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NASA-CR 135404
LYC 77-56

(NASA-CR-135404-Vol-1) YF 102 IN-DUCT
COMBUSTOR NOISE MEASUREMENT, VOLUME 1 Final
Report, 24 Jul. 1976 - 31 Aug. 1977 (Avco
Lycoming Div.) 72 p HC A04/MF A01 CSCL 20A

N78-25827

Unclas
G3/71 21340

FINAL REPORT

VOLUME I

YF 102 IN-DUCT COMBUSTOR NOISE MEASUREMENT

by

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prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NOVEMBER 1977

CONTRACT NAS 3-20052

NASA Lewis Research Center
Cleveland, Ohio



1. Report No. NASA CR 135404		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle YF 102 IN-DUCT COMBUSTOR NOISE MEASUREMENT				5. Report Date November 1977	
				6. Performing Organization Code	
7. Author(s) Craig A. Wilson				8. Performing Organization Report No. LYC 77-56	
9. Performing Organization Name and Address Avco Lycoming Division 550 S. Main Street Stratford, Connecticut 06497				10. Work Unit No.	
				11. Contract or Grant No. NAS 3-20052	
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio 44135				13. Type of Report and Period Covered Final Report 24 July 1976 - 31 August 1977	
				14. Sponsoring Agency Code	
15. Supplementary Notes Project Manager - Meyer Reshotko, V/STOL and Noise Division, NASA - Lewis Research Center, Cleveland, Ohio					
16. Abstract The combustion chamber from a YF 102 gas turbine engine was instrumented with semi-infinite acoustic wave guide probes and installed in a combustor test rig to complement the combustor noise test conducted by NASA on a YF 102 engine. This report describes those combustor rig tests and lists the data recorded. Internal dynamic pressure level measurements were made at the same locations and at the same operating conditions of the NASA YF 102 test. In addition, the combustor was operated at various off-design points where one parameter at a time was varied. Background noise recordings were made to determine the magnitude of facility or test rig noise present.					
17. Key Words (Suggested by Author(s)) Gas Turbine Engine Noise Internal Combustor Noise Spectra Far-Field Noise Signals Test Rig Combustor Noise				18. Distribution Statement* Publicly Available	
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages 450	22. Price*

* For sale by the National Technical Information Service, Springfield, Virginia 22161

FOREWORD

This program was conducted for the Lewis Research Center of the National Aeronautics and Space Administration under Contract NAS 3-20052. The period of performance was 24 July 1976 through 31 August 1977.

Technical direction was provided by the NASA Project Manager, Mr. Meyer Reshotko.

The Avco Lycoming Program Manager was Mr. Kenneth S. Collinge. Mr. Craig A. Wilson was the principal investigator.

TABLE OF CONTENTS

	<u>Page</u>
<u>VOLUME I</u>	
FOREWORD.....	i
LIST OF ILLUSTRATIONS.....	iii
LIST OF TABLES.....	iv
INTRODUCTION.....	1
EQUIPMENT DESCRIPTION.....	2
Combustion Chamber.....	2
Combustor Test Rig.....	2
Combustor Test Facility.....	2
Acoustic Probes.....	7
Probe Locations.....	7
Data Acquisition Equipment.....	7
Combustor Rig Instrumentation.....	15
SUMMARY OF TEST PHASE.....	15
Background Noise Levels.....	15
Combustor Operating Points.....	16
DATA REDUCTION AND ANALYSIS.....	30
Description of Data Reduction Equipment.....	30
Mode of Analysis.....	30
Allowances for Correlation Analysis.....	31
REFERENCES.....	33
APPENDIXES	
A. Tables of 1/3-Octave Band Pressure Levels.....	34
<u>VOLUME II</u>	
B. One-Third Octave Band Pressure Level Plots.....	67
<u>VOLUME III</u>	
C. Narrow Band Pressure Level Spectra	258
DISTRIBUTION LIST.....	450

LIST OF ILLUSTRATIONS

<u>Figure</u>		<u>Page</u>
1	YF 102 Combustion Chamber	3
2	YF 102 Combustor Test Rig	5
3	Combustor Test Facility Schematic.....	6
4	Dynamic Pressure Level Probe.....	8
5	Probe Instrumentation Setup	9
6	Combustor Test Rig Installed in Testway	10
7	Probe 1, 2, and 4 Locations in the Combustion Chamber.....	11
8	Probe 5 Location in the Combustion Chamber.....	12
9	NASA-Furnished Instrumentation Cabinet.....	13
10	Acoustic Data Acquisition System Schematic.....	14
11	Comparison of Combustor Pressure Levels With Background Noise Levels.....	17

