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PILOT PROGRAM TO DEVELOP OPERATING TIME EMISSION DEGRADATION FA--ETC(U).
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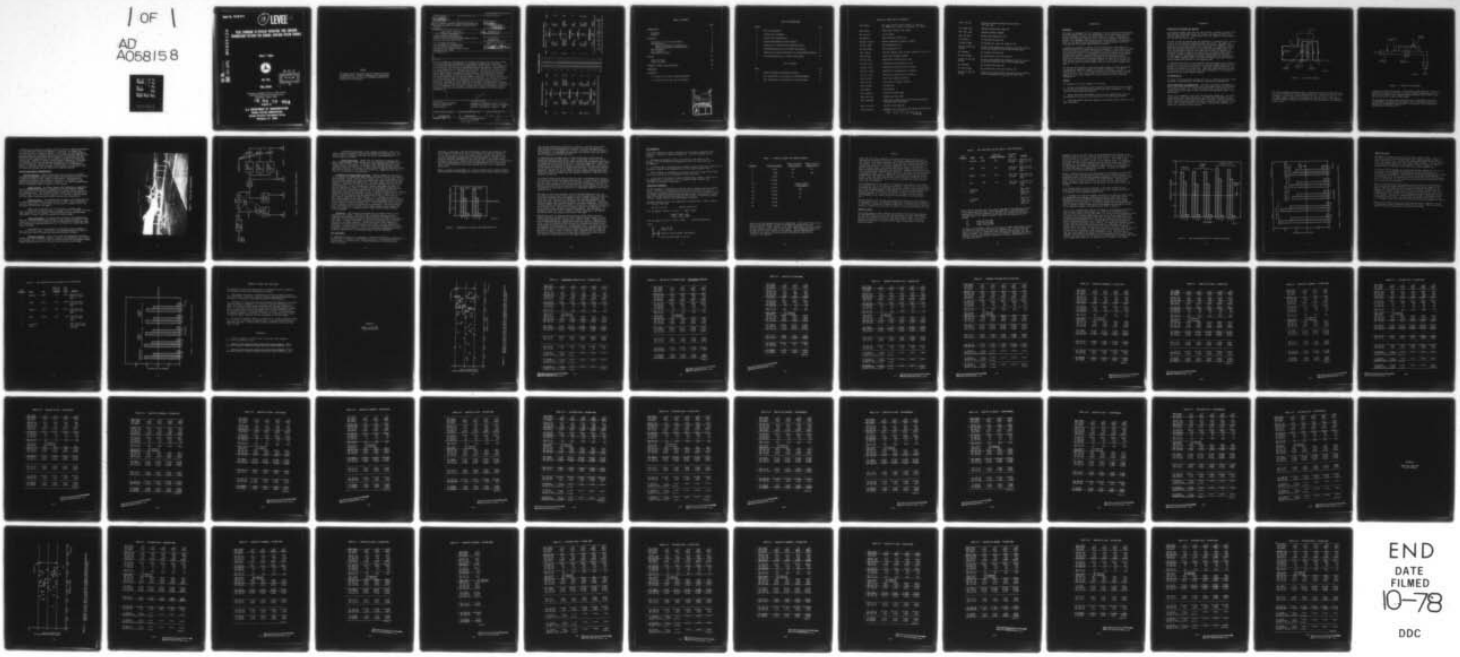

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PILOT PROGRAM TO DEVELOP OPERATING TIME EMISSION DEGRADATION FACTORS FOR GENERAL AVIATION PISTON ENGINES

Robert F. Salmon

JULY 1978

FINAL REPORT

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Systems Research & Development Service
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16. Abstract

A pilot program for investigating the problems associated with the piston engine continuous compliance requirement of the Emission Standards was undertaken at the National Aviation Facilities Experimental Center (NAFEC). The program used two aircraft as test vehicles to determine emission degradation characteristics of piston engines over a time period of 150 hours. This was the initial plan for the program, but due to a proposed modification in the Environmental Protection Agency (EPA) emission standards for piston engines, the program was shortened and terminated after 50 hours on each engine. This report describes the work and results obtained for the 50-hour engine time period. The results indicate that (1) no appreciable change in emissions occurs within the first 50 hours of engine operation, (2) emissions can be measured on aircraft-installed engines with accuracies comparable to those obtained in test stands, provided proper instrumentation and test procedures are used, and (3) aircraft instrumentation is satisfactory for some parameters, but in order to achieve EPA accuracy requirements, manifold pressure, fuel flow, and induction airflow must be measured on laboratory-type instruments.

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METRIC CONVERSION FACTORS

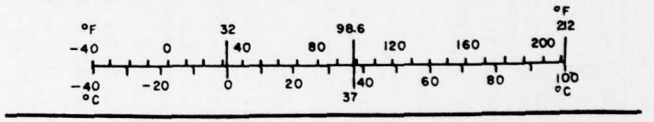
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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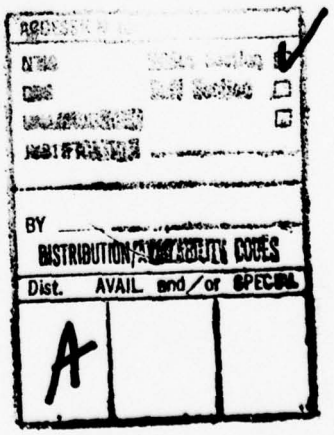

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GLOSSARY OF TERMS USED IN APPENDICES

Mode Number:	The power setting of the engine: 2 = taxi-out, 3 = takeoff, 4 = climb, 5 = approach, 6 = taxi-in
Rated Power:	Horse power rating of the engine
Rev per Min:	rpm of engine
Run Number:	Identification of data run
Baromet. Press.:	Ambient atmospheric pressure (inHgA)
Dry Air Temp:	Self-explanatory (°F)
Wet Bulb Temp:	Self-explanatory (°F)
Spec. Humid:	Specific humidity (lbs of water vapor/lb of dry air)
Vapor Press:	Water vapor pressure (inHgA)
HC Conc. ppm:	Measured HC concentration in ppm
NO_x Conc. ppm:	Measured NO_x concentration in ppm
CO Conc. Perc.:	Measured CO concentration in percent
CO_2 Conc. Perc.:	Measured CO_2 concentration in percent
O_2 Conc. Perc.:	Measured O_2 concentration in percent
Mols out Dry:	Mols of dry exhaust products
Mols out Wet:	Total Mols of exhaust products
Shaft Torque:	Not Measured
Horsepower:	Not Measured
Eng. Airflow:	Induction airflow (pph)
Eng. Fuel Flo:	Engine fuel flow (pph)
Diff. WFC-WFM:	Difference between measured fuel flow and exhaust calculated fuel flow (pph)
Meas. F/A Rat.:	Fuel/Air ratio measured
Cal. F/A Rat.:	Fuel/Air ratio calculated from emission measurements

Diff. M-C F/A:	Difference between measured and calculated F/A ratio (%)
Cyl. Temp. Max:	Maximum cylinder head temp (°F)
Man. Pres. HgA:	Manifold pressure (inHgA)
Exh. Gas Temp:	Exhaust gas temperature (°F)
CO lbs/Mode:	CO produced per mode (lb)
CO lbs/cyc-RHP:	CO produced per cycle per rated hp (lb)
Percent of EPA Std. for CO:	Percent of CO produced per cycle per rated hp compared to the EPA standard for CO (0.042 lb/cycle-RHP)
HC lbs/Mode:	HC produced per mode (lb)
HC lbs/cyc-RHP:	HC produced per cycle per rated hp
Percent of EPA Std. for HC:	Percent of HC produced per cycle per rated hp compared to the EPA standard for HC (0.0019 lb/cycle-RHP)
NO lbs/Mode:	NO_x produced per mode (lb)
NO lbs/cyc-RHP:	NO_x produced per cycle per rated hp (lb)
Percent of EPA Std. for NO:	Percent of NO_x produced per cycle per rated hp compared to the EPA standard for NO_x (0.0015 lb/cyc-rhp)

INTRODUCTION

BACKGROUND.

The Clean Air Amendments of 1970 (references 1 and 2) charged the Environmental Protection Agency (EPA) with the establishment of aircraft engine pollution control standards to protect the public health and welfare. Subsequently the EPA, has published standards for the control of emissions from aircraft engines. The Amendments also specified that the Department of Transportation (DOT) and the Federal Aviation Administration (FAA) promulgate regulations enforcing the EPA aircraft engine emission standards.

A program was initiated in October of 1973 authorizing a three-phase test program entitled "Piston Engine Emission Investigation." This effort, together with other follow-on projects, was designed to provide baseline information on the emission levels of a cross-section of general aviation piston engines, develop test procedures and calculation methods of handling the test data, determine the effects of ambient conditions on the emissions produced, explore the possibilities of reducing emissions by lean-out of the fuel/air (F/A) mixture or spark-timing changes (advance or retard spark timing), and evaluate the impact on aircraft safety that such minor engine changes would have.

The FAA was also required to determine whether general aviation engines met the continuous compliance aspects of the EPA's standards. In order to understand the scope of a full-scale continuous compliance program, a pilot program was run. This report deals with the results obtained from the pilot program entitled "Pilot Program for Piston Engine Continuous Compliance (Emissions)."

PURPOSE.

The purpose of the pilot program is as follows:

1. Develop the equipment and test procedures which would be used in expeditiously and accurately measuring emissions and engine parameters in a large-scale continuous compliance program.

2. Obtain in-service information on two types of engines which would be representative of the type of aircraft used in the full-scale program.

3. Establish whether emissions change to a measurable extent, and if so, over what time frame.

DISCUSSION

DESCRIPTION OF AIRCRAFT AND ENGINES.

In the pilot program, there were two test aircraft, a Seneca II using a TSIO-360E (200-hp) turbocharged engine and a Baron B-55 using an IO-470L fuel-injected engine (260 hp). In both cases, the left engine of the twin-engine aircraft was used for the test.

In order to test the engines with the precision of a laboratory test, modifications to the aircraft were required during round tests. The engine was returned to its original configuration after a test was completed. The modifications included installation of the following: (1) a modified cowling which incorporated provisions for an induction air measuring system, (2) a fuel flow measuring system for both high and low flow, (3) pressure and temperature probes to monitor the cooling air, (4) exhaust pipes modified to accept an emission sampling probe and a thermocouple, (5) precision pressure gages for measurement of manifold pressure and fuel pressure, and (6) an emission sampling probe in the modified exhaust pipe and a chromel-alumel thermocouple upstream of the emission probe.

In conducting the tests, it was recognized that the engines could overheat if a high-power condition was maintained for extended periods during stationary testing. To avoid such a situation, a high-volume, high-pressure-rise air blower was installed at the test site. This unit ducted air into the engine at velocities up to 70 miles per hour (mph), equivalent to a 2.3-inch H_2O pressure rise to prevent engine overheat.

INSTRUMENTATION.

Two types of instrumentation systems were used in conducting the test; engine performance instrumentation and emission measurement instrumentation.

ENGINE PERFORMANCE INSTRUMENTATION. The engine performance instrumentation used in the tests was identical for both test engines except for differences in adapters, ducting, etc., which were required due to the differences in engine installation; however, these variations had negligible effect on the measurements.

Figure 1 is a schematic of the fuel flow measuring system used. The system incorporated a dual-path flow system. For high flows (20 pounds per hour (pph) to 250 pph), a high-flow Cox rotameter was used. This was calibrated using aviation gasoline (Avgas) and had an accuracy of $\pm$0.5 percent of full scale. For low fuel flows (0.5 to 22 pph), a low-flow Cox rotameter was used with an accuracy of $\pm$0.5 percent.

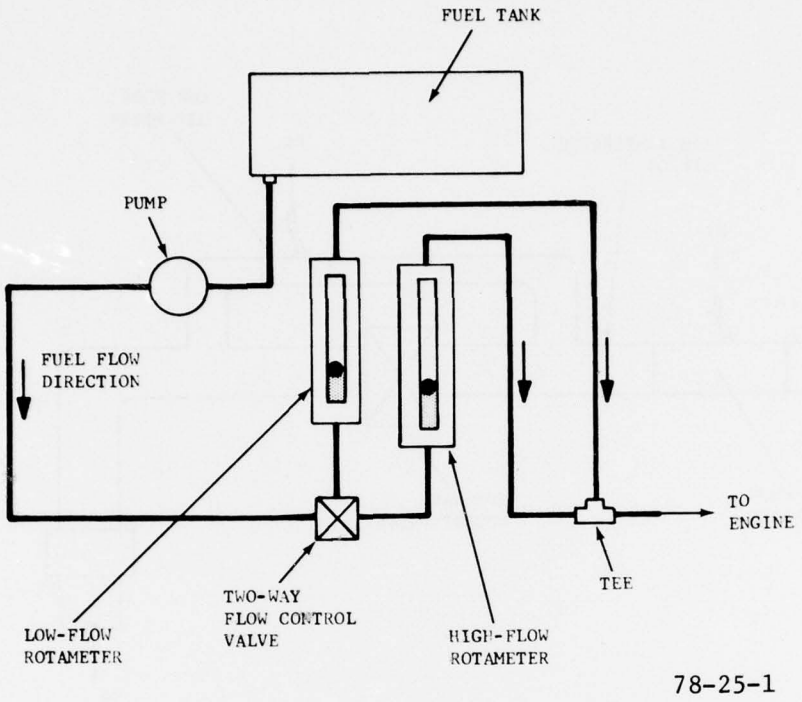

FIGURE 1. FUEL FLOW SCHEMATIC

The airflow measuring system was also a dual-path flow system using Autronics air meters (turbine-type volume-measuring devices). There were two size ranges of meters 0 to 100 cubic feet per minute (cfm) for taxi and 0 to 600 cfm for higher powers. Figure 2 is a schematic of the air system. The tolerance of the air measuring system was ± 3 percent at taxi and ± 2 percent at approach to takeoff power.

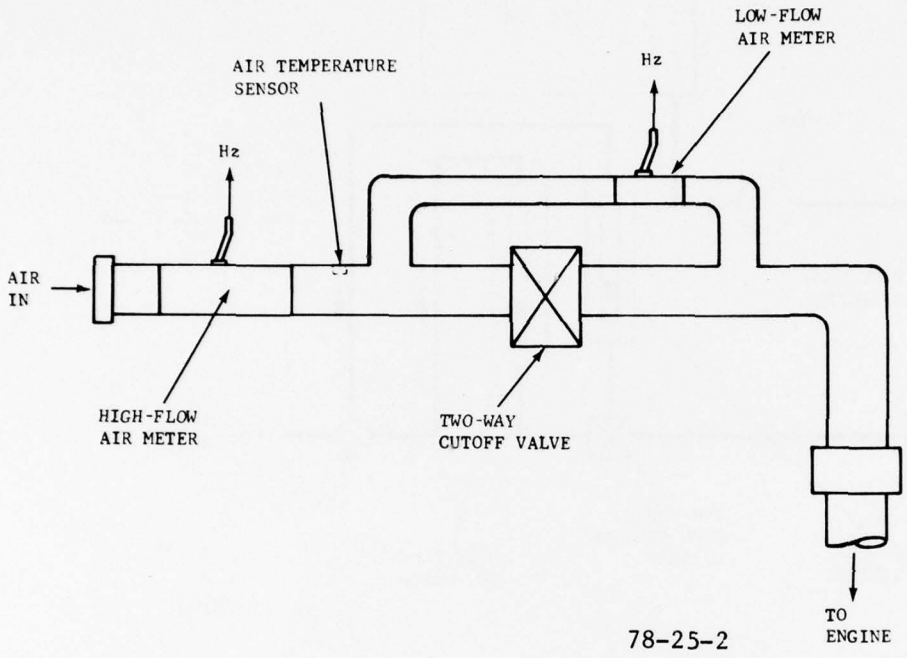

FIGURE 2. INDUCTION AIR SCHEMATIC

To measure the manifold pressure, a high-accuracy gage was used. This was a Wallace and Tiernan, 0-60 inches of mercury absolute (inHgA) gage, which was teed into the pressure line carrying manifold pressure to the cockpit gage. This device had an accuracy of $\pm$0.1 inHgA.

The measurement of exhaust gas temperature was accomplished by inserting a chromel-alumel thermocouple in the exhaust pipe of the engine upstream of the emission measurement sampling probe. The accuracy of the temperature reading was $\pm$3° Fahrenheit (F).

In addition, the cooling air pressure drop (Δp) across the engine was measured on an inclined water (H_2O) tube manometer. Typically, Δp ranged from 0.5 inH_2O at taxi to 3 inH_2O at takeoff. The accuracy of this measurement was $\pm$0.1 inH_2O, but it should be noted that the probe locations used for this measurement were selected based only on geometric considerations and thus may not be truly representative of the pressure drop which the engine was experiencing. However, it served a useful purpose, inasmuch as it provided an indication of the level of pressure developed by the cooling air as it entered the nacelle. The overall test configuration, as illustrated in figure 3, shows the relative position of the aircraft, the cooling air duct, the engine and cowling, and the induction air measuring system.

EMISSION MEASUREMENT INSTRUMENTATION.

Emission Analyzers. The instrumentation used to monitor the exhaust emissions from general aviation piston engines was basically the same as that recommended by EPA but with a number of modifications and additions to enhance the reliability and accuracy of the system. A schematic of the emissions measurement system is shown in figure 4. The basic instrumentation used in this system, shown in figure 4, is as follows.

Carbon dioxide. The carbon dioxide (CO_2) subsystem is constructed around a Beckman model 864-28-2-4 Nondispersive Infrared Analyzer (NDIR). This analyzer has a specified repeatability of $\pm$1 percent of full scale for each operating range. The calibration ranges on this particular unit are as follows: range 1, 0 to 20 percent; range 3, 0 to 5 percent. Stated accuracy for each range is therefore $\pm$0.2 and $\pm$0.05 percent CO_2, respectively.

Carbon monoxide. The subsystem used to measure carbon monoxide (CO) is constructed around a Beckman model 865-X-4-4-4 NDIR. This analyzer has a specified repeatability of $\pm$1 percent of full scale for ranges 1 and 2, and $\pm$2 percent of full scale for range 3.

Range 1 was calibrated for 0 to 20 percent by volume, range 2 for 0 to 1,000 parts per million (ppm), and range 3 for 0 to 100 ppm). The wide-range capability of this analyzer is made possible by using stacked sample cells which, in effect, give this analyzer six usable ranges.

Total hydrocarbons. The system used to measure total hydrocarbons (HC) was a modified Beckman model 402 heated flame ionization detector. This analyzer has a full-scale sensitivity that is adjustable to 150,000 ppm carbon with intermediate range multipliers of 0.5, 0.1, 0.05, 0.01, 0.005, and 0.001 times full scale.

Repeatability for this analyzer is specified to be $\pm$1 percent of full scale for each range. In addition, this modified analyzer is linear to the full-scale limit of 150,000 ppm carbon when properly adjusted.

Oxides of nitrogen. Oxides of nitrogen are measured by a modified Beckman Model 951H atmospheric pressure, heated, chemiluminescent (CL) analyzer. This analyzer has a full-scale range of 10,000 ppm with six intermediate ranges. Nominal minimum sensitivity is 0.1 ppm on the 10 ppm full-scale range.

