-ston H. Hickox
.gency Secretary

Air Resources Board

Alan C. Lloyd, Ph.D.
Chairman
9528 Telstar Avenue • P.O. Box 8001 • El Monte, California 91731 • www.arb.ca.gov

Gray Davis
Governor

Reference No. C-2000-343

June 5, 2000

Mr. Larry Will, Chairman
General Engineering Committee
Portable Power Equipment Manufacturers Association (PPEMA)
4340 East West Highway, Suite 912
Bethesda, MD 20814

Dear Mr. Will:

This is in response to your letters dated November 22 and December 10, 1999, and January 18, March 8 and April 7, 2000, concerning test procedures for the certification of small off-road engines (SOREs) below 65 cubic centimeters (cc) in displacement. The issues were also discussed in a meeting between PPEMA and the Air Resources Board (ARB) in February 2000. Below are the three issues of concern to PPEMA followed by ARB response.

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In the interest of resolving this issue and moving forward, and partly based on the survey by the PPEMA manufacturer mentioned above, the ARB will allow the use of these duty cycles with the following stipulations (discussed on May 19, 2000, at a meeting with PPEMA representatives).

1) The use of the three-, six- and twenty-minute duty cycles for specific engine applications are approved as requested by PPEMA. For engines used in applications not mentioned by PPEMA, e.g., wheeled trimmers, portable pumps and generators, and blowers that are neither hand-held or back-packed, the twenty-minute duty cycle must be used. For all other engine applications,

PPEMA manufacturers should contact their assigned ARB Certification Section engineer for permission to use a particular duty cycle prior to running their durability programs.

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3) These duty cycles are the minimum acceptable. PPEMA manufacturers are permitted to use a longer cycle without prior ARB approval. On the other hand, the ARB will not approve the use of a shorter cycle unless the manufacturer provides specific data demonstrating the applicability of a shorter cycle for the engine involved.

ISSUE #2: PPEMA requests clarification on the need to perform manufacturer-conducted confirmatory testing when a test engine's emission results provide less than a fifteen percent compliance margin from the family emission limit (FEL) chosen by the manufacturer. Typically, a manufacturer sets an FEL close to the certification value in order to obtain the maximum number of credits under the average, banking and trading (ABT) program; any marginal compliance therefrom would be offset by these credits.

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However, in response to PPEMA's concerns, and based on the experience with SORE testing gained since 1995, the staff has developed an optional retest criteria that it believes will minimize manufacturers testing burden while ensuring the integrity of certification data. Under this option, a manufacturer must determine the standard deviation "A" of all of its paired certification tests (initial tests and retests) and the standard deviation "B" of all of its production QA tests. For a marginally complying EF, the manufacturer may add the larger of the standard deviation "A" and "B" to the initial test and then apply the DF. If the result is below the FEL (standard), then the initial test will be accepted for certification without a need for a retest. However, if the result (test data + standard deviation "A" or "B", with the DF applied) equals or exceeds the FEL (standard), a retest is then required and will be used for certification. A manufacturer should submit to ARB all test data and its determination of the standard deviations "A" and "B" in advance of the start of its certification program for a model-year (MY) to allow sufficient time for staff review and concurrence of these "A" and "B" values.

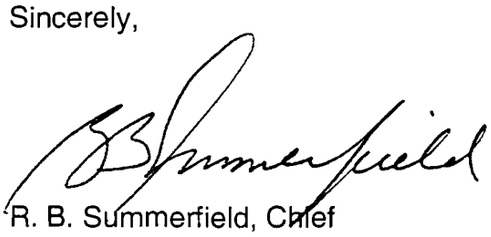
ISSUE #3: PPEMA requests approval to use common DFs for engine families (EFs) that have similar technologies and durability periods. Testing has shown that a manufacturer's DFs for a given engine technology remains constant among different EFs. Based on PPEMA data, conventional two-stroke engines without exhaust after-treatment have shown improved emissions over the intended useful life and should, therefore, be assigned a DF of 1.0. Use of common DFs would reduce unwarranted testing.

ARB RESPONSE: ARB staff reviewed PPEMA's study of tests conducted by its members during 1992-1994, but did not reach the same conclusions. Among staff's concerns are the study's methodology, test procedures and data interpretation. Certification data generated in accordance with durability and emission test procedures acceptable to ARB to date do not agree with PPEMA's conclusion of DFs of 1.0 for conventional two-stroke engines. Also, it is common experience that older two-stroke engines generally emit more smoke and exhaust odor, produce less power and/or consume more fuel. All these indications appear to point to higher emissions per unit of power. As durability testing is required for the first time starting with MY 2000 for SOREs below 65 cc, staff indicated to PPEMA that sufficient test data, measured in accordance with approved durability and emission test procedures, need to be accumulated to facilitate a detailed analysis about their emission deterioration trends.

As permitted in regulations, EFs that are similar in engine and emission control designs and emission characteristics may be grouped for durability demonstration purposes. From each durability group, the engine that is expected to exhibit the highest deterioration rate should be tested, and its durability data may be carried across with ARB approval to the other EFs in the same durability group. The ARB believes this is a balanced approach between a need to have valid durability data and a desire to minimize manufacturer test burden.

Should you have further questions on these issues, please contact Mr. Duc Nguyen, Manager, Certification Section, or Mr. Dean Hermano, Staff Engineer, at (626) 450-6103, or by e-mail at dhermano@arb.ca.gov.

Sincerely,



R. B. Summerfield, Chief
Mobile Source Operations Division

Portable Power Equipment Manufacturers Association

PPEMA

Sensible Products For a Better Outdoors

April 7, 2000

RECEIVED

APR 12 2000

CERTIFICATION BRANCH

Mr. Allen Lyons
California Environmental Protection Agency
Air Resources Board
Mobile Source Operations Division
9528 Telstar Avenue
El Monte, CA 91731

Dear Mr. Lyons:

This purpose of this letter is to provide supporting information related to PPEMA's request that a common deterioration factor of 1.0 be assigned to conventional two stroke engines without aftertreatment for the purpose of certification to Tier II.

We have enclosed a copy of the PPEMA "In-Use" Emission Study that was presented to the Environmental Protection Agency on February 1, 1994 by the PPEMA Air Quality Committee. We have also enclosed graphical representations of 50 and 300 hour testing results and relevant conclusions based on those results. These test results were generated by several PPEMA member companies during the course of the "In-Use" Emission Study. Some of these charts were used in the presentation to EPA on February 1, 1994. In all cases, the enclosures have been redacted to remove any identification of the participating manufacturers and/or their products.

We draw your attention to the overall conclusion on page 1 of the February 1, 1994 Report, which states, "Data indicates stable or slightly decreasing emission components over time for portable two-stroke products." Likewise, Section 9.2 states, "All components (HC, CO, and NOx) typically remained constant or decreased over time. This seems to indicate that the deterioration factor for portable two-stroke equipment could be a value of 1 or less." Figures 11 through 16 of the Report support this conclusion. Although there were limited instances where emissions measured slightly higher at the end of testing (see figures 12 and 13 for Unit 1), the measurements were made in grams/hour and do not reflect that there was actually an increase in power over time in many tests. These instances could simply be an artifact of power variability, typical during the break-in process of an engine due to reduced friction within the assembly, and/or testing variability. In any event, they do not detract from the overall conclusion of the study, namely that conventional two-stroke engines have stable or decreasing emissions over time.

Please consider the PPEMA request in light of the Report findings and supporting graphical representations and conclusions provided. Time is of the essence in this matter due to the

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(301) 652-0774 • TELEFAX: (301) 654-6138

increasing activities in Tier II certifications among our members, and the substantial costs involved in performing durability testing for which the outcome is predictable and repeatable. Consequently, we would appreciate your prompt attention to this matter. We hope that the information that we have provided is sufficient for you to reach a favorable decision on this issue. If there are other areas related to this issue that you feel are worth spending additional time discussing, please advise us and we will be happy to meet with you in El Monte. I will be contacting Mr. Duc Nguyen of your staff within the next week for further discussion.

Sincerely,

James L. Cigler
Manager, Technical and Standards Programs

cc: Duc Nguyen

enclosures

Reference No. C-2000-343

June 5, 2000

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General Engineering Committee
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R. B. Summerfield, Chief
Mobile Source Operations Division

SUMMARY COMMENTS From Report concerning Graphs1 through 4

Engine power output

"Aside from the deposit build up in Unit I, peak power didn't change much with time although at 50 hours, peak power was down slightly from break-in. Unit I had a little more power than the other two units at the start and the difference was more pronounced after 50 hours. Below 7000 rpm, power in Unit I was somewhat higher at the end of the 50 hour test."

HC emissions

"HC emissions didn't change much during the test. When exhaust ports were restricted by deposits, HC emissions went down as did fuel flow (graph 1)."

CO emissions

"CO emissions varied significantly but without trend (graph 2) and %CO showed similar characteristics (graph 4). Cleaning restricted exhaust ports in units I & II resulted in sharp increases in CO."

NOx emissions

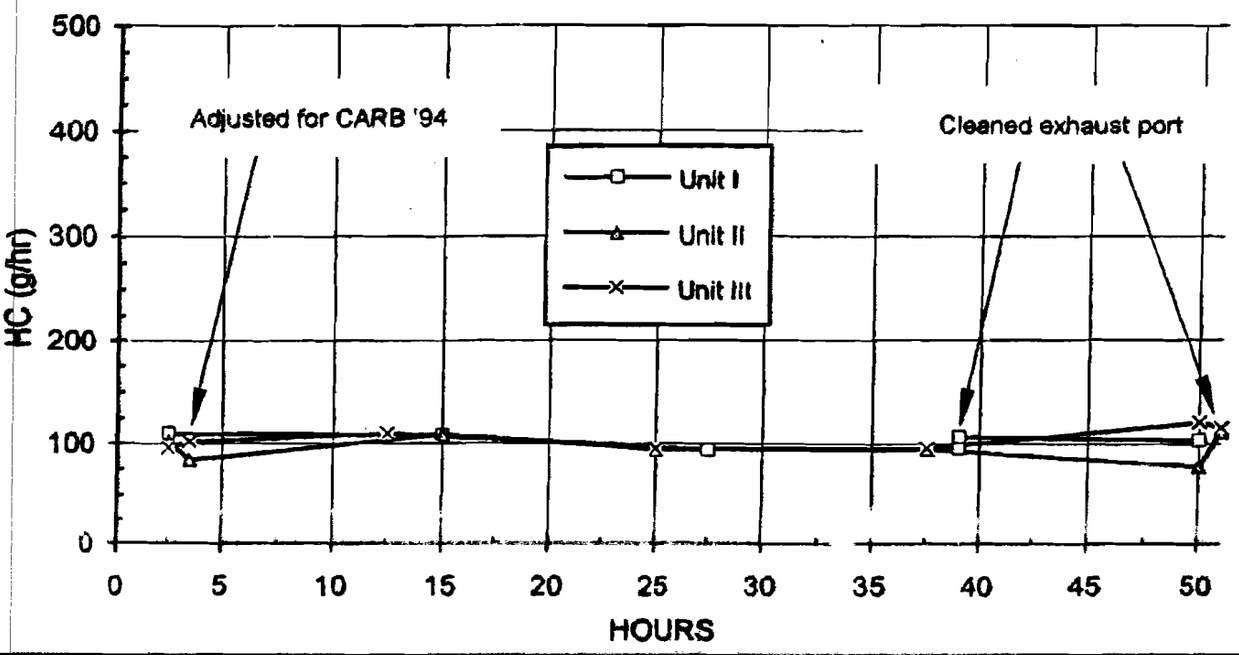
"NOx emissions were low and varied little during the test (graph 3). There was no trend."

"For all three pollutants, there was greater variation between the three units near the beginning and end of the test and only small differences between 15 and 30 hours (graphs 1, 2 & 3)."

"Except for when the exhaust port became restricted, all three units pretty much maintained their emission levels for the entire 50 hours of the test and complied with CARB '94 emissions limits. Variations in CO emissions were much wider than for HC and NOx. There was certainly no tendency for emissions to increase with time and exhaust port deposits tended to reduce emissions."

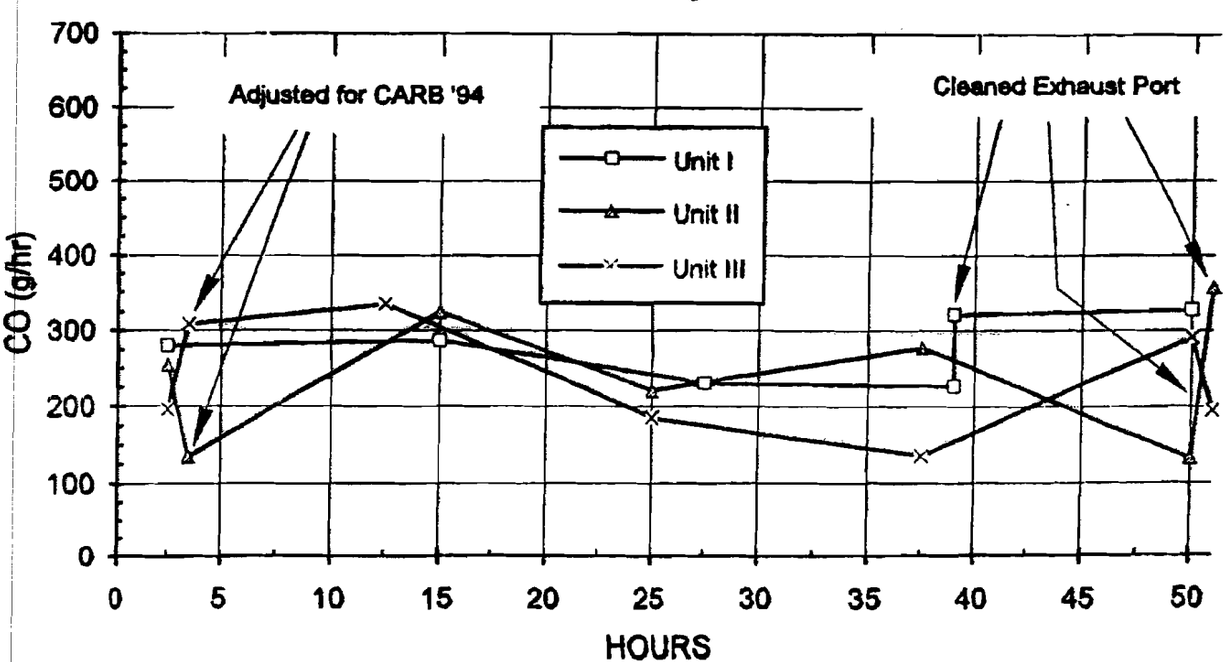
Graph 1 - HC Emissions

25 cc String Trimmer

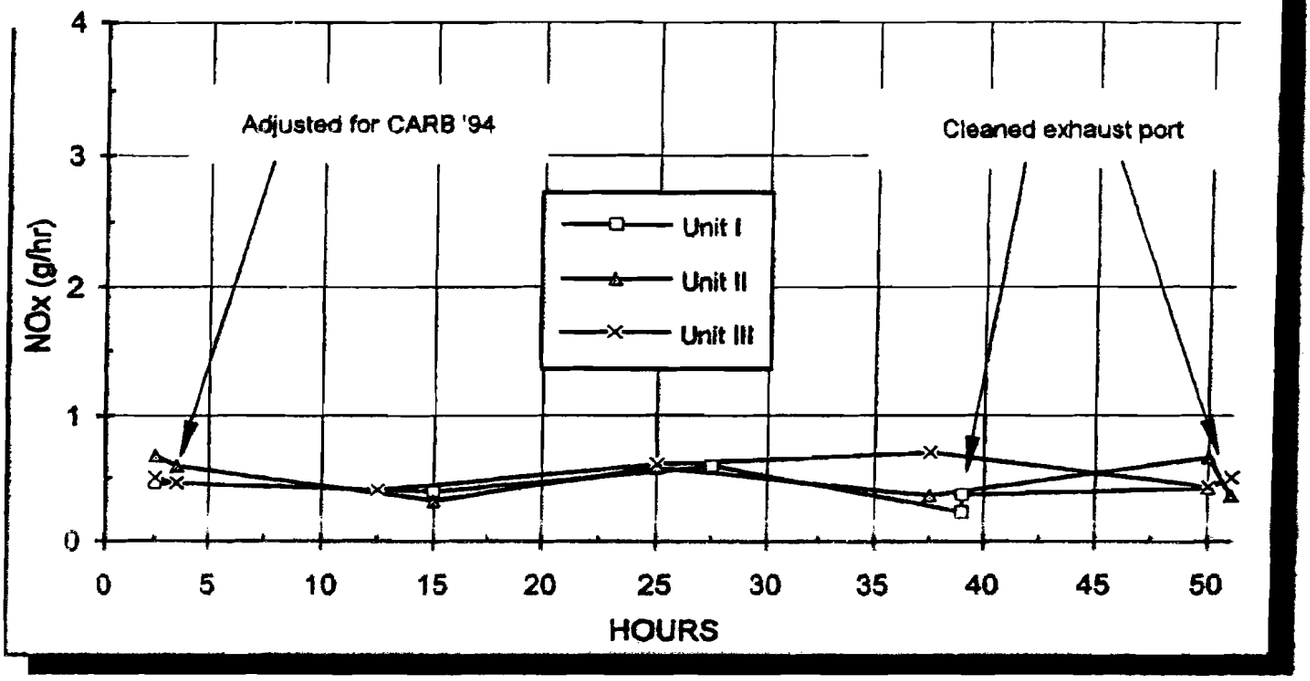


Graph 2 - CO Emissions

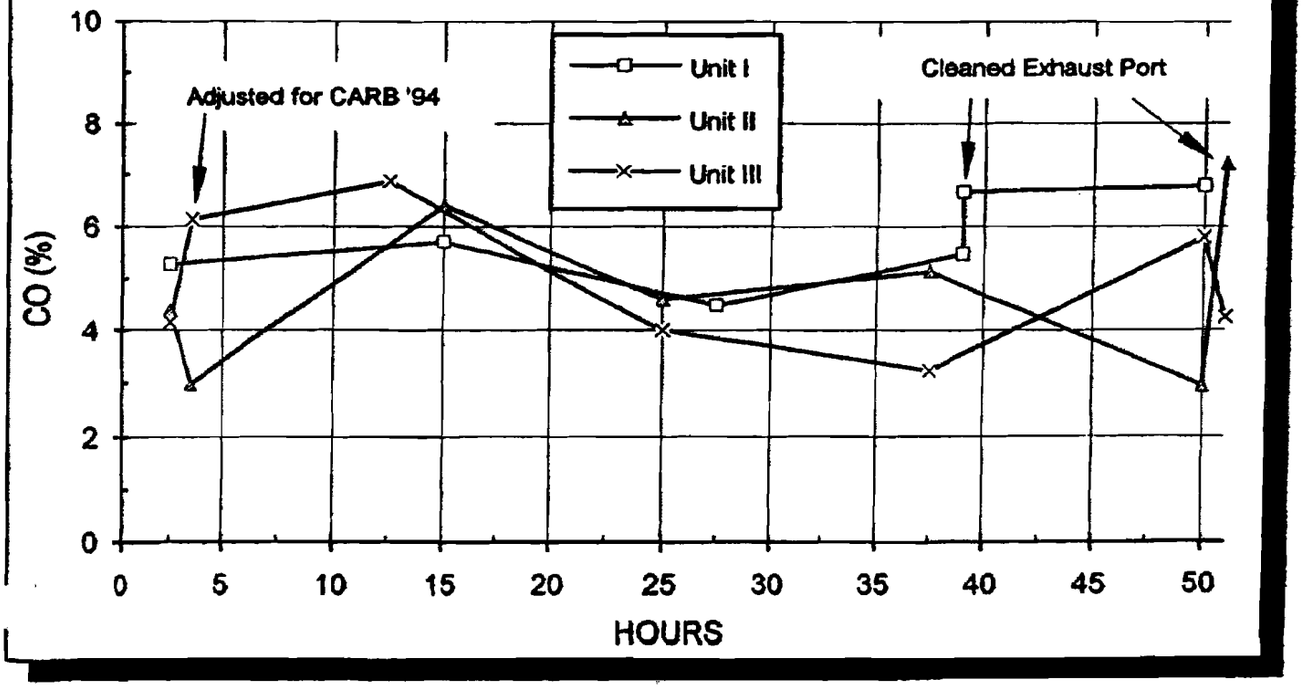
25 cc String Trimmer



Graph 3 - NOx Emissions
25 cc String Trimmer



Graph 4 - %CO
25 cc String Trimmer



SUMMARY COMMENTS From Report concerning Graphs1 through 4

.1 Power trends

"All machines indicated an increase in the power curve until the end of the test."

"The increase was between 0.07 kW (0.09 hp) and 0.19 kW (0.25 hp), i.e. between 10.8 and 29% of the nominal power."

.3 HC emissions

"All units, when measured at original base line conditions remained fairly stable throughout the test."

"The HC-emission of unit I indicated a slight decrease while unit II and III increased there (sic) mass emissions. However, it must be notified (sic) that the power of the units increased too."

.4 CO emissions

"The CO-emissions of the three units show different trends. While unit I indicates a considerable decrease, unit II remains nearly on the same level with a significant increase at the end of the test. Unit III indicates a very unsteady CO-mass flow."

"Again, the results must be considered in conjunction with the increase of the power of the units."

.5 NOx emissions

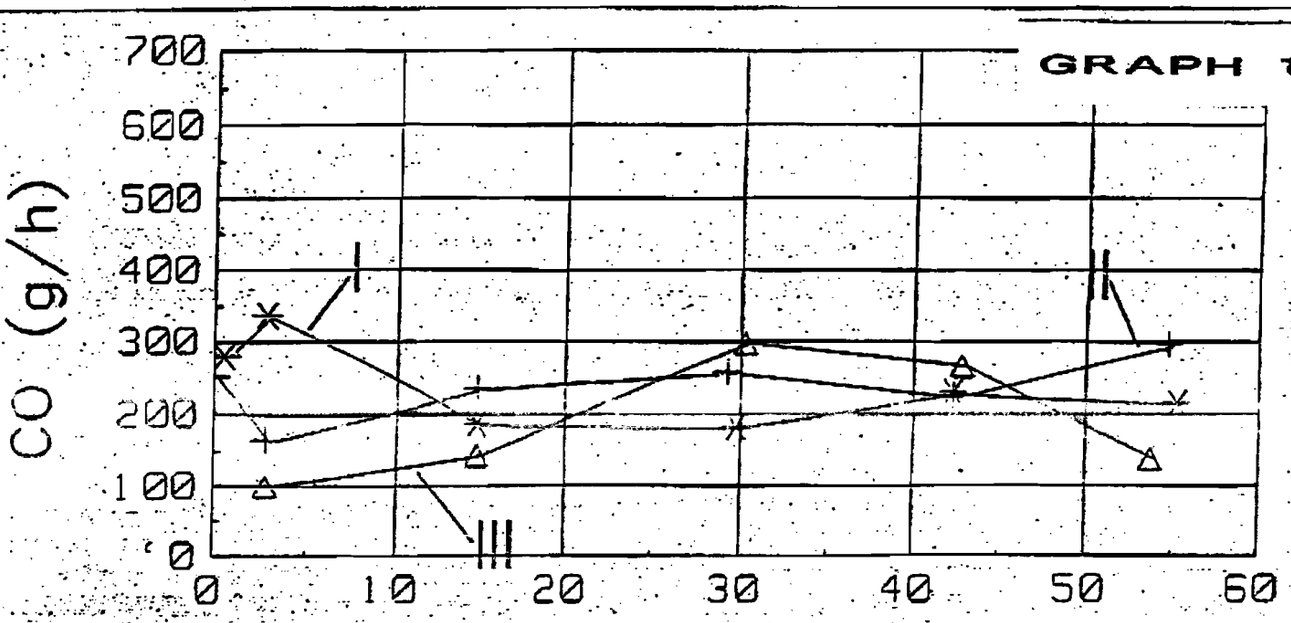
"Units I and II gave the same unchanged trend over the test duration. The NOx-emissions of unit III however were relatively unstable and showed a slight increase of (sic) the end of test."