LIST OF TABLES

<u>Table</u>		<u>Page</u>
I	Combustor Rig Parameters for YF 102 Operating Points (Group I).....	18
II	Combustor Rig Parameters for Zero Fuel Flow Operating Points (Group II).....	20
III	Combustor Rig Parameters for Computer Defined Operating Points (Group III).....	22
IV	Combustor Rig Parameters for Off-Design Airflow Operating Points (Group IV).....	24
V	Combustor Rig Parameters for Off-Design Fuel-Air Ratio Operating Points (Group V).....	26
VI	Combustor Rig Parameters for Off-Design Inlet Temperature Operating Points (Group VI).....	28
VII	List of One-Third Octave Band Pressure Level Correction Factors.....	32

INTRODUCTION

In the past several years considerable progress has been made in reducing the noise generated by gas turbine engines in aviation. The two largest sources of engine noise, the fan and the jet exhaust, can be reduced sufficiently to enable current aircraft to comply with federal noise standards. Further treatment of these sources may not reduce the overall engine noise because an acoustic threshold has been reached. This threshold is attributed to the noise generated by heretofore poorly understood sources within the engine itself. One of the most likely sources of far-field noise originating from within the engine is the combustion process, where large amounts of chemical energy are released (Reference 1).

At the National Aeronautics and Space Administration Lewis Research Center, a program is being conducted to determine the characteristics of combustion noise and its propagation through the engine core to the far field. Part of the experimental phase of this program was conducted with an Avco Lycoming YF 102 turbofan engine (Reference 2). Preliminary results, which include combustor spectra and cross-correlation data of internal and far-field noise signals, indicated that below certain engine power settings the signal measured in the combustor significantly contributes to the far-field noise level (Reference 3).

Future research into the relationship between internal engine noise and combustor noise is now aimed at predicting the contribution of combustor-related noise from internal noise measurements. Due to the expense and difficulty of running engines to measure combustion noise internally, it would be advantageous to be able to gather this data from rig tests of the combustor alone. If such a relationship does in fact exist between installed engine combustor noise and test rig combustor noise, then noise data gathered on developmental combustor designs could be used to predict engine noise levels.

The objective of the noise measurement program reported herein was to record the internal noise of the Avco Lycoming YF 102 engine combustor installed in a test rig. These measurements in a combustor installed in an engine have already been recorded by NASA at the Lewis Research Center (LeRC) (Reference 2). The YF 102 combustion chamber was instrumented and installed in a rig for testing. The acoustic probes used in this program were those used by LeRC on the installed engine combustor tests.

The combustor was operated at the same operating points as for the installed engine case and at operating points where one parameter at a time was varied. The internal dynamic pressure level measurements at these operating points were recorded on magnetic tape from which narrow band and one-third octave band pressure level spectra were later developed. At the conclusion of the test, the tapes were forwarded to LeRC for additional analysis.

EQUIPMENT DESCRIPTION

An Avco Lycoming YF 102 combustion chamber, similar to the one installed in the YF 102 and tested in conjunction with the NASA YF 102 test program, was instrumented, assembled into a test rig and installed in the Avco Lycoming combustion test facilities in the Stratford, Connecticut plant. The combustor was operated at specific conditions of airflow, pressure and temperature, and fuel flow to simulate engine operating and off-point operating conditions.