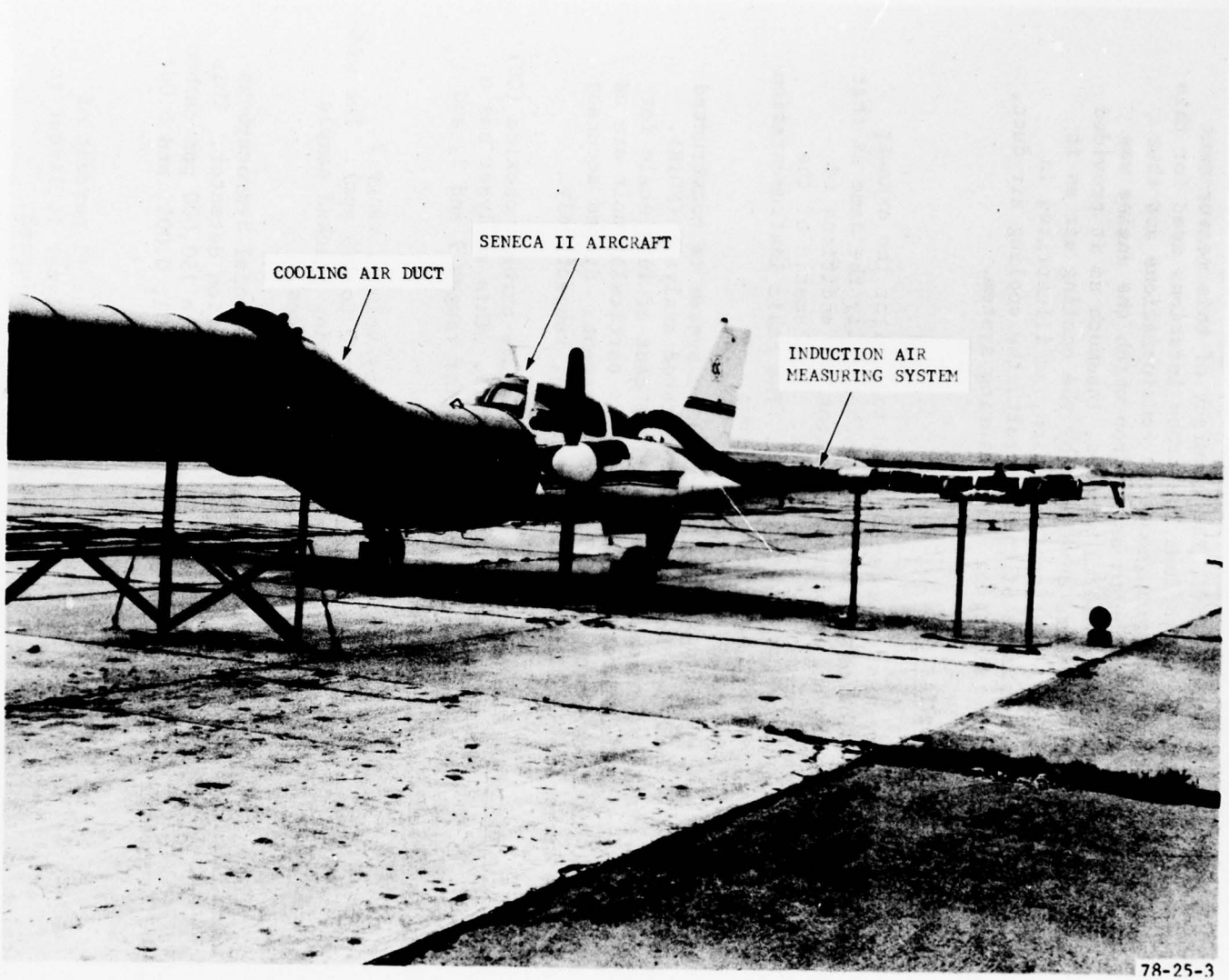

FIGURE 3. TYPICAL TEST CONFIGURATION

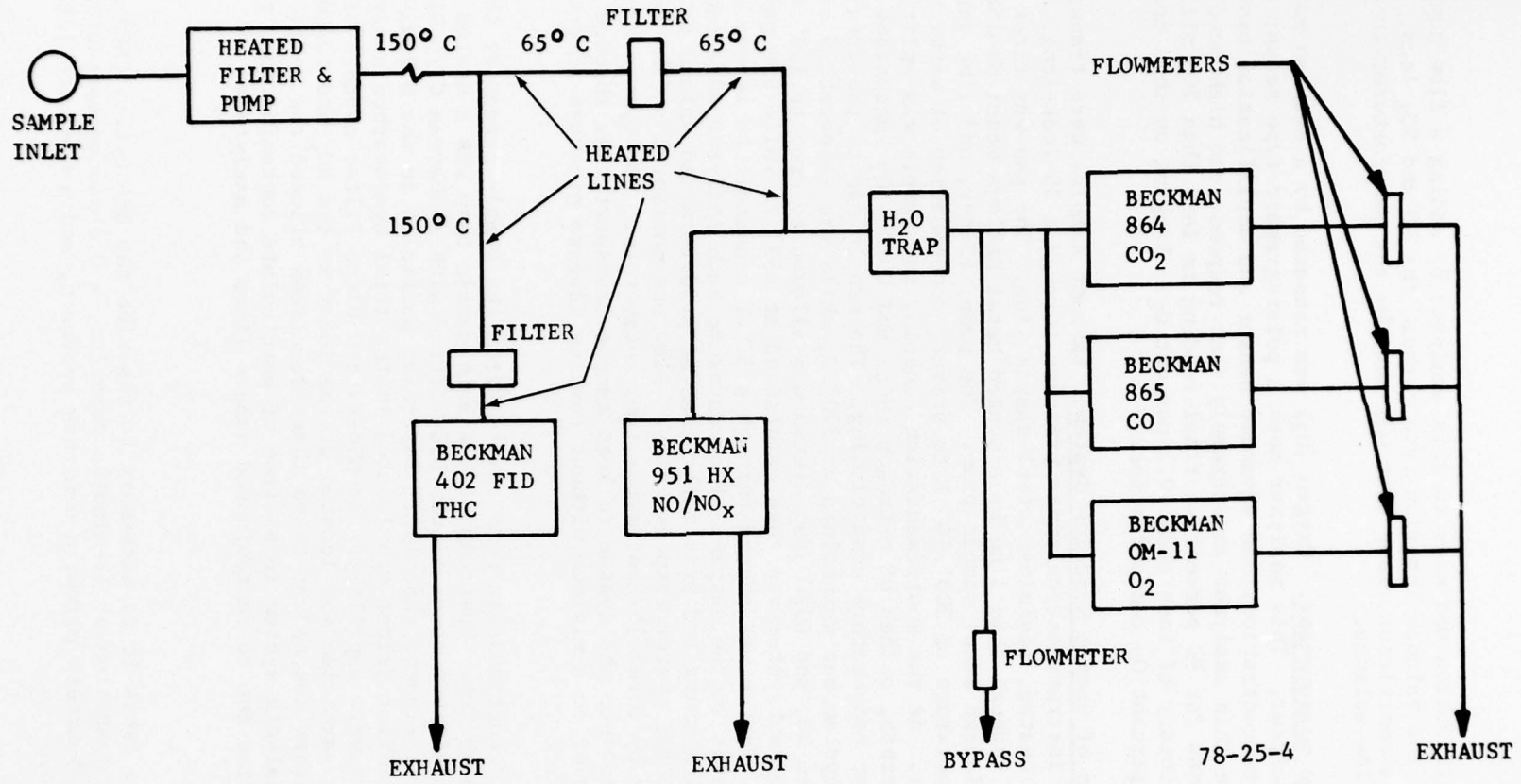

FIGURE 4. EMISSION MEASUREMENT SYSTEM SCHEMATIC

A modification was made to this analyzer by adding a flow control valve to adjust and balance the flow rate through the NO and NO_x legs. This valve replaced a restrictor clamp that was used by the manufacturer to set the NO to NO_x flow balance.

Oxygen measurement. Oxygen (O_2) was measured by a Beckman model OM-11 oxygen analyzer. This analyzer uses a polaragraphic-type sensor unit to measure oxygen concentration. An advanced sensor and amplification system combined to give this analyzer an extremely fast response and high accuracy. Specified response for 90 percent of final reading is less than 200 milliseconds (ms) with an accuracy of less than $\pm$0.1 percent O_2. Ranging on this unit is a fixed 0 to 100 percent O_2 concentration.

Description of Sample Handling System. Exhaust samples were transported to the analysis instrumentation under pressure through a 35-foot-long, 3/8-inch outer diameter, heated, stainless steel sample line. The gas was first filtered and then pumped through this line by a heated Metal Bellows model MB-158 high-temperature stainless steel sample pump. The pump, filter, and line were maintained at a temperature of 300° $\pm$4° F to prevent condensation of water vapor and hydrocarbons. At the instrumentation console, the sample was split to feed the hydrocarbon, oxides of nitrogen (NO_x) and $CO/CO_2/O_2$ subsystems which require different temperature conditioning. The sample gas to the total hydrocarbon subsystem was maintained at 300° F, while the temperature of remaining sample gas to the NO_x and $CO/CO_2/O_2$ system was allowed to drop to 150° F. Gas routed to the NO_x subsystem was then maintained at 150° F, while the gas to the $CO/CO_2/O_2$ subsystem was passed through a 32° F condenser to remove any water vapor present in the sample. Flow rates to each analyzer were controlled by a fine-metering valve and were maintained at predetermined values to minimize sample transport and system response time. Flow was monitored at the exhaust of each analyzer by three 15-centimeter (cm) rotameters. Two system bypasses were incorporated into the system to keep sample transport time through the lines and condenser to a minimum without causing adverse pressure effects in the analyzers.

Filtration. Particulates were removed from the sample stream at three locations in the system. Upstream of the main sample pump was a heated clamshell-type stainless steel filter body fitted with a Whatman GF/C Glass Fibre paper filter element capable of retaining particles in the 0.1-micrometer (μm) range. A similar filter was located in the total hydrocarbon analyzer upstream of the sample capillary. An MSA-Type H Ultra Filter capable of retaining 0.3-μm particles was located at the inlet to the NO_x and $CO/CO_2/O_2$ subsystems. Filters located at these three locations allowed the entire sample transport and analysis system to be free of particulate contamination, thereby minimizing downtime due to contaminated sample lines and analyzers.

TEST PROCEDURES.

To understand the tests it is necessary to describe the EPA cycle. EPA specifies an idle/taxi-out operation of 12-minutes duration, a 0.3-minute operation at takeoff power, a 5-minute climb, a 6-minute approach, and a 4-minute idle/taxi-in operation.

Initially, a seven-mode cycle was used wherein 1 minute was assigned to idle and 11 minutes to taxi at the start, and 3 minutes to taxi and 1 minute to idle at the end of the cycle. By eliminating the 1-minute idle-power time at start and finish and assigning it to the taxi modes, the accuracy of the tests was improved, inasmuch as it was very difficult to get stable engine readings at idle power. Earlier work indicated that this decision is conservative. The actual emission production at taxi is approximately twice as much as at idle, but the reliability of the data obtained at taxi is of a considerably higher order.

Figure 5 compares the bargraphs for a typical engine based on results obtained from tests with an IO-320 engine in the earlier piston engine emission program.

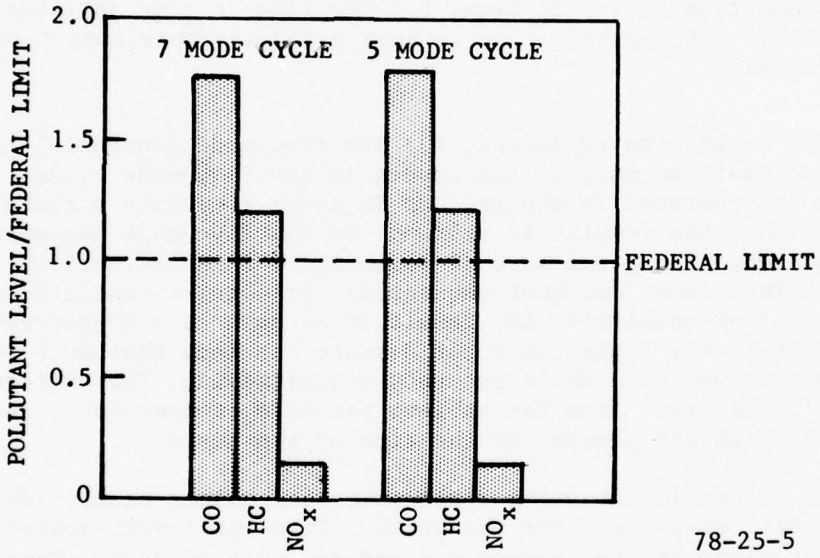

FIGURE 5. COMPARISON OF FIVE-MODE AND SEVEN-MODE CYCLE

The five-mode baseline was conducted in sequence so that the actual time in mode for any run was approximately 5 minutes. This time was required to assure stability of the engine and to record the values of engine performance and emissions. In calculating the emissions over the EPA cycle, the times in mode as specified by the EPA are used.

In conducting the five-mode tests, it was observed that taxi-out was not necessarily identical with taxi-in. This is attributed to the fact that at startup the preconditioning of the engine consists only of starting and running the engine until the oil is heated up to a specified temperature. During this warmup period, some buildup of carbon, oil past the rings, etc., would occur, and this would be reflected in the emissions measured. The taxi-out condition is set with no clear-out of the engine, and this has an impact on the measured emissions. However, at taxi-in, which follows a sequence of high-power runs which have cleared the engine out, the emissions usually are lower than those measured at taxi-out.

The previous observations indicate that the level of emissions can be changed by varying the procedure used during the testing. It also should be recognized that the impact of the taxi mode in the five-mode baseline is quite significant. The total time assigned to the five-mode cycle is 27.3 minutes. The rate of emission production is low at taxi, but the time in mode assigned to taxi power (16 minutes) is sufficiently long to have a considerable impact on the overall emissions level.

Two types of tests were conducted, (1) the five-mode sequential cycle and (2) lean-out tests at each of the powers in the five-mode cycle. The lean-out tests were incorporated in the program in order to reduce variability that could enter into the results if reliance on the five-mode sequential cycle alone were used. There are several reasons for this variability. Comparing results obtained from five-mode sequential cycle tests conducted at two widely different ambient conditions may result in as much as a 20-percent difference in the pollutant level. This can occur despite the fact that both sets of data can be shown to meet the EPA's accuracy requirements. The differences in pollutant levels arise from the ambient pressure, temperature, and humidity differences which are present at the time of the tests.

Difficulties occur in comparing cycle emissions unless nearly identical ambient conditions prevail for the tests. Lean-out tests, however, provide a convenient mechanism for comparison and analysis of data. These tests are used in developing curves of pollutants versus F/A ratio at a constant power level. Tests at different ambient conditions can generate different lines of pollutant versus F/A ratio for the same power level. The curves can serve as guidelines for interpolation or extrapolation to other ambient conditions. The lean-out curves are also useful in constructing hypothetical flight profiles for an engine. Thus, at takeoff, climb, approach, and taxi, specific F/A ratios can be selected and the emissions from this cycle can be determined without actually trying to set the engine conditions.

TEST FREQUENCY.

Tests were conducted in order to determine if any change in emission levels occurs as a function of engine operating time. The test schedule was as follows:

1. Establish the emission levels of the engine at the outset of the program. This is the baseline information to which all later tests are to be compared.

2. At 25-hour engine operating time increments, conduct tests which duplicate the procedure, sequence, and instrumentation of the initial baseline tests.

3. When an engine is scheduled for a periodic check (oil change, plug change, etc.) run a test prior to and immediately after the check.

4. At the end of 150 hours of engine operating time, conduct a final test on the engine prior to restoring it to its original flight condition and returning the aircraft to the owners.

COMPUTATION PROCEDURE.

The EPA standard for determining acceptable data in emission tests is somewhat broad. In effect, it requires that the data must be accurate to within ±5 percent in comparing the measured F/A ratio to the F/A ratio calculated from the exhaust emissions measured by the sampling system. The computation method used is in accord with standard chemistry practice and is basically a carbon balance, hydrogen balance, and oxygen balance technique.

The basic equations used in the computation are shown below. Table 1 defines the chemical terms used.

$$M_f\ (W_f) + M_a\ (W_a) \rightarrow \text{Exhaust Constituents}$$

Dry: $$M_f\ (C_8H_{17}) + M_a\ (O_2 + 3.76\ N_2) \rightarrow M_1CO_2 + M_2CO + M_3H_2O + M_4H_2 + M_5O_2 + M_6CH_4 + M_7N_2 + M_8NO$$

Wet: $$M_f\ (C_8H_{17}) + M_a\ (O_2 + 3.76\ N_2 + XH_2O) \rightarrow \text{Exhaust Constituents}$$

where;

M_f = mols of fuel
M_a = mols of air
M_1 through M_8 = mols of various exhaust constituents
X = mols of water vapor in the air

TABLE 1. CHEMICAL ELEMENTS FOR EXHAUST ANALYSIS

Elements	Molecular Weight	Exhaust Products Measured Dry	Exhaust Products Measured Wet
C	12.011	CO_2	NO
H	1.008	CO	CH_4
O	16.000	O_2	
N	*14.080		
CO_2	44.011	Exhaust Products Calculated	
CO	28.011	H_2O	
H_2O	18.016	N_2	
O_2	32.000	H_2	
CH_4	16.043		
N_2	28.160		
NO	30.000		

*There is an approximation used in the computation. This occurs in the assignment of molecular weight of 14.080 to nitrogen (N) instead of the true absolute value of 14.000. However, this slight modification is used to account for the unmeasured inert gases in the exhaust. These unmeasured constituents account for less than 1 percent of the exhaust, and this approximation simplifies the computation without having a significant impact on the accuracy of the results.

RESULTS

There were three tests conducted on the Baron B-55 engine and four tests conducted on the Seneca II aircraft. The average elapsed time between tests was 25 hours. The results indicated that there was no appreciable change in the emission level for the Seneca II during the first 50 hours; however, the aircraft was involved in an accident immediately after it had undergone a 50-hour periodic check. The accident was severe enough to require that the shaft be removed and magnafluxed, the propellers repaired and rebalanced, the main bearings changed, and new rings installed. In effect, this was equivalent to an engine change. After a repair job of this magnitude, the manufacturer recommends that the engine be operated using mineral oil during the break-in period. Thus, the first three Seneca II tests can only be compared to each other, and the postoverhaul test is actually a baseline for a new series of tests with a new engine.

In the introduction to the report, the background and purpose of the program were described, but as the tests were underway, a change in the EPA's position as regards the emission requirements for general aviation piston engines developed. This proposed change in requirements by the EPA in effect removed all the emission level standards as they applied to general aviation piston engines (reference 3). For this reason, all testing on the two aircraft was terminated at the 50-hour point for both the Seneca II and the Baron B-55.

The data obtained from the tests were reduced and analyzed and are tabulated in appendices A and B. The emissions measured at the outset of the program and at the 25-hour increments are shown in these data. The discussion of the test results is divided into two areas, the Seneca II tests and the Baron B-55 tests.

SENECA II TESTS.

Each of the Seneca II tests consisted of obtaining six sets of data wherein the TSIO-360E engine was run in the sequence and at the power levels shown in table 2. It should be noted that the values shown in table 2 for rpm and manifold pressure were the target conditions; however, under actual test, there were tolerances of $\pm$25 rpm and $\pm$0.5 inHgA, respectively, on rpm and manifold pressure.

TABLE 2. TEST CONDITIONS FOR THE SENECA II TSIO-360E ENGINE

Test Sequence	Power	rpm	Manifold (inHgA) Pressure	Fuel Flow pph	Remarks
1	Approach	1,900	24.0	Full rich to lean	Lean-out; full rich to 12 lb, lean
2	Climb	2,450	34.0	Full rich to lean	Lean-out; full rich to 12 lb, lean
3	Takeoff	2,550	40.0	Full rich to lean	Lean-out; full rich to 12 lb, lean
4	Taxi	1,200	17.5	Full rich to lean	Lean-out; full rich to 5 lb, lean
5	Five-Mode Cycle	-	-	-	Full rich at taxi, T/O climb, App., and taxi
6	Five-Mode Cycle	-	-	-	Full rich at taxi, T/O Climb, App., and taxi

Using the data obtained from these tests, bargraphs of the emissions produced by the engine were developed. These bargraphs are a convenient method of indicating an engine's pollutants in the EPA cycle relative to the federal pollutant limit. The Federal pollutant limits for the emissions are as follows

CO	0.042 lb/cycle-RHP
HC	0.0019 lb/cycle-RHP
NO_x	0.0015 lb/cycle-RHP

As shown on the bargraph, figure 6, the Seneca II engine (TSIO-360E) exceeded the limits for both CO and HC during the baseline run. This was expected based on the results of laboratory tests conducted during phase I of this program at NAFEC. The baseline tests on the Seneca II indicated that the CO emission level was 102 percent in excess of the limit, and the HC was 57 percent above the limit.