"However, the specific NOx-emission are all in the range of less than 0.65 g/hph (unit III, end of test) and therefore not significant when compared to the CARB 94-limits (4 g/hph)."

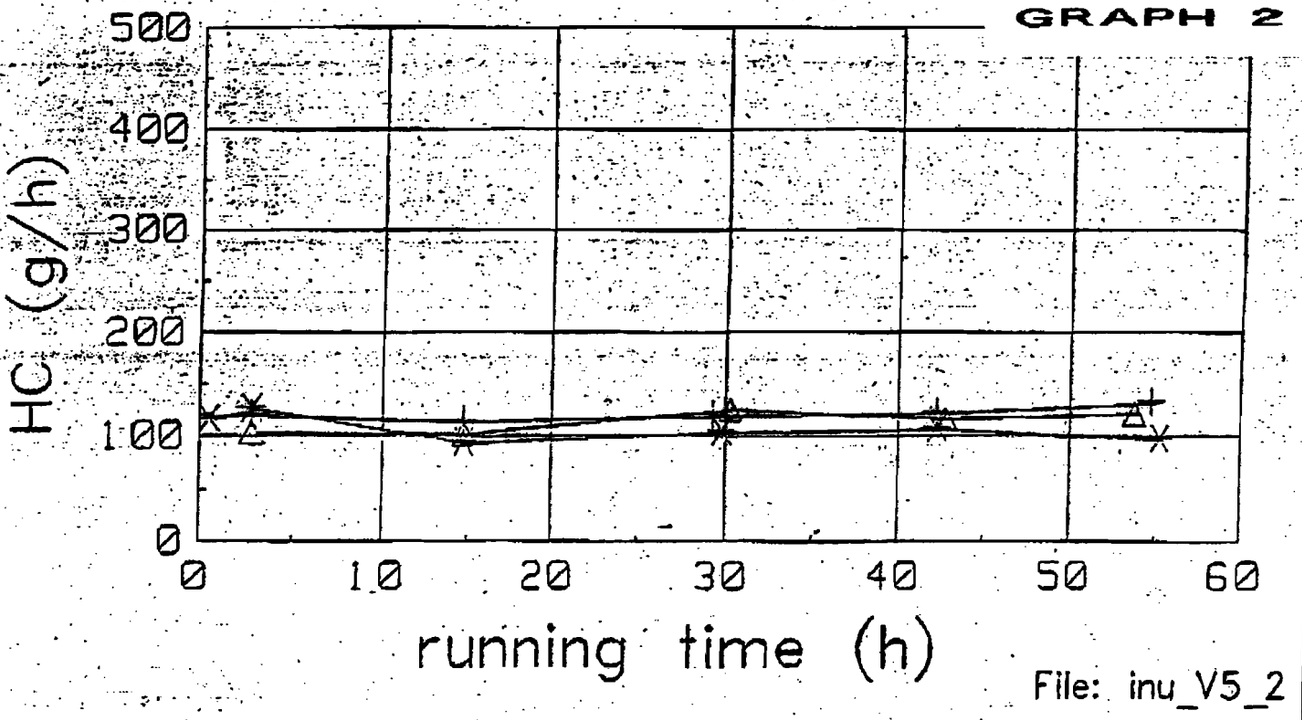
IN USE-EMISSION TEST, Blower 24cc

I×—Serial—lab II+—Carb 95—lab III △—Carb 95—field

GRAPH 1



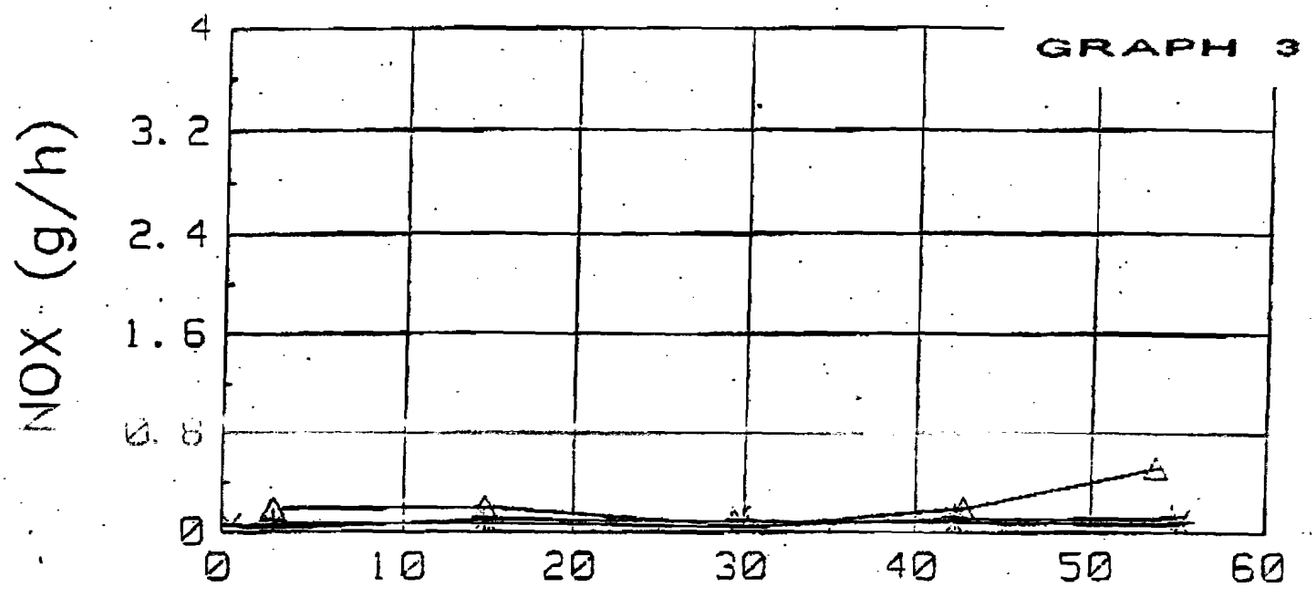
GRAPH 2

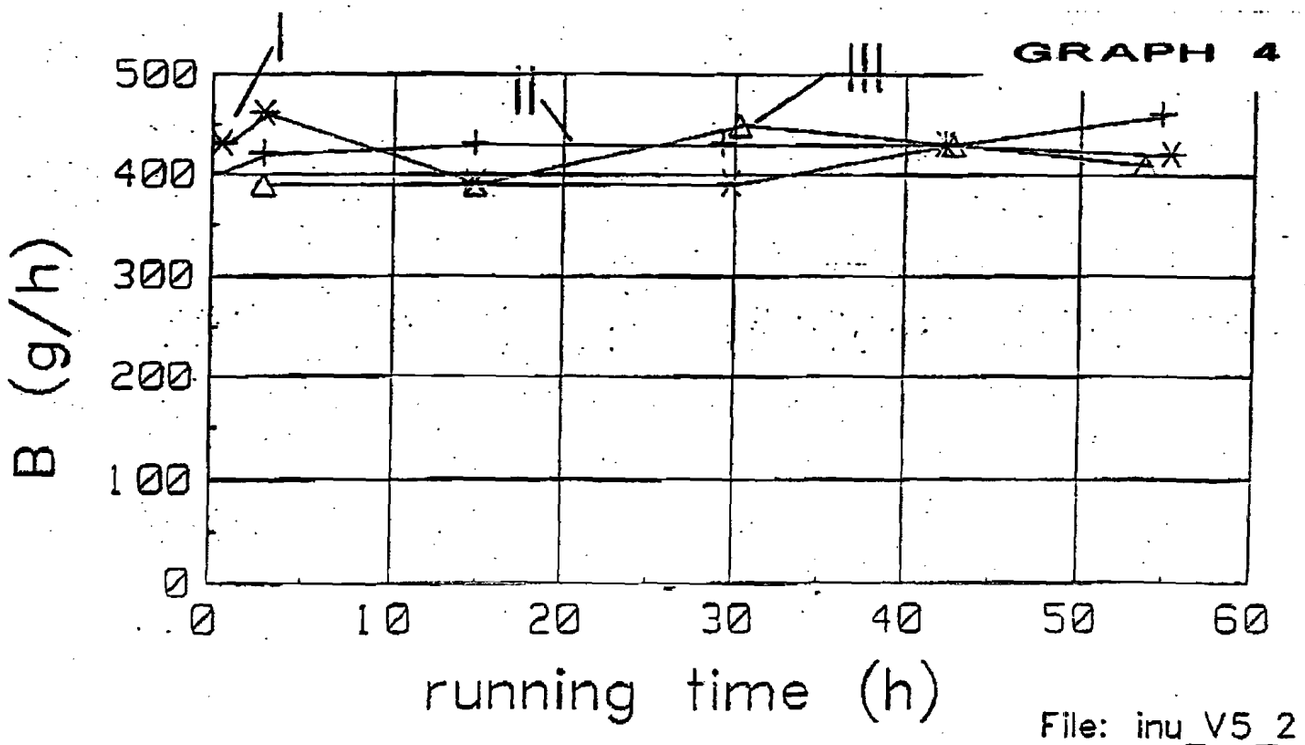


File: inu_V5_2

IN USE-EMISSION TEST, Blower 24cc

*Serial-lab II +Carb 95-lab III ≙Carb 95-field





File: inu_V5_2

SUMMARY COMMENTS From Report concerning Figures 1 through 9

.1 Comparison of power trends

"With the carburetors adjusted to their tamper resistant rich limits, the data indicates an approximate power loss of 10% at the end of the 50 hour test."

"Analysis of the engines at the end of the test are inconclusive due to ring and cylinder wear. Some carbon formation was also found in the exhaust port area. The ring and cylinder wear are critical in that it indicates the product may be reaching the end of its useful life."

.3 HC emissions

"Except for an unexplained deviation on unit I at 37.5 hours, the emission trends on the lab test units (with and without modification to CARB '94) are almost identical."

"The field test unit, when measured at original base line conditions remained fairly stable throughout the test."

"There seems to be no comparison to other units and unit III when tested in the "as received without maintenance" condition. Throughout the course of the test it does generally appear to trend lower in HC values however."

"With exception to the comments above, HC emission remained fairly stable or reduced for the length of the test conducted."

.4 CO emissions

"The emission trends for CO for units I and II (lab units with and without modification to CARB '94) follow the same trend and indicate an overall reduction (approximately 10%-20% in this case) of output."

"Unit III had very low CO in the "as received" condition at 12.5, 25, and 37.5 hours. These values raised significantly with maintenance and carb adjustments to base line conditions (figures 5 and 6). The increase under maintenance and carb adjustment did not yield CO values which were higher than units I and II. The low CO values of unit III in the "as received" condition indicate a very lean carb setting which was preferred by the operators. This preference is not uncommon and sometimes leads to premature failure of the unit due to lean side scoring or seizure."

"Overall there appears to be very good correlation of CO values between lab units and field units when measurements are taken at baseline conditions."

.5 NOx emissions

"Units I and II yielded almost identical trends over the test duration. While the overall increase was in the order of 40%-50% the final values are well below the CARB "94 requirements. NOx output is not a problem on this engine (in comparison to CARB '94)."

"The NOx values on unit III in the "as received" condition with and without maintenance are higher than units I and II (figures 7 and 8). This was explained in .4 above and was due to user preference in the carb setting. The values recorded were still well below those prescribed by the CARB '94 regulations."

III. Emission data graphs (reduced)

1.0 HC (g/hr) vs TIME (hours)

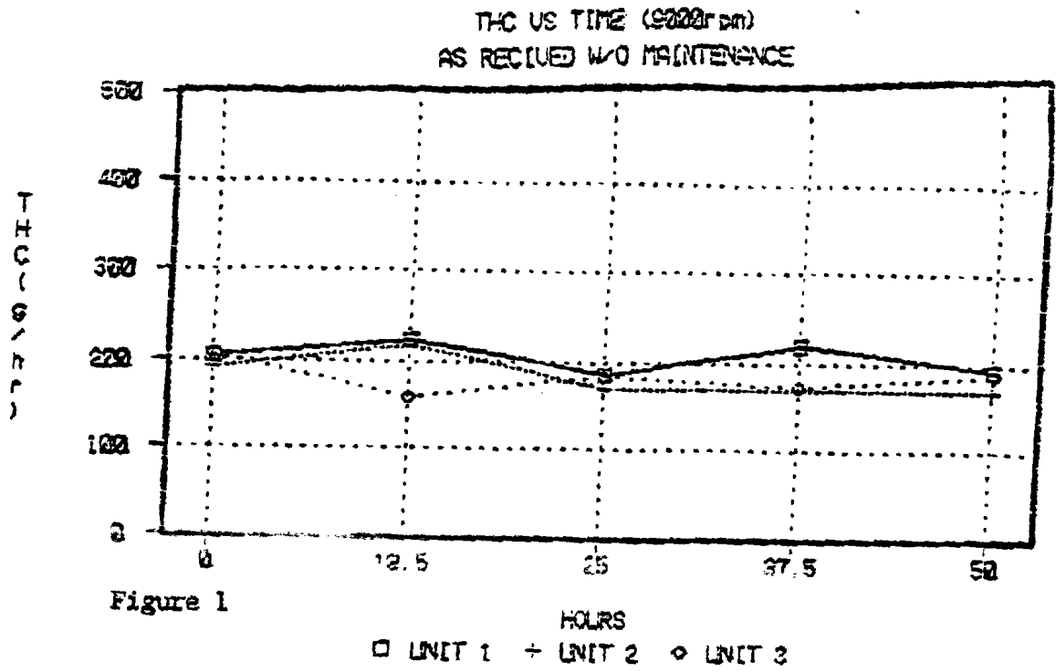


Figure 1

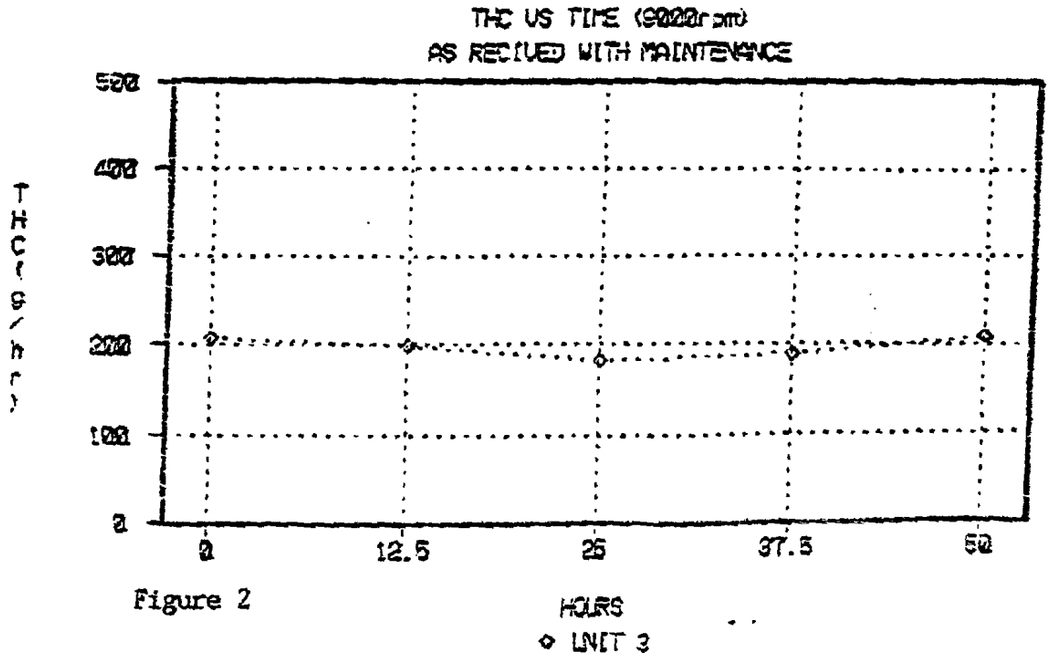


Figure 2

NOTE: Units I and II needed no maintenance therefore tests not conducted.

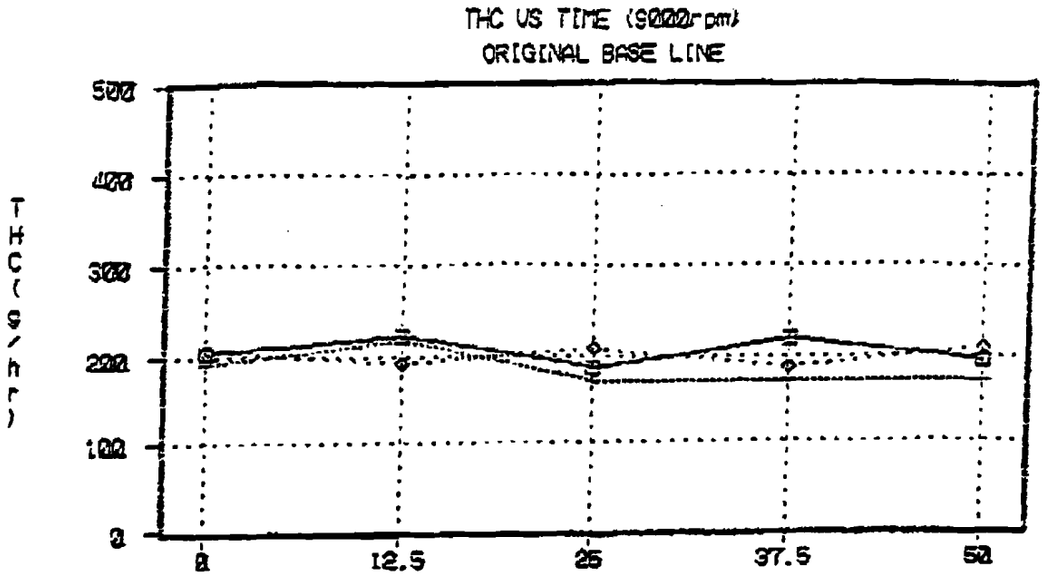


Figure 3

2.0 CO (g/hr) vs. TIME (hours)

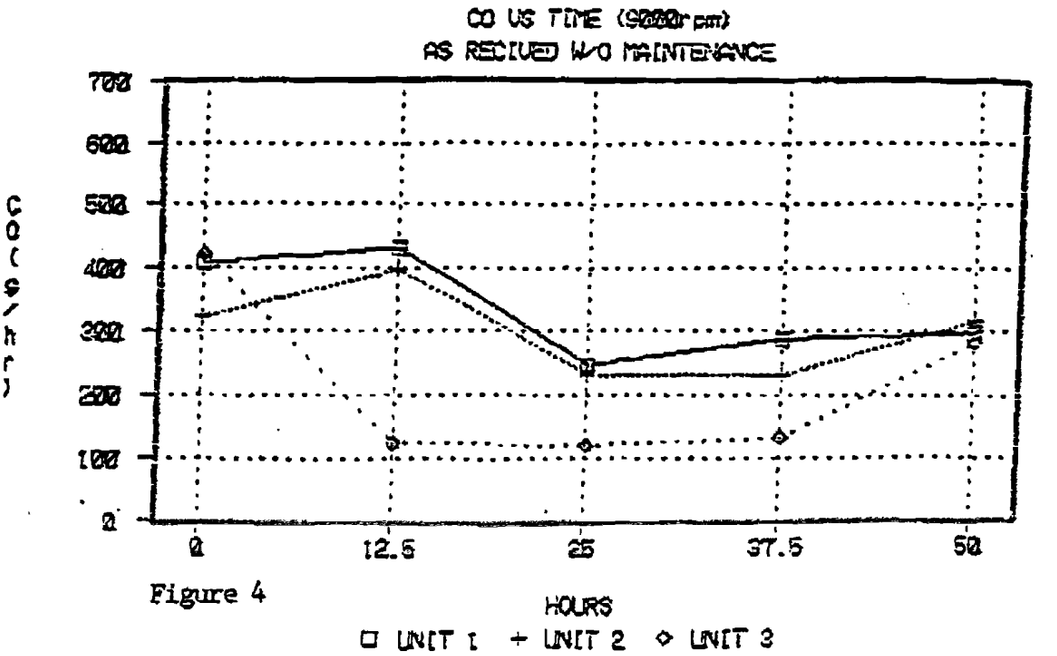


Figure 4

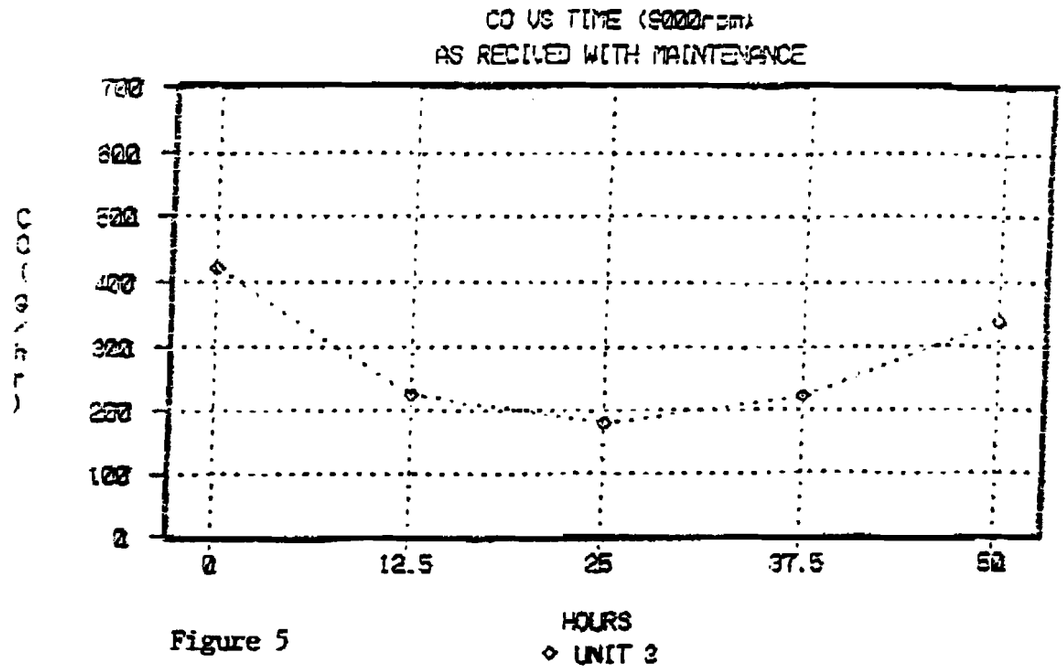


Figure 5

NOTE: Units I and II needed no maintenance therefore no emission tests run.