Combustion Chamber

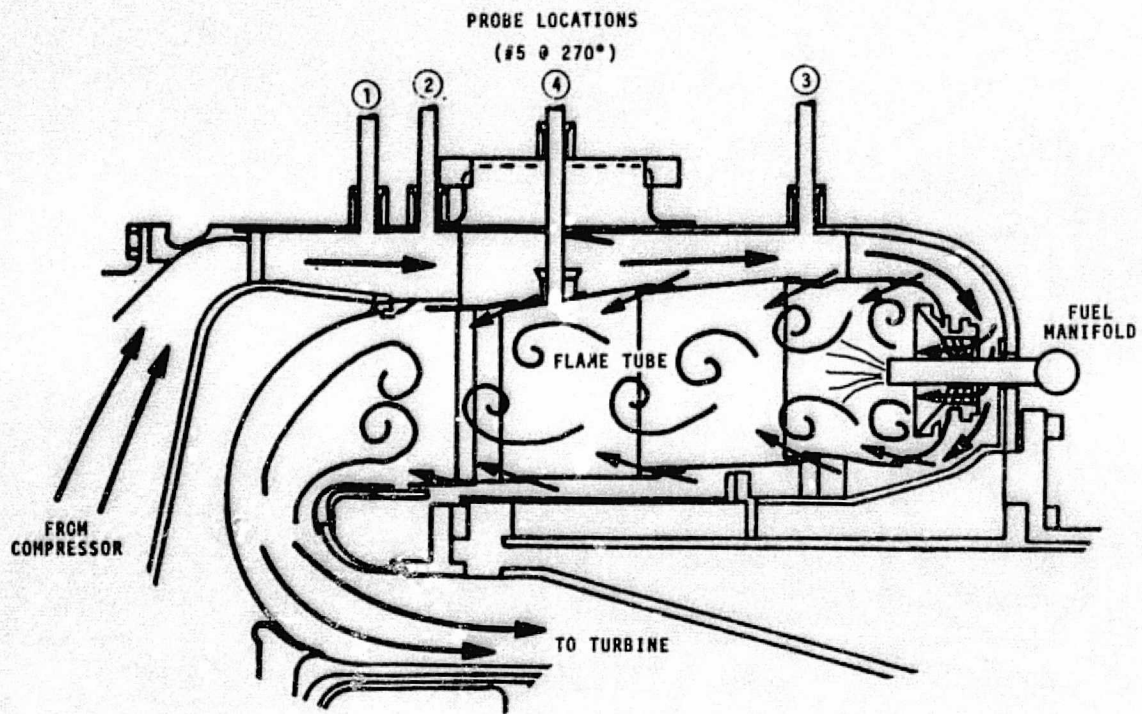
The YF 102 combustion chamber, shown in Figure 1, is of the reverse-flow annular-type design. Air from a compressor enters the combustion chamber section through a set of diffuser vanes. The air then passes over the outer liner and reverses direction where part of the air enters the flame tube to mix with the fuel and burn. As the hot gas moves downstream, it is diluted and cooled by the remaining air entering through the holes and slots provided in the liner. The hot gas is reversed again and directed to the turbine inlet nozzles.

Combustor Test Rig

For this test program the YF 102 combustor chamber was modified to accept five semi-infinite acoustic probes and was then installed in a test rig, shown in Figure 2. A sixth probe was installed in the exit section of the rig. The rig served to substitute for the compressor normally upstream of the combustor chamber and the turbine downstream. The test rig also contains the necessary measurement probe and sensors to monitor the test and provide for the necessary performance information. Air, preset by the facility to the appropriate pressure and temperature, is admitted to the test rig inlet plenum. The air then is diffused through the compressor discharge diffuser to the combustion chamber. The hot gas from the combustor exhausts through the exhaust diffuser and hence out of the rig.