Subsequent tests at 25 hours and at 50 hours indicated some increase in the pollutant level for CO; i.e., from 202 to 220 percent of the federal limit and from 157 percent to 172 percent of the limit for HC. The change in NO_x indicated a decline of about 7 percent in the emission level. It should be noted that the three tests shown were run with ambient conditions essentially the same; i.e., the ambient temperatures were within 10° F of each other, and the ambient pressures were within 0.1 inHgA. There was no attempt made to correct the data to a standard-day condition. All data are compared directly in the bargraph presentation.

Figure 6 indicates that the CO and HC measured in the baseline run was within 10 percent of the CO and HC measured after 50 hours of engine operation. A $\pm$10-percent band on the baseline reading encompasses all the CO and HC values measured for the EPA cycle throughout the 50-hour period. The NO_x values shown in figure 6 range from 10/72 to 8.2 percent of the federal limit during the 50-hour test period. This indicates a band of $\pm$1.25 percent for the NO_x.

It is clearly shown in figure 6 that NO_x is the least critical of the emissions produced by the piston engines, since it is usually only about 8 to 15 percent of the allowable federal limit.

It is reasonable to state that changes observed in the emission levels during the abbreviated test program cannot be attributed to engine wear, since measurement accuracy and ambient atmospheric differences at the time of testing could have an impact on the emission levels equal to the changes observed in the 50-hour period. An extended program would probably have been able to determine whether engine wear or measurement accuracy was the cause of the emission increase in CO and HC levels shown in figure 6.

Figure 7 is a bargraph which depicts the change in cycle emissions resulting from the major engine overhaul which took place after the 50-hour test. There are three groups of bargraphs shown: (1) the two 50-hour preoverhaul tests, (2) the two sets of postoverhaul tests, and (3) the 50-hour preoverhaul test bargraph constructed from lean-out data with the same F/A ratios which were run during the postoverhaul test. The contrast between the first and second group of bargraphs indicates a very marked change in emissions between the 50-hour and the postoverhaul tests. However, in rigging the reinstalled engine it was found that the full-rich mixture setting of the engine for the post-overhaul tests was leaner than the full-rich setting obtained during the 50-hour tests. Therefore, to compare the emissions on an equal footing, lean-out curves were used to generate cycle information for the 50-hour tests at the same F/A ratios experienced during postoverhaul tests. The third set of bargraphs constructed as described is in good agreement with the postoverhaul results, thus indicating that the extensive overhaul which the engine experienced had no appreciable impact on the emission levels produced by the engine.

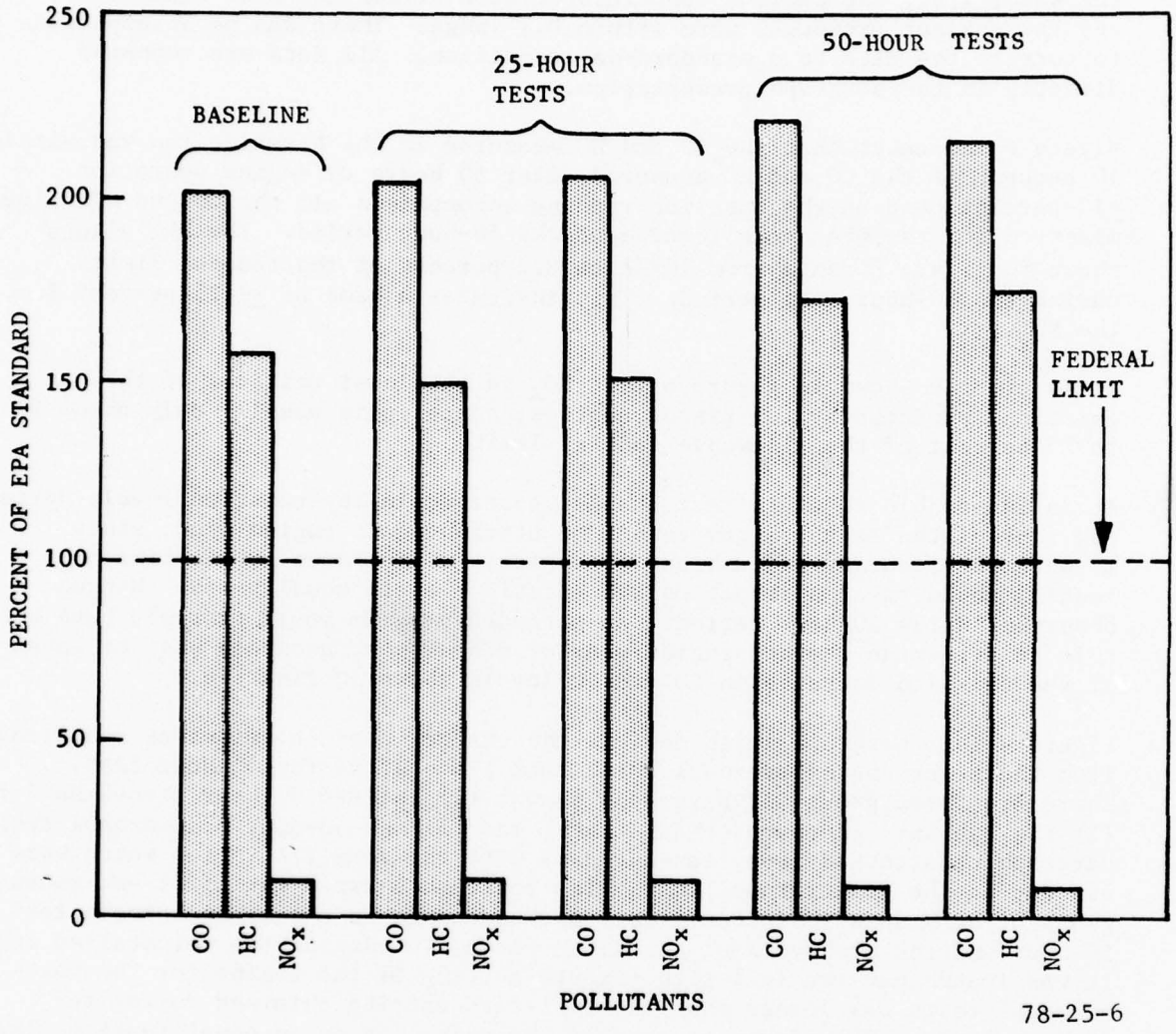

FIGURE 6. TSIO-360E EMISSIONS OVER A 50-HOUR TIME PERIOD

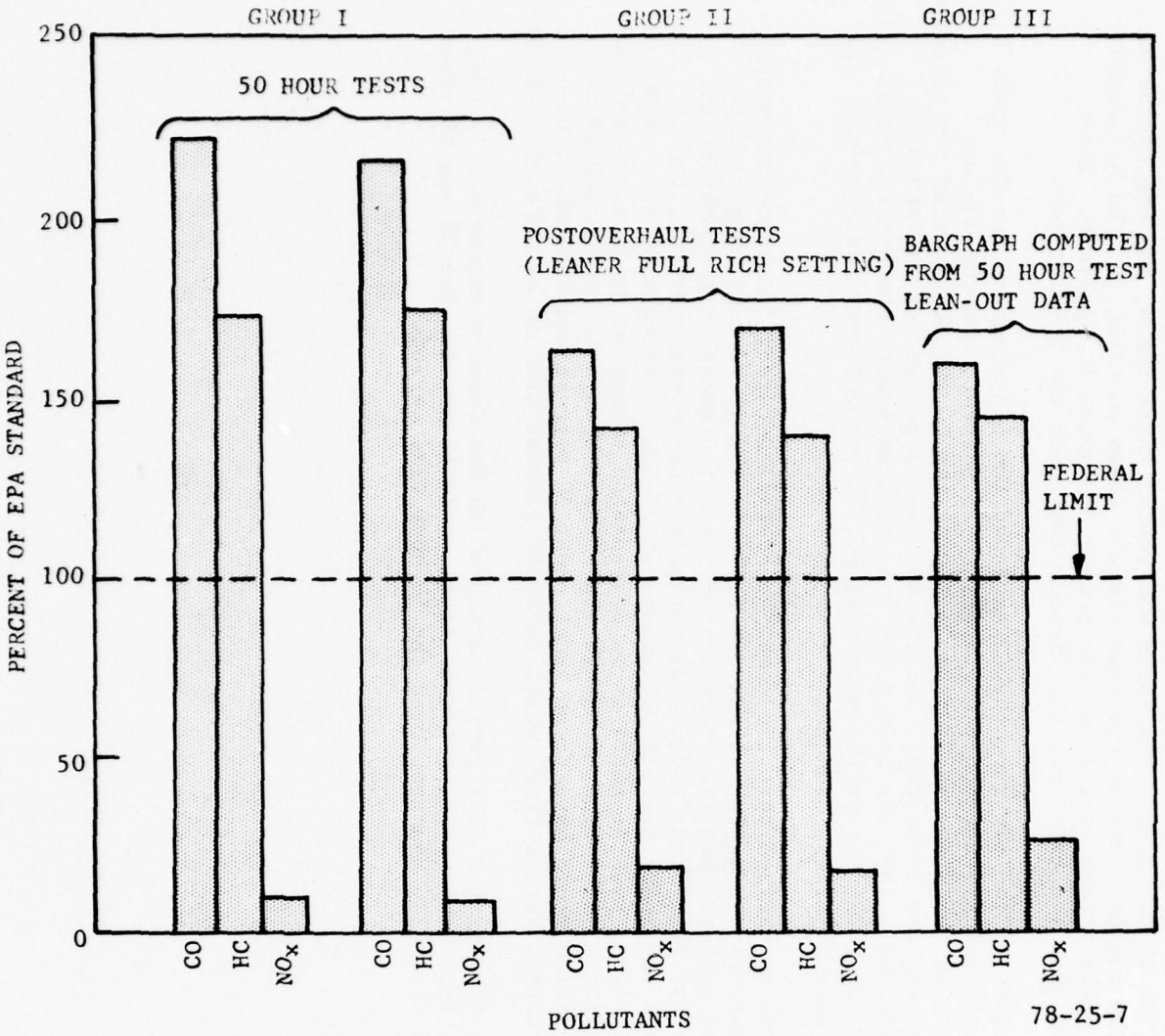

FIGURE 7. COMPARISON OF 50-HOUR EMISSIONS WITH POSTOVERHAUL EMISSIONS

BARON B-55 TESTS.

The engine of the Baron aircraft was an IO-470L rated at 260 hp. This is a naturally aspirated fuel-injected engine with a maximum nominal airflow of about 1,550 lb per hour. The Baron was tested three times, and the engine was run in the sequence and at the power levels shown in table 3. The bargraphs for the pollutants measured on this engine are shown in figure 8. These bargraphs show the baseline, the 25-hour test, and the 50-hour test.

At the start of the program, the CO exceeded the EPA standard for the cycle by 61 percent, the HC exceeded the standard by 8 percent, and the NO_x was 12 percent of the standard. After 24 hours, the CO and HC exceeded the standard by 61 percent and 26 percent, and the NO_x was 12 percent of the standard. At the 50-hour point, the values for the pollutants were essentially unchanged; i.e., CO, 56 percent over the standard; HC, 22 percent over the standard; and NO_x, 13 percent of the standard.

When it is recognized that the combined overall accuracy of the measurements for pollutants and engine parameters falls in the $\pm$5 percent range and the impact of ambient conditions for even minor differences in temperature and pressure can contribute additional variations of several percent, then it is reasonable to expect overall variations at 25-hour intervals to vary as much as $\pm$10 percent, even if there is no degradation change in pollutants produced by the engines. The type of change significant enough to be considered due to degradation would have to at least equal 10 percent and indicate a trend, i.e., a change versus time, which could be plotted over an extended time period.

Based on the limited time period during which the Baron's engine was tested, no appreciable change in pollutant level could be noted. The CO and HC levels remained virtually constant over the 50-hour time period.

TABLE 3. TEST CONDITIONS FOR THE BARON B-55 IO-470L ENGINE

Test Sequence	Power	rpm	Manifold Pressure (inHgA)	Fuel Flow (pph)	Remarks
1	Approach	2,000	21.0	58.0	Lean out; full rich to 12 lbs, lean
2	Climb	2,500	27.0	105.0	Lean out; full rich to 12 lbs, lean
3	Takeoff	2,575	29.0	126.0	Lean out; full rich to 12 lbs, lean
4	Taxi	1,100	15.0	17.0	Lean out; full rich to 4 lbs, lean
5	Five Mode Cycle	-	-	-	Full rich at taxi, T/O, climb, Appr.. and taxi

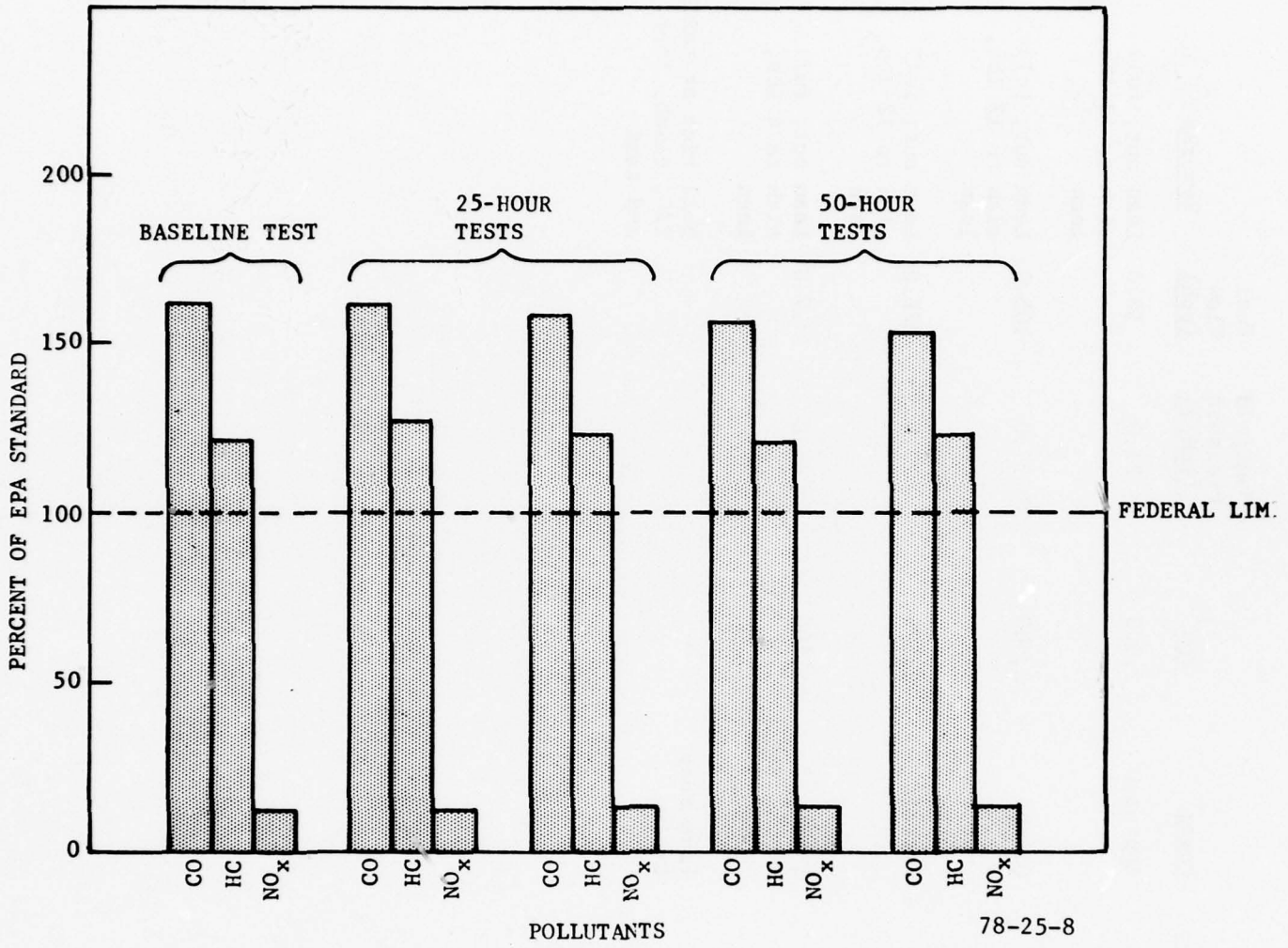

FIGURE 8. IO-470L EMISSIONS OVER A 50-HOUR TIME PERIOD

SUMMARY OF RESULTS AND CONCLUSIONS

The results and conclusions drawn from the foreshortened tests conducted in the degradation study can be summarized as follows:

1. The limited time period of approximately 50 hours of engine operation was insufficient to establish a definite emission degradation trend for either the Seneca II TSIO-360E or the Beech Baron B-55 IO-470L engines.

2. The degree of accuracy of emission measurement attainable on an aircraft-installed engine is comparable to the level of accuracy obtainable on an engine test stand, provided proper instrumentation and test procedures are used. It is essential that accurate fuel flow and manifold pressure measurements be made; typical cockpit instrumentation for these parameters does not provide the degree of accuracy specified by the EPA. If the requirement of provable accuracy of ± 5 percent is imposed, it is essential that a means of measuring engine induction airflow be included in the test design.

3. The use of an external supply of cooling air to a static engine installed in an aircraft is essential in emission tests to prevent engine overheat at high power settings. Propeller wash provides insufficient cooling at high power settings.

REFERENCES

1. Clean Air Amendments of 1970, Public Law 91-604, 91st Congress, H. R. 17255, December 31, 1970.

2. Control of Air Pollution from Aircraft and Aircraft Engines, Federal Register, Volume 43, Number 58, Pages 12614 thru 12634, March 24, 1978.

3. Control of Air Pollution from Aircraft and Aircraft Engines, Federal Register, Volume 43, Number 58, Pages 12,614 thru 12,634, March 24, 1978.

