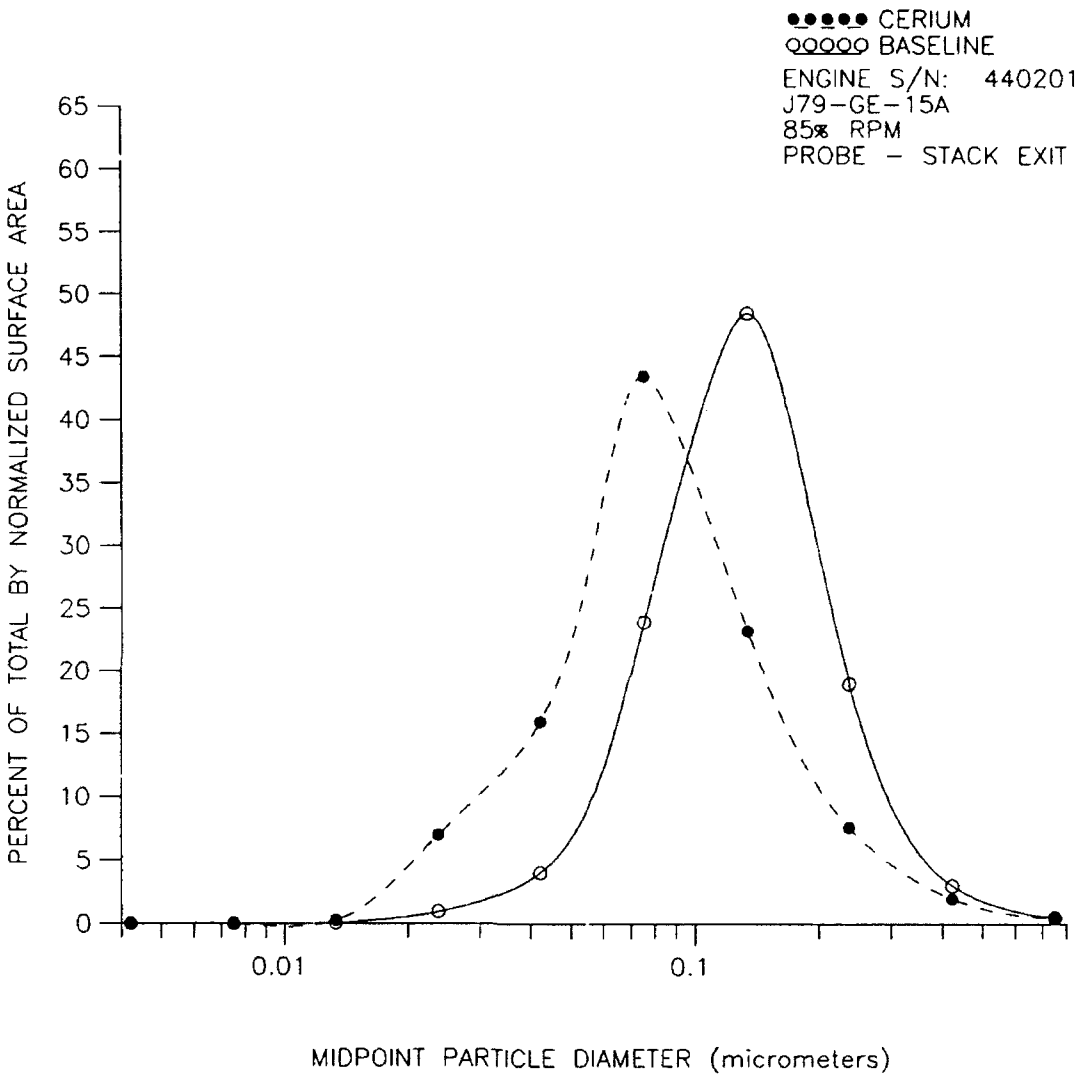

Figure 65. Particle Diameter vs Percent of Total by Normalized Surface Area.

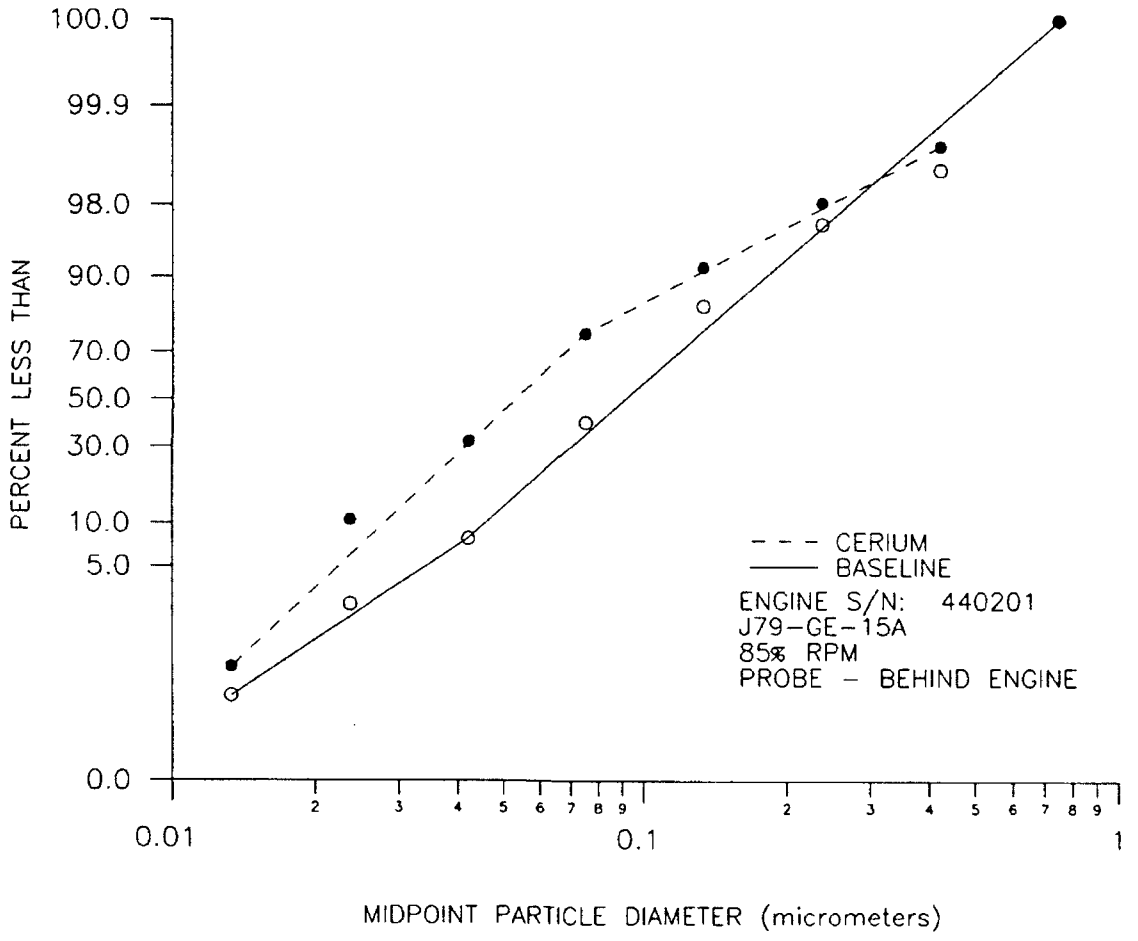

Figure 66. Cumulative Mass Distribution by Surface Area.