Combustor Test Facility

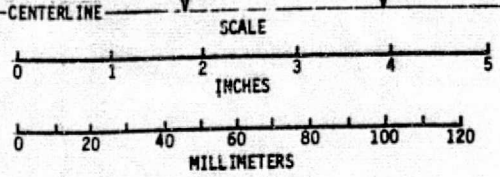
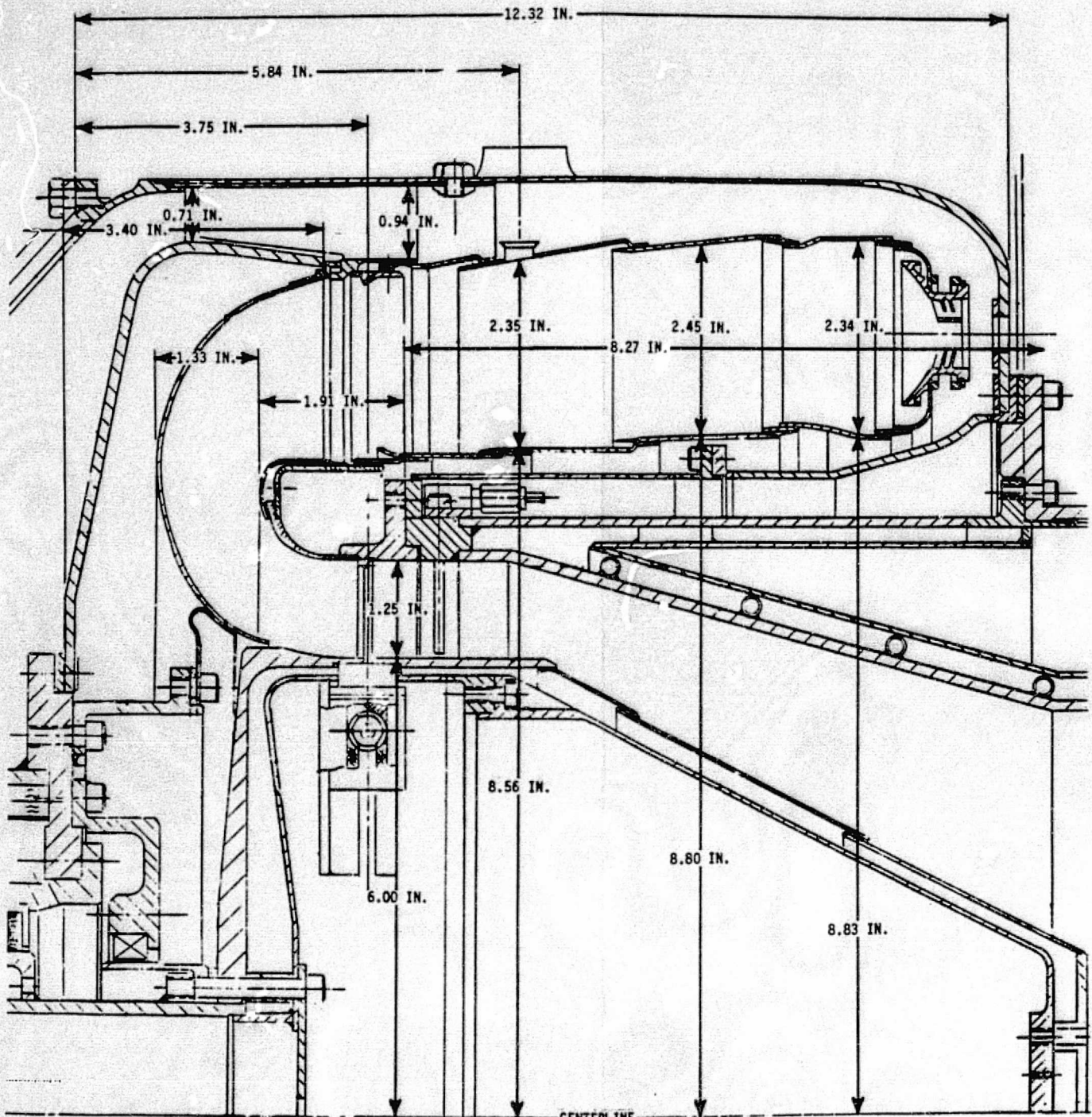
The combustor test rig was installed in the No. 1 testway, shown in Figure 3 in the combustor test facility. Butterfly valves, located immediately upstream and downstream of the testway, regulated the flow of air through the test rig. The downstream valve was water-cooled through which the hot gases exhausted to a muffler and then to the atmosphere. The piping and valving upstream of the testway were arranged to connect the rig with an inline electric heater and the facility compressor. A T55-L-11 gas turbine compressor, driven by three gas turbine engines through a reduction gearbox, provided the compressed air for the tests. The control room located adjacent to the testway,



a. Schematic Diagram

FOLDOUT FRAME 1

Figure 1. YF 102 Combustion Chamber.