APPENDIX A

SENECA II TEST DATA
(TSIO-360E ENGINE)

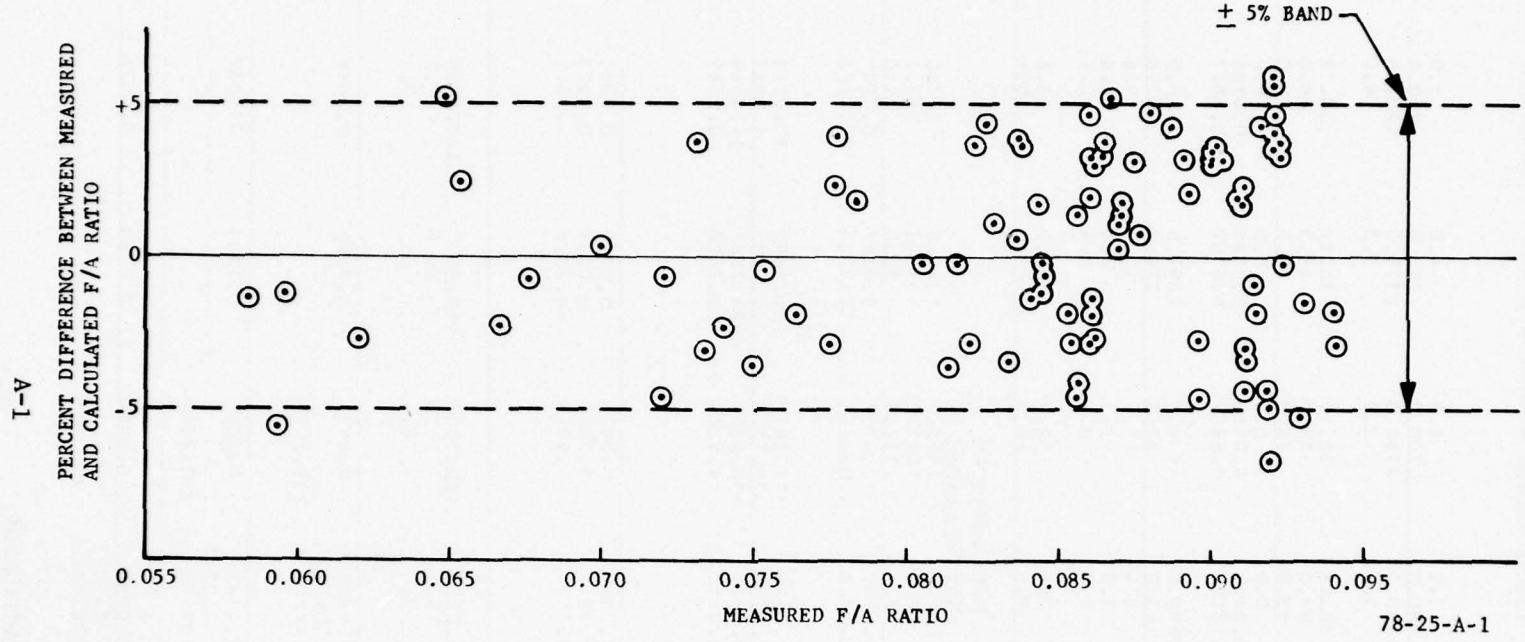

FIGURE A-1. MEASURED F/A RATIO VERSUS THE PERCENT DIFFERENCE BETWEEN THE CALCULATED AND MEASURED F/A RATIO FOR THE SENECA II AIRCRAFT WITH TSIO 360E ENGINE

TABLE A-1. NONSTANDARD BASELINE CYCLE - (CHECKOUT RUNS)

MODE NUMBER	2.0	3.0	4.0	5.0	6.0
RATED POWER	200.0	200.0	200.0	200.0	200.0
REV PER MIN	1200.0	2550.0	2375.0	1700.0	1225.0
RUN NUMBER	1.0	2.0	3.0	4.0	5.0
BAROMET PRES	30.12	30.12	30.12	30.12	30.12
DRY AIR TEMP	88.0	88.0	88.0	88.0	88.0
WET BULB TEM	78.0	78.0	78.0	78.0	78.0
IND AIR TEMP	0.0	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0185	0.0185	0.0185	0.0185	0.0185
VAPOR PRESS.	0.8807	0.8807	0.8807	0.8807	0.8807
HC CONC-PPM	15698.0	1938.0	2098.0	2748.0	17754.0
NOX CONC-PPM	163.0	87.0	274.0	163.0	55.0
CO CONC-PERC	8.4	11.5	10.3	9.8	8.8
CO2 CON-PERC	7.3	7.2	7.8	8.4	7.1
O2 CONC-PERC	3.0	0.4	0.4	0.4	3.1
MOLS OUT DRY	7.5	52.2	37.0	13.8	8.0
MOLS OUT WET	8.6	58.7	42.2	15.6	9.1
SHAFT TORQUE	Not Measured				
HORSEPOWER	Not Measured				
ENG AIR FLOW	216.0	1455.0	1049.0	392.0	229.2
DRY AIR FLOW	212.8	1433.6	1033.6	386.2	225.8
ENG FUEL FLO	18.5	132.0	96.0	34.0	19.5
DRY AIR DENS	0.0707	0.0707	0.0707	0.0707	0.0707
WET AIR DENS	0.0728	0.0728	0.0728	0.0728	0.0728
EXH CARBON	14.2642	117.3977	80.6690	30.0823	15.3070
EXH HYDROGEN	2.4102	19.1307	14.0832	4.8845	2.5026
EXH FUEL FLO	16.6745	136.5284	94.7522	34.9669	17.8096
DIFF WFC-WFM	-1.8255	4.5284	-1.2478	0.9669	-1.6904
MEAS F/A RAT	0.0869	0.0921	0.0929	0.0880	0.0864
CAL F/A RAT	0.0871	0.0976	0.0927	0.0923	0.0895
DIFF M-C F/A	0.2124	5.9978	-0.2326	4.8813	3.6928
CYL TEMP MAX	286.0000	420.0000	420.0000	320.0000	280.0000
MAN PRES.HGA	18.0	44.0	34.0	21.0	18.5
EXH GAS TEMP	0.	0.	0.	0.	0.
CO LBS/MODE	3.5633	0.8401	8.9190	3.7838	1.3153
CO LBS/CYC-RHP	0.0921				
PERCENT OF EPA STD FOR CO	219.3035				
HC LBS/MODE	0.4383	0.0091	0.1183	0.0687	0.1758
HC LBS/CYC-RHP	0.0041				
PERCENT OF EPA STD FOR HC	213.2096				
NO LBS/MODE	0.0085	0.0008	0.0289	0.0076	0.0010
NO LBS/CYC-RHP	0.0002				
PERCENT OF EPA STD FOR NO	15.5986				

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TABLE A-2. LEAN-OUT AT 25 PERCENT POWER - (NONSTANDARD APPROACH)

MODE NUMBER	5.0	5.0	5.0	5.0
RATED POWER	200.0	200.0	200.0	200.0
REV PER MIN	1725.0	1690.0	1500.0	1850.0
RUN NUMBER	6.0	7.0	8.0	9.0
BAROMET PRES	30.12	30.12	30.12	30.12
DRY AIR TEMP	88.0	88.0	88.0	88.0
WET BULB TEM	78.0	78.0	78.0	78.0
IND AIR TEMP	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0185	0.0185	0.0185	0.0185
VAPOR PRESS.	0.8807	0.8807	0.8807	0.8807
HC CONC-PPM	2863.0	916.0	579.8	2262.0
NOX CONC-PPM	180.0	1003.0	789.0	248.0
CO CONC-PERC	9.4	2.1	0.4	8.7
CO2 CON-PERC	8.6	12.7	11.0	9.0
02 CONC-PERC	0.7	2.0	1.9	1.0
MOLS OUT DRY	14.9	13.8	13.8	16.1
MOLS OUT WET	16.7	15.5	16.6	18.1
SHAFT TORQUE	Not Measured			
HORSEPOWER	Not Measured			
ENG AIR FLOW	424.0	423.0	445.0	460.0
DRY AIR FLOW	417.8	416.8	438.4	453.2
ENG FUEL FLO	36.0	27.0	26.0	40.6
DRY AIR DENS	0.0707	0.0707	0.0707	0.0707
WET AIR DENS	0.0728	0.0728	0.0728	0.0728
EXH CARBON	32.1066	24.5195	18.9687	34.3667
EXH HYDROGEN	5.0055	3.5141	5.6738	5.3478
EXH FUEL FLO	37.1121	28.0336	24.6426	39.7145
DIFF WFC-WFM	1.1121	1.0336	-1.3574	-0.8855
MEAS F/A RAT	0.0862	0.0648	0.0593	0.0896
CAL F/A RAT	0.0903	0.0680	0.0560	0.0867
DIFF M-C F/A	4.7556	5.0250	-5.5989	-3.1788
CYL TEMP MAX	275.0000	295.0000	310.0000	300.0000
MAN PRES.HGA	21.0	21.5	23.0	22.9
EXH GAS TEMP	0.	0.	0.	0.
CO LBS/MODE	3.9086	0.7981	0.1472	3.9397
HC LBS/MODE	0.0768	0.0226	0.0154	0.0657
NO LBS/MODE	0.0090	0.0464	0.0393	0.0135

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TABLE A-3. LEAN-OUT AT CLIMB POWER

MODE NUMBER	4.0	4.0	4.0
RATED POWER	200.0	200.0	200.0
REV PER MIN	2425.0	2495.0	2495.0
RUN NUMBER	10.0	11.0	12.0
BAROMET PRES	30.12	30.12	30.12
DRY AIR TEMP	88.0	88.0	88.0
WET BULB TEM	78.0	78.0	78.0
IND AIR TEMP	0.0	0.0	0.0
SPEC.HUMID.,	0.0185	0.0185	0.0185
VAPOR PRESS.	0.8807	0.8807	0.8807
HC CONC-PPM	2063.0	1562.0	1365.0
NOX CONC-PPM	134.0	330.0	569.0
CO CONC-PERC	10.3	7.4	5.6
CO2 CON-PERC	8.0	9.8	10.9
O2 CONC-PERC	1.1	1.2	0.0
MOLS OUT DRY	38.6	38.8	36.7
MOLS OUT WET	42.9	43.5	42.5
SHAFT TORQUE	Not Measured		
HORSEPOWER	Not Measured		
ENG AIR FLOW	1081.0	1123.0	1101.0
DRY AIR FLOW	1065.1	1106.5	1084.8
ENG FUEL FLO	95.0	94.5	89.0
DRY AIR DENS	0.0707	0.0707	0.0707
WET AIR DENS	0.0728	0.0728	0.0728
EXH CARBON	85.0864	80.5948	72.9957
EXH HYDROGEN	12.4754	12.2775	13.5929
EXH FUEL FLO	97.5618	92.8723	86.5886
DIFF WFC-WFM	2.5618	-1.6277	-2.4114
MEAS F/A RAT	0.0892	0.0854	0.0820
CAL F/A RAT	0.0919	0.0826	0.0792
DIFF M-C F/A	3.0331	-3.3263	-3.4363
CYL TEMP MAX	380.0000	420.0000	450.0000
MAN PRES.HGA	34.0	34.7	34.5
EXH GAS TEMP	0.	0.	0.
CO LBS/MODE	9.2998	6.7438	4.8374
HC LBS/MODE	0.1182	0.0909	0.0776
NO LBS/MODE	0.0144	0.0359	0.0605

78-25-A-3

TABLE A-4. STANDARD FIVE-MODE CYCLE - BASELINE RUN

MODE NUMBER	2.0	3.0	4.0	5.0	6.0
RATED POWER	200.0	200.0	200.0	200.0	200.0
REV PER MIN	1210.0	2550.0	2450.0	1900.0	1250.0
RUN NUMBER	13.0	14.0	15.0	16.0	18.0
BAROMET PRES	30.12	30.12	30.12	30.12	30.12
DRY AIR TEMP	96.0	96.0	96.0	96.0	96.0
WET BULB TEM	78.0	78.0	78.0	78.0	78.0
IND AIR TEMP	0.0	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0166	0.0166	0.0166	0.0166	0.0166
VAPOR PRESS.	0.7958	0.7958	0.7958	0.7958	0.7958
HC CONC-PPM	11091.0	1809.0	1868.0	2234.0	11253.0
NOX CONC-PPM	67.0	89.0	135.0	186.0	64.0
CO CONC-PERC	7.1	10.2	9.1	8.1	7.3
CO2 CON-PERC	9.4	8.2	8.8	9.3	9.2
O2 CONC-PERC	1.0	0.4	0.4	0.4	1.5
MOLS OUT DRY	7.3	52.3	39.0	17.5	7.4
MOLS OUT WET	8.5	58.9	44.2	20.1	8.4
SHAFT TORQUE	Not Measured				
HORSEPOWER	Not Measured				
ENG AIR FLOW	215.0	1475.0	1118.0	509.0	214.0
DRY AIR FLOW	212.1	1455.4	1103.1	502.2	211.2
ENG FUEL FLO	19.5	131.0	95.0	45.0	18.4
DRY AIR DENS	0.0699	0.0699	0.0699	0.0699	0.0699
WET AIR DENS	0.0718	0.0718	0.0718	0.0718	0.0718
EXH CARBON	14.6241	115.7119	83.7544	36.6114	14.5688
EXH HYDROGEN	2.6791	18.5805	13.8351	6.5653	2.4436
EXH FUEL FLO	17.3032	134.2924	97.5895	43.1767	17.0124
DIFF WFC-WFM	-2.1968	3.2924	2.5895	-1.8233	-1.3876
MEAS F/A RAT	0.0919	0.0900	0.0861	0.0896	0.0871
CAL F/A RAT	0.0858	0.0932	0.0894	0.0855	0.0856
DIFF M-C F/A	-6.6752	3.5222	3.8023	-4.6230	-1.7201
CYL TEMP MAX	280.0000	440.0000	460.0000	380.0000	280.0000
MAN PRES.HGA	17.5	40.0	34.0	23.0	17.5
EXH GAS TEMP	0.	0.	0.	0.	0.
CO LBS/MODE	2.9433	0.7497	8.2615	3.9815	1.0006
CO LBS/CYC-RHP	0.0847				
PERCENT OF EPA STD FOR CO	201.6261				
HC LBS/MODE	0.3065	0.0085	0.1103	0.0722	0.1024
HC LBS/CYC-RHP	0.0030				
PERCENT OF EPA STD FOR HC	157.8578				
NO LBS/MODE	0.0035	0.0008	0.0149	0.0112	0.0011
NO LBS/CYC-RHP	0.0002				
PERCENT OF EPA STD FOR NO	10.4942				

78-25-A-4

TABLE A-5. STANDARD FIVE-MODE CYCLE 25-HOUR TEST

MODE NUMBER	2.0	3.0	4.0	5.0	6.0
RATED POWER	200.0	200.0	200.0	200.0	200.0
REV PER MIN	1200.0	2525.0	2450.0	1900.0	1200.0
RUN NUMBER	20.0	21.0	22.0	23.0	45.0
BAROMET PRES	30.02	30.02	30.02	30.02	30.02
DRY AIR TEMP	84.0	84.0	84.0	84.0	84.0
WET BULB TEM	78.0	78.0	78.0	78.0	78.0
IND AIR TEMP	0.0	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0194	0.0194	0.0194	0.0194	0.0194
VAPOR PRESS.	0.9231	0.9231	0.9231	0.9231	0.9231
HC CONC-PPM	10559.0	1920.0	2002.0	2131.0	11387.0
NOX CONC-PPM	62.0	86.0	131.0	249.0	65.0
CO CONC-PERC	7.6	10.7	9.7	7.9	7.2
CO2 CON-PERC	9.6	8.0	8.6	9.4	9.9
O2 CONC-PERC	0.4	0.2	0.2	0.2	0.5
MOLS OUT DRY	7.0	52.9	38.5	17.2	6.9
MOLS OUT WET	8.0	59.7	43.9	19.6	7.9
SHAFT TORQUE	Not Measured				
HORSEPOWER	Not Measured				
ENG AIR FLOW	204.0	1490.0	1097.0	502.0	203.0
DRY AIR FLOW	200.8	1466.9	1080.0	494.2	199.9
ENG FUEL FLO	17.5	135.0	102.0	41.0	17.2
DRY AIR DENS	0.0709	0.0709	0.0709	0.0709	0.0709
WET AIR DENS	0.0731	0.0731	0.0731	0.0731	0.0731
EXH CARBON	14.4255	119.0596	84.3003	35.8751	14.2242
EXH HYDROGEN	2.4491	19.2113	14.5017	6.1812	2.3457
EXH FUEL FLO	16.8746	138.2708	98.8020	42.0563	16.5700
DIFF WFC-WFM	-0.6254	3.2708	-3.1980	1.0563	-0.6300
MEAS F/A RAT	0.0871	0.0920	0.0944	0.0830	0.0861
CAL F/A RAT	0.0899	0.0955	0.0910	0.0863	0.0891
DIFF M-C F/A	3.1316	3.7474	-3.6449	4.0152	3.5391
CYL TEMP MAX	275.0000	440.0000	440.0000	350.0000	275.0000
MAN PRES.HGA	17.5	40.0	34.5	24.0	17.8
EXH GAS TEMP	762.0	1265.0	1261.0	1103.0	803.0
CO LBS/MODE	2.9791	0.7953	8.6718	3.8218	0.9312
CO LBS/CYC-RHP	0.0860				
PERCENT OF EPA STD FOR CO	204.7525				
HC LBS/MODE	0.2748	0.0092	0.1174	0.0671	0.0979
HC LBS/CYC-RHP	0.0028				
PERCENT OF EPA STD FOR HC	149.0424				
NO LBS/MODE	0.0030	0.0008	0.0144	0.0142	0.0010
NO LBS/CYC-RHP	0.0002				
PERCENT OF EPA STD FOR NO	11.2858				

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TABLE A-6. LEAN-OUT AT APPROACH - 25-HOUR TEST

MODE NUMBER	5.0	5.0	5.0	5.0
RATED POWER	200.0	200.0	200.0	200.0
REV PER MIN	1900.0	1900.0	1900.0	1900.0
RUN NUMBER	24.0	25.0	26.0	27.0
BAROMET PRES	30.02	30.02	30.02	30.02
DRY AIR TEMP	84.0	84.0	84.0	84.0
WET BULB TEM	78.0	78.0	78.0	78.0
IND AIR TEMP	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0194	0.0194	0.0194	0.0194
VAPOR PRESS.	0.9231	0.9231	0.9231	0.9231
HC CONC-PPM	1942.0	1682.0	1409.0	927.0
NOX CONC-PPM	233.0	400.0	684.0	1076.0
CO CONC-PERC	8.0	6.2	4.4	2.2
CO2 CON-PERC	9.4	10.3	11.6	12.8
O2 CONC-PERC	0.3	0.3	0.3	0.7
MOLS OUT DRY	17.3	16.9	16.4	15.9
MOLS OUT WET	19.7	19.4	18.8	18.3
SHAFT TORQUE	Not Measured			
HORSEPOWER	Not Measured			
ENG AIR FLOW	504.0	503.0	497.0	494.0
DRY AIR FLOW	496.2	495.2	489.3	486.3
ENG FUEL FLO	41.0	38.5	36.0	34.0
DRY AIR DENS	0.0709	0.0709	0.0709	0.0709
WET AIR DENS	0.0731	0.0731	0.0731	0.0731
EXH CARBON	36.1635	33.5543	31.5050	28.7726
EXH HYDROGEN	6.1064	6.0126	5.4811	5.1290
EXH FUEL FLO	42.2699	39.5668	36.9861	33.9016
DIFF WFC-WFM	1.2699	1.0668	0.9861	-0.0984
MEAS F/A RAT	0.0826	0.0777	0.0736	0.0699
CAL F/A RAT	0.0862	0.0808	0.0763	0.0699
DIFF M-C F/A	4.3593	3.9869	3.7069	0.0293
CYL TEMP MAX	305.0000	315.0000	325.0000	335.0000
MAN PRES.HGA	23.9	23.9	23.9	23.9
EXH GAS TEMP	1094.0	1118.0	1151.0	1184.0
CO LBS/MODE	3.8582	2.9522	2.0113	0.9873
HC LBS/MODE	0.0613	0.0523	0.0424	0.0272
NO LBS/MODE	0.0138	0.0232	0.0385	0.0591

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TABLE A-7. LEAN-OUT AT CLIMB - 25-HOUR TEST