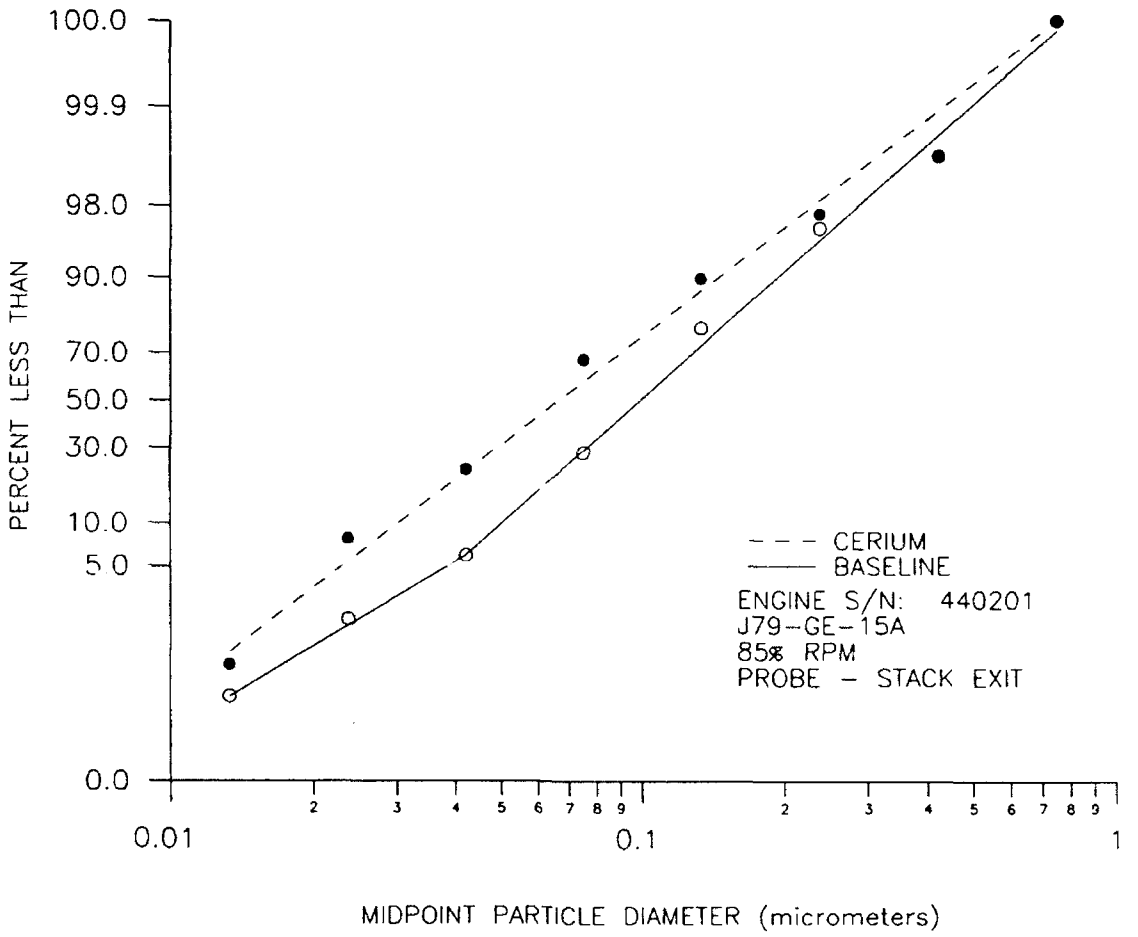

Figure 67. Cumulative Mass Distribution by Surface Area.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 85% RPM - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-02.5 A:D9MAC-04.1 A:D9MAC-04.4

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	19.534	1196.22	0.09	0.09
2.371375E-02	322.241	463.43	1.48	1.57
4.216968E-01	1233.226	266.70	5.68	7.26
7.498948E-01	7190.215	205.19	33.12	40.38
0.1333522	9430.351	175.83	43.44	83.82
0.2371376	2811.531	175.45	12.95	96.77
0.4216968	538.721	173.89	2.48	99.25
0.7498948	163.135	213.88	0.75	100.00

TOTAL = 5427.239

MEAN-DIA = 0.1127673 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 85% RPM - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 5

FILES INCLUDED:
A:D9MAC-12.1 A:D9MAC-12.2 A:D9MAC-12.5
A:D9MAC-13.7 A:D9MAC-13.9

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	26.918	943.45	0.09	0.09
2.371375E-02	281.583	591.80	0.95	1.05
4.216968E-01	1190.052	344.01	4.03	5.08
7.498948E-01	7055.757	241.03	23.92	29.00
0.1333522	14302.809	178.98	48.48	77.48
0.2371376	5600.206	233.92	18.98	96.46
0.4216968	893.327	346.98	3.03	99.49
0.7498948	151.226	557.70	0.51	100.00

TOTAL = 7375.469

MEAN-DIA = 0.1268851 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 85% - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-02.6 A:D9MAC-02.7 A:D9MAC-03.4
A:D9MAC-03.7

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	42.615	290.12	0.25	0.25
2.371375E-02	1723.231	32.27	10.13	10.38
4.216968E-01	3836.667	46.98	22.55	32.92
7.498948E-01	7304.680	140.25	42.92	75.85
0.1333522	2743.106	387.35	16.12	91.96
0.2371376	1044.853	275.99	6.14	98.10
0.4216968	260.478	212.54	1.53	99.63
0.7498948	62.154	370.92	0.37	100.00
TOTAL =	4254.446			

MEAN-DIA = 7.116357E-02 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 85% RPM - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-12.3 A:D9MAC-12.4 A:D9MAC-13.0
A:D9MAC-13.3

----------FINAL AVERAGED NORMALIZED SURFACE AREA ----------

MID-PT-DIA	AVERAGE DS/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	57.054	586.32	0.27	0.27
2.371375E-02	1497.988	170.93	6.98	7.25
4.216968E-01	3429.476	179.73	15.98	23.23
7.498948E-01	9334.303	258.80	43.49	66.72
0.1333522	4980.125	664.80	23.21	89.93
0.2371376	1630.069	1026.01	7.60	97.52
0.4216968	427.411	946.43	1.99	99.51
0.7498948	104.567	1060.25	0.49	100.00
TOTAL =	5365.249			

MEAN-DIA = 8.202697E-02 MICROMETERS

CONTENTS OF SECTION:

VOLUME GRAPHICS
OF
PERCENT FREQUENCY VS MID-POINT DIAMETER
&
CUMULATION MASS DISTRIBUTION VS MID-POINT DIAMETER

1. Graphics

Baseline	Cerium Additive
Military	Military
92% RPM	92% RPM
85% RPM	85% RPM

2. All averaged summary data sheets.

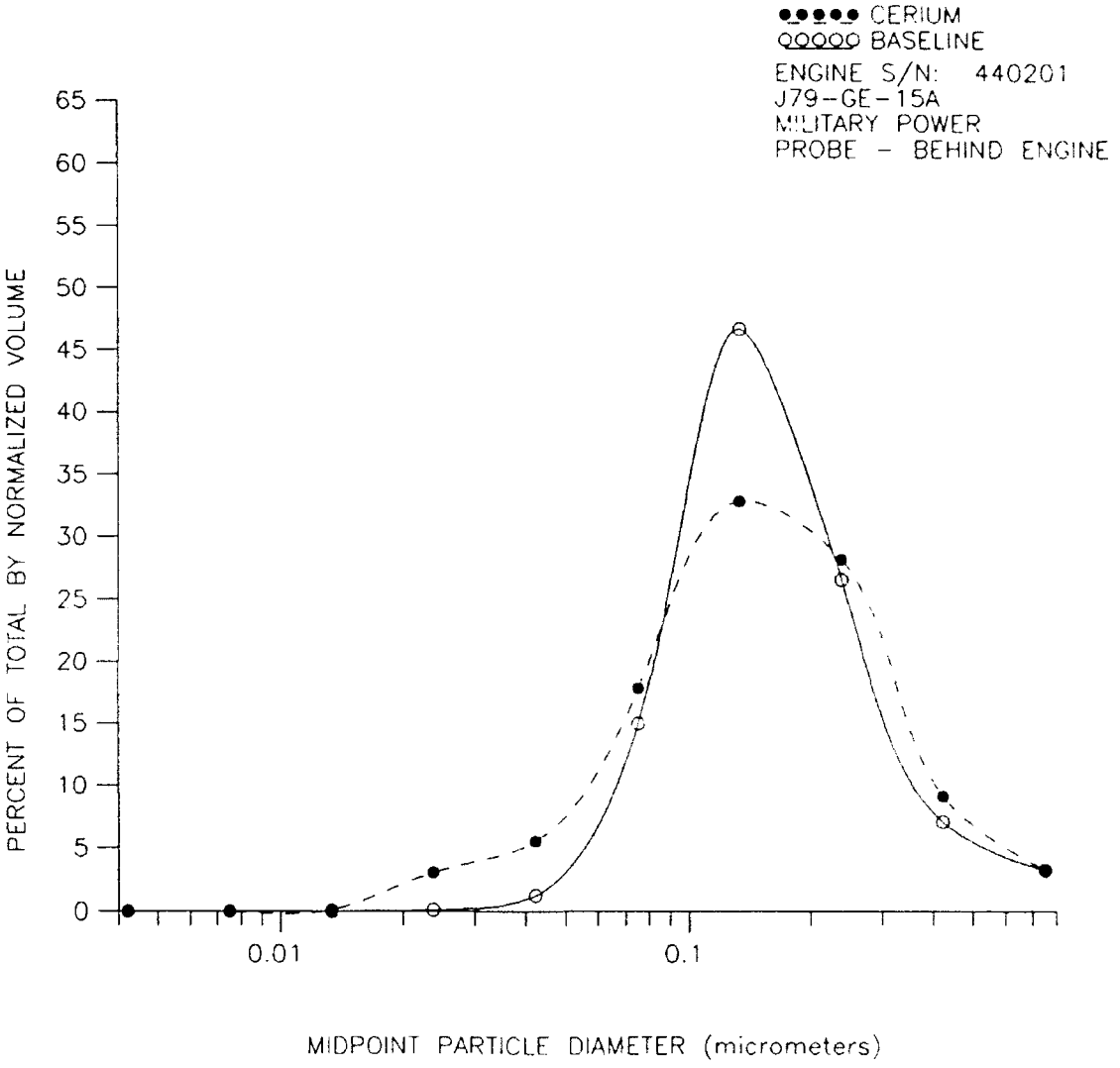

Figure 68. Particle Diameter vs Percent of Total by Normalized Volume.