b. Engineering Drawing

FOLDOUT FRAME 2

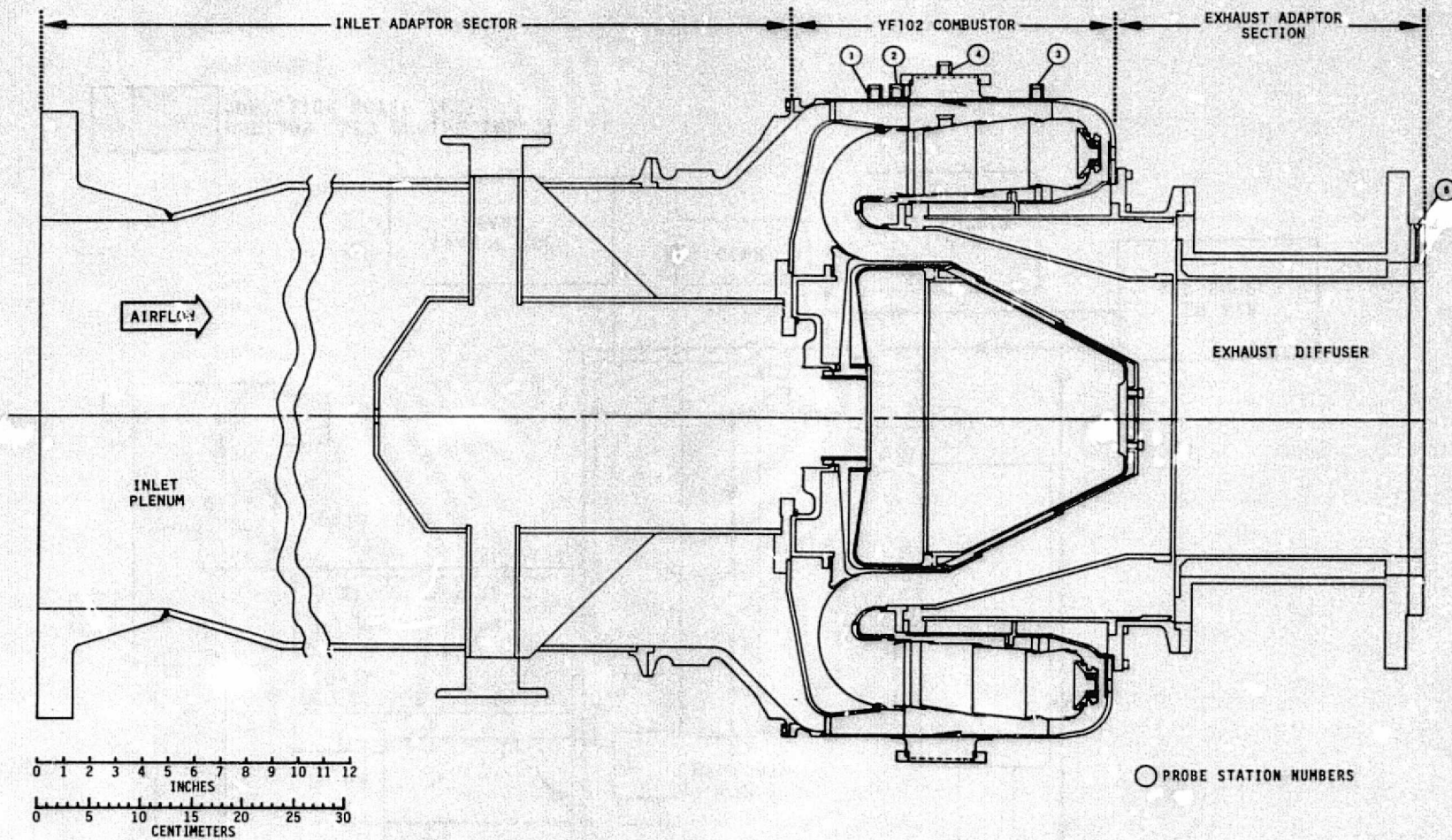


Figure 2. YF 102 Combustor Test Rig.