MODE NUMBER	4.0	4.0	4.0	4.0	4.0
RATED POWER	200.0	200.0	200.0	200.0	200.0
REV PER MIN	2460.0	2460.0	2450.0	2450.0	2450.0
RUN NUMBER	28.0	29.0	30.0	31.0	32.0
BAROMET PRES	30.02	30.02	30.02	30.02	30.02
DRY AIR TEMP	84.0	84.0	84.0	84.0	84.0
WET BULB TEM	78.0	78.0	78.0	78.0	78.0
IND AIR TEMP	0.0	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0194	0.0194	0.0194	0.0194	0.0194
VAPOR PRESS.	0.9231	0.9231	0.9231	0.9231	0.9231
HC CONC-PPM	1596.0	1862.0	1995.0	2003.0	1884.0
NOX CONC-PPM	273.0	155.0	118.0	115.0	160.0
CO CONC-PERC	7.1	8.9	10.1	9.9	8.7
CO2 CON-PERC	9.7	8.8	8.1	8.2	8.8
O2 CONC-PERC	0.2	0.2	0.2	0.2	0.2
MOLS OUT DRY	38.3	39.0	39.1	38.6	38.4
MOLS OUT WET	44.4	44.9	44.7	44.2	44.4
SHAFT TORQUE	Not Measured				
HORSEPOWER	Not Measured				
ENG AIR FLOW	1130.0	1128.0	1112.0	1103.0	1115.0
DRY AIR FLOW	1112.5	1110.5	1094.8	1085.9	1097.7
ENG FUEL FLO	96.5	102.0	103.0	101.0	100.0
DRY AIR DENS	0.0709	0.0709	0.0709	0.0709	0.0709
WET AIR DENS	0.0731	0.0731	0.0731	0.0731	0.0731
EXH CARBON	77.3751	82.6812	85.8603	83.8624	80.5097
EXH HYDROGEN	14.9279	15.2511	15.0311	15.0204	15.2816
EXH FUEL FLO	92.3030	97.9323	100.8914	98.8827	95.7913
DIFF WFC-WFM	-4.1970	-4.0677	-2.1086	-2.1173	-4.2087
MEAS F/A RAT	0.0867	0.0918	0.0941	0.0930	0.0911
CAL F/A RAT	0.0823	0.0878	0.0926	0.0916	0.0871
DIFF M-C F/A	-5.1288	-4.3841	-1.6284	-1.4926	-4.3830
CYL TEMP MAX	380.0000	385.0000	395.0000	410.0000	420.0000
MAN PRES.HGA	34.2	34.2	34.3	34.5	34.7
EXH GAS TEMP	1258.0	1261.0	1284.0	1317.0	1280.0
CO LBS/MODE	6.3578	8.0616	9.2702	8.9292	7.7963
HC LBS/MODE	0.0946	0.1118	0.1191	0.1185	0.1119
NO LBS/MODE	0.0303	0.0174	0.0132	0.0127	0.0178

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TABLE A-8. LEAN-OUT AT TAKEOFF - 25-HOUR TEST

MODE NUMBER	3.0	3.0	3.0
RATED POWER	200.0	200.0	200.0
REV PER MIN	2500.0	2500.0	2500.0
RUN NUMBER	33.0	34.0	35.0
BAROMET PRES	30.02	30.02	30.02
DRY AIR TEMP	84.0	84.0	84.0
WET BULB TEM	78.0	78.0	78.0
IND AIR TEMP	0.0	0.0	0.0
SPEC.HUMID.,	0.0194	0.0194	0.0194
VAPOR PRESS.	0.9231	0.9231	0.9231
HC CONC-PPM	1935.0	1892.0	1575.0
NOX CONC-PPM	72.0	98.0	149.0
CO CONC-PERC	11.3	10.3	8.7
CO2 CON-PERC	7.3	7.8	8.9
O2 CONC-PERC	0.2	0.2	0.2
MOLS OUT DRY	52.6	51.3	50.4
MOLS OUT WET	59.7	58.7	57.7
SHAFT TORQUE	Not Measured		
HORSEPOWER	Not Measured		
ENG AIR FLOW	1479.0	1462.0	1459.0
DRY AIR FLOW	1456.1	1439.3	1436.4
ENG FUEL FLO	134.0	131.0	125.0
DRY AIR DENS	0.0709	0.0709	0.0709
WET AIR DENS	0.0731	0.0731	0.0731
EXH CARBON	117.4133	111.5402	106.4258
EXH HYDROGEN	20.1928	19.9992	19.0669
EXH FUEL FLO	137.6061	131.5394	125.4928
DIFF WFC-WFM	3.6061	0.5394	0.4928
MEAS F/A RAT	0.0920	0.0910	0.0870
CAL F/A RAT	0.0972	0.0930	0.0880
DIFF M-C F/A	5.6288	2.2310	1.0724
CYL TEMP MAX	420.0000	435.0000	460.0000
MAN PRES.HGA	40.0	40.0	40.0
EXH GAS TEMP	1267.0	1291.0	1328.0
CO LBS/MODE	0.8305	0.7369	0.6152
HC LBS/MODE	0.0093	0.0089	0.0073
NO LBS/MODE	0.0006	0.0009	0.0013

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TABLE A-9. FIVE-MODE CYCLE - 25-HOUR TEST

MODE NUMBER	2.0	3.0	4.0	5.0	6.0
RATED POWER	200.0	200.0	200.0	200.0	200.0
REV PER MIN	1200.0	2500.0	2450.0	1900.0	1200.0
RUN NUMBER	36.0	37.0	38.0	39.0	40.0
BAROMET PRES	30.02	30.02	30.02	30.02	30.02
DRY AIR TEMP	84.0	84.0	84.0	84.0	84.0
WET BULB TEM	78.0	78.0	78.0	78.0	78.0
IND AIR TEMP	0.0	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0194	0.0194	0.0194	0.0194	0.0194
VAPOR PRESS.	0.9231	0.9231	0.9231	0.9231	0.9231
HC CONC-PPM	11062.0	1809.0	1927.0	2105.0	11192.0
NOX CONC-PPM	68.0	88.0	123.0	235.0	68.0
CO CONC-PERC	7.2	10.8	9.8	8.1	7.2
CO2 CON-PERC	9.7	7.9	8.7	9.8	9.8
O2 CONC-PERC	0.4	0.2	0.2	0.2	0.5
MOLS OUT DRY	6.9	53.6	39.3	16.8	6.7
MOLS OUT WET	8.0	60.5	44.4	18.9	7.7
SHAFT TORQUE	Not Measured				
HORSEPOWER	Not Measured				
ENG AIR FLOW	204.0	1509.0	1117.0	485.0	197.0
DRY AIR FLOW	200.8	1485.6	1099.7	477.5	193.9
ENG FUEL FLO	17.5	137.0	101.5	41.0	17.0
DRY AIR DENS	0.0709	0.0709	0.0709	0.0709	0.0709
WET AIR DENS	0.0731	0.0731	0.0731	0.0731	0.0731
EXH CARBON	14.1295	120.7314	87.4624	36.0195	13.6495
EXH HYDROGEN	2.4793	19.5776	14.0401	5.6923	2.3673
EXH FUEL FLO	16.6088	140.3090	101.5025	41.7119	16.0168
DIFF WFC-WFM	-0.8912	3.3090	0.0025	0.7119	-0.9832
MEAS F/A RAT	0.0871	0.0922	0.0923	0.0859	0.0877
CAL F/A RAT	0.0887	0.0957	0.0922	0.0876	0.0883
DIFF M-C F/A	1.7578	3.7639	-0.1443	1.9950	0.7651
CYL TEMP MAX	275.0000	440.0000	440.0000	350.0000	280.0000
MAN PRES.HGA	17.8	40.0	34.5	23.6	17.8
EXH GAS TEMP	790.0	1269.0	1261.0	1102.0	806.0
CO LBS/MODE	2.8150	0.8128	8.9761	3.8059	0.9007
CO LBS/CYC-RHP	0.0866				
PERCENT OF EPA STD FOR CO	206.0774				
HC LBS/MODE	0.2879	0.0088	0.1144	0.0639	0.0938
HC LBS/CYC-RHP	0.0028				
PERCENT OF EPA STD FOR HC	149.6924				
NO LBS/MODE	0.0033	0.0008	0.0137	0.0133	0.0011
NO LBS/CYC-RHP	0.0002				
PERCENT OF EPA STD FOR NO	10.7272				

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TABLE A-10. LEAN-OUT AT TAXI - 25-HOUR TEST

MODE NUMBER	2.0	2.0	2.0	2.0
RATED POWER	200.0	200.0	200.0	200.0
REV PER MIN	1200.0	1220.0	1200.0	1200.0
RUN NUMBER	41.0	42.0	43.0	44.0
BAROMET PRES	30.02	30.02	30.02	30.02
DRY AIR TEMP	84.0	84.0	84.0	84.0
WET BULB TEM	78.0	78.0	78.0	78.0
IND AIR TEMP	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0194	0.0194	0.0194	0.0194
VAPOR PRESS.	0.9231	0.9231	0.9231	0.9231
HC CONC-PPM	24213.0	8859.1	6090.0	6776.0
NOX CONC-PPM	43.0	77.0	56.0	60.0
CO CONC-PERC	8.7	7.8	6.2	5.8
CO2 CON-PERC	7.7	9.4	10.2	10.8
O2 CONC-PERC	2.4	0.3	0.5	0.6
MOLS OUT DRY	7.3	7.0	6.8	6.8
MOLS OUT WET	8.3	8.1	7.9	7.8
SHAFT TORQUE	Not Measured			
HORSEPOWER	Not Measured			
ENG AIR FLOW	209.0	206.0	202.0	201.0
DRY AIR FLOW	205.8	202.8	198.9	197.9
ENG FUEL FLO	19.0	17.5	17.0	16.5
DRY AIR DENS	0.0709	0.0709	0.0709	0.0709
WET AIR DENS	0.0731	0.0731	0.0731	0.0731
EXH CARBON	14.4247	14.5091	13.3415	13.4185
EXH HYDROGEN	2.2727	2.5508	2.5208	2.3371
EXH FUEL FLO	16.6975	17.0600	15.8623	15.7556
DIFF WFC-WFM	-2.3025	-0.4400	-1.1377	-0.7444
MEAS F/A RAT	0.0923	0.0863	0.0855	0.0834
CAL F/A RAT	0.0955	0.0893	0.0816	0.0806
DIFF M-C F/A	3.3810	3.4404	-4.5324	-3.3253
CYL TEMP MAX	270.0000	275.0000	280.0000	285.0000
MAN PRES,HGA	18.5	17.5	17.5	17.5
EXH GAS TEMP	740.0	771.0	792.0	786.0
CO LBS/MODE	3.5752	3.0564	2.3492	2.1909
HC LBS/MODE	0.6656	0.2326	0.1549	0.1195
NO LBS/MODE	0.0022	0.0038	0.0027	0.0028

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TABLE A-11. LEAN-OUT AT APPROACH - 50-HOUR TEST

MODE NUMBER	5.0	5.0	5.0	5.0
RATED POWER	200.0	200.0	200.0	200.0
REV PER MIN	1900.0	1925.0	1900.0	1875.0
RUN NUMBER	46.0	47.0	48.0	49.0
BAROMET PRES	30.01	30.01	30.01	30.01
DRY AIR TEMP	73.0	73.0	73.0	73.0
WET BULB TEM	62.0	62.0	62.0	62.0
IND AIR TEMP	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0095	0.0095	0.0095	0.0095
VAPOR PRESS.	0.4546	0.4546	0.4546	0.4546
HC CONC-PPM	1839.0	1497.0	1050.0	502.0
NOX CONC-PPM	273.0	631.0	1043.0	1398.0
CO CONC-PERC	7.3	4.6	2.8	1.1
CO2 CON-PERC	9.7	11.1	12.6	13.4
O2 CONC-PERC	0.4	0.4	0.5	1.0
MOLS OUT DRY	17.8	17.1	16.9	16.5
MOLS OUT WET	20.5	19.9	19.4	18.8
SHAFT TORQUE	Not Measured			
HORSEPOWER	Not Measured			
ENG AIR FLOW	520.0	515.0	515.0	511.0
DRY AIR FLOW	516.0	511.1	511.1	507.1
ENG FUEL FLO	43.5	39.5	36.9	33.1
DRY AIR DENS	0.0735	0.0735	0.0735	0.0735
WET AIR DENS	0.0746	0.0746	0.0746	0.0746
EXH CARBON	36.4784	32.0893	31.1394	28.7473
EXH HYDROGEN	6.5308	6.3234	5.4748	4.8568
EXH FUEL FLO	43.0092	38.4127	36.6142	33.6041
DIFF WFC-WFM	-0.4908	-1.0873	-0.2558	0.4791
MEAS F/A RAT	0.0843	0.0773	0.0721	0.0653
CAL F/A RAT	0.0834	0.0750	0.0717	0.0669
DIFF M-C F/A	-1.0986	-2.9536	-0.6060	2.3524
CYL TEMP MAX	295.0000	300.0000	300.0000	310.0000
MAN PRES.HGA	23.5	23.5	23.7	24.0
EXH GAS TEMP	1093.0	1143.0	1176.0	1203.0
CO LBS/MODE	3.6488	2.1915	1.3135	0.5036
HC LBS/MODE	0.0604	0.0477	0.0326	0.0151
NO LBS/MODE	0.0168	0.0376	0.0605	0.0788

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TABLE A-12. LEAN-OUT AT CLIMB - 50-HOUR TEST

MODE NUMBER	4.0	4.0	4.0	4.0
RATED POWER	200.0	200.0	200.0	200.0
REV PER MIN	2450.0	2475.0	2475.0	2425.0
RUN NUMBER	50.0	51.0	52.0	53.0
BAROMET PRES	30.01	30.01	30.01	30.01
DRY AIR TEMP	73.0	73.0	73.0	73.0
WET BULB TEM	62.0	62.0	62.0	62.0
IND AIR TEMP	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0095	0.0095	0.0095	0.0095
VAPOR PRESS.	0.4546	0.4546	0.4546	0.4546
HC CONC-PPM	1933.0	1919.0	1602.0	1239.0
NOX CONC-PPM	84.0	86.0	173.0	348.0
CO CONC-PERC	10.2	10.1	7.9	5.9
CO2 CON-PERC	7.9	7.7	9.2	10.2
O2 CONC-PERC	0.3	0.2	0.2	0.0
MOLS OUT DRY	39.7	39.3	38.4	37.0
MOLS OUT WET	45.2	45.0	44.0	43.0
SHAFT TORQUE	Not Measured			
HORSEPOWER	Not Measured			
ENG AIR FLOW	1120.0	1115.0	1115.0	1104.0
DRY AIR FLOW	1111.5	1106.5	1106.5	1095.6
ENG FUEL FLO	100.5	98.0	91.0	85.0
DRY AIR DENS	0.0735	0.0735	0.0735	0.0735
WET AIR DENS	0.0746	0.0746	0.0746	0.0746
EXH CARBON	86.3942	84.1478	78.7801	71.8186
EXH HYDROGEN	15.1521	15.4327	14.3295	14.2676
EXH FUEL FLO	101.5463	99.5806	93.1096	86.0862
DIFF WFC-WFM	1.0463	1.5806	2.1096	1.0862
MEAS F/A RAT	0.0904	0.0886	0.0822	0.0776
CAL F/A RAT	0.0930	0.0923	0.0852	0.0793
DIFF M-C F/A	2.8331	4.2661	3.6510	2.1884
CYL TEMP MAX	390.0000	400.0000	420.0000	435.0000
MAN PRES.HGA	34.2	34.8	34.5	34.2
EXH GAS TEMP	1249.0000	1420.0	1465.0	1520.0
CO LBS/MODE	9.4884	9.2597	7.0505	5.1131
HC LBS/MODE	0.1169	0.1156	0.0943	0.0713
NO LBS/MODE	0.0095	0.0097	0.0190	0.0374

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TABLE A-13. LEAN-OUT AT TAKEOFF - 50-HOUR TEST

MODE NUMBER	3.0	3.0	3.0
RATED POWER	200.0	200.0	200.0
REV PER MIN	2500.0	2500.0	2500.0
RUN NUMBER	54.0	55.0	56.0
BAROMET PRES	30.01	30.01	30.01
DRY AIR TEMP	73.0	73.0	73.0
WET BULB TEM	62.0	62.0	62.0
IND AIR TEMP	0.0	0.0	0.0
SPEC.HUMID.,	0.0095	0.0095	0.0095
VAPOR PRESS.	0.4546	0.4546	0.4546
HC CONC-PPM	1864.0	1562.0	1396.0
NOX CONC-PPM	55.0	94.0	149.0
CO CONC-PERC	11.1	9.3	7.8
CO2 CON-PERC	7.2	8.4	9.1
O2 CONC-PERC	0.2	0.1	0.1
MOLS OUT DRY	53.2	52.1	50.1
MOLS OUT WET	60.7	59.6	58.1
SHAFT TORQUE	Not Measured		
HORSEPOWER	Not Measured		
ENG AIR FLOW	1490.0	1488.0	1462.0
DRY AIR FLOW	1478.7	1476.7	1450.9
ENG FUEL FLO	136.0	129.0	122.0
DRY AIR DENS	0.0735	0.0735	0.0735
WET AIR DENS	0.0746	0.0746	0.0746
EXH CARBON	116.9086	111.0002	101.6248
EXH HYDROGEN	21.0738	20.0654	19.9604
EXH FUEL FLO	137.9825	131.0656	121.3851
DIFF WFC-WFM	1.9825	2.0656	-0.6149
MEAS F/A RAT	0.0920	0.0874	0.0841
CAL F/A RAT	0.0961	0.0901	0.0844
DIFF M-C F/A	4.5008	3.1320	0.3168
CYL TEMP MAX	440.0000	450.0000	455.0000
MAN PRES.HGA	40.0	40.0	40.0
EXH GAS TEMP	1267.0	1309.0	1351.0
CO LBS/MODE	0.8261	0.6811	0.5447
HC LBS/MODE	0.0091	0.0075	0.0065
NO LBS/MODE	0.0005	0.0008	0.0013

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TABLE A-14. LEAN-OUT AT TAXI - 50-HOUR TEST

MODE NUMBER	2.0	2.0	2.0	2.0
RATED POWER	200.0	200.0	200.0	200.0
REV PER MIN	1200.0	1225.0	1175.0	1150.0
RUN NUMBER	58.0	59.0	60.0	61.0
BAROMET PRES	30.01	30.01	30.01	30.01
DRY AIR TEMP	73.0	73.0	73.0	73.0
WET BULB TEM	62.0	62.0	62.0	62.0
IND AIR TEMP	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0095	0.0095	0.0095	0.0095
VAPOR PRESS.	0.4546	0.4546	0.4546	0.4546
HC CONC-PPM	15629.0	4146.0	5413.0	27227.0
NOX CONC-PPM	54.0	74.0	86.0	35.0
CO CONC-PERC	7.9	5.7	3.2	8.0
CO2 CON-PERC	8.5	10.4	10.2	6.9
O2 CONC-PERC	0.9	0.4	2.6	2.9
MOLS OUT DRY	6.6	6.5	6.3	6.9
MOLS OUT WET	7.7	7.5	7.3	8.1
SHAFT TORQUE	Not Measured			
HORSEPOWER	Not Measured			
ENG AIR FLOW	192.0	193.0	191.0	200.0
DRY AIR FLOW	190.5	191.5	189.5	198.5
ENG FUEL FLO	17.0	15.0	12.8	17.9
DRY AIR DENS	0.0735	0.0735	0.0735	0.0735
WET AIR DENS	0.0746	0.0746	0.0746	0.0746
EXH CARBON	12.9930	12.5043	10.0976	12.3496
EXH HYDROGEN	2.4967	2.3755	2.1043	2.4669
EXH FUEL FLO	15.4897	14.8799	12.2019	14.8165
DIFF WFC-WFM	-1.5103	-0.1201	-0.5981	-3.0835
MEAS F/A RAT	0.0892	0.0783	0.0675	0.0902
CAL F/A RAT	0.0911	0.0798	0.0669	0.0929
DIFF M-C F/A	2.0953	1.8341	-0.8669	3.0124
CYL TEMP MAX	280.0000	285.0000	295.0000	280.0000
MAN PRES,HGA	17.8	17.0	18.0	18.1
EXH GAS TEMP	770.0	777.0	777.0	722.0
CO LBS/MODE	2.9080	2.0736	1.1291	3.0915
HC LBS/MODE	0.3939	0.1003	0.1270	0.7308
NO LBS/MODE	0.0025	0.0033	0.0038	0.0018