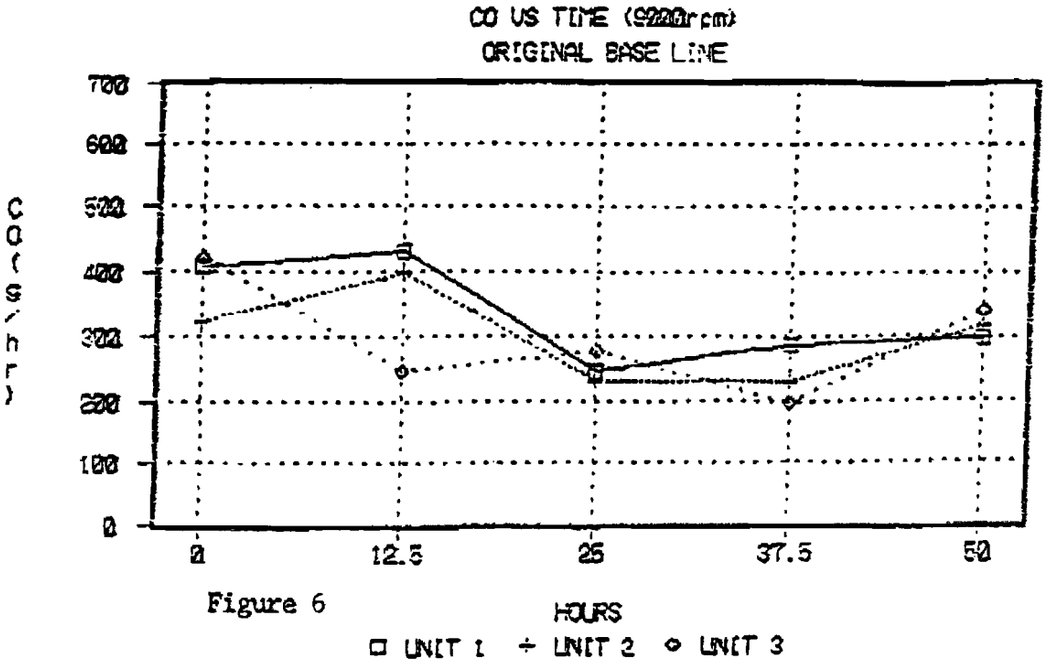


Figure 6

3.0 NOx (g/hr) vs. TIME (hours)

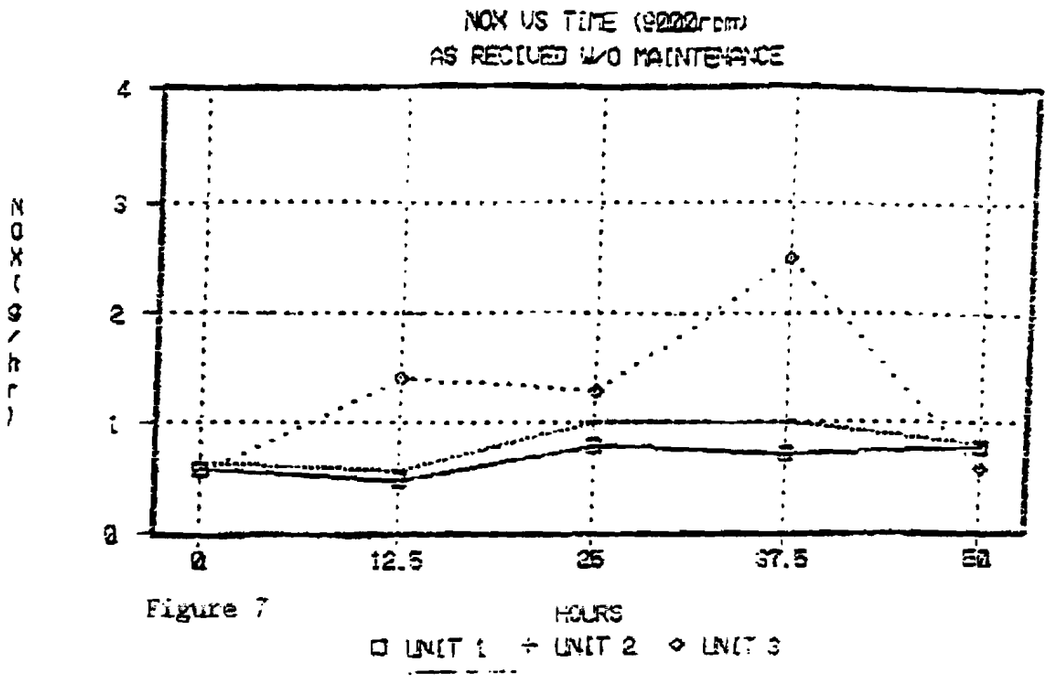


Figure 7

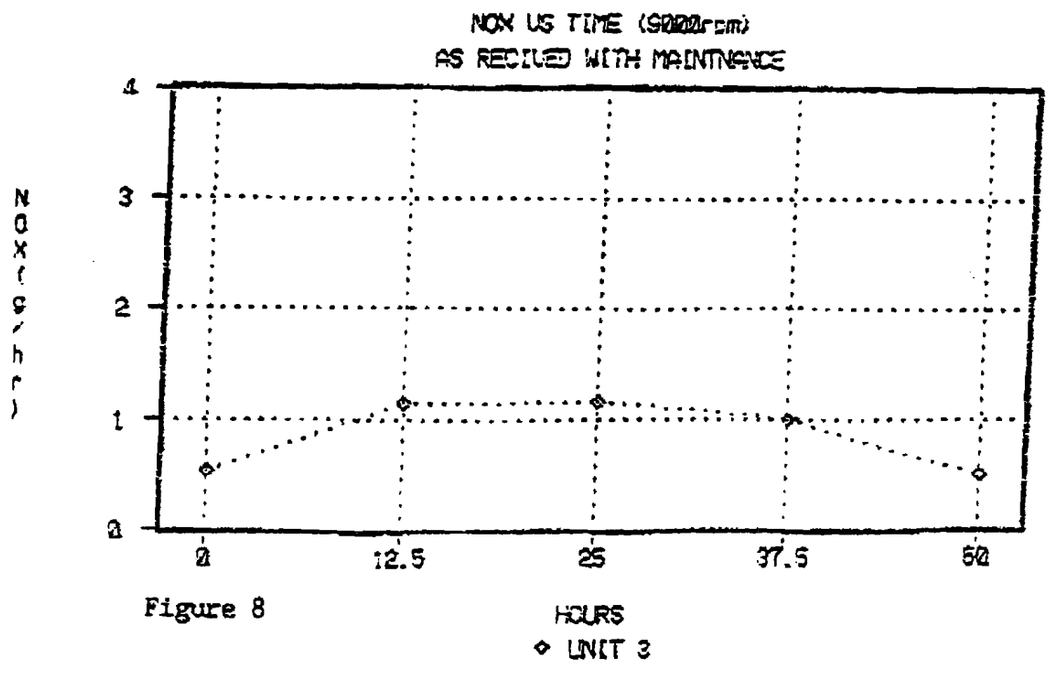


Figure 8

NOTE: Since no maintenance was required on units 1 and 2 - no emission tests were run.

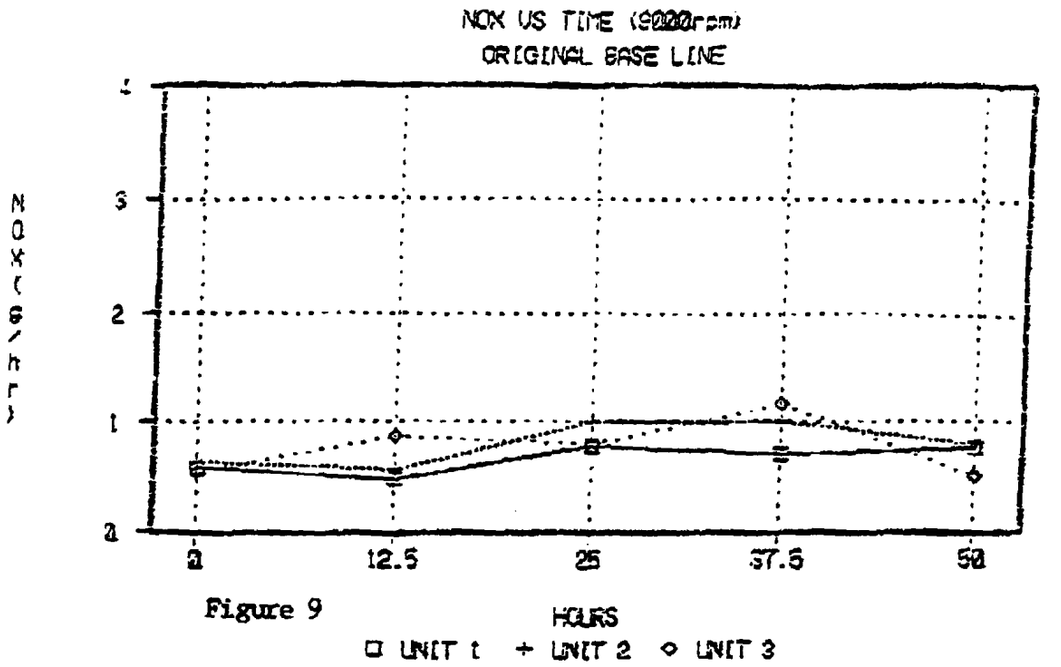


Figure 9

4.0 Fuel flow (g/hr) vs TIME (hours)

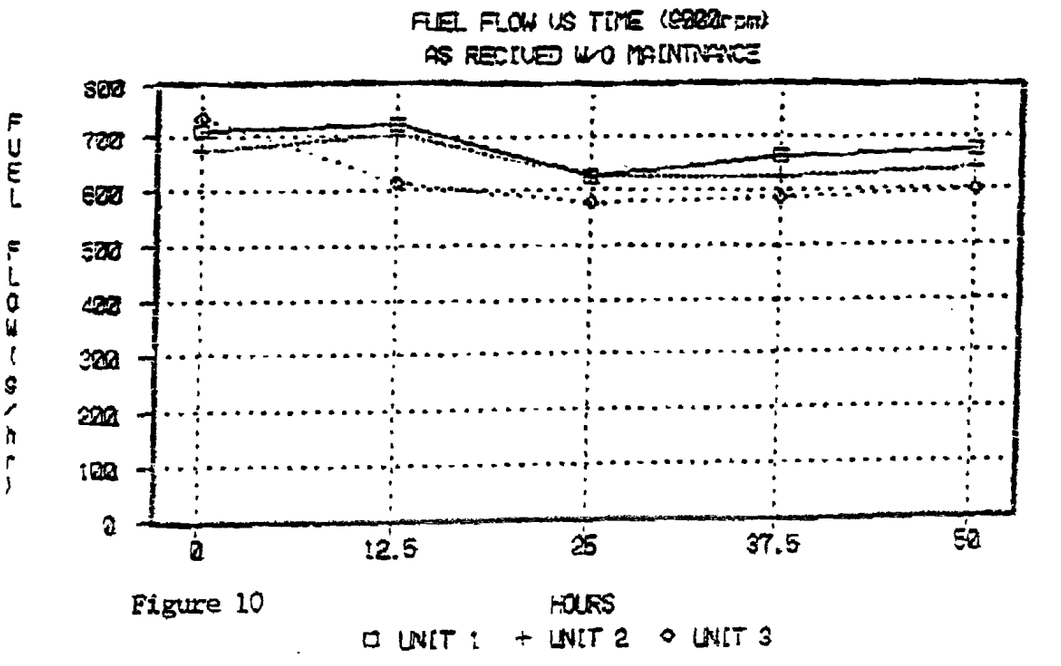


Figure 10

SUMMARY COMMENTS From Report concerning Figures coded III,2 through III,7

3.1 HC emissions (g/h)

3.1.1 Lab test

"The mass flow of HC (g/h) is rather constant over the 300 hours of in-use lab testing. The trend is an increase of 7-8% from new to 300 hours."

3.1.2 Field test

"The mass flow of HC (g/h) is rather constant over the 300 hours of in-use field testing. Both engines show an increase of around 10% from new to 75 hours. Thereafter unit no.6 does not change at all up to 300 hours."

3.2 CO emissions (g/h)

3.2.1 Lab test

"Unit no. 2 (current production) and no. 3 (CARB '94) show similar trends, i.e. a decrease from new to 75 hours. Thereafter the trend is increasing until 300 hours. The total increase from new until 300 hours is in the range of 15-20%, with the main increase from 225 to 300 hours."

"Unit no.4 (CARB94) keeps decreasing util 225 hours, after which a slight increase can be seen. Totally, unit no.4 shows a reduction from new until 300 hours of approximately 5%."

"Unit no.1 (current production) starts at a higher level and has an increasing trend from new to 300 hours; approximately 15%. The reasons for this unit starting at a higher level is not fully clear. One contributory reason is that high speed needle of the current production units were set to give a racing speed of 12500 rpm, which is our present recommendation. This method is not optimised (sic) for emissions repeatability and reproducability (sic)."

3.2.2 Field test
"Both units show an increasing trend, unit 5 around 8%, unit 6 around 13% from new to 75 hours. Unit 6 thereafter shows a further slight increase (2-3%) up to 150 hours. At 225 hours it is back to where it was when new."

3.3 NOx emissions (g/h)

3.3.1 Lab test

"The tendency for units 2,3, and 4 is a slight increase until 150 hours, after which the NOx emissions starts to decrease. The explanation is that initially the compression

pressure increases due to deposits. However, after some time the engine wear becomes dominant, which results in lower power output and consequently lower NOx emissions."

"Unit 1 emits less NOx than the other due to initially richer carburettor (sic) setting. The levels are rather stable vs time. The tendency (field test) is no significant change up to 150 hours. However, from 150 to 225 hours unit 6 has increased approximately 17%."

3.3.2 Field test

"The tendency is no significant change up to 150 hours. However, from 150 to 225 hours unit 6 has increased approximately 17%."

3.5 Engine power output

3.5.1 Lab test

"The power of all four engines show an increasing trend from new until 150 hours of use, when the power starts decreasing."

"The power increase at 150 hours is 10-15% as compared to new condition."

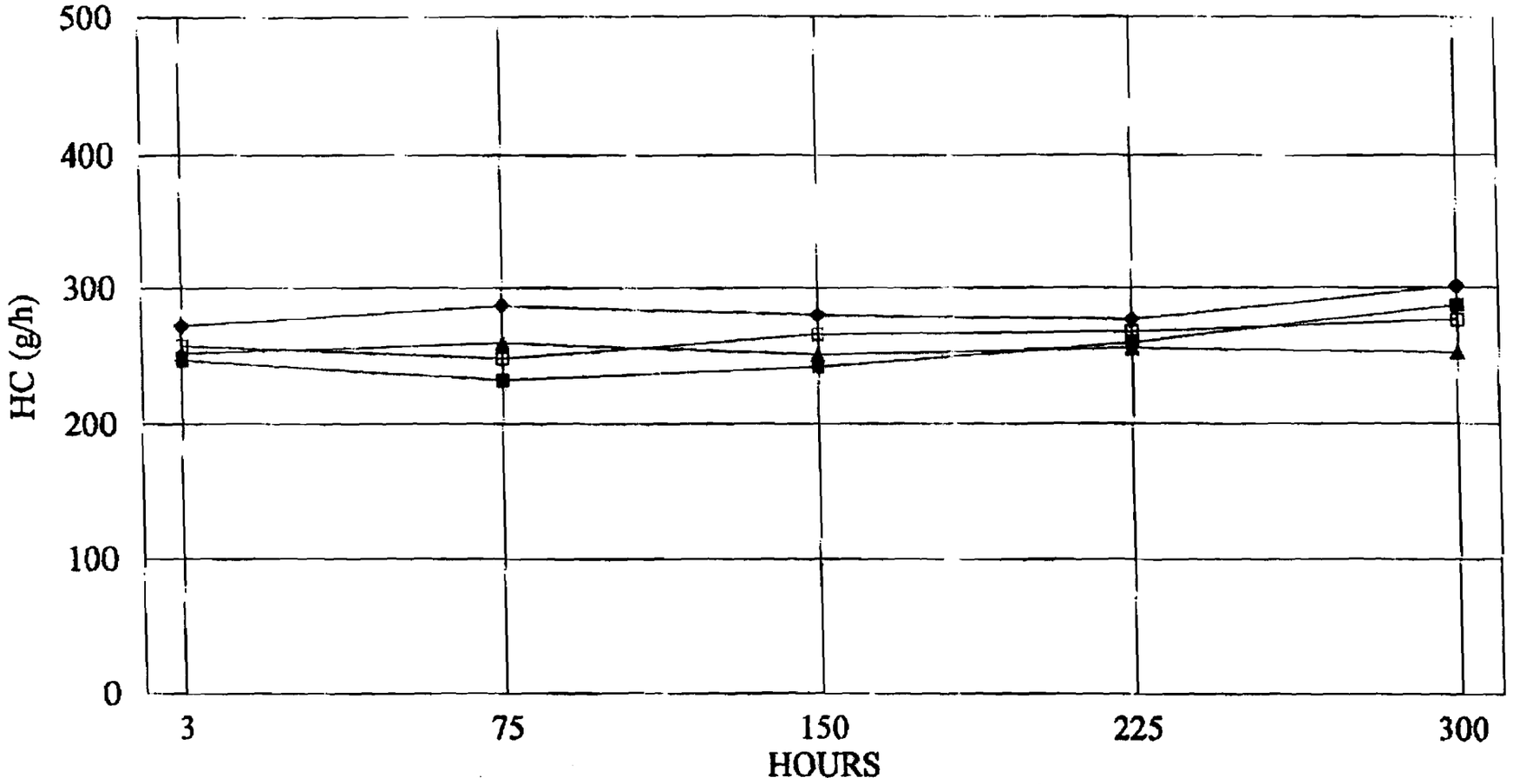
"At the end of the test (300 hours), the power is back to the same region as when new. For this particular model, the unit-to-unit performance variation is dominant in relation to the CARB94 versus standard variation."

3.5.2 Field test

"Unit no. 5 increases its power out up to 75 hours. Unit no. 6 shows an increasing tendency up to 225 hours, with the exception of a dip nearly back to as-new condition at 150 hours. A contributory explanation for this dip can be that the ambient air pressure on the day of measuring was lower than normal."

HC (g/h) VS TIME

9000 RPM. ENDURANCE TEST



③ Unit no.3 — ENGINE NR. 2220694 MODIFIED TO CARB 94.

① Unit no.1 — ENGINE NR. 2220695 ADJUSTED TO MANUFACTURER REC.

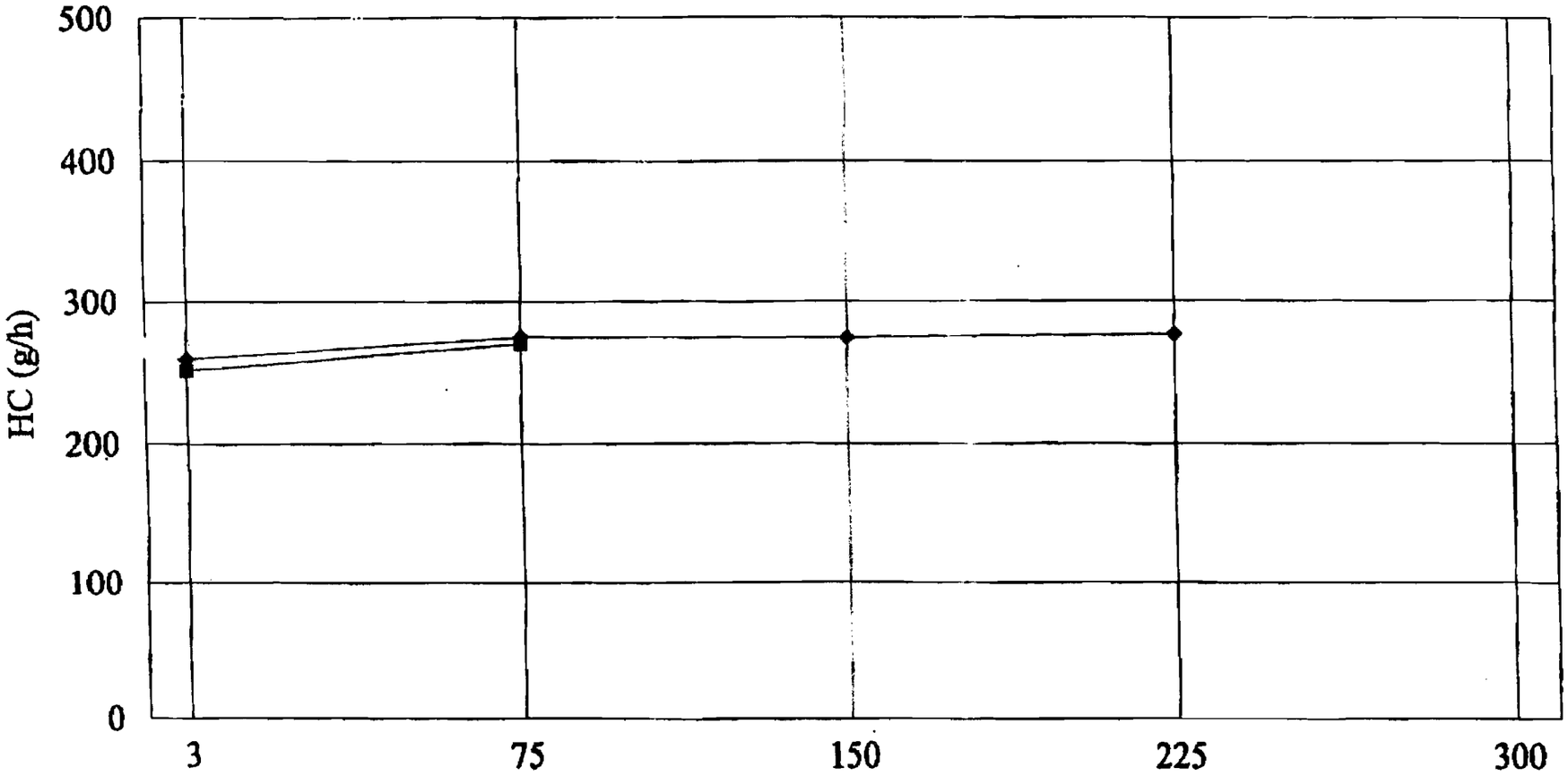
④ Unit no.4 — ENGINE NR. 2220696 MODIFIED TO CARB 94.

② Unit no.2 — ENGINE NR. 2220697 ADJUSTED TO MANUFACTURER REC.