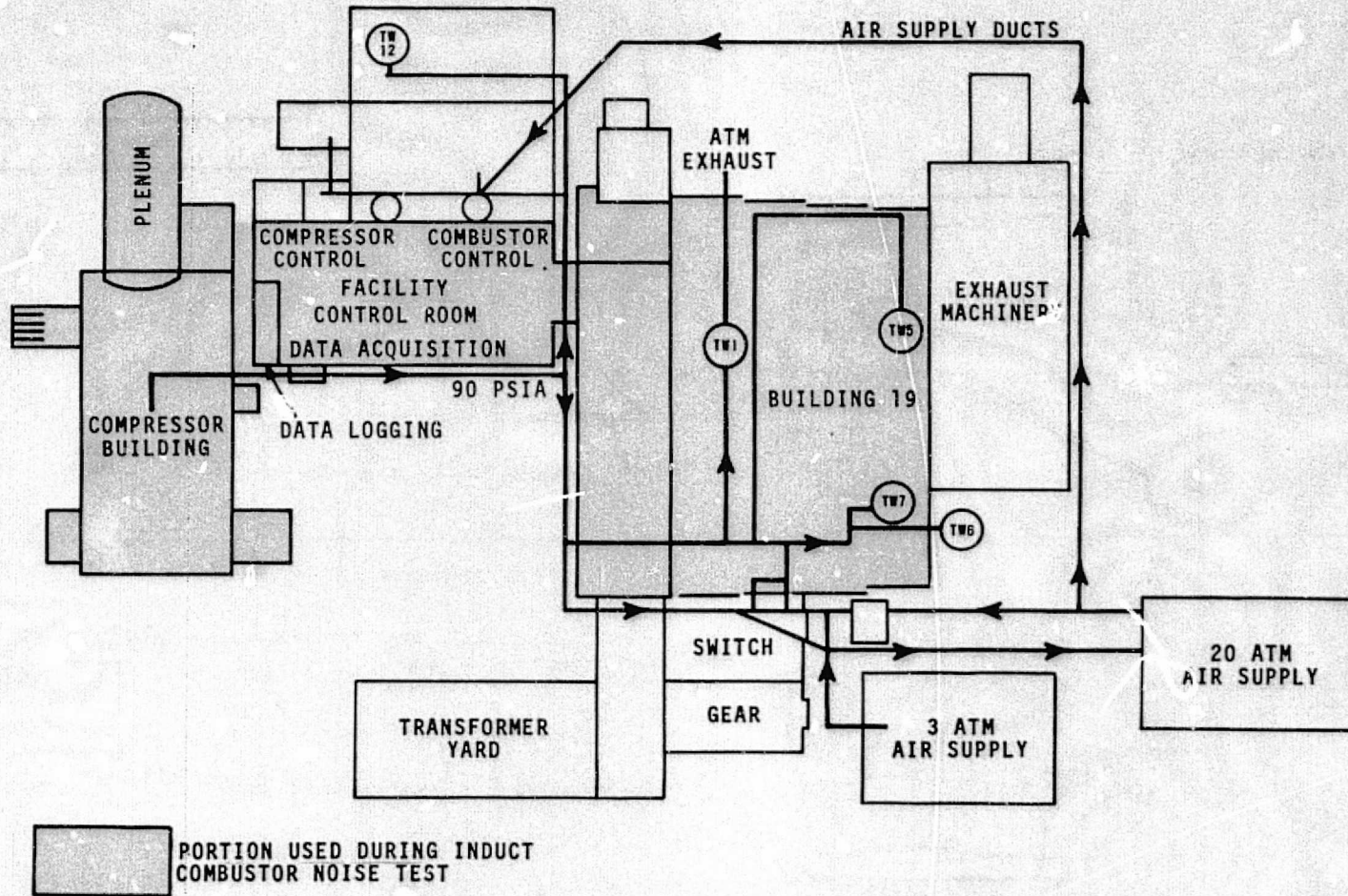


Figure 3. Combustor Test Facility Schematic.

provides the operator locations where the specific condition of airflow, pressure, and temperature were set for each test.

JP-5 fuel was supplied to the combustion chamber at the required pressure and flow by the test facility fuel supply system. The fuel flow rate was adjusted to correspond to the required fuel-air ratio for each test.

Acoustic Probes

The dynamic pressure fluctuations in the combustion chamber and test rig were sensed by six Government-furnished "semi-infinite wave guide" probes. These probes, depicted in Figure 4, were the same probes employed by NASA during the YF 102 noise measurement program at LeRC. Each probe consisted of a 6.35 millimeters (1/4-inch) condenser microphone mounted flush on the wave guide that passed through the probe block. The probe system shown in Figure 5, is fully described in Reference 2. The microphone was connected through a bulkhead fitting to a preamplifier and power supply, which in turn was connected to the signal amplifier and tape recorder

A vent in the probe support block equalized static pressure across the microphone and provided the back pressure to regulate the flow of nitrogen through the wave guide. The flow regulators were adjusted to provide sufficient nitrogen purge to prevent hot gases from the combustion chamber from entering the wave guide but low enough not to affect the dynamic pressure level measurements made by the microphone.