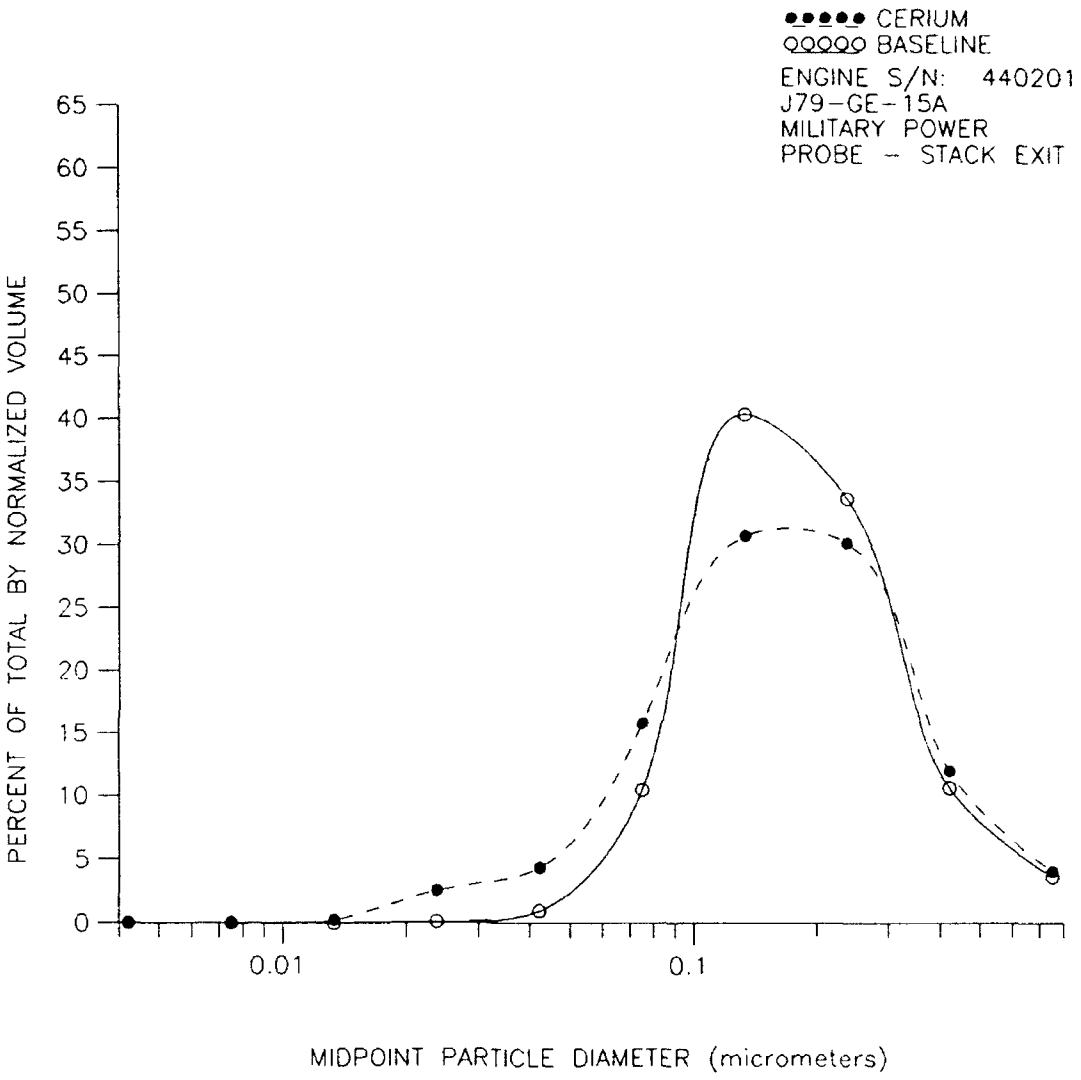

Figure 69. Particle Diameter vs Percent of Total by Normalized Volume.

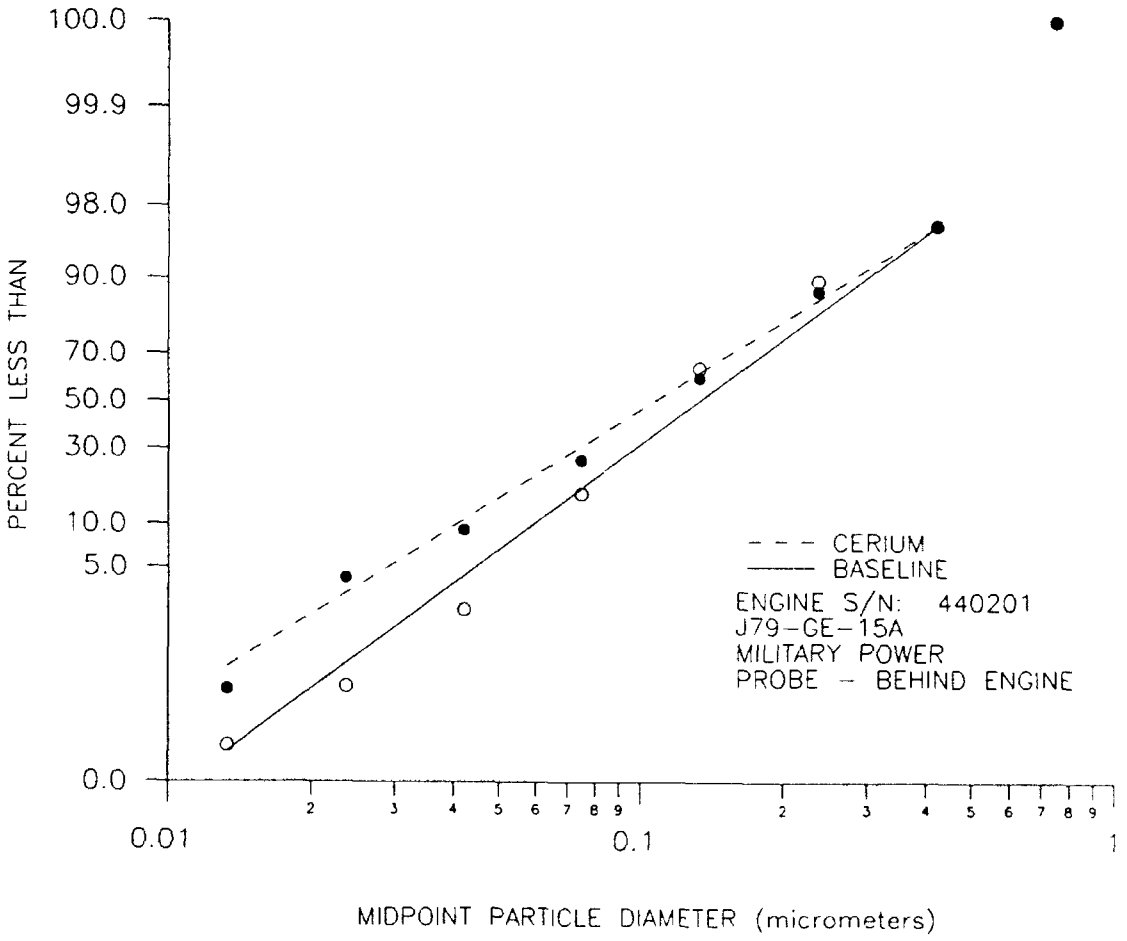

Figure 70. Cumulative Mass Distribution by Volume.