III.2

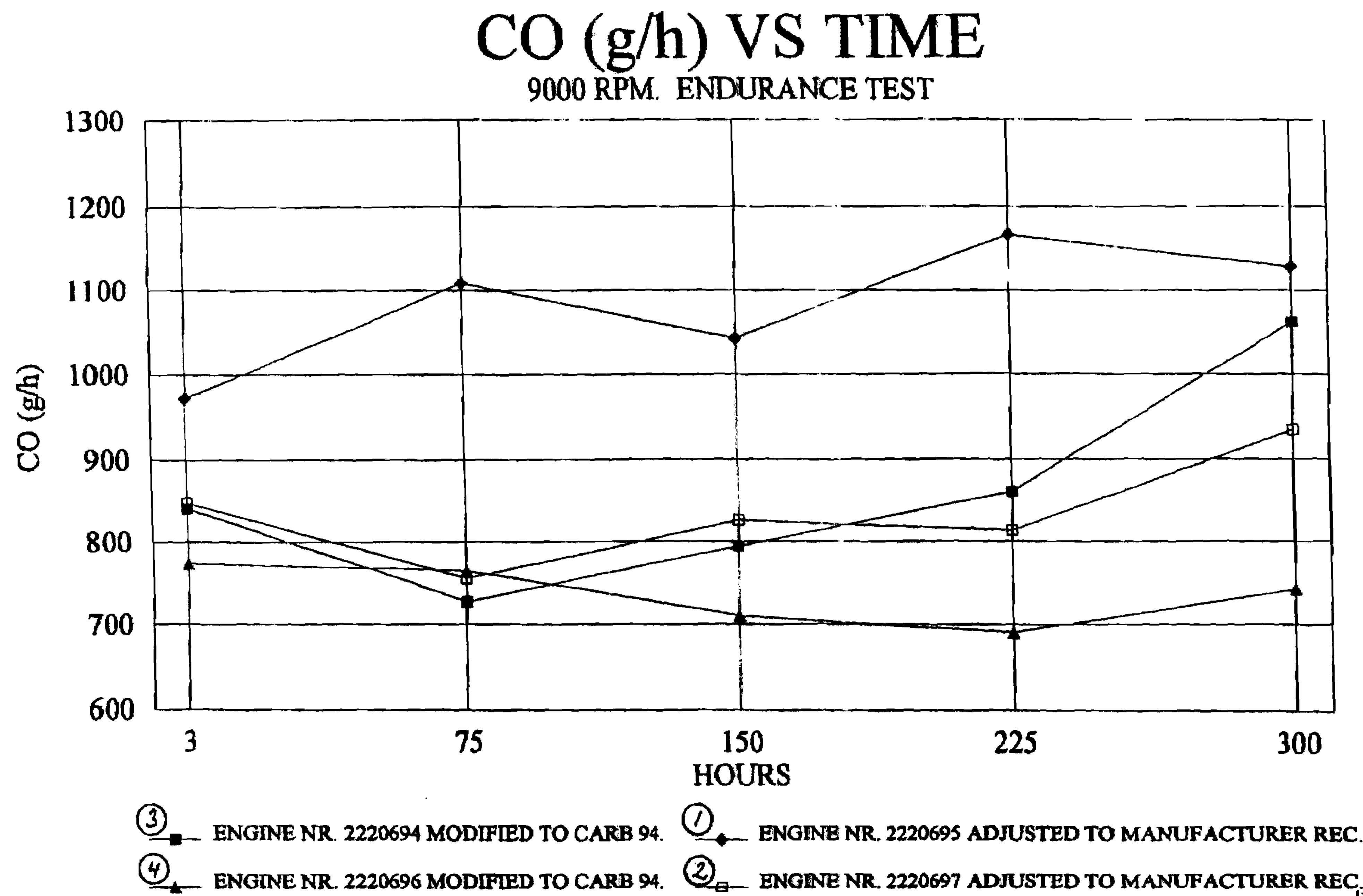
HC (g/h) VS TIME

9000 RPM. FIELD TEST



⑤ ENGINE NR. 2220691 MODIFIED TO CARB 94.

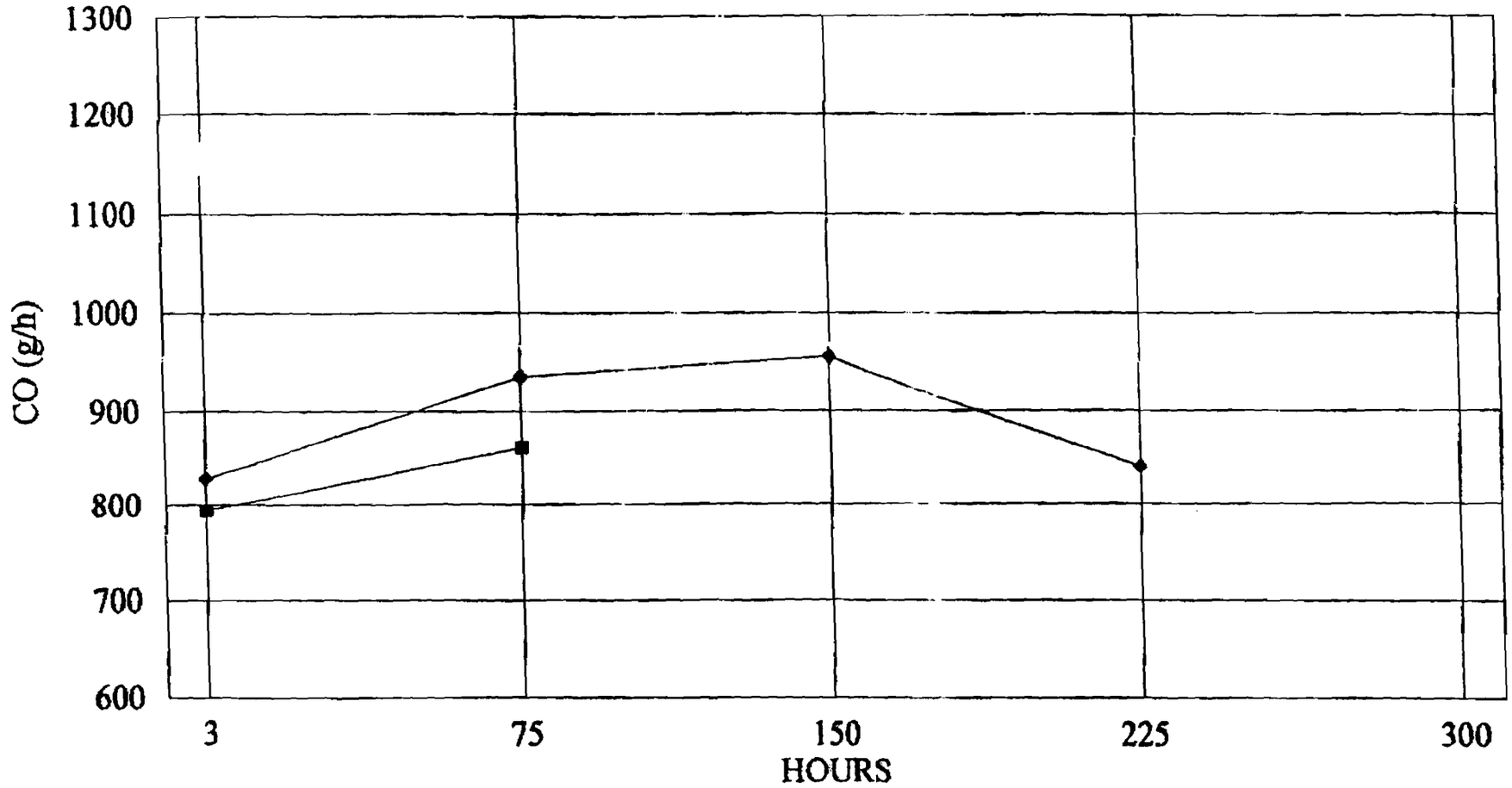
⑥ ENGINE NR. 2220693 MODIFIED TO CARB 94.



III, 4

CO (g/h) VS TIME

9000 RPM. FIELD TEST

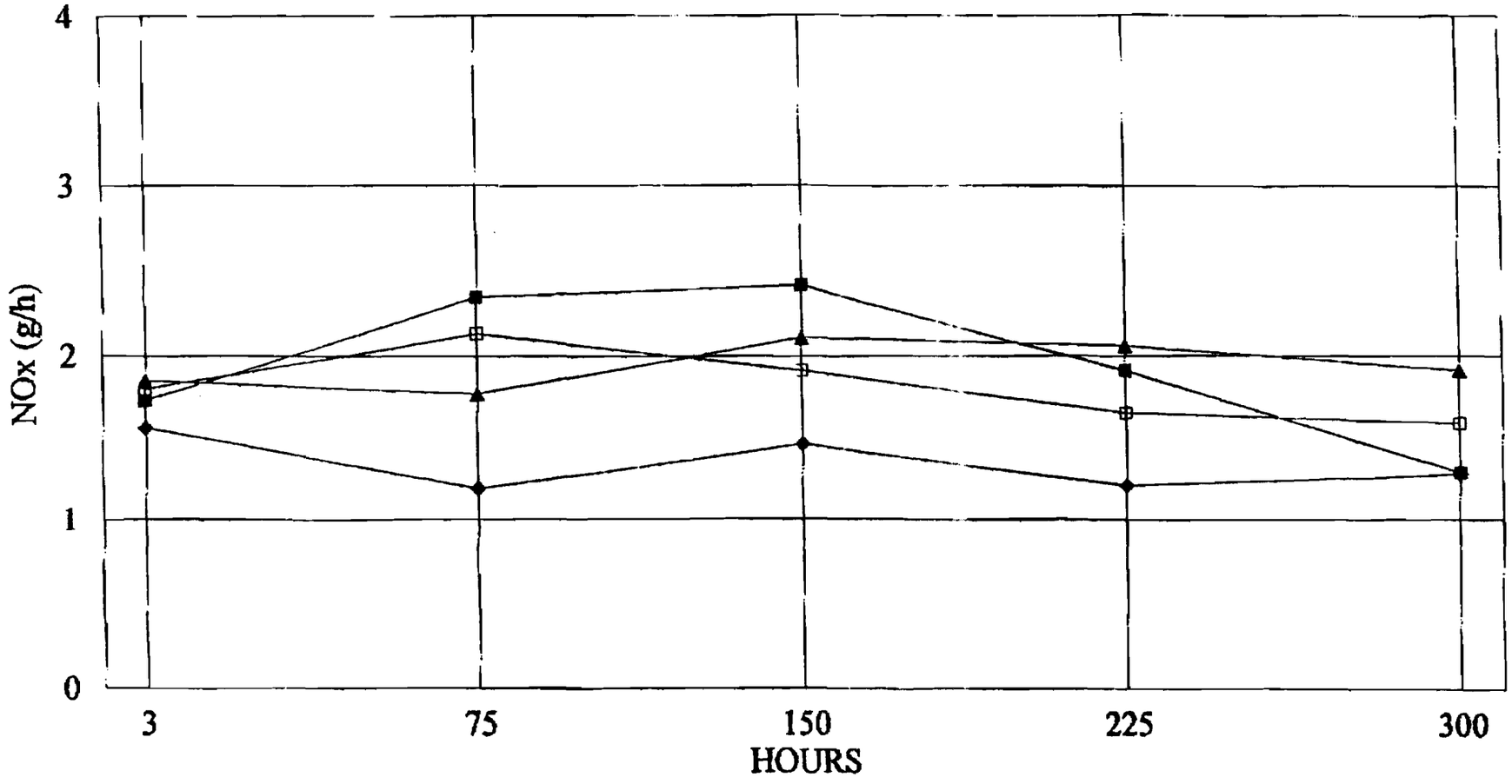


⑤ ENGINE NR. 2220691 MODIFIED TO CARB 94.

⑥ ENGINE NR. 2220693 MODIFIED TO CARB 94.

NOx (g/h) VS TIME

9000 RPM. ENDURANCE TEST



③ ENGINE NR. 2220694 MODIFIED TO CARB 94.

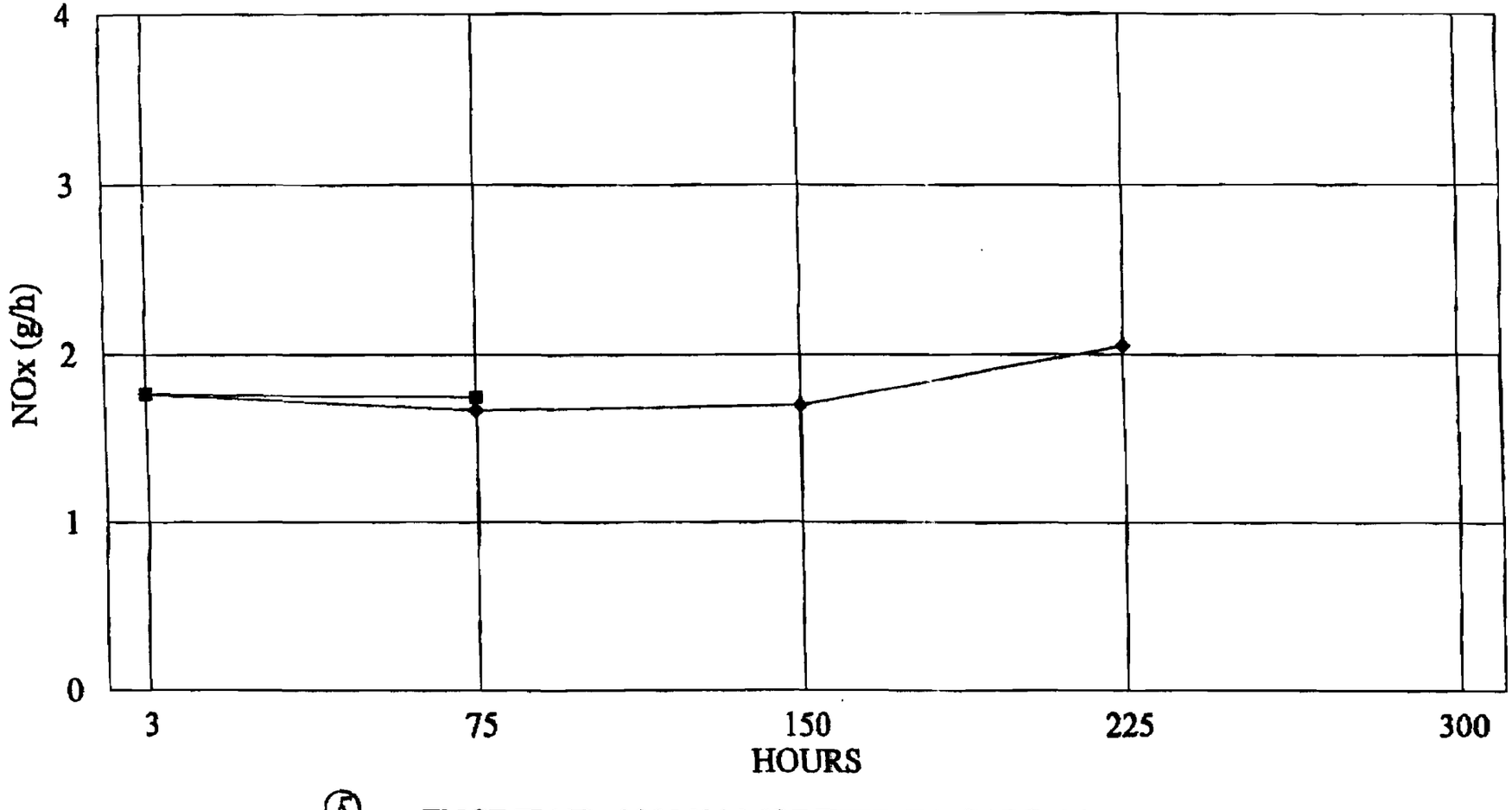
① ENGINE NR. 2220695 ADJUSTED TO MANUFACTURER REC.

④ ENGINE NR. 2220696 MODIFIED TO CARB 94.

② ENGINE NR. 2220697 ADJUSTED TO MANUFACTURER REC.

NOx (g/h) VS TIME

9000 RPM. FIELD TEST



⑤ ENGINE NR. 2220691 MODIFIED TO CARB 94.

⑥ ENGINE NR. 2220693 MODIFIED TO CARB 94.

PPEMA

"IN-USE"

EMISSION

STUDY

PRESENTED BY:

PPEMA A.Q.C.

FEBRUARY 1, 1994

1/20/94

PPEMA "IN-USE" EMISSION TEST PROGRAM

(Presented to EPA - Test Procedure Task Group -- 2/1/94)

1.0 PURPOSE & CONCLUSIONS

.1 Determine and compare long term emission characteristics of lab and field test units.

"BASED ON LIMITED TESTS, NO SIGNIFICANT DIFFERENCE WAS NOTED ON PORTABLE TWO-STROKE PRODUCTS"

.2 Determine and compare long term emission characteristics of "current production" and "reduced emission technology" units.

"DATA INDICATES STABLE OR SLIGHTLY DECREASING EMISSION COMPONENTS OVER TIME FOR PORTABLE TWO-STROKE PRODUCTS"

.3 Determine effects of maintenance on long term emission characteristics.

- "SOME UNITS INDICATE REDUCED EMISSIONS BEFORE MAINTENANCE IS PERFORMED"
- "AFTER MAINTENANCE PORTABLE TWO-STROKE PRODUCTS EMISSION CHARACTERS REMAIN STABLE OR SLIGHTLY REDUCED"

.4 Determine repeatability of test equipment and test procedure.

"GOOD REPEATABILITY OBTAINED FOR ALL TEST LABS FOR:"

- TESTS ON SAME UNITS
- TESTS ON UNITS OF SAME MODEL TYPE
- TESTS ON CURRENT PRODUCTION AND "REDUCED EMISSION TECHNOLOGY" UNITS
- TEST ON FIELD OR LAB UNITS

.5 Add to EPA and PPEMA emission database.

"MISSION ACCOMPLISHED"

.6 Gather reliability data on "current production" and "reduced emission technology" units.

- "NO PROBLEMS ENCOUNTERED ON CURRENT PRODUCTION UNITS"
- "ONE TEST ON 'REDUCED EMISSION TECHNOLOGY' DISCONTINUED DUE TO FAILURE"
- "PROBLEMS ON DURABILITY ENCOUNTERED ON THREE OTHER TEST UNIT TYPES ('REDUCED EMISSION TECHNOLOGY')"

2.0 **TEST DATES:** 10/92 - 5/93

3.0 **PRODUCT EVALUATED AND TEST DURATIONS**

.1 44.0cc "professional" backpack blower -- 300 hours

.2 23.9cc "occasional use" hand-held blower -- 50 hours

.3 53.1cc "professional" chain saw -- 300 hours

.4 38cc "occasional use" chain saw -- 50 hours

.5 30.1cc "occasional use" chain saw -- 50 hours

.6 25cc "occasional use weed trimmer -- 50 hours

.7 21cc "occasional use weed trimmer -- 50 hours

4.0 **NUMBER OF PRODUCTS TESTED AND TEST TYPE:**

.1 Minimum of one (and up to two) of each product type in "3.0" above was "current production" and lab tested.

.2 Minimum of one (and up to two) of each product type in "3.0" above was "reduced emission technology" and lab tested.

.3 Minimum of one (and up to two) of each product type in "3.0" above was "reduced emission technology" and field tested.

.4 Total of 24 units used in test.

.5 Tests conducted in [redacted], [redacted], [redacted] and U.S.A.

5.0 **EMISSION TEST SCHEDULES:**

.1 Professional products -- After break-in and every 75 hours until E.O.T.

.2 Occasional use products -- After break-in and every 12.5 hours until E.O.T.

6.0 **EMISSION TEST PROCEDURE USED:** SAE J1088 (RGM)

7.0 **MAINTENANCE**

.1 Procedures outlined in operator's manual followed (test run before and after if maintenance required).

8.0 **DATA RECORDED** (See Figures 1-10)

.1 Emission data (raw and reduced) for tests. (Figure 1)

.2 Non-proprietary test equipment list. (Figures 2-3)

.3 Test logs (maintenance, etc.). (Figure 4)

.4 Field unit documentation. (Figure 5)

.5 Performance data (power and fuel consump.). (Figures 6-7)

.6 Emission plots. (g/hr vs. time) (Figure 8)

.7 Fuels used (durability and emission tests).

.8 Test unit profiles. (Figure 9)

.9 Teardown analysis (Figure 10)

(NOTE: Over 400 pages of reports generated.)

9.0 DISCUSSION

.1 Comparison of lab and field test units

and

.2 Comparison of long term emission characteristics of "current Production" and "reduced emission technology units"

Typically all units tested showed excellent correlation between lab test and field test results.

Referencing Figure 11 which is CO and HC vs. time of a 21cc trimmer, it is adequately seen that the emission trends (slightly up and down) mirror each other for lab and field units (units 2 and 3) which were "reduced technology" types.

Trends under non-baseline and baseline conditions were similar. When the units were readjusted to baseline conditions the variation was diminished. (See Figures 11 and 12)

All components (HC, CO and NOx) typically remained constant or decreased over time. This seems to indicate that the deterioration factor for portable two-stroke equipment could be a value of 1 or less. Reference Figures 11, 13, 14, 15, 16. Figure 11 is from the same 21cc trimmer. Figures 13 and 14 are from a 38cc chain saw. Figures 15 and 16 are data from a 30.1cc chain saw.

.3 Determine maintenance effects on emission characteristics

Figures 17 and 18 demonstrate well the typical trend seen on field test units. This data is from a 30.1cc chain saw tested with a firewood cutter in Japan. We will only look at CO here. The THC trend was the same as the CO. As one might expect, the NOx trend was just the opposite.

Unit 3 (field unit) showed considerably lower CO levels at all test intervals between 0 and 50 hours (Figure 17). When this saw had maintenance, which was cleaning the air filter, these points rose slightly.
For the third emission test (Figure 18) the saw was then measured at the original baseline setting determined by the factory. Figure 18 shows that Unit 3 now has similar emission characteristics as units 1 and 2 and they all generally trended longer.

These lower levels (prior to readjustment to baseline) are what we might expect from this user. The user preferred more cutting speed and had leaned the mixture screws to get this. This is not good for product durability. Tests on power, and inspection after 50 hours showed this unit was nearing the end of its useful life.

.4 Repeatability and accuracy

150-160 emission tests were conducted. Tests from lab to lab and within labs showed good correlation.

This is even more credible when one considers that for each test the unit had to be fixtured to the emission test apparatus.

PPEMA members were both surprised and pleased by the results achieved. It is our position that SAE J1088 is a sound test procedure for measuring the emission characteristics of portable two-stroke products.

.5 Add to EPA and PPEMA data base

All test results were presented to EPA (March 1993) in paper form as well as on diskette. An example of the typical data format is seen in Figure 1.

.6 Gather reliability data

All "current production" units lasted their respective lab tests with no abnormal problems.

Unfortunately, "reduced emission technology" units did not fair as well.

One test (44.0cc blower) was discontinued due to continued seizures.

Two tests (38cc chain saw) were started over due to failures.

One test unit (53.1cc chain saw) required a piston replacement in order to complete testing.

This suggests that "reduced emission technology" units' durability still need further study.