Probe Locations

A total of six probes were installed in the test rig (Figure 6). An additional spare probe was used for calibration. Probes 1 and 2 were installed in the compressor diffuser (Figure 7). Probe 3 was installed in the combustor inlet duct to sense the noise in the flame tube. Probe 5 (Figure 8) was similarly located only rotated 90 degrees. Probe 6 was located at the exhaust end of the test rig. These six probes were mounted on the combustion chamber rig and connected to the NASA furnished panel (Figure 9), containing the nitrogen flow regulators and power supplies.

Data Acquisition Equipment

Figure 10 is a schematic of the acoustic data acquisition equipment setup. The six precision sound level meters, one for each probe, were used to condition the signals from the microphones to provide sufficient voltage to the FM tape recorder amplifiers. The microphone signals were simultaneously recorded on 25.4 mm (1-inch) wide magnetic tape using the same recording head stack. The probe signals were sampled prior to recording and afterwards by

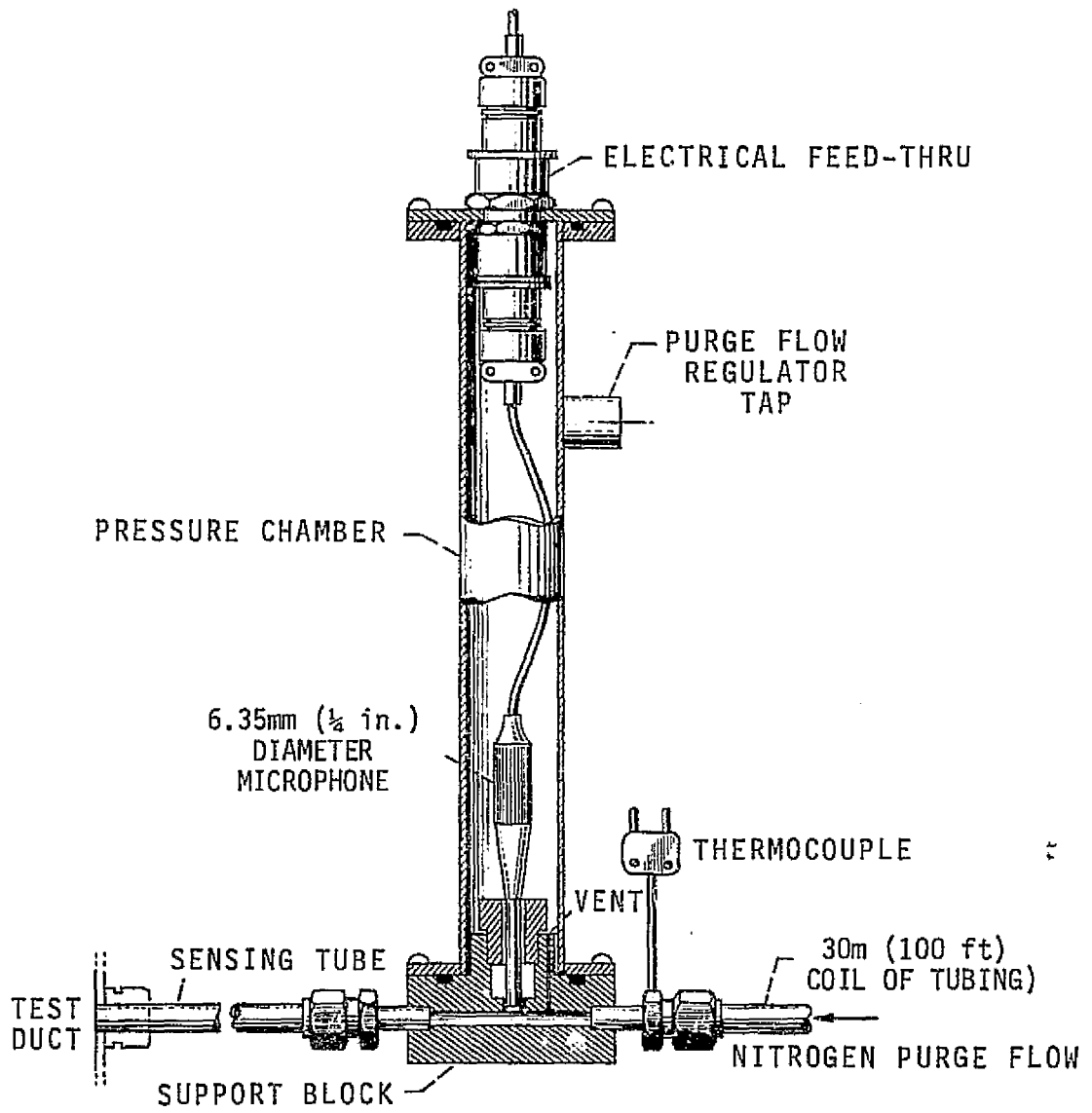


Figure 4. Dynamic Pressure Level Probe.