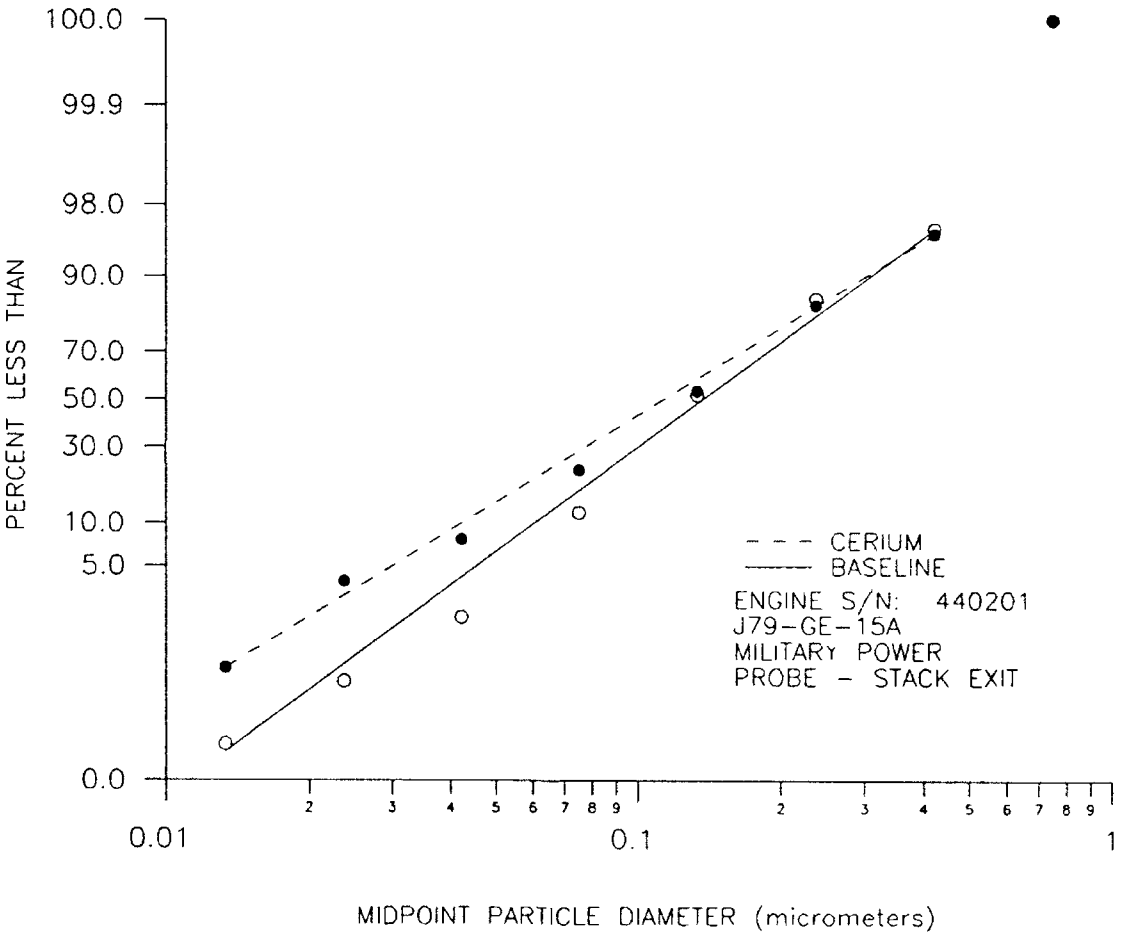

Figure 71. Cumulative Mass Distribution by Volume.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - MILITARY - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-02.4 A:D9MAC-02.8 A:D9MAC-04.5
A:D9MAC-04.7

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.090	284.31	0.01	0.01
2.371375E-02	0.859	207.74	0.12	0.13
4.216968E-01	9.371	105.28	1.26	1.39
7.498948E-01	111.422	96.73	15.00	16.39
0.1333522	346.539	64.08	46.66	63.06
0.2371376	197.332	54.66	26.57	89.63
0.4216968	52.726	69.74	7.10	96.73
0.7498948	24.283	105.86	3.27	100.00
TOTAL =	185.655			

MEAN-DIA = 0.1609334 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - MILITARY - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-11.9 A:D9MAC-14.0 A:D9MAC-14.2

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.064	1391.48	0.01	0.01
2.371375E-02	1.287	734.77	0.14	0.15
4.216968E-01	8.656	446.62	0.95	1.10
7.498948E-01	95.957	292.10	10.52	11.62
0.1333522	368.203	216.81	40.37	51.99
0.2371376	307.205	230.90	33.68	85.67
0.4216968	97.268	300.81	10.67	96.34
0.7498948	33.390	440.39	3.66	100.00
TOTAL =	228.007			

MEAN-DIA = 0.1810576 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - MILITARY - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 5

FILES INCLUDED:
A:D9MAC-02.9 A:D9MAC-03.2 A:D9MAC-03.6
A:D9MAC-03.8 A:D9MAC-04.0

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.296	101.97	0.12	0.12
2.371375E-02	7.353	46.49	3.07	3.19
4.216968E-01	13.197	102.19	5.51	8.70
7.498948E-01	42.790	252.63	17.85	26.55
0.1333522	78.672	251.46	32.83	59.38
0.2371376	67.549	144.38	28.18	87.56
0.4216968	21.992	151.24	9.18	96.74
0.7498948	7.816	313.71	3.26	100.00
TOTAL =	59.916			

MEAN-DIA = 0.1477031 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - MILITARY - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 7

FILES INCLUDED:

A:D9MAC-12.6 A:D9MAC-12.6A A:D9MAC-12.6B
A:D9MAC-12.9 A:D9MAC-13.2 A:D9MAC-13.4
A:D9MAC-13.6

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	1.161	87.81	0.24	0.24
2.371375E-02	12.128	96.11	2.54	2.78
4.216968E-01	20.842	168.66	4.36	7.14
7.498948E-01	75.632	260.78	15.83	22.98
0.1333522	146.924	332.48	30.76	53.73
0.2371376	144.166	329.18	30.18	83.91
0.4216968	57.471	360.62	12.03	95.94
0.7498948	19.375	487.01	4.06	100.00
TOTAL =	119.425			