C\EPA

Figure 1

SFLD-09

Project: PFEMA TEST
Engine: CHAIN SAW
Displacement: 38 cc
Carb: WT-20
Tested By: BH

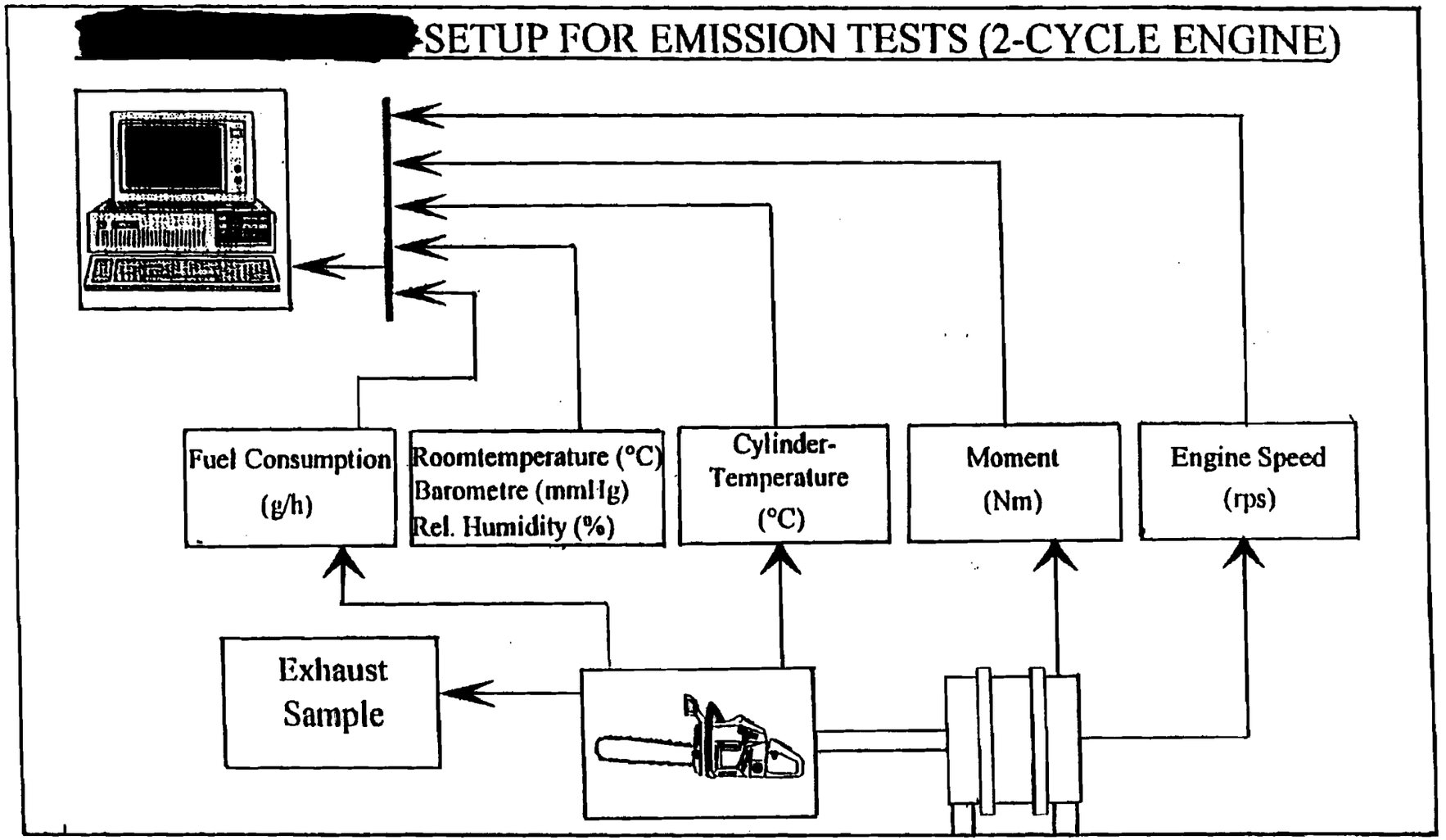
Comments: 40:1 INDOLENE SYNTHETIC OIL
MUFFLER PROBE
FIELD UNIT;50HRS

DRY BULB 74 °F
BAROMETER 29.05 inHg
Y= 1.09
WET BULB 64 °F

TIME HH:MM:SS	RPM	TORQUE in·lbs	FUEL FLOW g/hr	OBSV HP hp	BSFC g/hp·hr	CO %	CO2 %	HC ppm	O2 %	NOX ppm	INLET °F	SPARK °F	CO g/hr	CO2 g/hr	HC g/hr	NOx g/hr
15:18:56	5997	14.70	832	1.51	551	4.09	5.48	52361	8.61	48	76	483	450	947	309	0.94
15:19:00	5997	14.72	834	1.51	552	4.14	5.44	52460	8.61	48	78	486	456	941	310	0.94
15:19:05	5997	14.77	833	1.52	548	4.10	5.46	52184	8.61	48	80	488	452	946	309	0.94
15:19:10	5997	14.82	832	1.52	547	4.06	5.48	52382	8.63	49	76	490	447	949	310	0.96
15:19:16	5997	14.76	831	1.52	547	4.10	5.46	52582	8.61	49	79	491	450	941	310	0.95
15:19:21	5998	14.76	831	1.52	547	4.17	5.43	52875	8.60	49	81	494	455	932	310	0.95
15:19:26	5997	14.76	832	1.50	555	4.17	5.43	52873	8.59	49	82	496	456	933	310	0.95
15:19:31	5997	14.90	835	1.54	542	4.16	5.44	52924	8.59	48	84	497	456	938	312	0.93
15:19:50	5997	14.76	828	1.52	545	4.18	5.41	53407	8.61	49	85	501	453	922	311	0.94
15:19:56	5997	14.68	827	1.52	544	4.18	5.41	53405	8.62	49	80	502	453	921	311	0.94
AVG	5997	14.78	832	1.52	548	4.14	5.44	52765	8.61	49	80	493	453	937	310	0.94
%ERR MIN	0.0	0.5	0.5	1.7	1.0	1.8	0.6	1.1	0.2	1.7	5.1	2.0	1.2	1.7	0.4	1.1
%ERR MAX	0.0	0.8	0.4	1.4	1.3	1.1	0.7	1.3	0.3	0.8	6.1	1.9	0.8	1.3	0.5	1.4

TIME HH:MM:SS	RPM	TORQUE in·lbs	FUEL FLOW g/hr	OBSV HP hp	BSFC g/hp·hr	CO %	CO2 %	HC ppm	O2 %	NOX ppm	INLET °F	SPARK °F	CO g/hr	CO2 g/hr	HC g/hr	NOx g/hr
15:21:02	6502	14.34	836	1.60	523	4.28	5.74	52717	8.32	45	88	501	458	964	304	0.86
15:21:06	6501	14.42	838	1.59	527	4.26	5.75	52745	8.32	45	88	502	457	969	305	0.86
15:21:11	6501	14.34	836	1.60	523	4.25	5.74	52986	8.33	45	86	506	454	964	305	0.86
15:21:16	6501	14.28	836	1.58	529	4.26	5.72	52955	8.35	45	87	506	456	962	305	0.86
15:21:20	6501	14.32	838	1.59	527	4.25	5.73	53000	8.36	45	88	507	456	966	306	0.86
15:21:25	6501	14.41	840	1.59	528	4.25	5.72	53132	8.37	45	85	508	457	966	308	0.86
15:21:30	6501	14.39	842	1.58	533	4.31	5.68	53221	8.37	45	85	507	463	960	308	0.86
15:21:35	6502	14.30	839	1.57	534	4.37	5.67	52982	8.35	45	89	507	467	953	305	0.86
15:21:40	6502	14.38	837	1.59	526	4.34	5.69	52911	8.35	45	91	507	464	955	305	0.86
15:21:46	6502	14.40	838	1.59	527	4.25	5.73	53064	8.37	46	89	509	456	965	306	0.88
AVG	6501	14.36	838	1.59	528	4.28	5.72	52971	8.35	45	88	506	459	962	306	0.86
%ERR MIN	0.0	0.5	0.2	1.1	1.0	0.7	0.8	0.5	0.3	0.2	3.0	1.0	0.9	1.0	0.7	0.5
%ERR MAX	0.0	0.4	0.5	0.8	1.3	2.1	0.6	0.5	0.3	2.0	3.9	0.6	1.8	0.7	0.8	2.0

TIME HH:MM:SS	RPM	TORQUE in·lbs	FUEL FLOW g/hr	OBSV HP hp	BSFC g/hp·hr	CO %	CO2 %	HC ppm	O2 %	NOX ppm	INLET °F	SPARK °F	CO g/hr	CO2 g/hr	HC g/hr	NOx g/hr
15:28:31	7003	13.72	907	1.64	553	4.70	5.68	52547	8.37	44	88	517	533	1012	322	0.89
15:28:35	7003	13.73	904	1.63	555	4.67	5.70	52430	8.37	45	88	517	529	1014	321	0.91
15:28:40	7003	13.70	901	1.65	546	4.61	5.73	52581	8.37	45	85	517	521	1017	321	0.91
15:28:45	7003	13.74	901	1.65	546	4.61	5.73	52567	8.37	45	85	517	521	1017	321	0.91
15:28:50	7003	13.79	900	1.66	542	4.63	5.72	52550	8.37	45	88	516	522	1013	320	0.91
15:28:55	7002	13.81	904	1.65	548	4.60	5.73	52530	8.37	45	89	516	522	1021	322	0.91
15:29:00	7002	13.89	909	1.65	551	4.65	5.71	52715	8.36	45	84	514	529	1020	324	0.91
15:29:05	7003	13.86	913	1.66	550	4.74	5.66	53153	8.37	44	85	513	538	1010	326	0.89
15:29:10	7004	13.86	911	1.64	555	4.74	5.65	53027	8.38	44	90	514	538	1007	325	0.89
15:29:15	7004	13.86	909	1.65	551	4.68	5.67	52973	8.38	44	88	514	531	1012	325	0.89
AVG	7003	13.80	906	1.65	550	4.66	5.70	52707	8.37	45	87	516	528	1014	323	0.90
%ERR MIN	0.0	0.7	0.7	1.1	1.4	1.8	0.8	0.5	0.1	1.3	3.4	0.5	1.5	0.7	0.8	1.2
%ERR MAX	0.0	0.7	0.8	0.7	1.1	1.7	0.6	0.8	0.1	0.8	3.4	0.3	1.8	0.7	1.1	1.3


[redacted] SETUP FOR EMISSION TESTS (2-CYCLE ENGINE)
Fuel Consumption (g/h)
Roomtemperature (°C)
Barometre (mmHg)
Rel. Humidity (%)
Cylinder-Temperature (°C)
Moment (Nm)
Engine Speed (rps)
Exhaust Sample

[redacted]-GAS ANALYSIS SYSTEM (2-CYCLE ENGINE)

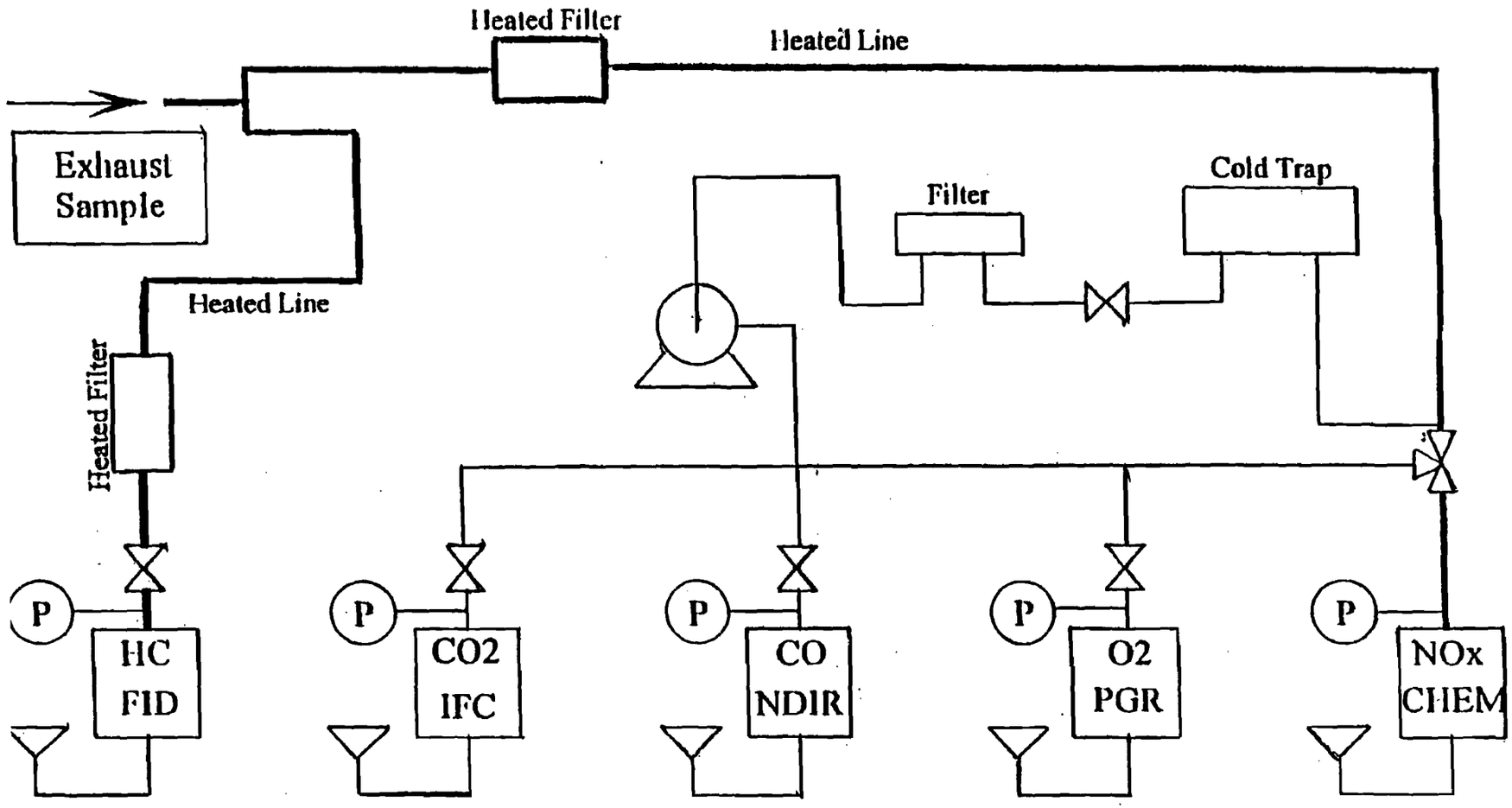


Figure 4

#80

DAILY HOUR SHEET

LOG BOOK

PAGE 1

SUPERVISOR: [redacted] TECH: [redacted]

UNIT NO. 23-18 UNIT TYPE Saw PPEMA UNIT #3

PROTOTYPE X PRODUCTION ____ MODEL 38 cc

COMMENTS Date Code K166 - MODIFIED UNIT #3

DATE	HOURS TODAY	TOTAL HRS ON TEST	PROBLEM YES	PROBLEM NO	COMMENTS
12-4	2.85	2.85		✓	
12-7	1.76	4.61		✓	
12-8	1.76	6.37	✓		2-4 cycle in the cut all day
12-10	1.98	8.35		✓	
12-11	3.33	11.68		✓	Cleaned Air Filter
12-14	.83	12.51	✓		Unit died rich @ idle 4 times. Unit returned To Emissions Group for Emissions Test.
12-18	3.76	16.27		✓	
12-21	3.91	20.18	✓		Fan housing broke @ rear mount.
12-22	3.78	23.96		✓	
12-23	1.1	25.06		✓	Unit returned To Emissions Group for Emissions Test.
1-4	.38	25.44		✓	
1-5	3.05	28.49		✓	Cleaned Air Filter
1-6	2.86	31.35			Cleaned Air Filter
1-7	3.75	35.10		✓	
1-8	2.5	37.60		✓	Unit returned To Emissions Group for Emissions Test.
1-20	4.61	42.21		✓	
1-21	5.5	47.71	✓		Fan housing broke @ rear mount.
1-22	2.30	50.01		✓	Unit returned To Emissions Group for Emissions Test.

FORM . 'D DAILY FIELD TEST DATA SHEET Figure 5

PAGE 1 OF 2

DATE: 1-21-9

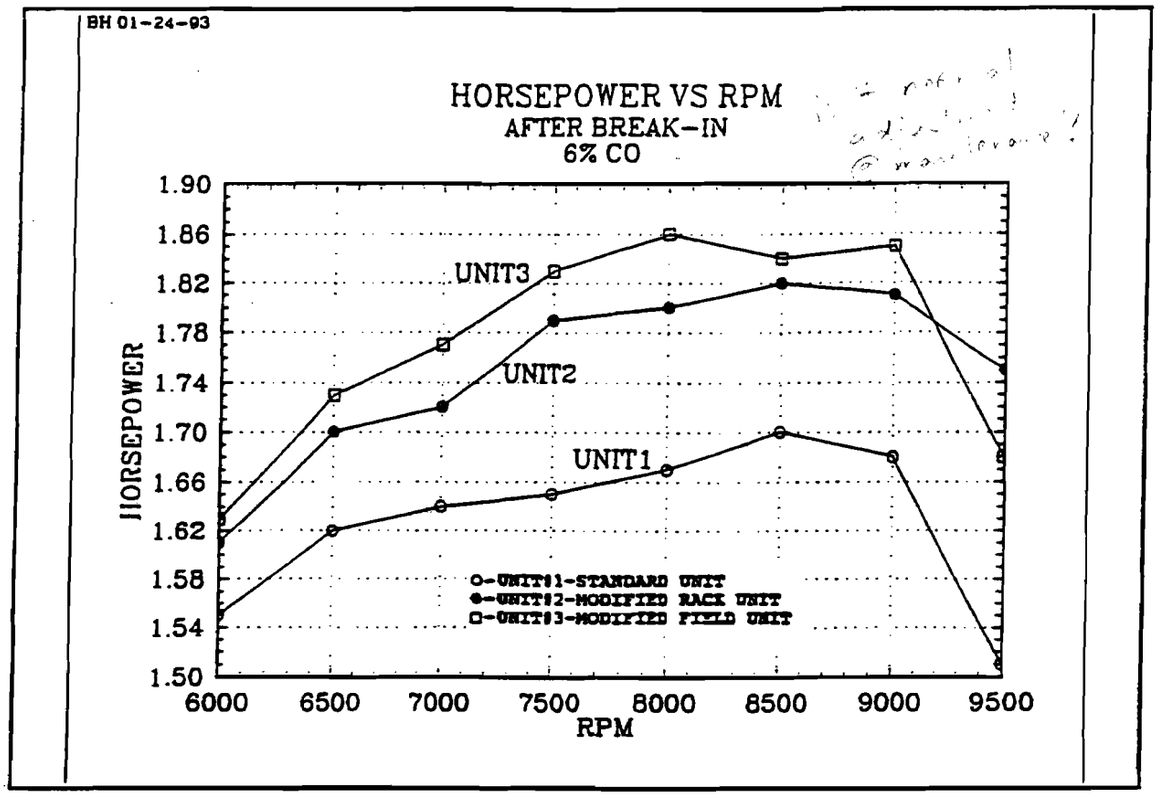
UNIT NO.: 23-B UNIT TYPE/MODEL: 38cc
MEDIA CUT: Pine/Hardwood LOCATION: Keithville Rd.
TOTAL HRS.: 5.5 TOTAL PULLS: 76 TOTAL TANKS: 23
TOTAL STARTS: 23 STARTING DAILY AVG.: 3.30

4.06 1 of 2 days.