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TABLE A-15. FIVE-MODE CYCLE - 50-HOUR TEST

MODE NUMBER	2.0	3.0	4.0	5.0	6.0
RATED POWER	200.0	200.0	200.0	200.0	200.0
REV PER MIN	1200.0	2525.0	2450.0	1900.0	1200.0
RUN NUMBER	62.0	63.0	64.0	65.0	66.0
BAROMET PRES	30.01	30.01	30.01	30.01	30.01
DRY AIR TEMP	73.0	73.0	73.0	73.0	73.0
WET BULB TEM	62.0	62.0	62.0	62.0	62.0
IND AIR TEMP	0.0	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0095	0.0095	0.0095	0.0095	0.0095
VAPOR PRESS.	0.4546	0.4546	0.4546	0.4546	0.4546
HC CONC-PPM	13648.0	1880.0	2001.0	2124.0	12172.0
NOX CONC-PPM	45.0	68.0	90.0	175.0	55.0
CO CONC-PERC	8.4	10.8	10.1	8.5	8.3
CO2 CON-PERC	7.9	7.6	7.9	8.7	8.5
O2 CONC-PERC	1.4	0.2	0.2	0.2	0.9
MOLS OUT DRY	6.8	53.4	39.2	17.9	6.8
MOLS OUT WET	7.9	60.7	44.8	20.7	7.9
SHAFT TORQUE	Not Measured				
HORSEPOWER	Not Measured				
ENG AIR FLOW	195.0	1496.0	1110.0	518.0	196.0
DRY AIR FLOW	193.5	1484.6	1101.6	514.1	194.5
ENG FUEL FLO	17.7	136.0	99.0	44.0	17.8
DRY AIR DENS	0.0735	0.0735	0.0735	0.0735	0.0735
WET AIR DENS	0.0746	0.0746	0.0746	0.0746	0.0746
EXH CARBON	13.3188	118.1625	85.1265	36.9376	13.7196
EXH HYDROGEN	2.5460	20.4484	15.1266	7.0012	2.5489
EXH FUEL FLO	15.8648	138.6109	100.2531	43.9388	16.2686
DIFF WFC-WFM	-1.8352	2.6109	1.2531	-0.0612	-1.4814
MEAS F/A RAT	0.0915	0.0916	0.0899	0.0856	0.0913
CAL F/A RAT	0.0898	0.0955	0.0929	0.0868	0.0904
DIFF M-C F/A	-1.8213	4.2007	3.3394	1.4527	-0.9576
CYL TEMP MAX	280.0000	390.0000	400.0000	360.0000	300.0000
MAN PRES.HGA	17.7	40.0	33.7	24.0	17.9
EXH GAS TEMP	780.0	1250.0	1250.0	1130.0	829.0
CO LBS/MODE	3.2010	0.8097	9.2887	4.2394	1.0564
CO LBS/CYC-RHP	0.0930				
PERCENT OF EPA STD FOR CO		221.3703			
HC LBS/MODE	0.3501	0.0092	0.1199	0.0704	0.1040
HC LBS/CYC-RHP	0.0033				
PERCENT OF EPA STD FOR HC		171.9942			
NO LBS/MODE	0.0022	0.0006	0.0101	0.0109	0.0009
NO LBS/CYC-RHP	0.0001				
PERCENT OF EPA STD FOR NO		8.1974			

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TABLE A-16. FIVE-MODE CYCLE - 50-HOUR TEST

MODE NUMBER	2.0	3.0	4.0	5.0	6.0
RATED POWER	200.0	200.0	200.0	200.0	200.0
REV PER MIN	1200.0	2520.0	2450.0	1900.0	1200.0
RUN NUMBER	67.0	68.0	69.0	70.0	71.0
BAROMET PRES	30.01	30.01	30.01	30.01	30.01
DRY AIR TEMP	73.0	73.0	73.0	73.0	73.0
WET BULB TEM	62.0	62.0	62.0	62.0	62.0
IND AIR TEMP	0.0	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0095	0.0095	0.0095	0.0095	0.0095
VAPOR PRESS.	0.4546	0.4546	0.4546	0.4546	0.4546
HC CONC-PPM	13798.0	1898.0	1982.0	1965.0	13110.0
NOX CONC-PPM	46.0	65.0	92.0	186.0	44.0
CO CONC-PERC	8.3	10.9	10.1	8.2	8.4
CO2 CON-PERC	7.7	7.5	7.8	9.0	7.6
O2 CONC-PERC	1.8	0.2	0.2	0.2	1.8
MOLS OUT DRY	6.9	53.6	38.0	17.5	6.9
MOLS OUT WET	8.0	61.0	43.6	20.1	8.0
SHAFT TORQUE	Not Measured				
HORSEPOWER	Not Measured				
ENG AIR FLOW	199.0	1501.0	1077.0	506.0	198.0
DRY AIR FLOW	197.5	1489.6	1068.8	502.2	196.5
ENG FUEL FLO	18.0	137.0	97.0	42.0	17.9
DRY AIR DENS	0.0735	0.0735	0.0735	0.0735	0.0735
WET AIR DENS	0.0746	0.0746	0.0746	0.0746	0.0746
EXH CARBON	13.3492	118.3972	81.7387	36.2351	13.2042
EXH HYDROGEN	2.5879	20.7908	15.0927	6.5664	2.6247
EXH FUEL FLO	15.9371	139.1880	96.8314	42.8015	15.8288
DIFF WFC-WFM	-2.0629	2.1880	-0.1686	0.8015	-2.0712
MEAS F/A RAT	0.0911	0.0920	0.0908	0.0836	0.0911
CAL F/A RAT	0.0885	0.0957	0.0924	0.0866	0.0880
DIFF M-C F/A	-2.9491	4.0887	1.8594	3.5338	-3.3662
CYL TEMP MAX	280.0000	410.0000	390.0000	360.0000	275.0000
MAN PRES.HGA	18.0	40.0	33.2	23.3	17.0
EXH GAS TEMP	764.0	1266.0	1249.0	1109.0	772.0
CO LBS/MODE	3.2275	0.8201	8.9760	4.0317	1.0746
CO LBS/CYC-RHP	0.0906				
PERCENT OF EPA STD FOR CO		215.8315			
HC LBS/MODE	0.3610	0.0093	0.1156	0.0632	0.1139
HC LBS/CYC-RHP	0.0033				
PERCENT OF EPA STD FOR HC		174.4757			
NO LBS/MODE	0.0023	0.0006	0.0100	0.0112	0.0007
NO LBS/CYC-RHP	0.0001				
PERCENT OF EPA STD FOR NO		8.2627			

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TABLE A-17. LEAN-OUT AT APPROACH - (POSTOVERHAUL)

MODE NUMBER	5.0	5.0	5.0	5.0
RATED POWER	200.0	200.0	200.0	200.0
REV PER MIN	1900.0	1900.0	1875.0	1740.0
RUN NUMBER	72.0	73.0	74.0	75.0
BAROMET PRES	30.01	30.01	30.01	30.01
DRY AIR TEMP	65.0	65.0	65.0	65.0
WET BULB TEM	62.5	62.5	62.5	62.5
IND AIR TEMP	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0117	0.0117	0.0117	0.0117
VAPOR PRESS.	0.5577	0.5577	0.5577	0.5577
HC CONC-PPM	1575.0	934.0	502.0	1537.0
NOX CONC-PPM	579.0	849.0	970.0	982.0
CO CONC-PERC	4.1	2.0	0.7	0.2
CO2 CON-PERC	10.7	11.6	11.6	11.8
O2 CONC-PERC	0.5	0.9	1.7	2.8
MOLS OUT DRY	18.3	17.9	17.3	17.3
MOLS OUT WET	21.6	21.2	20.5	20.1
SHAFT TORQUE	Not Measured			
HORSEPOWER	Not Measured			
ENG AIR FLOW	560.0	560.0	548.0	546.0
DRY AIR FLOW	554.8	554.8	542.9	540.9
ENG FUEL FLO	41.0	37.0	32.5	31.5
DRY AIR DENS	0.0743	0.0743	0.0743	0.0743
WET AIR DENS	0.0758	0.0758	0.0758	0.0758
EXH CARBON	32.7044	29.1764	25.5356	25.0638
EXH HYDROGEN	7.1992	6.9193	6.4386	5.5680
EXH FUEL FLO	39.9037	36.0957	31.9741	30.6318
DIFF WFC-WFM	-1.0963	-0.9043	-0.5259	-0.8682
MEAS F/A RAT	0.0739	0.0667	0.0599	0.0582
CAL F/A RAT	0.0723	0.0653	0.0591	0.0574
DIFF M-C F/A	-2.2037	-2.1593	-1.2717	-1.4160
CYL TEMP MAX	320.0000	315.0000	320.0000	320.0000
MAN PRES.HGA	23.9	24.0	24.5	25.1
EXH GAS TEMP	1174.0	1202.0	1226.0	1192.0
CO LBS/MODE	2.1109	1.0028	0.3343	0.1118
HC LBS/MODE	0.0545	0.0317	0.0164	0.0496
NO LBS/MODE	0.0374	0.0539	0.0594	0.0592

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TABLE A-18. LEAN-OUT AT CLIMB - (POSTOVERHAUL)

MODE NUMBER	4.0	4.0	4.0	4.0
RATED POWER	200.0	200.0	200.0	200.0
REV PER MIN	2450.0	2450.0	2450.0	2450.0
RUN NUMBER	76.0	77.0	78.0	79.0
BAROMET PRES	30.01	30.01	30.01	30.01
DRY AIR TEMP	65.0	65.0	65.0	65.0
WET BULB TEM	62.5	62.5	62.5	62.5
IND AIR TEMP	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0117	0.0117	0.0117	0.0117
VAPOR PRESS.	0.5577	0.5577	0.5577	0.5577
HC CONC-PPM	1460.0	1350.0	1207.0	1133.0
NOX CONC-PPM	124.0	193.0	368.0	588.0
CO CONC-PERC	8.0	6.8	5.1	4.0
CO2 CON-PERC	8.3	9.3	10.1	10.4
O2 CONC-PERC	0.2	0.2	0.2	0.2
MOLS OUT DRY	38.7	38.2	37.2	36.7
MOLS OUT WET	45.4	44.8	44.1	43.8
SHAFT TORQUE	Not Measured			
HORSEPOWER	Not Measured			
ENG AIR FLOW	1136.0	1136.0	1131.0	1131.0
DRY AIR FLOW	1125.4	1125.4	1120.4	1120.4
ENG FUEL FLO	94.0	90.5	85.5	82.0
DRY AIR DENS	0.0743	0.0743	0.0743	0.0743
WET AIR DENS	0.0758	0.0758	0.0758	0.0758
EXH CARBON	76.0872	73.6966	67.8521	63.4111
EXH HYDROGEN	16.5862	15.7877	15.5798	15.7982
EXH FUEL FLO	92.6734	89.4843	83.4319	79.2092
DIFF WFC-WFM	-1.3266	-1.0157	-2.0681	-2.7908
MEAS F/A RAT	0.0835	0.0804	0.0763	0.0732
CAL F/A RAT	0.0840	0.0803	0.0748	0.0710
DIFF M-C F/A	0.5466	-0.0895	-1.9603	-3.0114
CYL TEMP MAX	405.0000	430.0000	450.0000	460.0000
MAN PRES.HGA	34.1	34.5	34.8	35.0
EXH GAS TEMP	1285.0	1315.0	1355.0	1380.0
CO LBS/MODE	7.2625	6.0502	4.3897	3.3975
HC LBS/MODE	0.0886	0.0809	0.0711	0.0664
NO LBS/MODE	0.0141	0.0216	0.0405	0.0644

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TABLE A-19. LEAN-OUT AT TAKEOFF - (POSTOVERHAUL)

MODE NUMBER	3.0	3.0	3.0
RATED POWER	200.0	200.0	200.0
REV PER MIN	2500.0	2500.0	2480.0
RUN NUMBER	80.0	81.0	82.0
BAROMET PRES	30.01	30.01	30.01
DRY AIR TEMP	65.0	65.0	65.0
WET BULB TEM	62.5	62.5	62.5
IND AIR TEMP	0.0	0.0	0.0
SPEC.HUMID.,	0.0117	0.0117	0.0117
VAPOR PRESS.	0.5577	0.5577	0.5577
HC CONC-PPM	1398.0	1371.0	1323.0
NOX CONC-PPM	121.0	137.0	170.0
CO CONC-PERC	8.4	7.9	7.4
CO2 CON-PERC	8.3	8.4	8.5
O2 CONC-PERC	0.1	0.1	0.1
MOLS OUT DRY	52.6	52.3	51.7
MOLS OUT WET	61.4	61.3	61.1
SHAFT TORQUE	Not Measured		
HORSEPOWER	Not Measured		
ENG AIR FLOW	1535.0	1536.0	1534.0
DRY AIR FLOW	1520.7	1521.7	1519.7
ENG FUEL FLO	128.0	126.0	124.0
DRY AIR DENS	0.0743	0.0743	0.0743
WET AIR DENS	0.0758	0.0758	0.0758
EXH CARBON	105.2777	102.7607	98.8467
EXH HYDROGEN	22.1994	22.2802	22.7482
EXH FUEL FLO	127.4771	125.0409	121.5950
DIFF WFC-WFM	-0.5229	-0.9591	-2.4050
MEAS F/A RAT	0.0842	0.0828	0.0816
CAL F/A RAT	0.0856	0.0838	0.0815
DIFF M-C F/A	1.7017	1.2190	-0.1210
CYL TEMP MAX	440.0000	450.0000	460.0000
MAN PRES.HGA	40.0	40.0	40.0
EXH GAS TEMP	1500.0	1510.0	1530.0
CO LBS/MODE	0.6193	0.5812	0.5336
HC LBS/MODE	0.0069	0.0067	0.0065
NO LBS/MODE	0.0011	0.0013	0.0016

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TABLE A-20. LEAN-OUT AT TAXI - (POSTOVERHAUL)

MODE NUMBER	2.0	2.0	2.0	2.0
RATED POWER	200.0	200.0	200.0	200.0
REV PER MIN	1220.0	1250.0	1225.0	1150.0
RUN NUMBER	84.0	85.0	86.0	87.0
BAROMET PRES	30.01	30.01	30.01	30.01
DRY AIR TEMP	65.0	65.0	65.0	65.0
WET BULB TEM	62.5	62.5	62.5	62.5
IND AIR TEMP	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0117	0.0117	0.0117	0.0117
VAPOR PRESS.	0.5577	0.5577	0.5577	0.5577
HC CONC-PPM	10580.0	6120.0	2299.0	8256.0
NOX CONC-PPM	93.0	110.0	105.0	89.0
CO CONC-PERC	7.0	5.9	3.6	2.4
CO2 CON-PERC	8.7	9.0	10.2	9.0
O2 CONC-PERC	0.6	0.4	1.0	4.1
MOLS OUT DRY	7.1	7.0	6.7	6.9
MOLS OUT WET	8.4	8.3	8.0	8.1
SHAFT TORQUE	Not Measured			
HORSEPOWER	Not Measured			
ENG AIR FLOW	210.0	210.0	208.0	213.0
DRY AIR FLOW	208.0	208.0	206.1	211.0
ENG FUEL FLO	17.9	16.9	14.8	13.1
DRY AIR DENS	0.0743	0.0743	0.0743	0.0743
WET AIR DENS	0.0758	0.0758	0.0758	0.0758
EXH CARBON	13.3017	12.4574	11.2125	9.4371
EXH HYDROGEN	2.9770	3.0897	2.7884	2.3860
EXH FUEL FLO	16.2787	15.5471	14.0009	11.8231
DIFF WFC-WFM	-1.6213	-1.3529	-0.7991	-1.2769
MEAS F/A RAT	0.0860	0.0812	0.0718	0.0621
CAL F/A RAT	0.0848	0.0783	0.0685	0.0605
DIFF M-C F/A	-1.4283	-3.6659	-4.6068	-2.5894
CYL TEMP MAX	260.0000	280.0000	290.0000	300.0000
MAN PRES.HGA	17.0	16.9	17.5	18.5
EXH GAS TEMP	790.0	797.0	813.0	780.0
CO LBS/MODE	2.7631	2.2860	1.3689	0.9214
HC LBS/MODE	0.2883	0.1646	0.0593	0.2160
NO LBS/MODE	0.0047	0.0055	0.0051	0.0044

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TABLE A-21. FIVE-MODE CYCLE - (POSTOVERHAUL)

MODE NUMBER	2.0	3.0	4.0	5.0	6.0
RATED POWER	200.0	200.0	200.0	200.0	200.0
REV PER MIN	1200.0	2500.0	2450.0	1900.0	1200.0
RUN NUMBER	88.0	89.0	90.0	91.0	92.0
BAROMET PRES	30.01	30.01	30.01	30.01	30.01
DRY AIR TEMP	65.0	65.0	65.0	65.0	65.0
WET BULB TEM	62.5	62.5	62.5	62.5	62.5
IND AIR TEMP	0.0	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0117	0.0117	0.0117	0.0117	0.0117
VAPOR PRESS.	0.5577	0.5577	0.5577	0.5577	0.5577
HC CONC-PPM	10540.0	1446.0	1594.0	1660.0	9470.0
NOX CONC-PPM	77.0	102.0	132.0	507.0	91.0
CO CONC-PERC	6.9	8.2	8.0	4.7	6.7
CO2 CON-PERC	8.1	7.8	7.9	9.6	8.7
O2 CONC-PERC	0.7	0.1	0.2	0.3	0.5
MOLS OUT DRY	7.0	52.2	38.4	17.8	7.0
MOLS OUT WET	8.5	62.1	45.7	21.4	8.4
SHAFT TORQUE	Not Measured				
HORSEPOWER	Not Measured				
ENG AIR FLOW	210.0	1540.0	1135.0	546.0	210.0
DRY AIR FLOW	208.0	1525.6	1124.4	540.9	208.0
ENG FUEL FLO	17.9	130.0	94.5	40.5	17.9
DRY AIR DENS	0.0743	0.0743	0.0743	0.0743	0.0743
WET AIR DENS	0.0758	0.0758	0.0758	0.0758	0.0758
EXH CARBON	12.6631	100.3995	73.1673	30.6362	13.0367
EXH HYDROGEN	3.1823	24.1584	17.6741	8.0001	3.0728
EXH FUEL FLO	15.8453	124.5579	90.8414	38.6363	16.1095
DIFF WFC-WFM	-2.0547	-5.4421	-3.6586	-1.8637	-1.7905
MEAS F/A RAT	0.0860	0.0852	0.0840	0.0749	0.0860
CAL F/A RAT	0.0832	0.0836	0.0829	0.0722	0.0831
DIFF M-C F/A	-3.3293	-1.8418	-1.3558	-3.5152	-3.3894
CYL TEMP MAX	280.0000	440.0000	450.0000	400.0000	300.0000
MAN PRES.HGA	17.4	40.0	35.0	23.8	17.2
EXH GAS TEMP	791.0	1308.0	1285.0	1147.0	847.0
CO LBS/MODE	2.7169	0.6000	7.1636	2.3417	0.8859
CO LBS/CYC-RHP	0.0685				
PERCENT OF EPA STD FOR CO	163.1918				
HC LBS/MODE	0.2892	0.0072	0.0974	0.0569	0.0860
HC LBS/CYC-RHP	0.0027				
PERCENT OF EPA STD FOR HC	141.2324				
NO LBS/MODE	0.0040	0.0010	0.0151	0.0325	0.0015
NO LBS/CYC-RHP	0.0003				
PERCENT OF EPA STD FOR NO	18.0065				

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TABLE A-22. FIVE-MODE CYCLE - (POSTOVERHAUL)