MEAN-DIA = 0.1614927 MICROMETERS

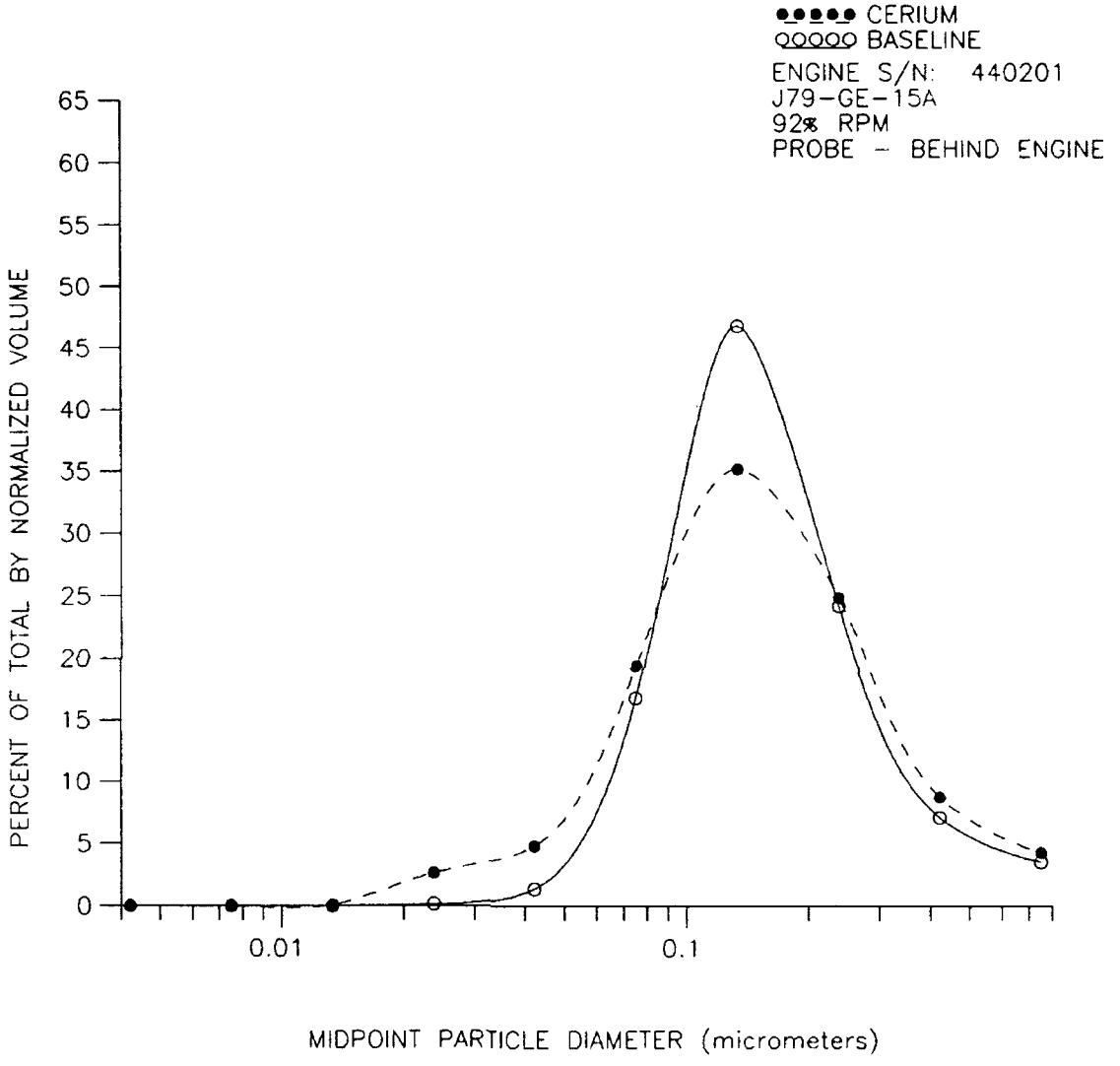

Figure 72. Particle Diameter vs Percent of Total by Normalized Volume.

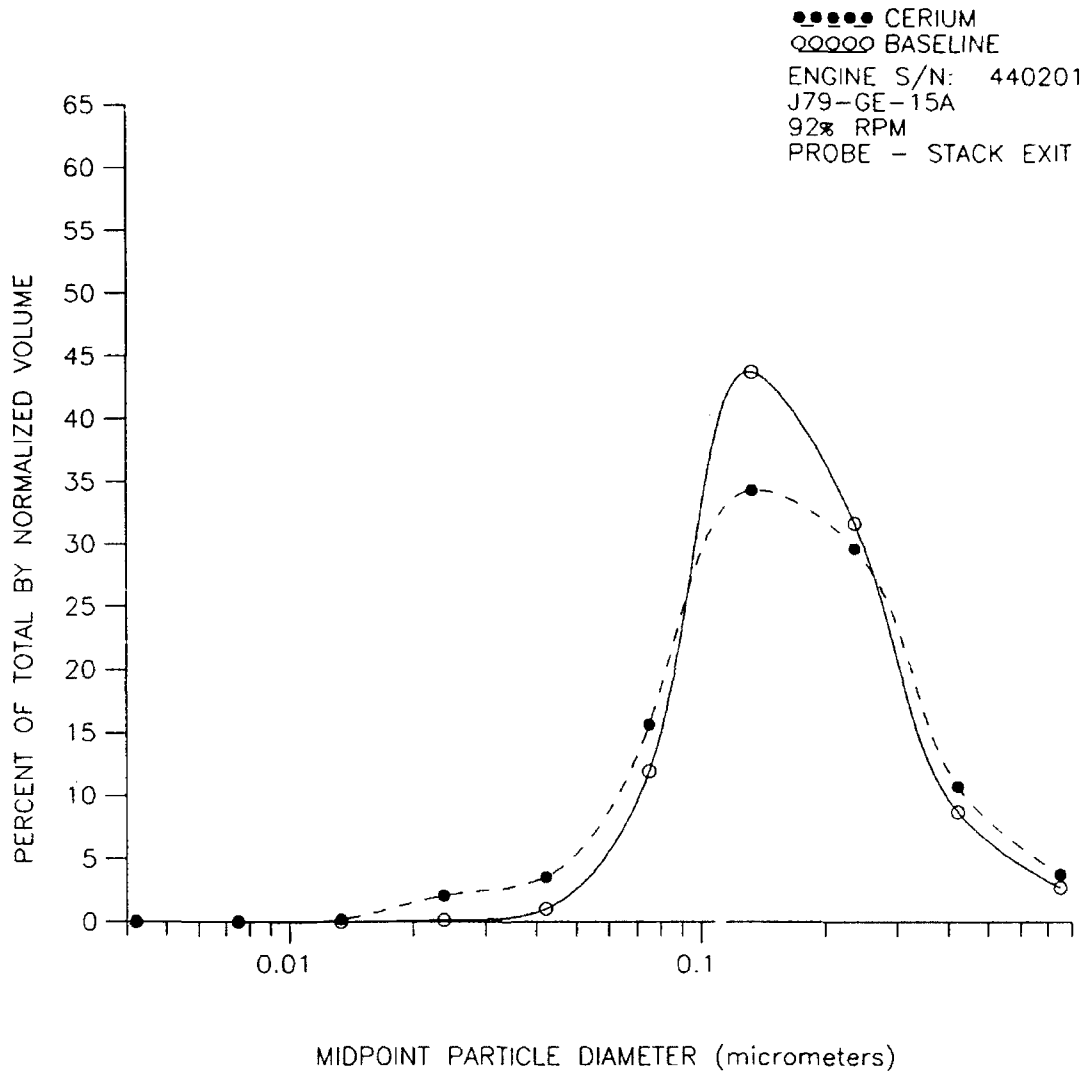

Figure 73. Particle Diameter vs Percent of Total by Normalized Volume.

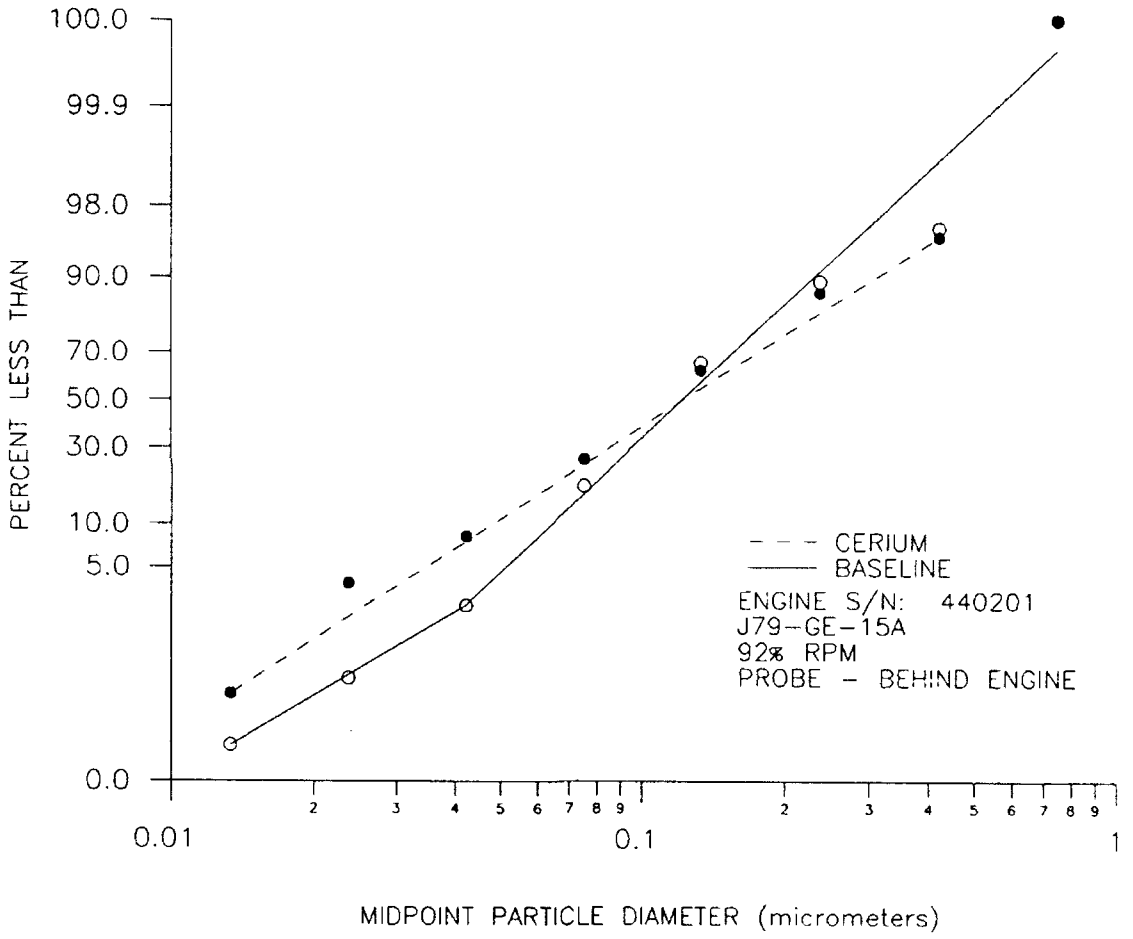

Figure 74. Cumulative Mass Distribution by Volume.