TYPE CUTTING CONDITIONS:
H = HEDGES M = MOWING
E = EDGING F = FELLING
L = LIMBING B = BUCKING only.
BC = BRUSH CUTTING TC = TRIMMING CONCRETE
TCL = TRIMMING CHAIN LINK FENCE

STARTING SEQUENCE # OF PULLS C	1/2	N/C	TOTAL # OF PULLS	REFUEL START YES	NO	TIME OF DAY PER TANK START	STOP	TOTAL RUN TIME	AMBIENT TEMP. mild	LINE USED FT. OIL OUTPUT CC	TYPE CUT COND.	OPERATOR'S INITIALS	WOOD COND. Green	MEDIA HEIGHT DIA. CUT	COMMENTS: emission test Wrist tach cutting between 7,500 / 8,000 R.P.M.'s NO LOAD R.P.M. 10,9 / 10.8 IDLE R.P.M. 2800 / 3100
4-P	2-R	-	6	X		6:55	7:10	15	47°	56	B	J.S.	Wet	8/10	sharpen + tighten chain
1-P	-	2-R	3	X		7:14	7:28	14	47°	80	B	D.D.	Wet	8/10	
1-P	-	2-R	3	X		7:39	7:50	15	47°	70	B	D.D.	Wet	8/10	
1-P	-	2-R	3	X		7:56	8:09	13	47°	90	B	D.D.	Wet	8/10	
1-P	-	3-R	4	X		8:12	8:25	13	47°	50	B	D.D.	Wet	8/10	
1-P	-	3-R	4	X		8:28	8:42	14	47°	60	B	D.D.	Wet	8/10	
1-P	-	2-R	3	X		8:47	9:02	15	48°	80	B	D.D.	Wet	8/10	
1-P	-	2-R	3	X		9:06	9:21	15	48°	62	B	D.D.	Wet	8/10	
1-P	-	2-R	3	X		9:24	9:38	14	50°	70	B	D.D.	Wet	8/10	
1-P	-	3-R	4	X		9:41	9:56	15	51°	110	B	D.D.	Wet	8/10	
1-P	-	2-R	3	X		9:59	10:14	15	52°	114	B	D.D.	Wet	8/10	Fan housing crack at
1-P	-	3-R	4	X		10:17	10:31	14	54°	112	B	D.D.	Wet	8/10	rear handle mounting
1P	-	2R	3	X		10:34	10:50	14	56°	80	B	D.D.	Wet	8/10	screw AREA.
1P	-	1R	2	X		10:54	11:09	15	56°	92	B	J.S.	WET	8/10	O-ring broke off oil
1P	-	1R	2	X		11:12	11:27	15	60°	128	B	D.D.	Wet	8/10	cap.
1-P	-	2-R	3	X		11:30	11:44	14	60°	144	B	D.D.	Wet	8/10	
1-P	-	2-R	3	X		11:48	12:02	14	61°	130	B	D.D.	Wet	8/10	tighten chain

Figure 6


BH 01-24-93
HORSEPOWER VS RPM
AFTER BREAK-IN
6% CO
HORSEPOWER
RPM
UNIT3
UNIT2
UNIT1
1.90
1.86
1.82
1.78
1.74
1.70
1.66
1.62
1.58
1.54
1.50
6000
6500
7000
7500
8000
8500
9000
9500
O-UNIT#1-STANDARD UNIT
●-UNIT#2-MODIFIED RACK UNIT
□-UNIT#3-MODIFIED FIELD UNIT

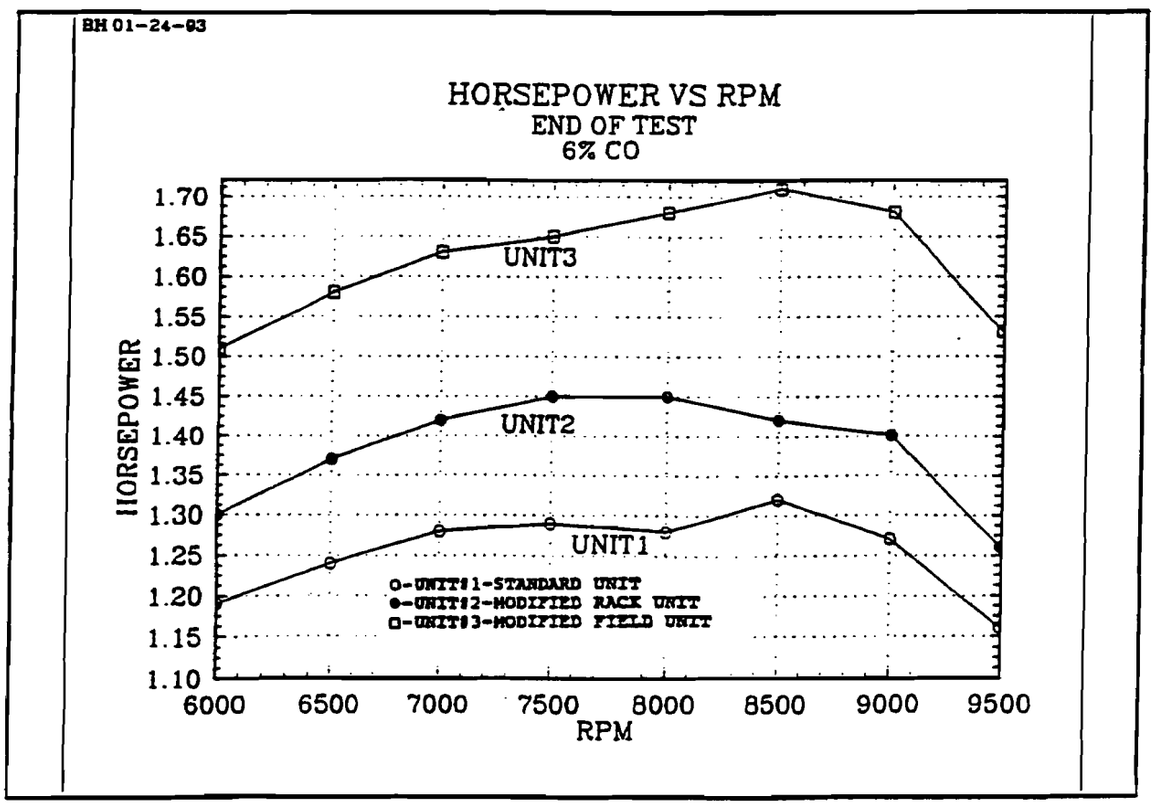
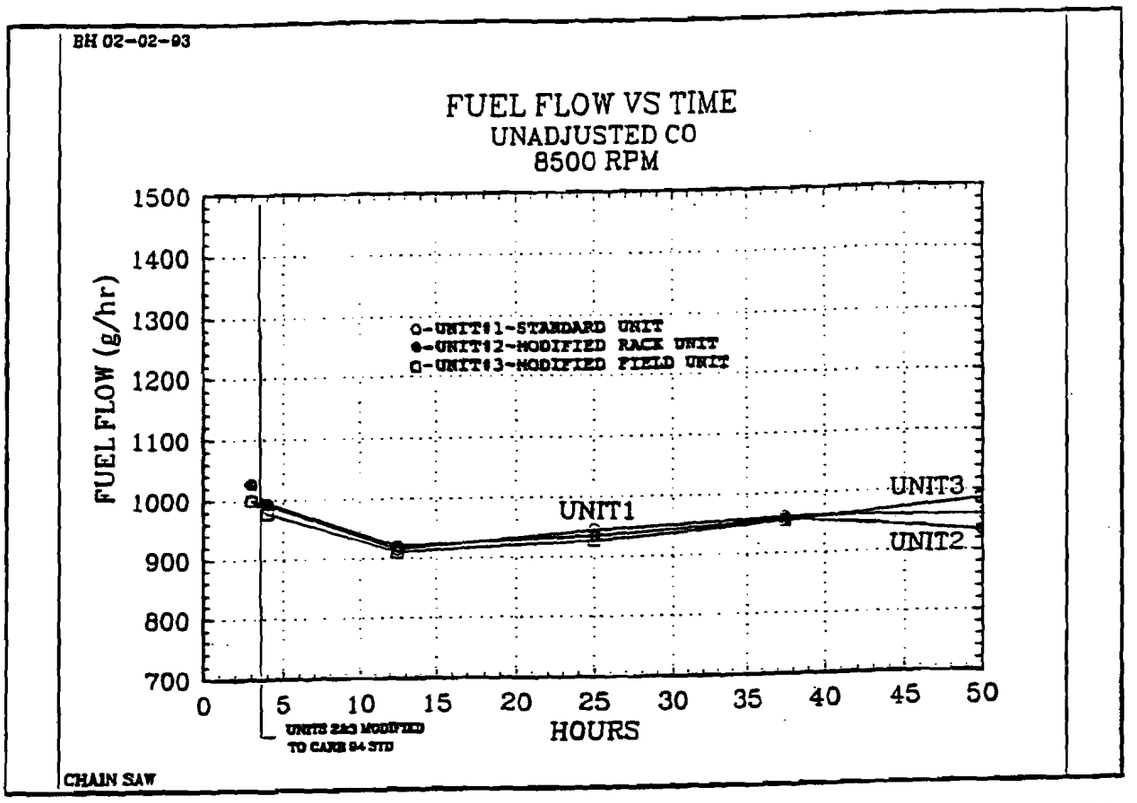

BH 01-24-93
HORSEPOWER VS RPM
END OF TEST
6% CO
HORSEPOWER
RPM
UNIT3
UNIT2
UNIT1
1.70
1.65
1.60
1.55
1.50
1.45
1.40
1.35
1.30
1.25
1.20
1.15
1.10
6000
6500
7000
7500
8000
8500
9000
9500
O-UNIT#1-STANDARD UNIT
●-UNIT#2-MODIFIED RACK UNIT
□-UNIT#3-MODIFIED FIELD UNIT

Figure 7


BH 02-02-93
FUEL FLOW VS TIME
UNADJUSTED CO
8500 RPM
FUEL FLOW (g/hr)
1500
1400
1300
1200
1100
1000
900
800
700
0
5
10
15
20
25
30
35
40
45
50
HOURS
O-UNIT#1-STANDARD UNIT
●-UNIT#2-MODIFIED RACK UNIT
□-UNIT#3-MODIFIED FIELD UNIT
UNIT1
UNIT3
UNIT2
UNITS 2&3 MODIFIED
TO CARB 94 STD
CHAIN SAW

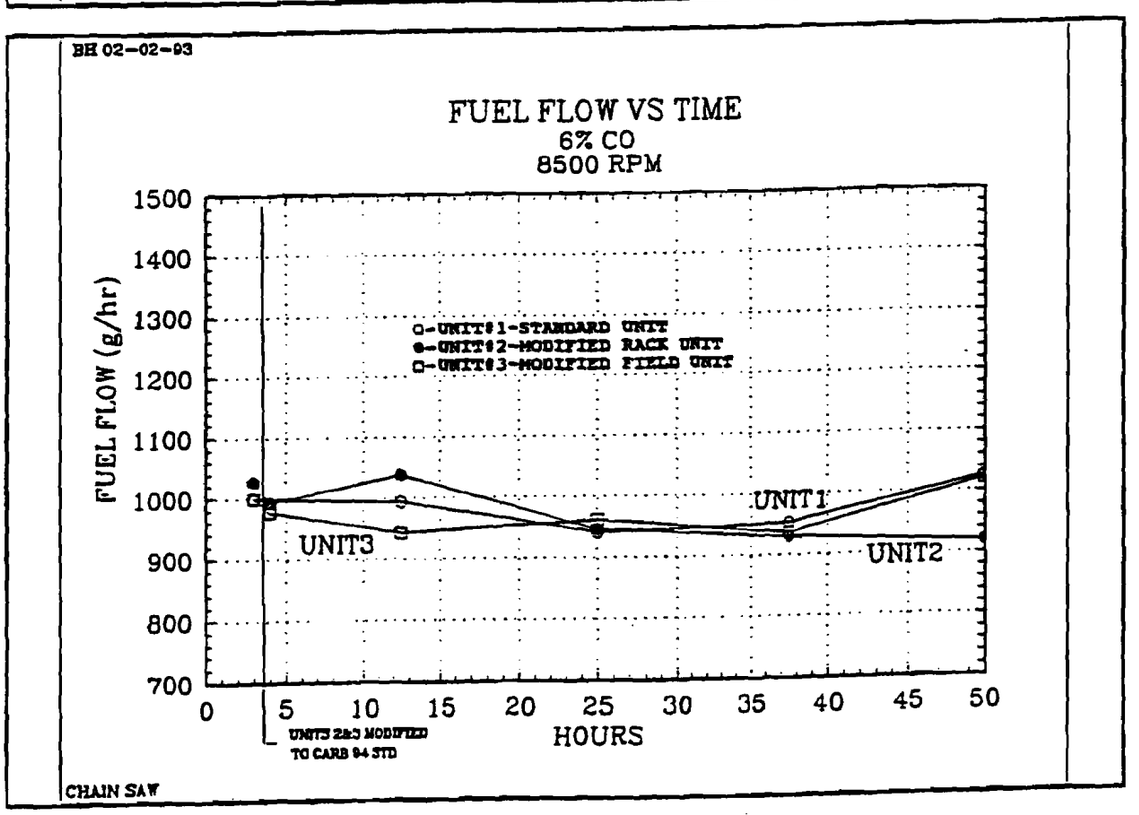
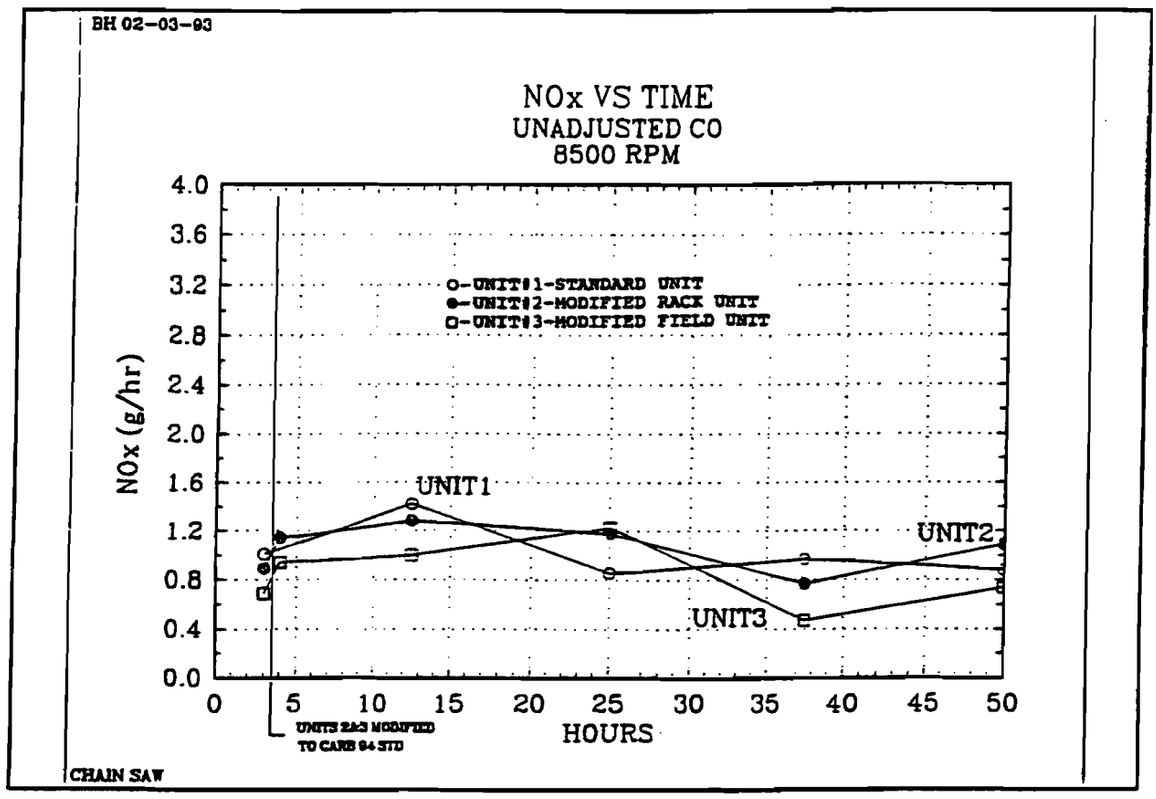

BH 02-02-93
FUEL FLOW VS TIME
6% CO
8500 RPM
FUEL FLOW (g/hr)
1500
1400
1300
1200
1100
1000
900
800
700
0
5
10
15
20
25
30
35
40
45
50
HOURS
O-UNIT#1-STANDARD UNIT
●-UNIT#2-MODIFIED RACK UNIT
□-UNIT#3-MODIFIED FIELD UNIT
UNIT1
UNIT3
UNIT2
UNITS 2&3 MODIFIED
TO CARB 94 STD
CHAIN SAW

Figure 8


BH 02-03-93
NOx VS TIME
UNADJUSTED CO
8500 RPM
NOx (g/hr)
4.0
3.6
3.2
2.8
2.4
2.0
1.6
1.2
0.8
0.4
0.0
0
5
10
15
20
25
30
35
40
45
50
HOURS
O-UNIT#1-STANDARD UNIT
●-UNIT#2-MODIFIED RACK UNIT
□-UNIT#3-MODIFIED FIELD UNIT
UNIT1
UNIT2
UNIT3
UNITS 2&3 MODIFIED
TO CARB 94 STD
CHAIN SAW

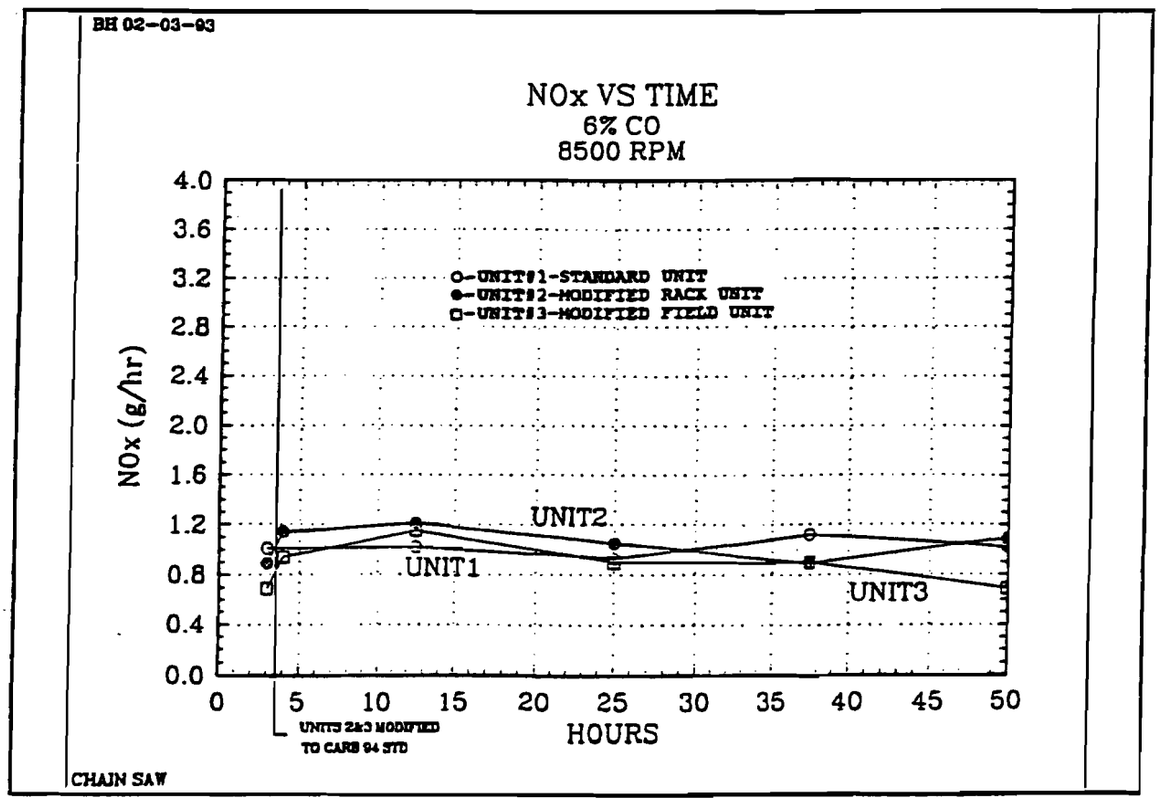

BH 02-03-93
NOx VS TIME
6% CO
8500 RPM
NOx (g/hr)
4.0
3.6
3.2
2.8
2.4
2.0
1.6
1.2
0.8
0.4
0.0
0
5
10
15
20
25
30
35
40
45
50
HOURS
O-UNIT#1-STANDARD UNIT
●-UNIT#2-MODIFIED RACK UNIT
□-UNIT#3-MODIFIED FIELD UNIT
UNIT2
UNIT1
UNIT3
UNITS 2&3 MODIFIED
TO CARB 94 STD
CHAIN SAW

Figure 9

II. Unit description:

1.0 Serial numbers:

.1 Unit (I) - S/N 001804

.2 Unit (II) - S/N 001801

.3 Unit (III) - S/N 001802

2.0 Displacement: 30.1 cc (1.84 CID)

3.0 Dry weight: 3.2 kg (7.1 lb) (without bar and chain)

4.0 Catalog rated power: 1.03 kw (1.4 hp)

5.0 Catalog rated speed: 8,500 - 9,000 rpm

6.0 Catalog rated torque: 1.39 NM (12.3 in-lbs)

7.0 Designation: Occasional user chain saw

8.0 Intended uses:

.1 Tree trimming

.2 Arborist

.3 Light felling

.4 Bucking

.5 Limbing

9.0 Typical operation conditions: Vary, can be used year round in all climates and weather conditions. Usually run at wide open throttle for all operations.

10.0 Attachments: (UL approved)

.1 10" guide bar with 91SG chain (optional)

.2 12" guide bar with 91SG chain (standard)

.3 14" guide bar with 91SG chain (optional)

.4 16" guide bar with 91SG chain (optional)

11.0 Application video: See Section "J"

PPEMA TEST
SAWS

ENGINE WEAR EVALUATION UNIT #1
(STANDARD UNIT)

RING WEAR: BEGINNING BY RING GAGE - .078
ENDING BY RING GAGE - .078
TOTAL WEAR - .001
CONDITION - GOOD, WITH NO TOOLING MARKS PRESENT
RING STICKING: NONE
PISTON SKIRT VARNISH: AT PIN BOSS/EXHAUST PORT AND THRUST SIDE OF PISTON SKIRT
PISTON UNDERCROWN VARNISH: MODERATE
PISTON CROWN DEPOSIT: MODERATE
PISTON SKIRT WEAR: LIGHT RUBBING
PIN BOSS CONDITION: TIGHT
BORE CONDITION: LIGHT WEAR
COMBUSTION CHAMBER DEPOSITS: MODERATE
EXHAUST PLUGGING: 10% OF PORT AREA PLUGGED

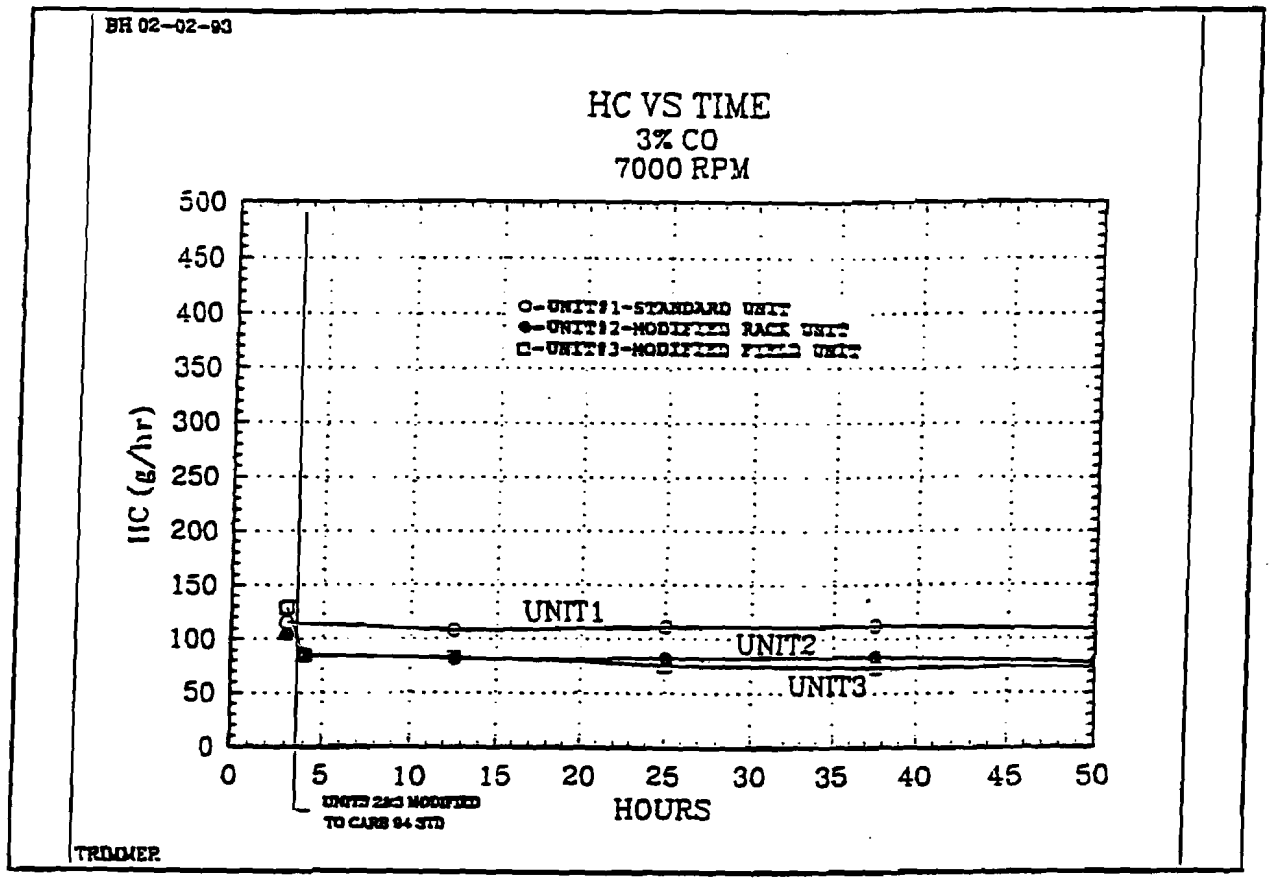
ENGINE WEAR EVALUATION UNIT #2
(MODIFIED RACK UNIT)