MODE NUMBER	2.0	3.0	4.0	5.0	6.0
RATED POWER	200.0	200.0	200.0	200.0	200.0
REV PER MIN	1200.0	2500.0	2450.0	1900.0	1225.0
RUN NUMBER	93.0	94.0	95.0	96.0	97.0
BAROMET PRES	30.01	30.01	30.01	30.01	30.01
DRY AIR TEMP	65.0	65.0	65.0	65.0	65.0
WET BULB TEM	62.5	62.5	62.5	62.5	62.5
IND AIR TEMP	0.0	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0117	0.0117	0.0117	0.0117	0.0117
VAPOR PRESS.	0.5577	0.5577	0.5577	0.5577	0.5577
HC CONC-PPM	10525.0	1400.0	1521.0	1648.0	9525.0
NOX CONC-PPM	91.0	104.0	127.0	489.0	91.0
CO CONC-PERC	6.6	8.3	8.1	4.9	6.8
CO2 CON-PERC	8.6	8.0	8.1	10.3	9.0
O2 CONC-PERC	0.5	0.2	0.2	0.3	0.6
MOLS OUT DRY	7.0	52.5	38.6	18.1	7.1
MOLS OUT WET	8.4	62.0	45.6	21.3	8.4
SHAFT TORQUE	Not Measured				
HORSEPOWER	Not Measured				
ENG AIR FLOW	210.0	1542.0	1135.0	549.0	210.0
DRY AIR FLOW	208.0	1527.6	1124.4	543.9	208.0
ENG FUEL FLO	17.8	129.0	95.0	41.0	17.9
DRY AIR DENS	0.0743	0.0743	0.0743	0.0743	0.0743
WET AIR DENS	0.0758	0.0758	0.0758	0.0758	0.0758
EXH CARBON	12.8160	102.3420	75.3928	33.1402	13.4280
EXH HYDROGEN	3.0902	23.4238	17.0651	7.2648	2.9254
EXH FUEL FLO	15.9062	125.7659	92.4579	40.4049	16.3534
DIFF WFC-WFM	-1.8938	-3.2341	-2.5421	-0.5951	-1.5466
MEAS F/A RAT	0.0856	0.0844	0.0845	0.0754	0.0860
CAL F/A RAT	0.0830	0.0843	0.0840	0.0750	0.0840
DIFF M-C F/A	-3.0014	-0.1900	-0.5623	-0.4743	-2.3170
CYL TEMP MAX	290.0000	450.0000	455.0000	405.0000	305.0000
MAN PRES.HGA	17.2	40.0	35.0	23.0	17.1
EXH GAS TEMP	809.0	1314.0	1285.0	1144.0	847.0
CO LBS/MODE	2.5781	0.6081	7.3486	2.5001	0.9044
CO LBS/CYC-RHP	0.0697				
PERCENT OF EPA STD FOR CO	165.9439				
HC LBS/MODE	0.2872	0.0070	0.0927	0.0563	0.0861
HC LBS/CYC-RHP	0.0026				
PERCENT OF EPA STD FOR HC	139.2661				
NO LBS/MODE	0.0046	0.0010	0.0145	0.0312	0.0015
NO LBS/CYC-RHP	0.0003				
PERCENT OF EPA STD FOR NO	17.6149				

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APPENDIX B

BARON B-55 TEST DATA
(IO-470L ENGINE)

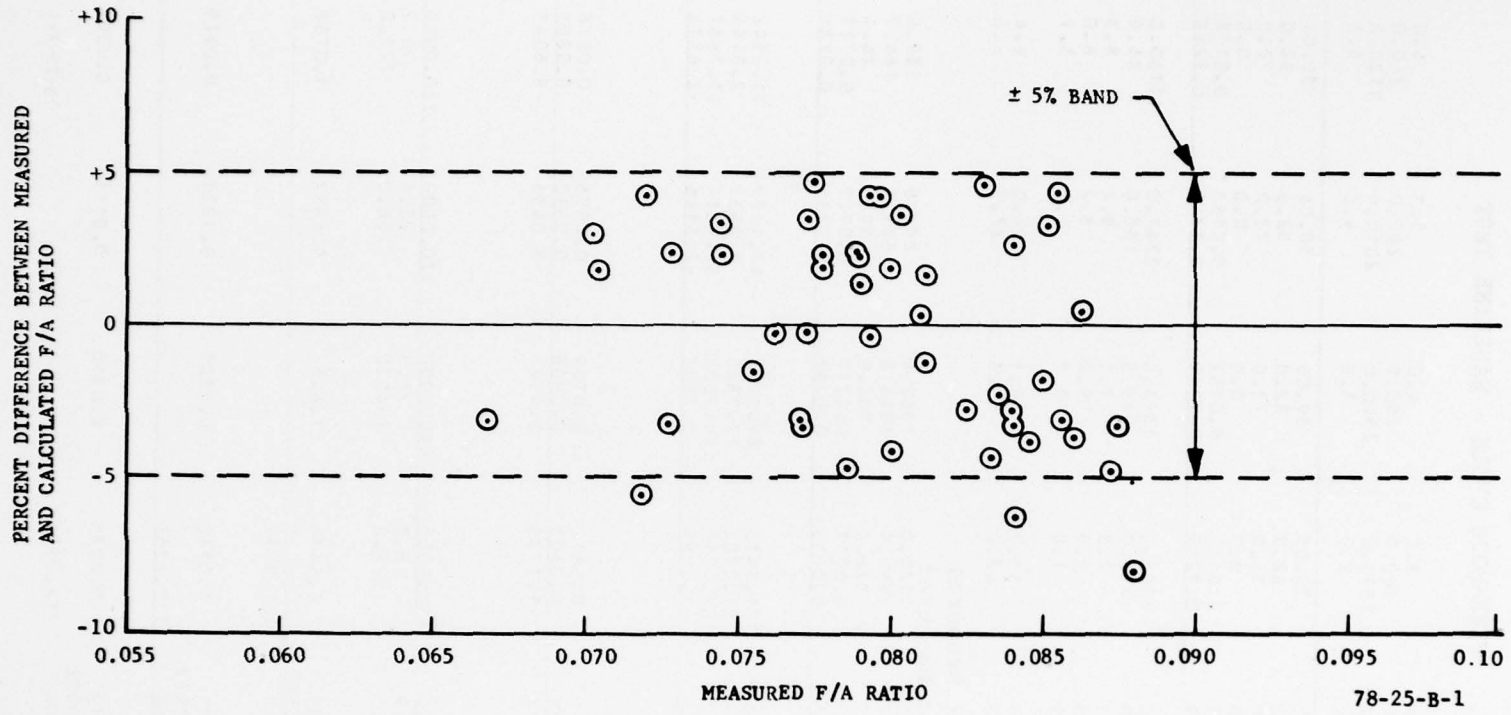

FIGURE B-1. MEASURED F/A RATIO VERSUS THE PERCENT DIFFERENCE BETWEEN THE CALCULATED AND MEASURED F/A RATIO FOR THE BARON B-55 AIRCRAFT WITH IO-470L ENGINE

TABLE B-1. FIVE-MODE CYCLE - BASELINE TEST

MODE NUMBER	2.0	3.0	4.0	5.0	6.0
RATED POWER	260.0	260.0	260.0	260.0	260.0
REV PER MIN	1100.0	2525.0	2500.0	2010.0	1120.0
RUN NUMBER	1.0	2.0	3.0	4.0	5.0
BAROMET PRES	30.05	30.05	30.05	30.05	30.05
DRY AIR TEMP	82.0	82.0	82.0	82.0	82.0
WET BULB TEM	72.0	72.0	72.0	72.0	72.0
IND AIR TEMP	0.0	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0152	0.0152	0.0152	0.0152	0.0152
VAPOR PRESS.	0.7249	0.7249	0.7249	0.7249	0.7249
HC CONC-PPM	9845.0	2376.0	1825.0	2747.0	11130.0
NOX CONC-PPM	27.0	210.0	239.0	138.0	25.0
CO CONC-PERC	8.1	7.3	7.1	8.2	8.3
CO2 CON-PERC	6.3	8.5	9.0	8.2	6.0
O2 CONC-PERC	3.9	1.0	0.7	1.2	3.7
MOLS OUT DRY	6.6	53.2	46.1	24.0	6.6
MOLS OUT WET	7.5	62.0	53.3	27.7	7.6
SHAFT TORQUE	Not Measured				
HORSEPOWER	Not Measured				
ENG AIR FLOW	189.0	1570.0	1360.0	698.0	189.0
DRY AIR FLOW	186.7	1550.9	1343.5	689.5	186.7
ENG FUEL FLO	15.7	126.0	106.0	59.0	16.4
DRY AIR DENS	0.0717	0.0717	0.0717	0.0717	0.0717
WET AIR DENS	0.0735	0.0735	0.0735	0.0735	0.0735
EXH CARBON	11.3855	101.1413	89.0277	47.1279	11.2542
EXH HYDROGEN	2.3277	21.2802	17.7324	9.3535	2.5145
EXH FUEL FLO	13.7133	122.4215	106.7602	56.4814	13.7687
DIFF WFC-WFM	-1.9867	-3.5785	0.7602	-2.5186	-2.6313
MEAS F/A RAT	0.0841	0.0812	0.0789	0.0856	0.0878
CAL F/A RAT	0.0788	0.0803	0.0808	0.0830	0.0803
DIFF M-C F/A	-6.3022	-1.1738	2.4573	-3.0433	-8.6043
CYL TEMP MAX	290.0000	410.0000	440.0000	370.0000	320.0000
MAN PRES.HGA	15.9	28.8	28.3	21.4	16.2
EXH GAS TEMP	763.0	1322.0	1340.0	1156.0	771.0
CO LBS/MODE	2.9809	0.5435	7.6455	5.4887	1.0156
CO LBS/CYC-RHP	0.0680				
PERCENT OF EPA STD FOR CO		161.8512			
HC LBS/MODE	0.2409	0.0118	0.1301	0.1223	0.0919
HC LBS/CYC-RHP	0.0023				
PERCENT OF EPA STD FOR HC		120.8356			
NO LBS/MODE	0.0012	0.0020	0.0318	0.0115	0.0004
NO LBS/CYC-RHP	0.0002				
PERCENT OF EPA STD FOR NO		12.0284			

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TABLE B-2. LEAN-OUT AT APPROACH - 25-HOUR TEST

MODE NUMBER	5.0	5.0	5.0	5.0
RATED POWER	260.0	260.0	260.0	260.0
REV PER MIN	2010.0	2010.0	2020.0	2020.0
RUN NUMBER	6.0	7.0	8.0	9.0
BAROMET PRES	30.35	30.35	30.35	30.35
DRY AIR TEMP	79.0	79.0	79.0	79.0
WET BULB TEM	73.0	73.0	73.0	73.0
IND AIR TEMP	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0165	0.0165	0.0165	0.0165
VAPOR PRESS.	0.7933	0.7933	0.7933	0.7933
HC CONC-PPM	2822.0	2452.0	2198.0	1683.0
NOX CONC-PPM	129.0	261.0	482.0	1036.0
CO CONC-PERC	8.1	6.0	4.6	2.6
CO2 CON-PERC	7.8	8.7	9.7	10.8
O2 CONC-PERC	1.5	1.5	1.6	1.9
MOLS OUT DRY	23.9	23.3	22.9	22.3
MOLS OUT WET	27.7	27.3	26.8	26.0
SHAFT TORQUE	Not Measured			
HORSEPOWER	Not Measured			
ENG AIR FLOW	698.0	697.0	696.0	690.0
DRY AIR FLOW	688.8	687.8	686.8	680.9
ENG FUEL FLO	57.5	53.0	50.0	45.5
DRY AIR DENS	0.0727	0.0727	0.0727	0.0727
WET AIR DENS	0.0746	0.0746	0.0746	0.0746
EXH CARBON	45.6807	41.0814	39.2007	35.8717
EXH HYDROGEN	9.4053	9.3561	8.7305	7.9153
EXH FUEL FLO	55.0860	50.4374	47.9312	43.7869
DIFF WFC-WFM	-2.4140	-2.5626	-2.0688	-1.7131
MEAS F/A RAT	0.0835	0.0771	0.0728	0.0668
CAL F/A RAT	0.0816	0.0744	0.0704	0.0647
DIFF M-C F/A	-2.2851	-3.4397	-3.2558	-3.1124
CYL TEMP MAX	330.0000	340.0000	345.0000	360.0000
MAN PRES.HGA	21.0	21.0	20.9	21.0
EXH GAS TEMP	1160.0	1203.0	1237.0	1270.0
CO LBS/MODE	5.4407	3.9273	2.9255	1.6045
HC LBS/MODE	0.1255	0.1072	0.0944	0.0701
NO LBS/MODE	0.0107	0.0213	0.0387	0.0807

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TABLE B-3. LEAN-OUT AT CLIMB - 25-HOUR TEST

MODE NUMBER	4.0	4.0	4.0
RATED POWER	260.0	260.0	260.0
REV PER MIN	2500.0	2490.0	2500.0
RUN NUMBER	10.0	11.0	12.0
BAROMET PRES	30.35	30.35	30.35
DRY AIR TEMP	79.0	79.0	79.0
WET BULB TEM	73.0	73.0	73.0
IND AIR TEMP	0.0	0.0	0.0
SPEC.HUMID.,	0.0165	0.0165	0.0165
VAPOR PRESS.	0.7933	0.7933	0.7933
HC CONC-PPM	2152.0	2365.0	1011.0
NOX CONC-PPM	311.0	438.0	418.0
CO CONC-PERC	6.4	5.4	5.6
CO2 CON-PERC	8.8	9.4	9.8
O2 CONC-PERC	1.1	1.1	0.9
MOLS OUT DRY	46.6	45.7	44.7
MOLS OUT WET	54.5	53.6	52.1
SHAFT TORQUE	Not Measured		
HORSEPOWER	Not Measured		
ENG AIR FLOW	1392.0	1380.0	1343.0
DRY AIR FLOW	1373.7	1361.8	1325.3
ENG FUEL FLO	106.0	102.8	104.0
DRY AIR DENS	0.0727	0.0727	0.0727
WET AIR DENS	0.0746	0.0746	0.0746
EXH CARBON	85.2929	81.6050	82.6627
EXH HYDROGEN	18.5961	18.0742	17.2773
EXH FUEL FLO	103.8890	99.6792	99.9399
DIFF WFC-WFM	-2.1110	-3.1208	-4.0601
MEAS F/A RAT	0.0772	0.0755	0.0785
CAL F/A RAT	0.0770	0.0743	0.0749
DIFF M-C F/A	-0.1761	-1.5515	-4.5480
CYL TEMP MAX	420.0000	460.0000	450.0000
MAN PRES.HGA	27.9	28.0	27.9
EXH GAS TEMP	1353.0	1370.0	1360.0
CO LBS/MODE	7.0092	5.8165	5.8038
HC LBS/MODE	0.1567	0.1694	0.0704
NO LBS/MODE	0.0423	0.0587	0.0544

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TABLE B-4. LEAN-OUT AT TAKEOFF - 25-HOUR TEST

MODE NUMBER	3.0
RATED POWER	260.0
REV PER MIN	2525.0
RUN NUMBER	14.0
BAROMET PRES	30.05
DRY AIR TEMP	82.0
WET BULB TEM	72.0
IND AIR TEMP	0.0
SPEC.HUMID..	0.0152
VAPOR PRESS.	0.7249
HC CONC-PPM	2168.0
NOX CONC-PPM	194.0
CO CONC-PERC	7.5
CO2 CON-PERC	8.5
O2 CONC-PERC	0.8
MOLS OUT DRY	52.7
MOLS OUT WET	61.4
SHAFT TORQUE	Not Measured
HORSEPOWER	Not Measured
ENG AIR FLOW	1554.0
DRY AIR FLOW	1535.1
ENG FUEL FLO	124.4
DRY AIR DENS	0.0717
WET AIR DENS	0.0735
EXH CARBON	101.0626
EXH HYDROGEN	21.3128
EXH FUEL FLO	122.3754
DIFF WFC-WFM	-2.0246
MEAS F/A RAT	0.0810
CAL F/A RAT	0.0813
DIFF M-C F/A	0.3796
CYL TEMP MAX	440.0000
MAN PRES.HGA	28.8
EXH GAS TEMP	1335.0
CO LBS/MODE	0.5530
HC LBS/MODE	0.0107
NO LBS/MODE	0.0018

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TABLE B-5. FIVE-MODE CYCLE - 25-HOUR TEST

MODE NUMBER	2.0	3.0	4.0	5.0	6.0
RATED POWER	260.0	260.0	260.0	260.0	260.0
REV PER MIN	1100.0	2575.0	2500.0	2000.0	1100.0
RUN NUMBER	25.0	26.0	27.0	28.0	29.0
BAROMET PRES	30.04	30.04	30.04	30.04	30.04
DRY AIR TEMP	73.0	73.0	73.0	73.0	73.0
WET BULB TEM	62.5	62.5	62.5	62.5	62.5
IND AIR TEMP	0.0	0.0	0.0	0.0	0.0
SPEC.HUMID..	0.0099	0.0099	0.0099	0.0099	0.0099
VAPOR PRESS.	0.4729	0.4729	0.4729	0.4729	0.4729
HC CONC-PPM	9168.0	2334.0	1798.0	3297.0	11512.0
NOX CONC-PPM	29.0	219.0	308.0	100.0	24.0
CO CONC-PERC	8.2	6.7	5.9	9.3	8.6
CO2 CON-PERC	7.4	10.2	10.3	8.3	6.8
O2 CONC-PERC	2.5	0.3	0.3	0.9	3.1
MOLS OUT DRY	6.8	53.2	45.8	24.3	6.6
MOLS OUT WET	7.8	60.7	52.8	27.4	7.5
SHAFT TORQUE	Not Measured				
HORSEPOWER	Not Measured				
ENG AIR FLOW	194.0	1561.0	1360.0	690.0	188.0
DRY AIR FLOW	192.5	1548.7	1349.3	684.5	186.5
ENG FUEL FLO	16.8	123.0	105.0	58.5	16.3
DRY AIR DENS	0.0735	0.0735	0.0735	0.0735	0.0735
WET AIR DENS	0.0747	0.0747	0.0747	0.0747	0.0747
EXH CARBON	12.7179	108.0074	89.3140	51.3120	12.2799
EXH HYDROGEN	2.4305	18.4461	16.8262	8.4340	2.2954
EXH FUEL FLO	15.1483	126.4535	106.1402	59.7460	14.5752
DIFF WFC-WFM	-1.6517	3.4535	1.1402	1.2460	-1.7248
MEAS F/A RAT	0.0873	0.0794	0.0778	0.0855	0.0874
CAL F/A RAT	0.0832	0.0828	0.0795	0.0893	0.0845
DIFF M-C F/A	-4.7305	4.2518	2.1054	4.4558	-3.3643
CYL TEMP MAX	250.0000	360.0000	390.0000	340.0000	280.0000
MAN PRES.HGA	15.2	28.7	26.8	20.2	15.2
EXH GAS TEMP	761.0	1415.0	1420.0	1166.0	780.0
CO LBS/MODE	3.1232	0.4963	6.3235	6.3068	1.0656
CO LBS/CYC-RHP	0.0666				
PERCENT OF EPA STD FOR CO	158.5662				
HC LBS/MODE	0.2309	0.0114	0.1270	0.1453	0.0943
HC LBS/CYC-RHP	0.0023				
PERCENT OF EPA STD FOR HC	123.2426				
NO LBS/MODE	0.0014	0.0020	0.0407	0.0082	0.0004
NO LBS/CYC-RHP	0.0002				
PERCENT OF EPA STD FOR NO	13.5002				

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TABLE B-6. FIVE-MODE CYCLE - 25-HOUR TEST