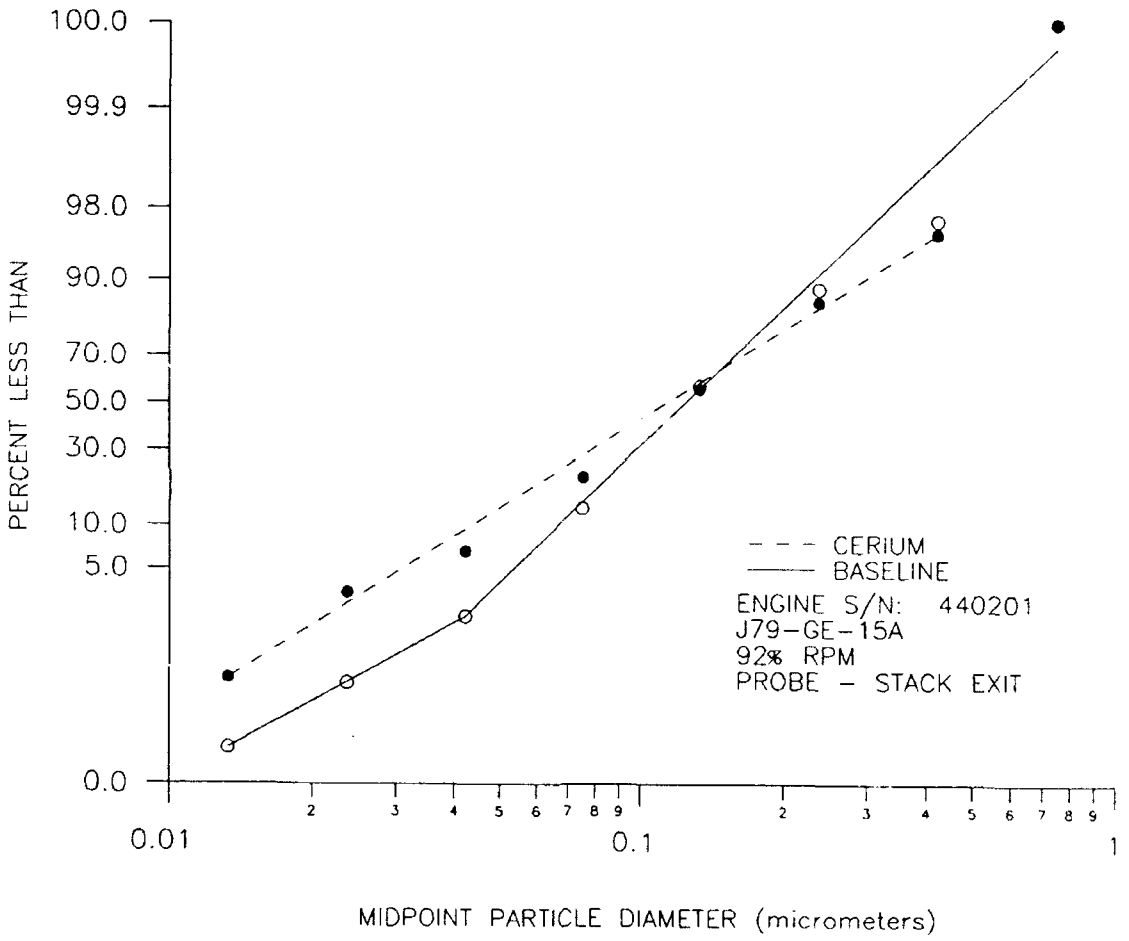

Figure 75. Cumulative Mass Distribution by Volume.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 92% RPM - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-02.3 A:D9MAC-04.3 A:D9MAC-4.6

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.070	799.91	0.01	0.01
2.371375E-02	1.016	599.07	0.16	0.17
4.216968E-01	8.990	262.95	1.38	1.55
7.498948E-01	109.524	175.53	16.79	18.34
0.1333522	305.276	139.96	46.81	65.15
0.2371376	157.894	146.65	24.21	89.36
0.4216968	46.216	150.25	7.09	96.45
0.7498948	23.177	224.61	3.55	100.00

TOTAL = 163.041

MEAN-DIA = 0.1575655 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 92% RPM - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-12.0 A:D9MAC-13.8 A:D9MAC-14.1

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.072	1259.45	0.01	0.01
2.371375E-02	1.272	784.77	0.15	0.16
4.216968E-01	8.595	484.38	1.04	1.21
7.498948E-01	98.379	310.29	11.95	13.16
0.1333522	359.979	233.40	43.72	56.88
0.2371376	260.609	287.84	31.65	88.53
0.4216968	71.797	435.54	8.72	97.25
0.7498948	22.604	687.10	2.75	100.00
TOTAL =	205.827			

MEAN-DIA = 0.1706044 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 92% RPM - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-03.0 A:D9MAC-03.1 A:D9MAC-03.5
A:D9MAC-03.9

----------FINAL AVERAGED NORMALIZED VOLUME ---- ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.254	197.88	0.10	0.10
2.371375E-02	7.024	77.62	2.66	2.75
4.216968E-01	12.691	159.01	4.80	7.56
7.498948E-01	51.238	291.17	19.39	26.94
0.1333522	92.954	352.93	35.17	62.12
0.2371376	65.744	273.75	24.88	86.99
0.4216968	23.129	236.16	8.75	95.74
0.7498948	11.249	367.58	4.26	100.00
TOTAL =	66.071			

MEAN-DIA = 0.1477402 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 92% RPM - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-12.7 A:D9MAC-12.8 A:D9MAC-13.1
A:D9MAC-13.5

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	1.003	105.04	0.19	0.19
2.371375E-02	11.109	115.84	2.09	2.28
4.216968E-01	18.945	255.16	3.57	5.85
7.498948E-01	83.038	380.73	15.65	21.51
0.1333522	182.026	429.04	34.31	55.81
0.2371376	157.240	469.15	29.64	85.45
0.4216968	57.036	560.28	10.75	96.20
0.7498948	20.146	756.17	3.80	100.00
TOTAL =	132.636			