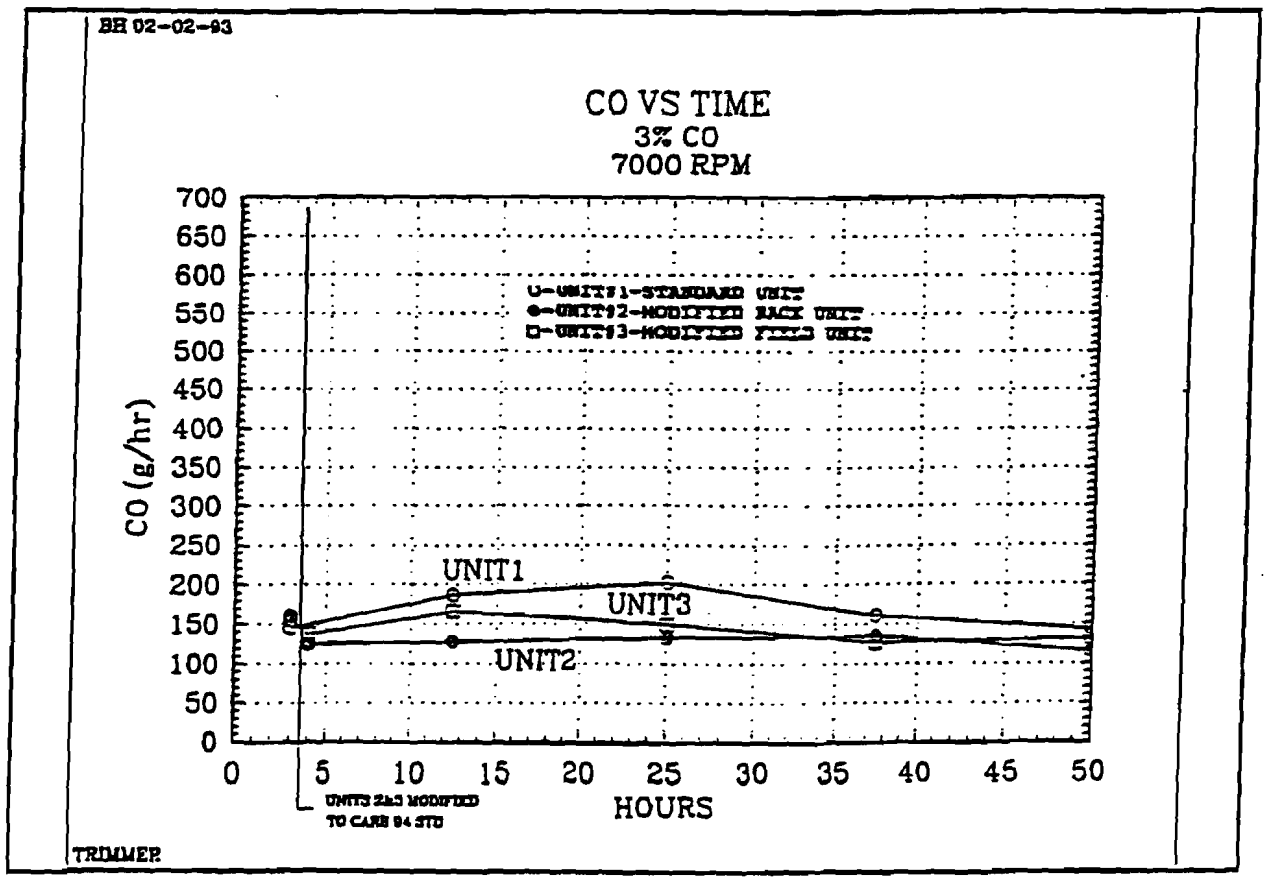
RING WEAR: BEGINNING BY RING GAGE - .078
ENDING BY RING GAGE - .079
TOTAL WEAR - .001
CONDITION - GOOD, WITH NO TOOLING MARKS PRESENT
RING STICKING: NONE
PISTON SKIRT VARNISH: MODERATE ON THRUST SIDE
PISTON UNDERCROWN VARNISH: MODERATE
PISTON CROWN DEPOSITS: MODERATE
PISTON SKIRT WEAR: LIGHT RUBBING
PIN BOSS CONDITION: TIGHT
BORE CONDITION: LIGHT WEAR
COMBUSTION CHAMBER DEPOSITS: MODERATE
EXHAUST PLUGGING: 15% OF PORT AREA PLUGGED

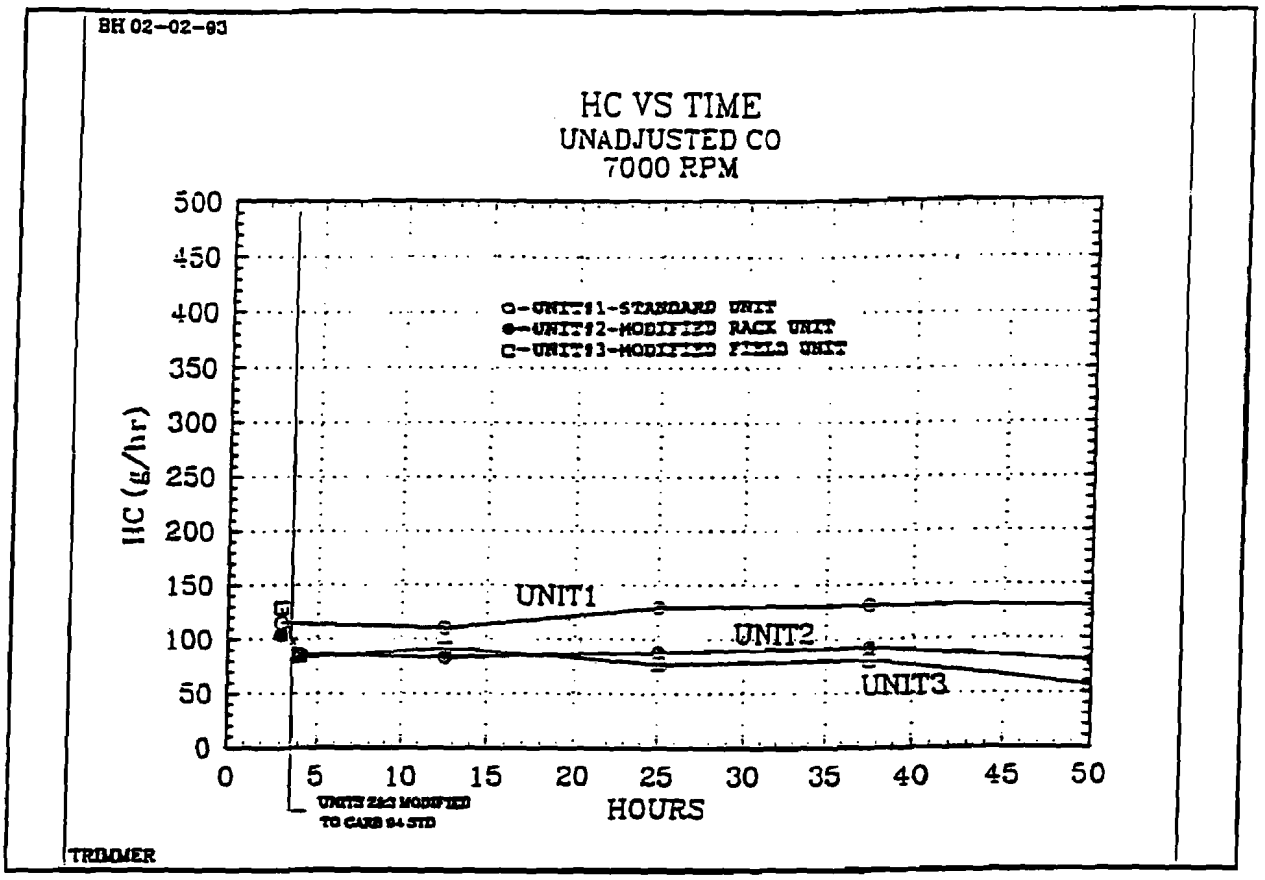
ENGINE WEAR EVALUATION UNIT #3
(MODIFIED FIELD UNIT)

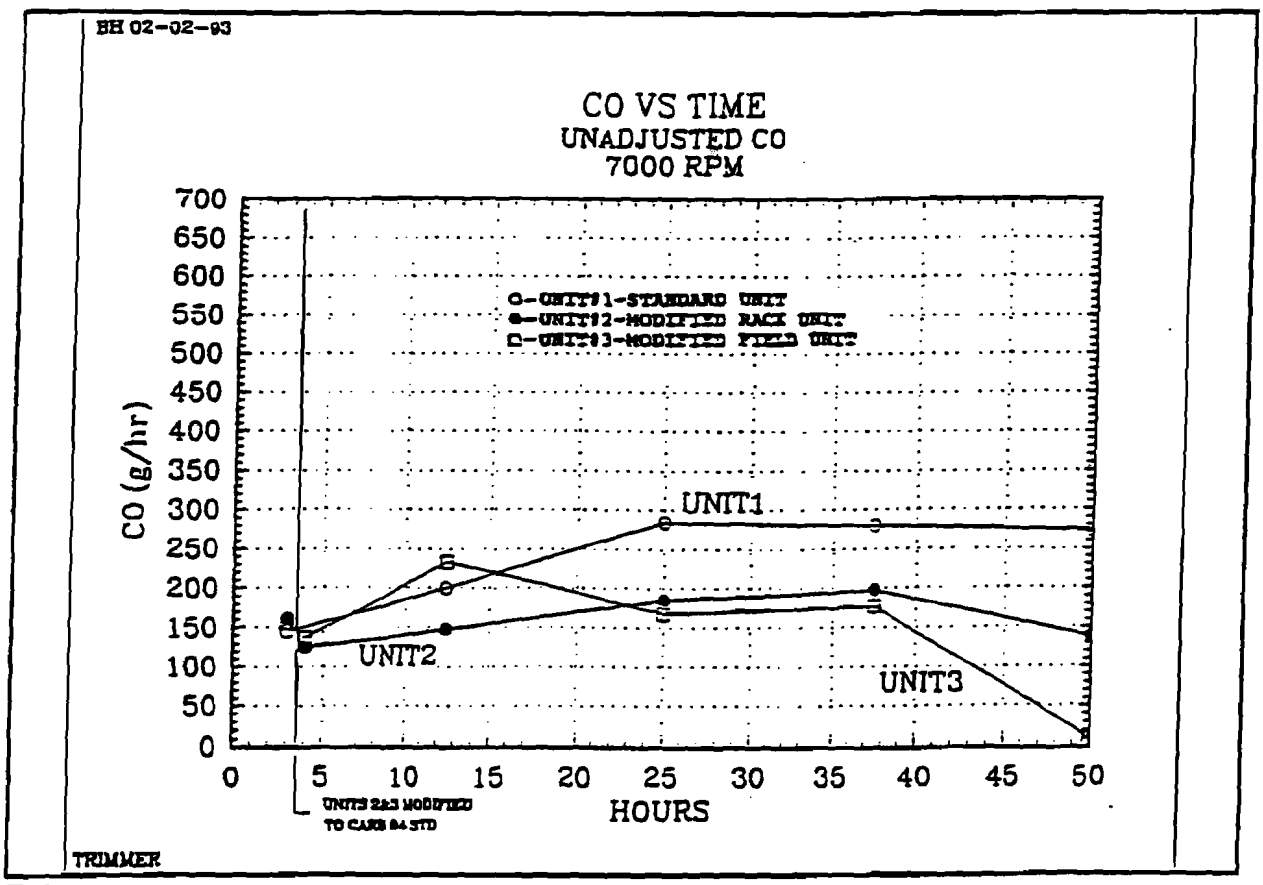
RING WEAR: BEGINNING BY RING GAGE - .078
ENDING BY RING GAGE - .085
TOTAL WEAR - .007
CONDITION - GOOD, WITH NO TOOLING MARKS PRESENT
RING STICKING: NONE
PISTON SKIRT VARNISH: LIGHT ON THRUST SIDE
PISTON UNDERCROWN VARNISH: LIGHT
PISTON CROWN DEPOSIT: MODERATE
PISTON SKIRT WEAR: LIGHT RUBBING
PIN BOSS CONDITION: TIGHT
BORE CONDITION: LIGHT WEAR
COMBUSTION CHAMBER DEPOSITS: MODERATE
EXHAUST PLUGGING: 5% OF PORT AREA PLUGGED

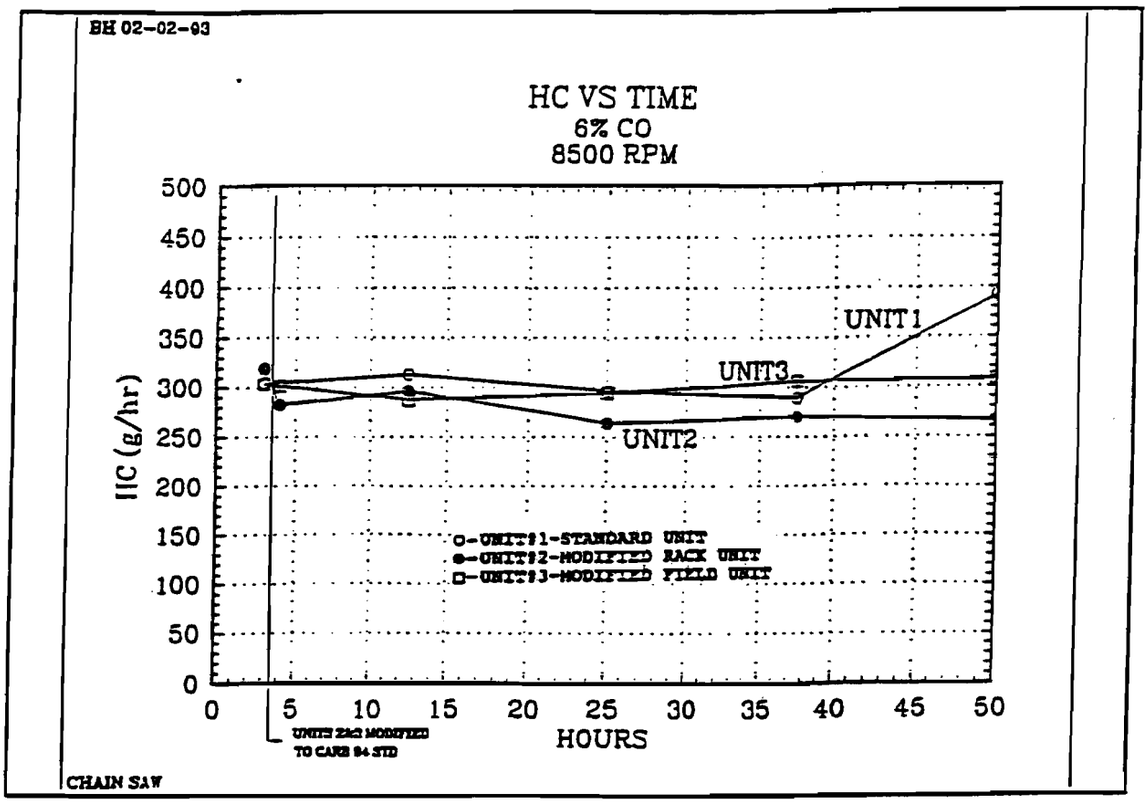
Figure 11


BH 02-02-93
HC VS TIME
3% CO
7000 RPM
O-UNIT#1-STANDARD UNIT
●-UNIT#2-MODIFIED RACK UNIT
□-UNIT#3-MODIFIED FIELD UNIT
HC (g/hr)
500
450
400
350
300
250
200
150
100
50
0
UNIT1
UNIT2
UNIT3
0 5 10 15 20 25 30 35 40 45 50
HOURS
UNITS 2&3 MODIFIED TO CARB 94 STD
TRIMMER


BH 02-02-93
CO VS TIME
3% CO
7000 RPM
O-UNIT#1-STANDARD UNIT
●-UNIT#2-MODIFIED RACK UNIT
□-UNIT#3-MODIFIED FIELD UNIT
CO (g/hr)
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
UNIT1
UNIT3
UNIT2
0 5 10 15 20 25 30 35 40 45 50
HOURS
UNITS 2&3 MODIFIED TO CARB 94 STD
TRIMMER


BH 02-02-93
HC VS TIME
UNADJUSTED CO
7000 RPM
HC (g/hr)
HOURS
UNIT1
UNIT2
UNIT3
TRIMMER


BH 02-02-93
CO VS TIME
UNADJUSTED CO
7000 RPM
CO (g/hr)
HOURS
UNIT1
UNIT2
UNIT3
TRIMMER


BH 02-02-93
HC VS TIME
6% CO
8500 RPM
HC (g/hr)
500
450
400
350
300
250
200
150
100
50
0
0
5
10
15
20
25
30
35
40
45
50
HOURS
UNIT1
UNIT3
UNIT2
O-UNIT#1-STANDARD UNIT
●-UNIT#2-MODIFIED RACK UNIT
□-UNIT#3-MODIFIED FIELD UNIT
UNITS 2&3 MODIFIED TO CARB 94 STD
CHAIN SAW

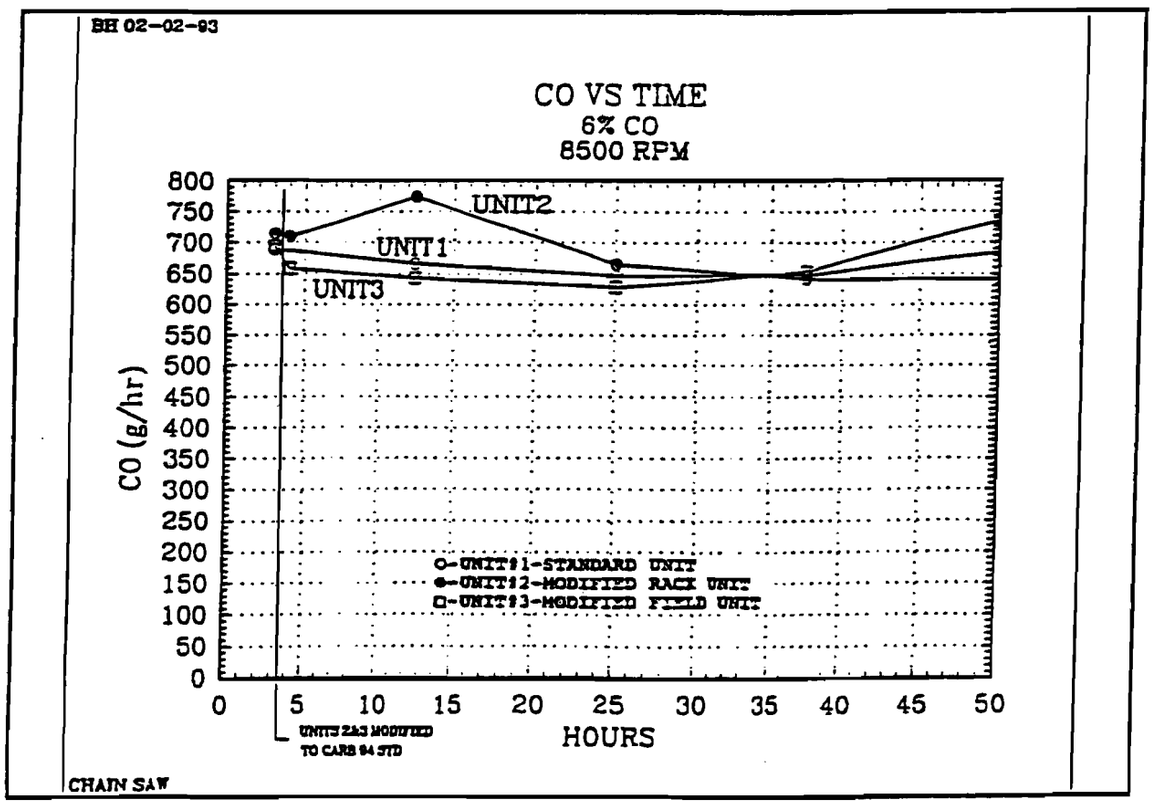

BH 02-02-93
CO VS TIME
6% CO
8500 RPM
CO (g/hr)
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0
5
10
15
20
25
30
35
40
45
50
HOURS
UNIT2
UNIT1
UNIT3
O-UNIT#1-STANDARD UNIT
●-UNIT#2-MODIFIED RACK UNIT
□-UNIT#3-MODIFIED FIELD UNIT
UNITS 2&3 MODIFIED TO CARB 94 STD
CHAIN SAW