MODE NUMBER	2.0	3.0	4.0	5.0	1.0
RATED POWER	260.0	260.0	260.0	260.0	260.0
REV PER MIN	1100.0	2525.0	2500.0	2000.0	1100.0
RUN NUMBER	18.0	19.0	20.0	21.0	22.0
BAROMET PRES	30.05	30.05	30.05	30.05	30.05
DRY AIR TEMP	82.5	82.5	82.5	82.5	82.5
WET BULB TEM	73.0	73.0	73.0	73.0	73.0
IND AIR TEMP	0.0	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0158	0.0158	0.0158	0.0158	0.0158
VAPOR PRESS.	0.7561	0.7561	0.7561	0.7561	0.7561
HC CONC-PPM	10170.0	2064.0	1772.0	2985.0	11792.0
NOX CONC-PPM	27.0	187.0	271.0	93.0	26.0
CO CONC-PERC	7.9	7.3	6.4	9.2	8.0
CO2 CON-PERC	6.7	8.9	9.6	7.6	6.5
O2 CONC-PERC	3.3	0.7	0.7	1.2	3.4
MOLS OUT DRY	6.7	52.9	46.4	23.7	6.7
MOLS OUT WET	7.8	61.2	53.7	27.2	7.7
SHAFT TORQUE	Not Measured				
HORSEPOWER	Not Measured				
ENG AIR FLOW	195.0	1560.0	1380.0	681.0	193.0
DRY AIR FLOW	192.5	1540.2	1362.5	672.4	190.6
ENG FUEL FLO	16.1	123.0	106.0	58.0	16.0
DRY AIR DENS	0.0716	0.0716	0.0716	0.0716	0.0716
WET AIR DENS	0.0734	0.0734	0.0734	0.0734	0.0734
EXH CARBON	11.7360	102.8451	89.3717	47.7402	11.6357
EXH HYDROGEN	2.4925	20.3771	17.3764	9.0983	2.4306
EXH FUEL FLO	14.2285	123.2222	106.7481	56.8385	14.0663
DIFF WFC-WFM	-1.8715	0.2222	0.7481	-1.1615	-1.9337
MEAS F/A RAT	0.0836	0.0799	0.0778	0.0863	0.0840
CAL F/A RAT	0.0800	0.0814	0.0793	0.0866	0.0811
DIFF M-C F/A	-4.3827	1.9359	1.9393	0.4439	-3.4386
CYL TEMP MAX	285.0000	390.0000	440.0000	370.0000	310.0000
MAN PRES.HGA	15.8	28.8	27.9	21.0	15.7
EXH GAS TEMP	733.0	1339.0	1362.0	1125.0	816.0
CO LBS/MODE	2.9666	0.5374	6.9713	6.0982	1.0017
CO LBS/CYC-RHP	0.0676				
PERCENT OF EPA STD FOR CO		160.9454			
HC LBS/MODE	0.2567	0.0101	0.1271	0.1304	0.0985
HC LBS/CYC-RHP	0.0024				
PERCENT OF EPA STD FOR HC		126.0883			
NO LBS/MODE	0.0013	0.0017	0.0364	0.0076	0.0004
NO LBS/CYC-RHP	0.0002				
PERCENT OF EPA STD FOR NO		12.1392			

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TABLE B-7. LEAN-OUT AT APPROACH - 50-HOUR TEST

MODE NUMBER	5.0	5.0	5.0	6.0
RATED POWER	260.0	260.0	260.0	260.0
REV PER MIN	2000.0	2000.0	2000.0	2000.0
RUN NUMBER	30.0	31.0	32.0	33.0
BAROMET PRES	30.04	30.04	30.04	30.04
DRY AIR TEMP	73.0	73.0	73.0	73.0
WET BULB TEM	62.5	62.5	62.5	62.5
IND AIR TEMP	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0099	0.0099	0.0099	0.0099
VAPOR PRESS.	0.4729	0.4729	0.4729	0.4729
HC CONC-PPM	3274.0	2724.0	2239.0	1902.0
NOX CONC-PPM	108.0	201.0	341.0	586.0
CO CONC-PERC	9.0	6.8	5.3	3.7
CO2 CON-PERC	8.2	9.3	10.2	11.5
O2 CONC-PERC	0.9	0.9	1.0	1.1
MOLS OUT DRY	23.6	23.5	23.1	22.8
MOLS OUT WET	26.9	27.0	26.6	26.1
SHAFT TORQUE	Not Measured			
HORSEPOWER	Not Measured			
ENG AIR FLOW	675.0	690.0	690.0	690.0
DRY AIR FLOW	669.7	684.5	684.5	684.5
ENG FUEL FLO	57.0	54.0	51.0	48.1
DRY AIR DENS	0.0735	0.0735	0.0735	0.0735
WET AIR DENS	0.0747	0.0747	0.0747	0.0747
EXH CARBON	48.8893	45.6525	43.2916	41.5074
EXH HYDROGEN	8.5414	8.5180	8.1501	7.4119
EXH FUEL FLO	57.4307	54.1705	51.4417	48.9193
DIFF WFC-WFM	0.4307	0.1705	0.4417	0.7943
MEAS F/A RAT	0.0851	0.0789	0.0745	0.0703
CAL F/A RAT	0.0878	0.0805	0.0762	0.0724
DIFF M-C F/A	3.1898	2.1090	2.3021	2.9827
CYL TEMP MAX	290.0000	295.0000	306.0000	315.0000
MAN PRES.HGA	19.8	19.9	19.9	20.0
EXH GAS TEMP	1141.0	1174.0	1209.0	1246.0
CO LBS/MODE	5.9458	4.5064	3.4604	1.5761
HC LBS/MODE	0.1413	0.1181	0.0956	0.0531
NO LBS/MODE	0.0087	0.0163	0.0272	0.0306

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TABLE B-8. LEAN-OUT AT CLIMB - 50-HOUR TEST

MODE NUMBER	4.0	4.0	4.0	4.0
RATED POWER	260.0	260.0	260.0	260.0
REV PER MIN	2500.0	2500.0	2490.0	2490.0
RUN NUMBER	34.0	35.0	36.0	37.0
BAROMET PRES	30.04	30.04	30.04	30.04
DRY AIR TEMP	73.0	73.0	73.0	73.0
WET BULB TEM	62.5	62.5	62.5	62.5
IND AIR TEMP	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0099	0.0099	0.0099	0.0099
VAPOR PRESS.	0.4729	0.4729	0.4729	0.4729
HC CONC-PPM	1756.0	1562.0	1412.0	1339.0
NOX CONC-PPM	341.0	484.0	732.0	1002.0
CO CONC-PERC	5.8	4.8	3.7	2.6
CO2 CON-PERC	10.4	11.0	12.0	12.5
O2 CONC-PERC	0.3	0.3	0.3	0.4
MOLS OUT DRY	44.7	43.6	43.1	42.1
MOLS OUT WET	51.7	50.5	49.6	48.6
SHAFT TORQUE	Not Measured			
HORSEPOWER	Not Measured			
ENG AIR FLOW	1330.0	1310.0	1307.0	1292.0
DRY AIR FLOW	1319.5	1299.6	1296.7	1281.8
ENG FUEL FLO	104.5	99.0	94.5	90.3
DRY AIR DENS	0.0735	0.0735	0.0735	0.0735
WET AIR DENS	0.0747	0.0747	0.0747	0.0747
EXH CARBON	86.9176	83.0054	81.5679	76.7818
EXH HYDROGEN	16.6579	15.8384	14.4084	14.1023
EXH FUEL FLO	103.5755	98.8438	95.9763	90.8841
DIFF WFC-WFM	-0.9245	-0.1562	1.4763	0.6341
MEAS F/A RAT	0.0792	0.0762	0.0729	0.0704
CAL F/A RAT	0.0788	0.0764	0.0746	0.0716
DIFF M-C F/A	-0.4725	0.3148	2.3550	1.6552
CYL TEMP MAX	360.0000	380.0000	395.0000	400.0000
MAN PRES.HGA	26.3	26.3	26.3	26.3
EXH GAS TEMP	1373.0	1393.0	1428.0	1446.0
CO LBS/MODE	6.0618	4.9228	3.7240	2.5934
HC LBS/MODE	0.1215	0.1054	0.0935	0.0870
NO LBS/MODE	0.0441	0.0610	0.0907	0.1217

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TABLE B-9. LEAN-OUT AT TAKEOFF - 50-HOUR TEST

MODE NUMBER	3.0	3.0	3.0	3.0
RATED POWER	260.0	260.0	260.0	260.0
REV PER MIN	2575.0	2520.0	2525.0	2525.0
RUN NUMBER	38.0	39.0	40.0	41.0
BAROMET PRES	30.04	30.04	30.04	30.04
DRY AIR TEMP	73.0	73.0	73.0	73.0
WET BULB TEM	62.5	62.5	62.5	62.5
IND AIR TEMP	0.0	0.0	0.0	0.0
SPEC.HUMID..	0.0099	0.0099	0.0099	0.0099
VAPOR PRESS.	0.4729	0.4729	0.4729	0.4729
HC CONC-PPM	2098.0	1963.0	2013.0	1743.0
NOX CONC-PPM	206.0	277.0	491.0	633.0
CO CONC-PERC	7.0	6.0	4.6	3.8
CO2 CON-PERC	9.8	10.3	11.4	11.9
O2 CONC-PERC	0.3	0.3	0.3	0.4
MOLS OUT DRY	53.2	52.5	51.2	51.3
MOLS OUT WET	61.0	60.5	58.8	58.8
SHAFT TORQUE	Not Measured			
HORSEPOWER	Not Measured			
ENG AIR FLOW	1560.0	1560.0	1537.0	1552.0
DRY AIR FLOW	1547.7	1547.7	1524.9	1539.7
ENG FUEL FLO	124.2	119.5	113.6	111.0
DRY AIR DENS	0.0735	0.0735	0.0735	0.0735
WET AIR DENS	0.0747	0.0747	0.0747	0.0747
EXH CARBON	107.6385	102.9299	98.2568	97.2457
EXH HYDROGEN	19.2910	19.0984	17.5207	16.8743
EXH FUEL FLO	126.9295	122.0283	115.7775	114.1200
DIFF WFC-WFM	2.7295	2.5283	2.1775	3.1200
MEAS F/A RAT	0.0802	0.0772	0.0745	0.0721
CAL F/A RAT	0.0832	0.0800	0.0769	0.0751
DIFF M-C F/A	3.6286	3.5453	3.2073	4.2066
CYL TEMP MAX	385.0000	395.0000	405.0000	420.0000
MAN PRES.HGA	28.7	28.7	28.7	28.7
EXH GAS TEMP	1360.0	1388.0	1424.0	1441.0
CO LBS/MODE	0.5243	0.4401	0.3310	0.2759
HC LBS/MODE	0.0103	0.0095	0.0095	0.0082
NO LBS/MODE	0.0019	0.0025	0.0043	0.0056

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TABLE B-10. LEAN-OUT AT TAXI - 50-HOUR TEST

MODE NUMBER	2.0	2.0	2.0	2.0
RATED POWER	260.0	260.0	260.0	260.0
REV PER MIN	1100.0	1100.0	1100.0	1090.0
RUN NUMBER	42.0	43.0	44.0	45.0
BAROMET PRES	30.04	30.04	30.04	30.04
DRY AIR TEMP	73.0	73.0	73.0	73.0
WET BULB TEM	62.5	62.5	62.5	62.5
IND AIR TEMP	0.0	0.0	0.0	0.0
SPEC.HUMID.	0.0099	0.0099	0.0099	0.0099
VAPOR PRESS.	0.4729	0.4729	0.4729	0.4729
HC CONC-PPM	7109.0	7044.0	8663.0	3027.0
NOX CONC-PPM	29.0	29.0	27.0	46.0
CO CONC-PERC	7.7	7.5	7.5	4.0
CO2 CON-PERC	7.6	7.8	7.6	10.1
O2 CONC-PERC	2.7	2.7	3.0	2.8
MOLS OUT DRY	6.9	6.3	6.2	5.9
MOLS OUT WET	7.9	7.2	7.1	6.8
SHAFT TORQUE	Not Measured			
HORSEPOWER	Not Measured			
ENG AIR FLOW	200.0	182.0	180.0	178.0
DRY AIR FLOW	198.4	180.6	178.6	176.6
ENG FUEL FLO	16.1	15.0	14.1	12.7
DRY AIR DENS	0.0735	0.0735	0.0735	0.0735
WET AIR DENS	0.0747	0.0747	0.0747	0.0747
EXH CARBON	12.7572	11.6256	11.3627	10.0553
EXH HYDROGEN	2.3817	2.1761	2.0459	1.8981
EXH FUEL FLO	15.1389	13.8017	13.4086	11.9533
DIFF WFC-WFM	-0.9611	-1.1983	-0.6914	-0.7467
MEAS F/A RAT	0.0811	0.0831	0.0790	0.0719
CAL F/A RAT	0.0799	0.0793	0.0799	0.0679
DIFF M-C F/A	-1.5253	-4.5010	1.2408	-5.6324
CYL TEMP MAX	275.0000	280.0000	280.0000	275.0000
MAN PRES.HGA	15.4	15.1	15.1	14.9
EXH GAS TEMP	746.0	770.0	754.0	765.0
CO LBS/MODE	2.9810	2.6617	2.6272	1.3281
HC LBS/MODE	0.1819	0.1643	0.1993	0.0662
NO LBS/MODE	0.0014	0.0013	0.0012	0.0019

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TABLE B-11. FIVE-MODE CYCLE - 50-HOUR TEST

MODE NUMBER	2.0	3.0	4.0	5.0	6.0
RATED POWER	260.0	260.0	260.0	260.0	260.0
REV PER MIN	1100.0	2550.0	2500.0	2000.0	1100.0
RUN NUMBER	46.0	47.0	48.0	49.0	50.0
BAROMET PRES	30.04	30.04	30.04	30.04	30.04
DRY AIR TEMP	73.0	73.0	73.0	73.0	73.0
WET BULB TEM	62.5	62.5	62.5	62.5	62.5
IND AIR TEMP	0.0	0.0	0.0	0.0	0.0
SPEC.HUMID.,	0.0099	0.0099	0.0099	0.0099	0.0099
VAPOR PRESS.	0.4729	0.4729	0.4729	0.4729	0.4729
HC CONC-PPM	9590.0	2194.0	1605.0	2678.0	14372.0
NOX CONC-PPM	26.0	206.0	292.0	124.0	22.0
CO CONC-PERC	8.0	6.9	6.2	8.6	8.4
CO2 CON-PERC	7.1	9.8	10.5	8.4	6.6
O2 CONC-PERC	3.1	0.3	0.3	0.8	3.7
MOLS OUT DRY	6.7	53.2	46.4	24.2	6.7
MOLS OUT WET	7.7	61.0	52.9	27.6	7.7
SHAFT TORQUE	Not Measured				
HORSEPOWER	Not Measured				
ENG AIR FLOW	193.0	1560.0	1368.0	695.0	192.0
DRY AIR FLOW	191.5	1547.7	1357.2	689.5	190.5
ENG FUEL FLO	16.2	123.0	105.0	58.0	16.2
DRY AIR DENS	0.0735	0.0735	0.0735	0.0735	0.0735
WET AIR DENS	0.0747	0.0747	0.0747	0.0747	0.0747
EXH CARBON	12.2351	106.7520	92.8221	49.3733	12.0889
EXH HYDROGEN	2.3635	19.3260	15.9973	8.9498	2.2372
EXH FUEL FLO	14.5987	126.0781	108.8194	58.3232	14.3261
DIFF WFC-WFM	-1.6013	3.0781	3.8194	0.3232	-1.8739
MEAS F/A RAT	0.0846	0.0795	0.0774	0.0841	0.0850
CAL F/A RAT	0.0813	0.0828	0.0810	0.0863	0.0836
DIFF M-C F/A	-3.9655	4.2186	4.7423	2.5928	-1.7214
CYL TEMP MAX	290.0000	365.0000	385.0000	360.0000	295.0000
MAN PRES.HGA	15.4	28.6	27.0	20.5	15.5
EXH GAS TEMP	766.0	1359.0	1367.0	1165.0	754.0
CO LBS/MODE	3.0285	0.5167	6.6876	5.8012	1.0549
CO LBS/CYC-RHP	0.0657				
PERCENT OF EPA STD FOR CO	156.4925				
HC LBS/MODE	0.2397	0.0107	0.1136	0.1188	0.1202
HC LBS/CYC-RHP	0.0023				
PERCENT OF EPA STD FOR HC	122.0633				
NO LBS/MODE	0.0012	0.0019	0.0386	0.0103	0.0003
NO LBS/CYC-RHP	0.0002				
PERCENT OF EPA STD FOR NO	13.4278				

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TABLE B-12. FIVE-MODE CYCLE - 50-HOUR TEST

MODE NUMBER	2.0	3.0	4.0	5.0	6.0
RATED POWER	260.0	260.0	260.0	260.0	260.0
REV PER MIN	1100.0	2550.0	2500.0	2000.0	1100.0
RUN NUMBER	51.0	52.0	53.0	54.0	55.0
BAROMET PRES	30.04	30.04	30.04	30.04	30.04
DRY AIR TEMP	73.0	73.0	73.0	73.0	73.0
WET BULB TEM	62.5	62.5	62.5	62.5	62.5
IND AIR TEMP	0.0	0.0	0.0	0.0	0.0
SPEC.HUMID.	0.0099	0.0099	0.0099	0.0099	0.0099
VAPOR PRESS.	0.4729	0.4729	0.4729	0.4729	0.4729
HC CONC-PPM	10720.0	2096.0	1753.0	2900.0	10455.0
NOX CONC-PPM	21.0	221.0	305.0	122.0	24.0
CO CONC-PERC	8.2	6.9	6.0	8.5	8.3
CO2 CON-PERC	6.4	10.0	10.2	8.7	7.1
O2 CONC-PERC	3.9	0.3	0.3	0.8	3.0
MOLS OUT DRY	6.5	51.3	46.2	24.1	6.7
MOLS OUT WET	7.4	58.5	53.3	27.4	7.6
SHAFT TORQUE	Not Measured				
HORSEPOWER	Not Measured				
ENG AIR FLOW	186.0	1500.0	1372.0	692.0	191.0
DRY AIR FLOW	184.5	1488.1	1361.2	686.5	189.5
ENG FUEL FLO	15.2	119.0	105.0	57.8	16.3
DRY AIR DENS	0.0735	0.0735	0.0735	0.0735	0.0735
WET AIR DENS	0.0747	0.0747	0.0747	0.0747	0.0747
EXH CARBON	11.4310	104.3055	89.9038	49.6889	12.4076
EXH HYDROGEN	2.2030	18.0145	17.0671	8.6191	2.2989
EXH FUEL FLO	13.6339	122.3200	106.9709	58.3080	14.7065
DIFF WFC-WFM	-1.5661	3.3200	1.9709	0.5580	-1.5935
MEAS F/A RAT	0.0824	0.0800	0.0771	0.0841	0.0860
CAL F/A RAT	0.0801	0.0833	0.0796	0.0865	0.0830
DIFF M-C F/A	-2.7517	4.1157	3.2024	2.7966	-3.5231
CYL TEMP MAX	260.0000	360.0000	380.0000	340.0000	280.0000
MAN PRES.HGA	15.6	28.6	27.1	20.3	15.4
EXH GAS TEMP	742.0	1360.0	1367.0	1163.0	766.0
CO LBS/MODE	3.0034	0.4990	6.4887	5.7096	1.0363
CO LBS/CYC-RHP	0.0644				
PERCENT OF EPA STD FOR CO		153.2700			
HC LBS/MODE	0.2587	0.0098	0.1250	0.1276	0.0864
HC LBS/CYC-RHP	0.0023				
PERCENT OF EPA STD FOR HC		122.9921			
NO LBS/MODE	0.0009	0.0019	0.0407	0.0100	0.0004
NO LBS/CYC-RHP	0.0002				
PERCENT OF EPA STD FOR NO		13.8371			

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