MEAN-DIA = 0.1609713 MICROMETERS

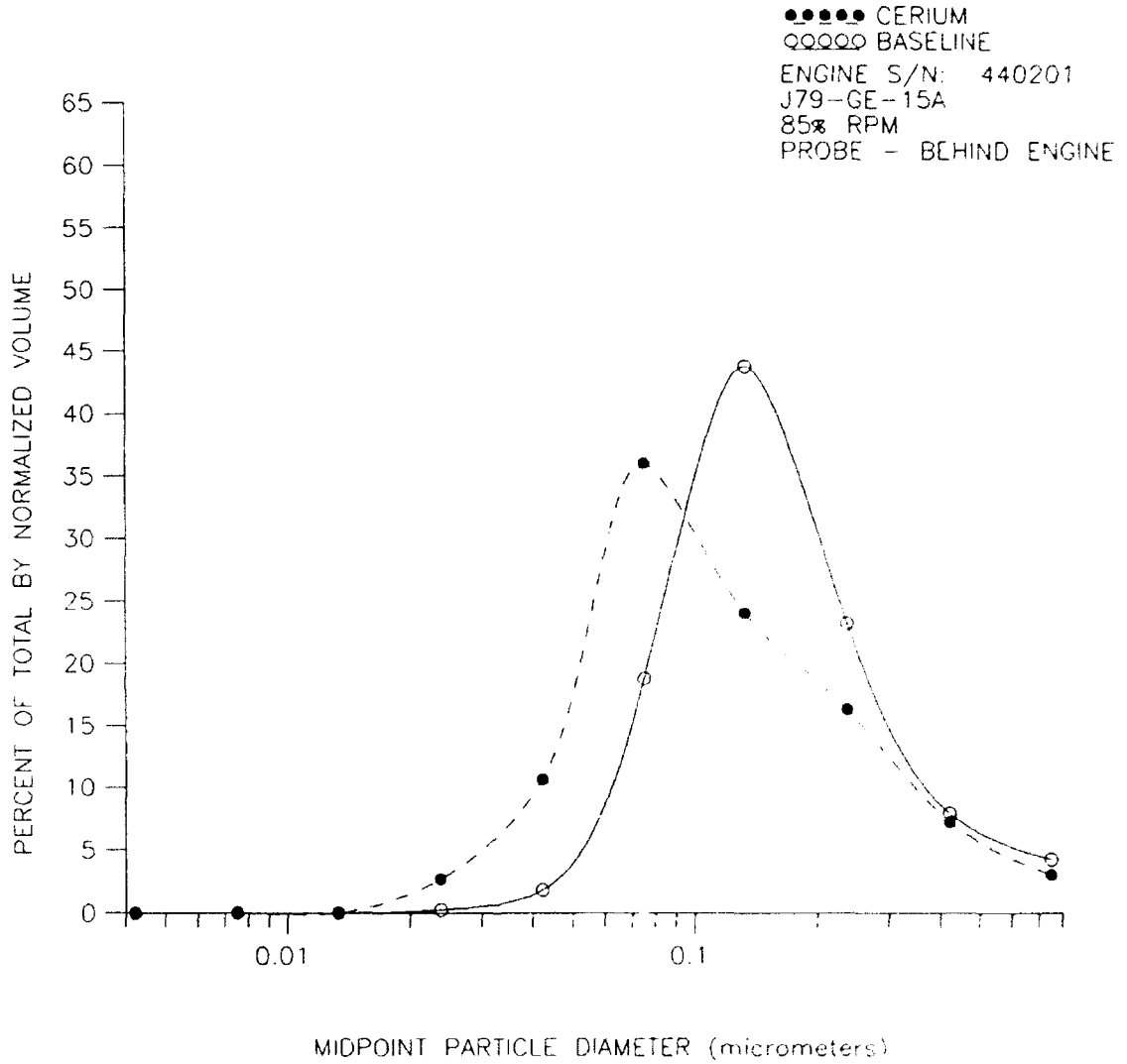

Figure 76. Particle Diameter vs Percent of Total by Normalized Volume.

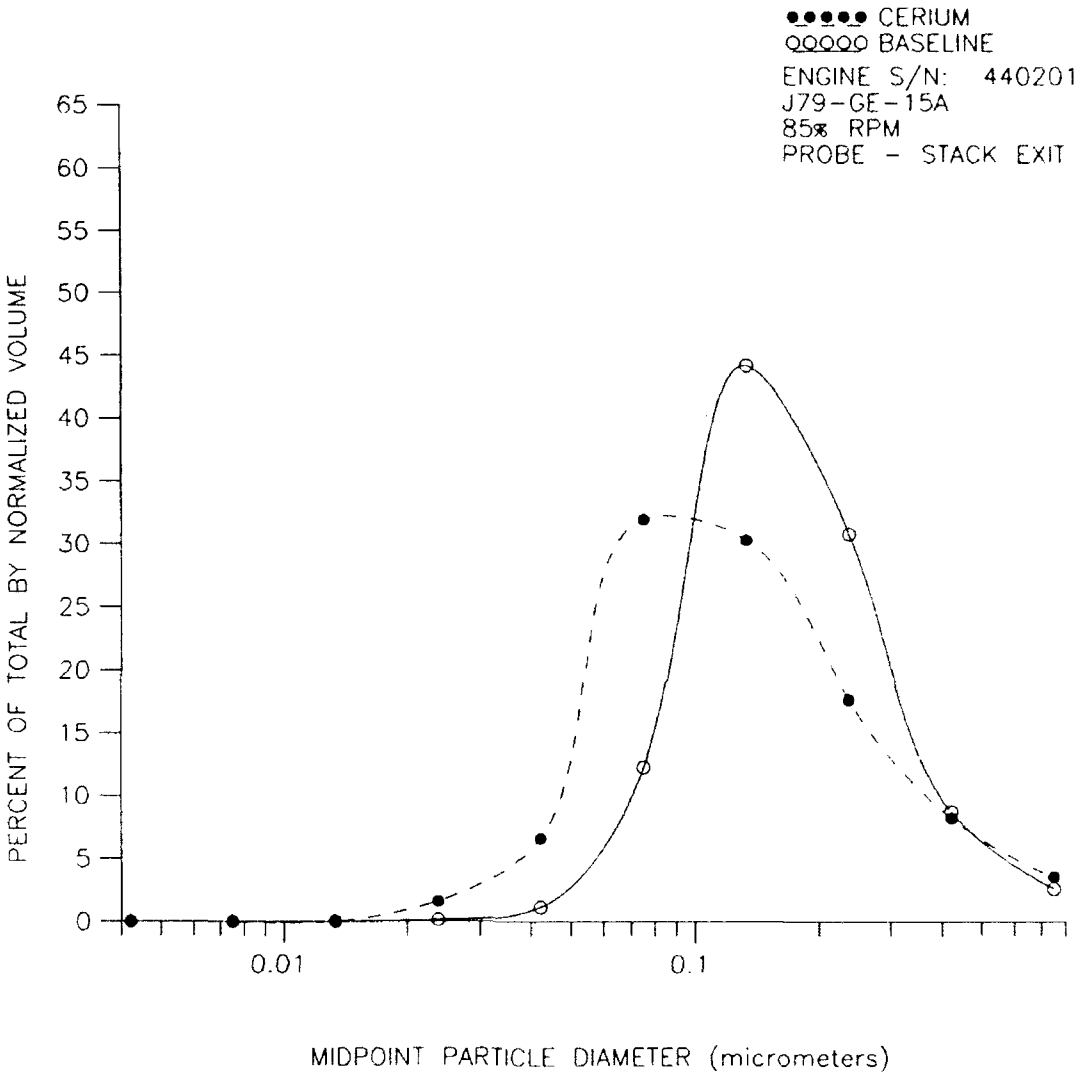

Figure 77. Particle Diameter vs Percent of Total by Normalized Volume.