Figure 14

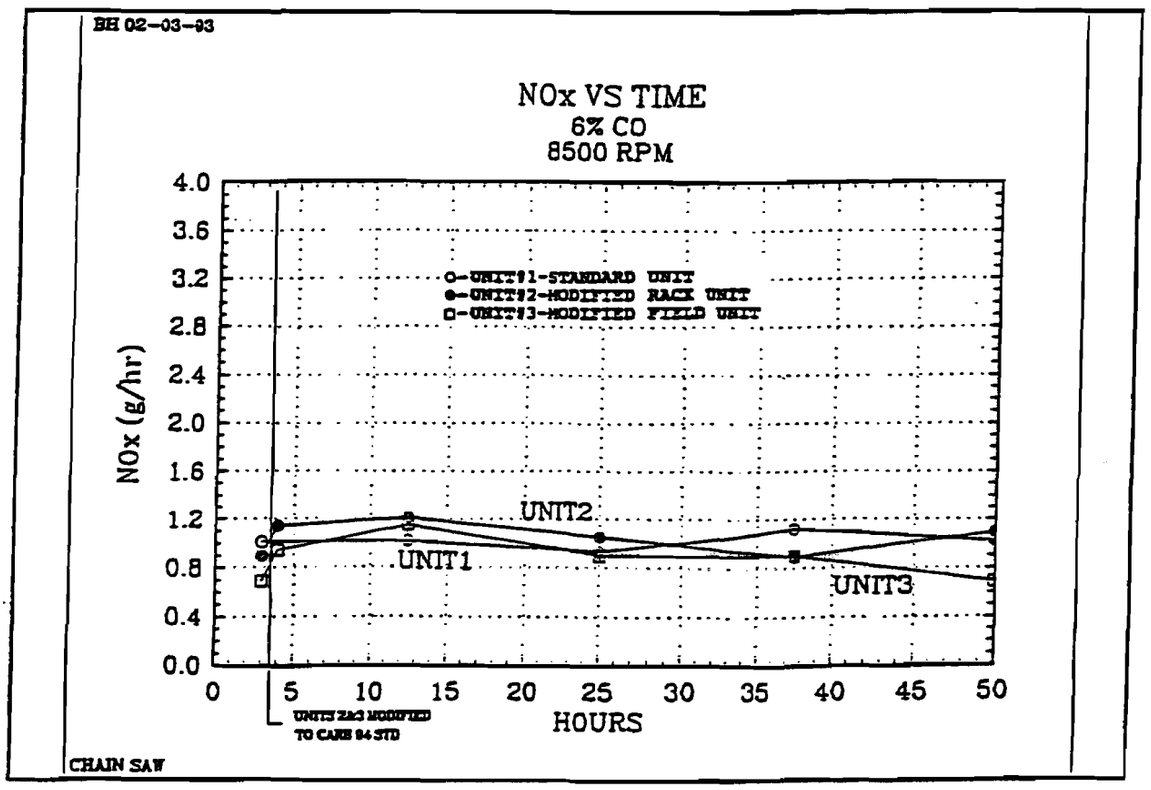
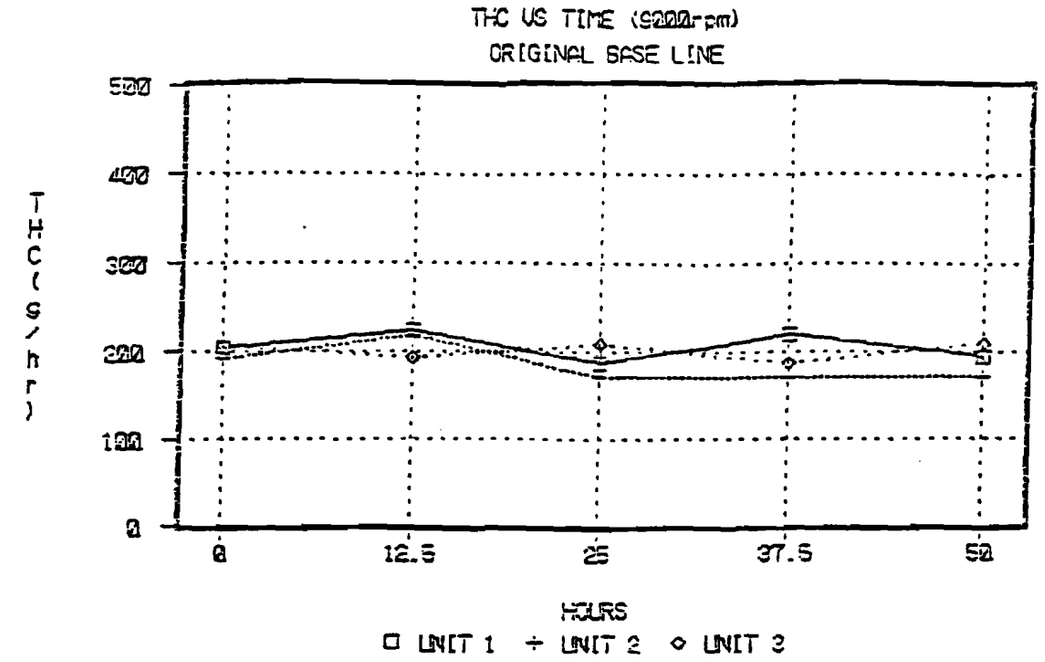

BH 02-03-93
NOx VS TIME
6% CO
8500 RPM
NOx (g/hr)
4.0
3.6
3.2
2.8
2.4
2.0
1.6
1.2
0.8
0.4
0.0
0
5
10
15
20
25
30
35
40
45
50
HOURS
O-UNIT#1-STANDARD UNIT
●-UNIT#2-MODIFIED RACE UNIT
□-UNIT#3-MODIFIED FIELD UNIT
UNIT2
UNIT1
UNIT3
UNITS 2&3 MODIFIED
TO CARB 94 STD
CHAIN SAW

Figure 15


THC VS TIME (2200rpm)
ORIGINAL BASE LINE
500
400
300
200
100
0
THC (G/hr)
0
12.5
25
37.5
50
HOURS
UNIT 1
UNIT 2
UNIT 3

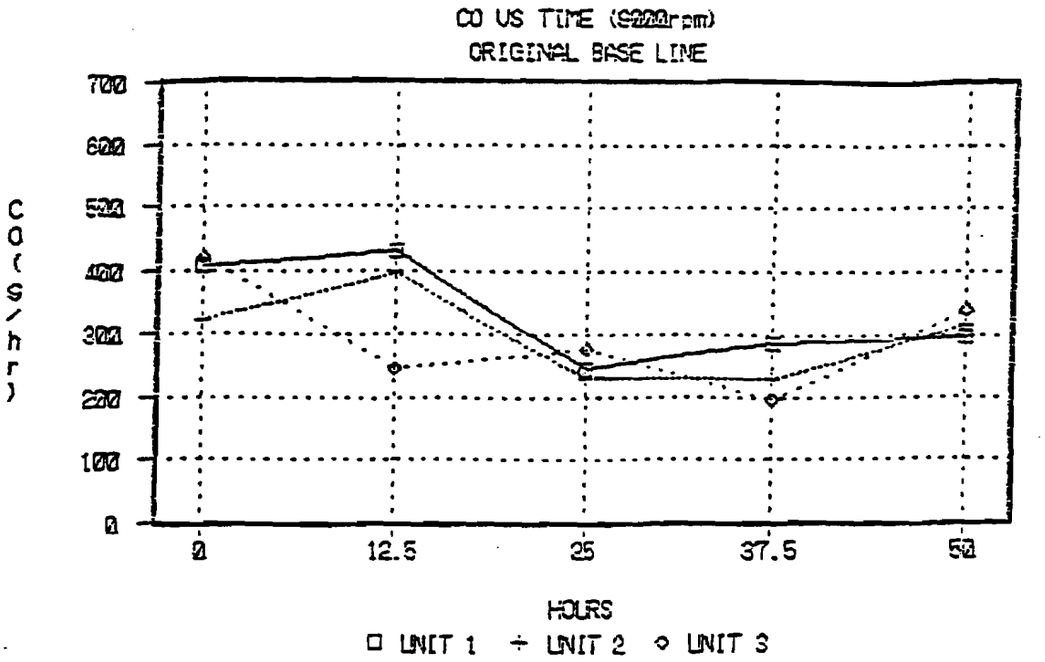

CO VS TIME (2200rpm)
ORIGINAL BASE LINE
700
600
500
400
300
200
100
0
CO (G/hr)
0
12.5
25
37.5
50
HOURS
UNIT 1
UNIT 2
UNIT 3

Figure 16

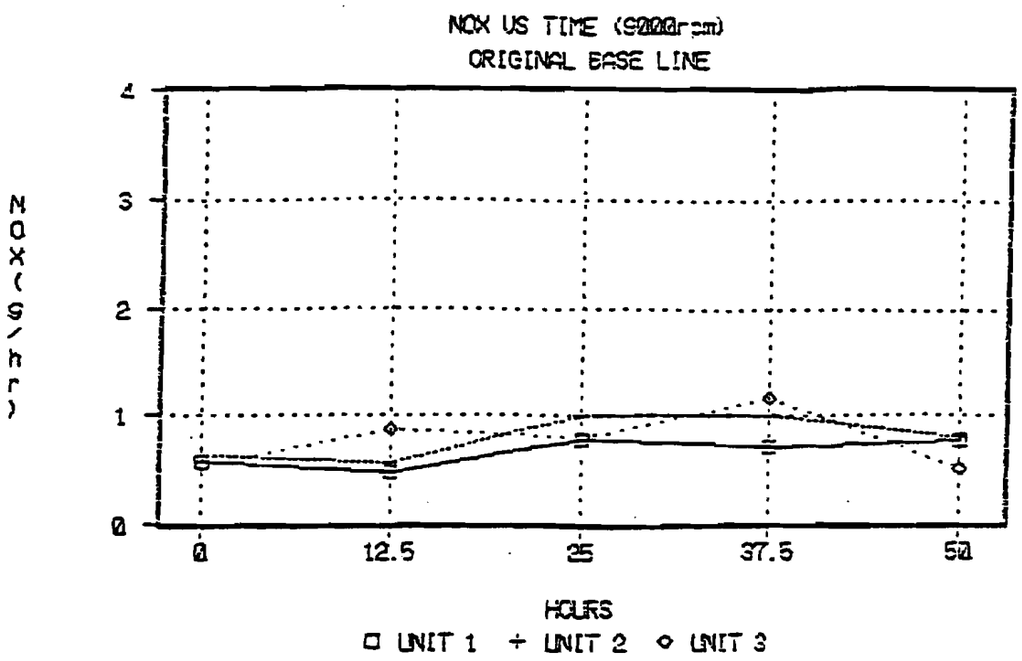
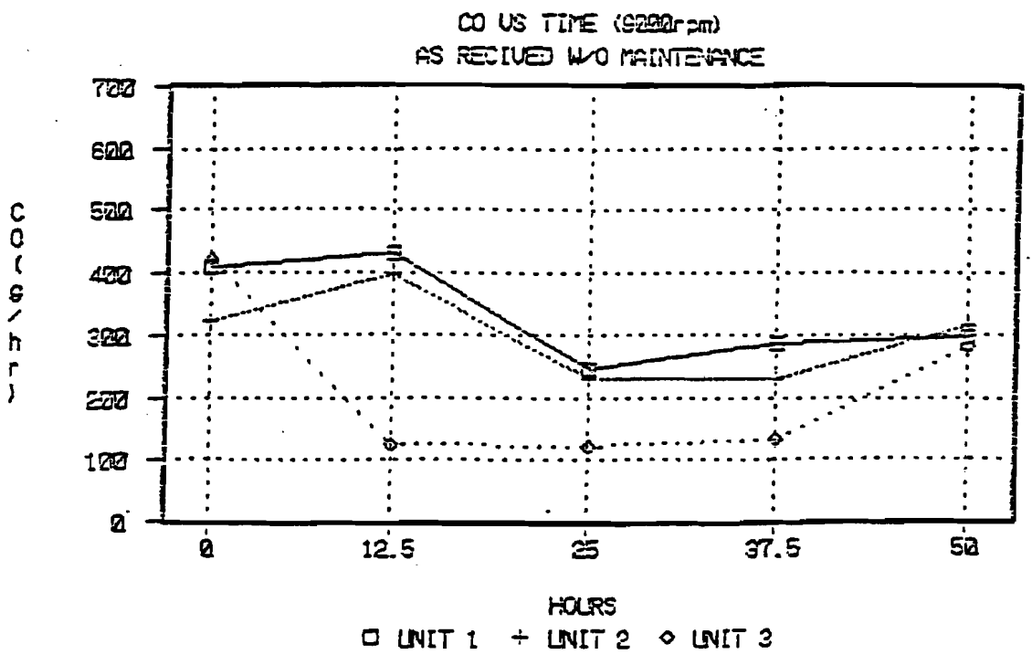
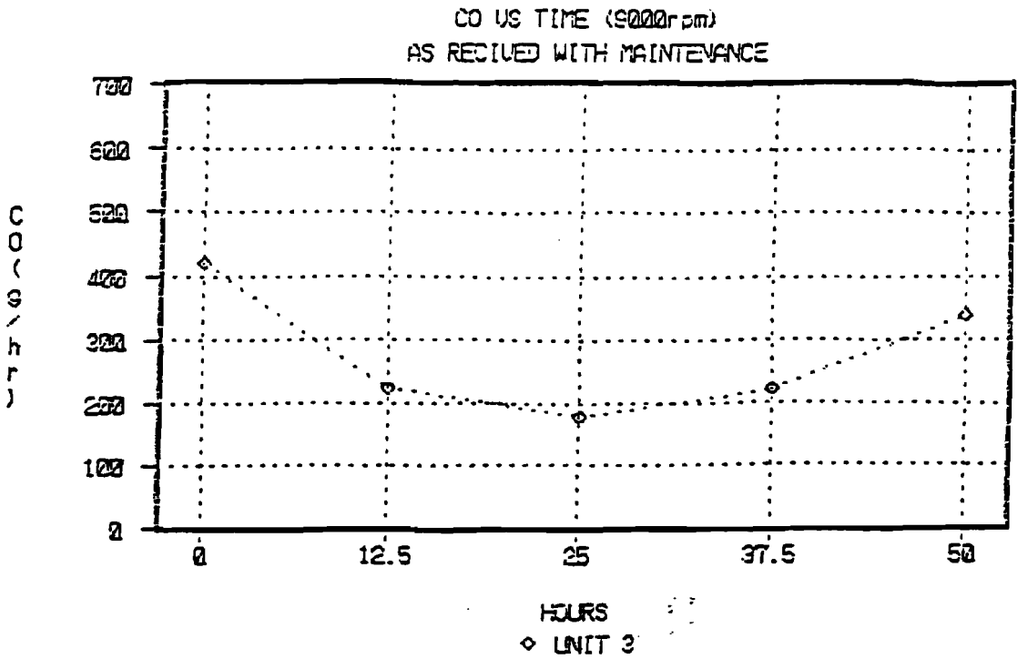

NOX US TIME (S2000rpm)
ORIGINAL BASE LINE
NOX(G/HR)
4
3
2
1
0
0
12.5
25
37.5
50
HOURS
UNIT 1
UNIT 2
UNIT 3

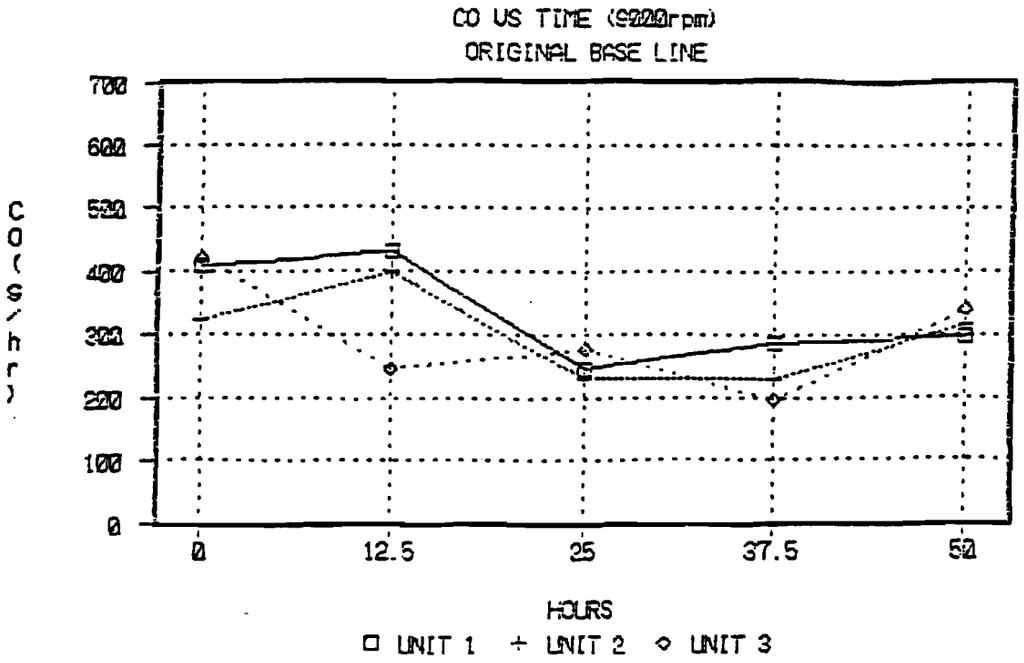
Figure 17

CO (g/hr) vs. TIME (hours)





NOTE: **Units I and II needed no maintenance therefore no emission tests run.**



Portable Power Equipment Manufacturers Association

PPEMA

Sensible Products For A Better Outdoors

April 7, 2000

RECEIVED

APR 1 2 2000

CERTIFICATION BRANCH

Mr. Allen Lyons
California Environmental Protection Agency
Air Resources Board
Mobile Source Operations Division
9528 Telstar Avenue
El Monte, CA 91731

Dear Mr. Lyons:

This purpose of this letter is to provide supporting information related to PPEMA's request that a common deterioration factor of 1.0 be assigned to conventional two stroke engines without aftertreatment for the purpose of certification to Tier II.

We have enclosed a copy of the PPEMA "In-Use" Emission Study that was presented to the Environmental Protection Agency on February 1, 1994 by the PPEMA Air Quality Committee. We have also enclosed graphical representations of 50 and 300 hour testing results and relevant conclusions based on those results. These test results were generated by several PPEMA member companies during the course of the "In-Use" Emission Study. Some of these charts were used in the presentation to EPA on February 1, 1994. In all cases, the enclosures have been redacted to remove any identification of the participating manufacturers and/or their products.

We draw your attention to the overall conclusion on page 1 of the February 1, 1994 Report, which states, "Data indicates stable or slightly decreasing emission components over time for portable two-stroke products." Likewise, Section 9.2 states, "All components (HC, CO, and NOx) typically remained constant or decreased over time. This seems to indicate that the deterioration factor for portable two-stroke equipment could be a value of 1 or less." Figures 11 through 16 of the Report support this conclusion. Although there were limited instances where emissions measured slightly higher at the end of testing (see figures 12 and 13 for Unit 1), the measurements were made in grams/hour and do not reflect that there was actually an increase in power over time in many tests. These instances could simply be an artifact of power variability, typical during the break-in process of an engine due to reduced friction within the assembly, and/or testing variability. In any event, they do not detract from the overall conclusion of the study, namely that conventional two-stroke engines have stable or decreasing emissions over time.

Please consider the PPEMA request in light of the Report findings and supporting graphical representations and conclusions provided. Time is of the essence in this matter due to the

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increasing activities in Tier II certifications among our members, and the substantial costs involved in performing durability testing for which the outcome is predictable and repeatable. Consequently, we would appreciate your prompt attention to this matter. We hope that the information that we have provided is sufficient for you to reach a favorable decision on this issue. If there are other areas related to this issue that you feel are worth spending additional time discussing, please advise us and we will be happy to meet with you in El Monte. I will be contacting Mr. Duc Nguyen of your staff within the next week for further discussion.

Sincerely,

James L. Cigler
Manager, Technical and Standards Programs

cc: Duc Nguyen

enclosures

Portable Power Equipment Manufacturers Association

PPEMA

Sensible Products For A Better Outdoors

March 8, 2000

RECEIVED

MAR 14 2000

CERTIFICATION BRANCH

Mr. Allen Lyons
California Environmental Protection Agency
Air Resources Board
Mobile Source Operations Division
9528 Telstar Avenue
El Monte, CA 91731

Dear Mr. Lyons:

This letter is sent pursuant to the meeting between PPEMA representatives Mssrs. Will, Cigler and Hall (via speakerphone), yourself, and some of your staff on February 1, 2000. As you will recall, PPEMA indicated that it would refer the points raised during the discussion to its General Engineering Committee and provide you with a letter clarifying PPEMA's understanding of the three main topics of discussion, Alternative Duty Cycles for deterioration testing, use of the 15% Compliance Margin, and establishment of common deterioration factors for engine families of the same technology.

Alternative Duty Cycles

Due to ARB's concern that engine manufacturers would always use a 3-minute duty cycle if given the opportunity, PPEMA suggests that products be categorized according to the duty cycles listed below for the purpose of deterioration factor testing:

Chain Saws	3 Minutes
Hedge Clippers	3 Minutes
Pole Pruners	3 Minutes
String Trimmers	6 Minutes
Stick Edgers	6 Minutes
Brushcutters	6 Minutes
Hand-held Leaf Blowers	6 Minutes
Back Pack Leaf Blowers	20 Minutes

These duty cycles would be used unless there are compelling reasons why they do not apply in individual cases. These cases would be presented to ARB with reasons for requesting a waiver. PPEMA's approach adds hedge clippers and pole pruners to the already established 3 minute cycle for chain saws, adds a 6 minute duty cycle for products such as string trimmers, stick edgers, brushcutters and hand-held leaf blowers, and places back pack blowers in the 20 minute

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w.w.w.ppema.org.

duty cycle currently allowed by ARB. It is felt that these duty cycles are representative of the actual usage of the products listed. Due to the urgent nature of this matter as it pertains to the model year 2000 certifications anticipated, ARB's prompt consideration and response is requested.

Application of 15% Compliance Margin

PPEMA understands that ARB's criteria for re-testing will be applied as follows:

Confirmation testing will not be required if a test engine's measured emissions are at least 15% lower than the manufacturer's established FEL. If the emissions are within 15% of the manufacturer's established FEL, the manufacturer has the option either to perform additional confirmation testing or to show that the measured emissions value plus the production line variability in grams/hp-h does not exceed the manufacturer's established FEL. If this condition is shown to be true, ARB will not require confirmation testing

PPEMA accepts this approach.

Common Deterioration Factors

New engine technologies will be certified under the ARB Tier II procedures specified for the Model 2000 products. PPEMA understands that ARB will evaluate data at the end of that period and consider allowing the assignment of a common deterioration factor for a family of engines employing the same technology if the result of the data analysis supports that finding.

PPEMA would like to submit, under separate cover, its rationale supporting its contention that deterioration factors for traditional two-stroke engine technology with no after engine treatment should be assigned a value of 1.0. It is requested that ARB then consider and respond to the PPEMA position as it relates to the Tier II certification process.

PPEMA requests that ARB acknowledge its agreement or disagreement with PPEMA's suggestions related to alternative duty cycles and its interpretation of the ARB's application of the 15% compliance margin at your earliest possible convenience. I will be contacting Mr. Duc Nguyen of your staff within the next week for further discussion of these matters.

Sincerely,

James L. Cigler
Manager, Technical and Standards Programs

cc: Duc Nguyen

Portable Power Equipment Manufacturers Association

PPEMA

Sensible Products For A Better Outdoors

November 22, 1999

R. B. Summerfield
Chief, Mobile Source Operations Division
Air Resources Board
9528 Telstar Avenue
P.O. Box 8001
El Monte, CA 91731

NOV 24 1999

Division Chief/MSOD (RBS)

Dear Mr. Summerfield:

This responds to your letter of October 20, 1999, Reference No. C-99-338, in which you suggested that the Portable Power Equipment Manufacturers Association (PPEMA) consult with its members regarding possible industry-wide alternative duty cycles for purposes of certifying engines 65 cc displacement and less.

PPEMA's General Engineering Committee agrees with your suggestion for industry-wide cycles. While variation between manufacturer-specific cycles would likely be small, the number of such cycles could be quite large. Under these circumstances, the burden on engine manufacturers to develop unique durability cycles, as well as the burden on ARB staff to consider and evaluate manufacturer-specific cycles, would not be justified.

At present, ARB has approved a 20-minute duty cycle that may be used for any engine 65 cc and less, and a 3-minute cycle that may be used with chain saw engines. We also understand that, for at least one manufacturer, ARB has approved a 6-minute cycle for trimmer/brushcutter engines. Given that ARB has sufficient data to support these three durability cycles as approximations of actual usage, PPEMA recommends that ARB approve each of them for all engines 65 cc and less instead of restricting each cycle to a particular application. Manufacturers would then use their engineering judgment to select the most appropriate duty cycle – 20, 6, or 3 minutes – to certify any single engine family. Handheld engine manufacturers need this flexibility because, in many instances, engines from the same family are used in each of the major handheld applications, *i.e.*, engines from Family Z are used in trimmers, blowers, edgers, and chain saws. At the same time, we are not aware of any data to support the assumption that a longer durability cycle necessarily presents a worst-case situation.

In light of the scheduled effective date of the Tier II requirements, please confirm in writing as soon as possible that this recommendation is acceptable. Should further discussion be necessary, we request that a conference call be scheduled at your earliest possible convenience.

Sincerely,

Larry Will
Chairman, PPEMA General Engineering Committee

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