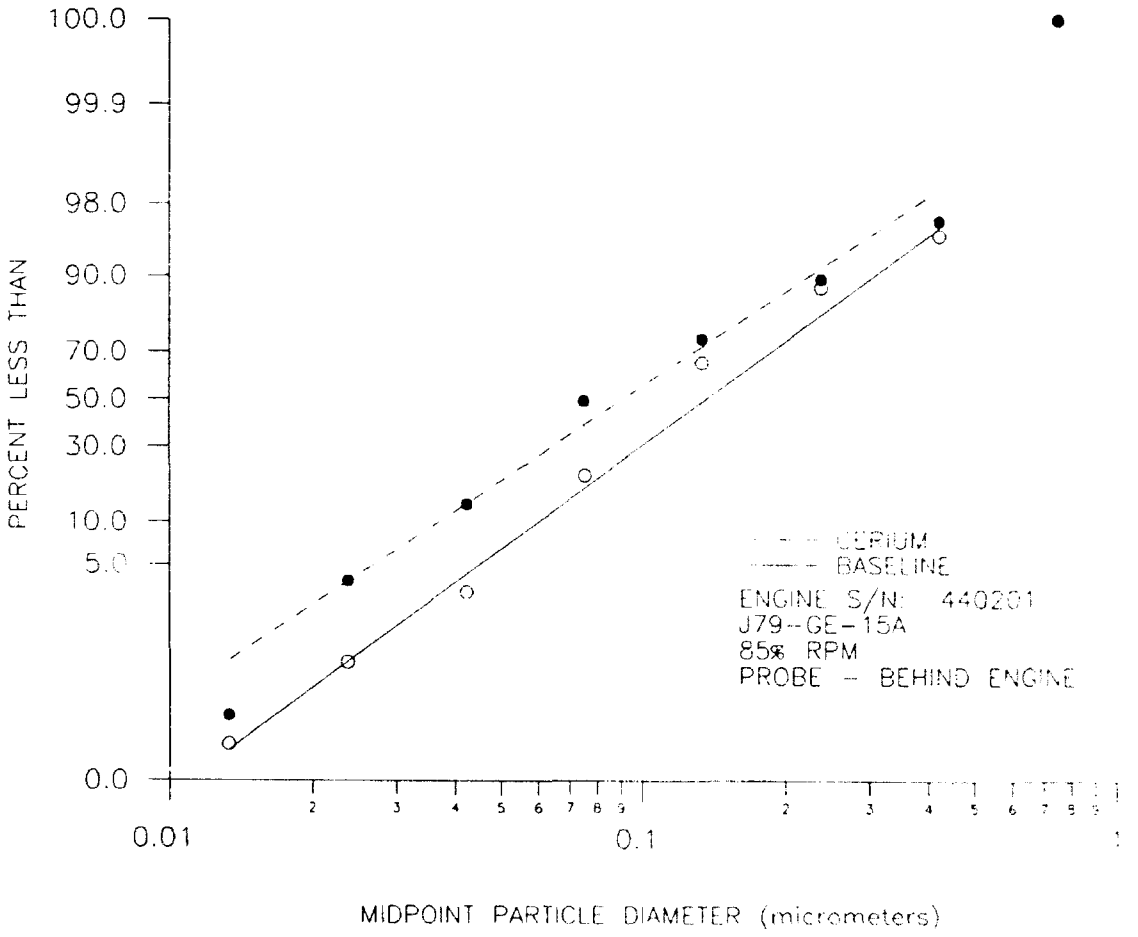

Figure 78. Cumulative Mass Distribution by Volume

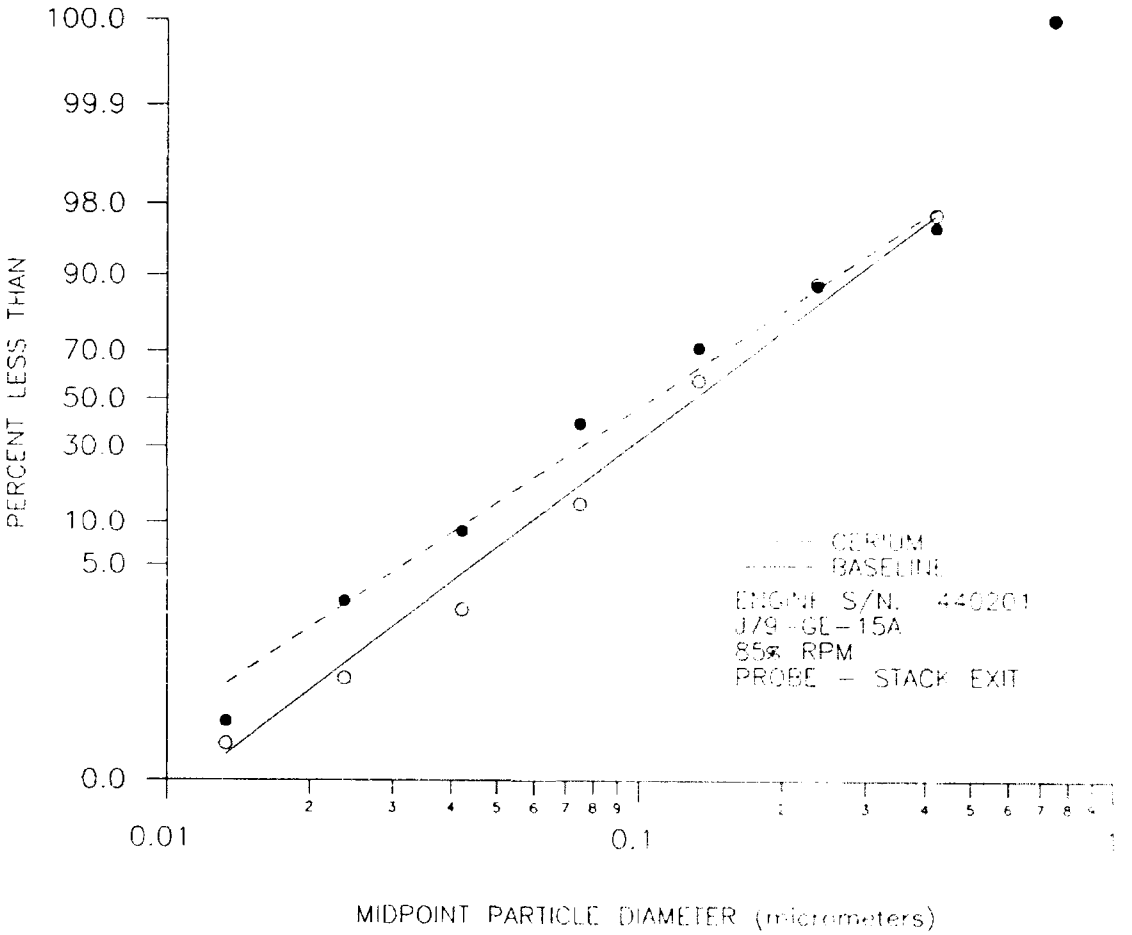

Figure 79. Cumulative Mass Distribution by Volume.

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 85% RPM - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 3

FILES INCLUDED:
A:D9MAC-02.5 A:D9MAC-04.1 A:D9MAC-04.4

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.043	1196.22	0.01	0.01
2.371375E-02	1.274	463.43	0.27	0.28
4.216968E-01	8.667	266.70	1.81	2.09
7.498948E-01	89.865	205.19	18.77	20.85
0.1333522	209.593	175.83	43.77	64.63
0.2371376	111.120	175.45	23.21	87.83
0.4216968	37.863	173.89	7.91	95.74
0.7498948	20.389	213.88	4.26	100.00
TOTAL =	119.704			

MEAN-DIA = 0.1571942 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 85% RPM - BASELINE FOR CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 5

FILES INCLUDED:
A:D9MAC-12.1 A:D9MAC-12.2 A:D9MAC-12.5
A:D9MAC-13.7 A:D9MAC-13.9

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.060	943.46	0.01	0.01
2.371375E-02	1.113	591.80	0.15	0.16
4.216968E-01	8.364	344.01	1.16	1.33
7.498948E-01	88.185	241.03	12.27	13.60
0.1333522	317.885	178.98	44.23	57.83
0.2371376	221.337	233.92	30.80	88.63
0.4216968	62.786	346.98	8.74	97.37
0.7498948	18.901	557.70	2.63	100.00
TOTAL =	179.657			

MEAN-DIA = 0.1689148 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

BEHIND ENGINE - 85% RPM - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-02.6 A:D9MAC-02.7 A:D9MAC-03.4
A:D9MAC-03.7

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.095	290.12	0.04	0.04
2.371375E-02	6.811	32.27	2.69	2.72
4.216968E-01	26.965	46.98	10.64	13.36
7.498948E-01	91.296	140.25	36.01	49.37
0.1333522	60.967	387.35	24.05	73.42
0.2371376	41.296	275.99	16.29	89.71
0.4216968	18.307	212.54	7.22	96.94
0.7498948	7.768	370.92	3.06	100.00
TOTAL =	63.376			

MEAN-DIA = 0.1150995 MICROMETERS

FINAL AVERAGE COMPUTATIONS - EAA DATA FILES

STACK - 85% RPM - CERIUM - McCLELLAN AFB

TOTAL DATA FILES: 4

FILES INCLUDED:
A:D9MAC-12.3 A:D9MAC-12.4 A:D9MAC-13.0
A:D9MAC-13.3

----------FINAL AVERAGED NORMALIZED VOLUME ----------

MID-PT-DIA	AVERAGE DV/DLGD	PCT MEAN DEVIATION	PERCENT	PERCENT<DIA
4.21697E-03	0.000	0.00	0.00	0.00
7.49895E-03	0.000	0.00	0.00	0.00
1.333522E-02	0.127	586.32	0.03	0.03
2.371375E-02	5.920	170.93	1.62	1.66
4.216968E-01	24.103	179.73	6.60	8.26
7.498948E-01	116.662	258.80	31.96	40.22
0.1333522	110.685	664.80	30.32	70.54
0.2371376	64.425	1026.01	17.65	88.19
0.4216968	30.040	946.43	8.23	96.42
0.7498948	13.069	1060.25	3.58	100.00
TOTAL =	91.258			

MEAN-DIA = 0.129329 MICROMETERS