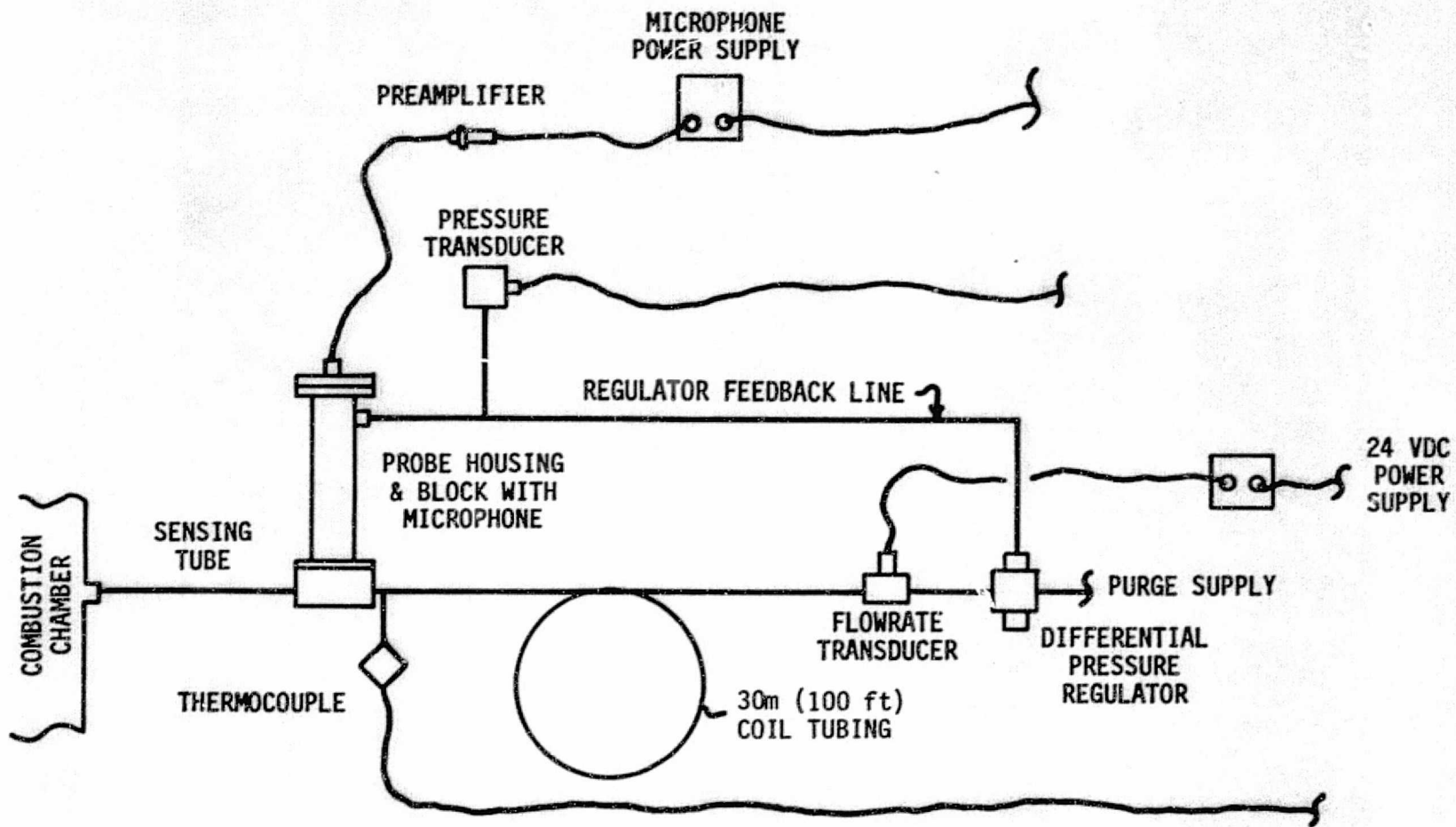


Figure 5. Probe Instrumentation Setup.

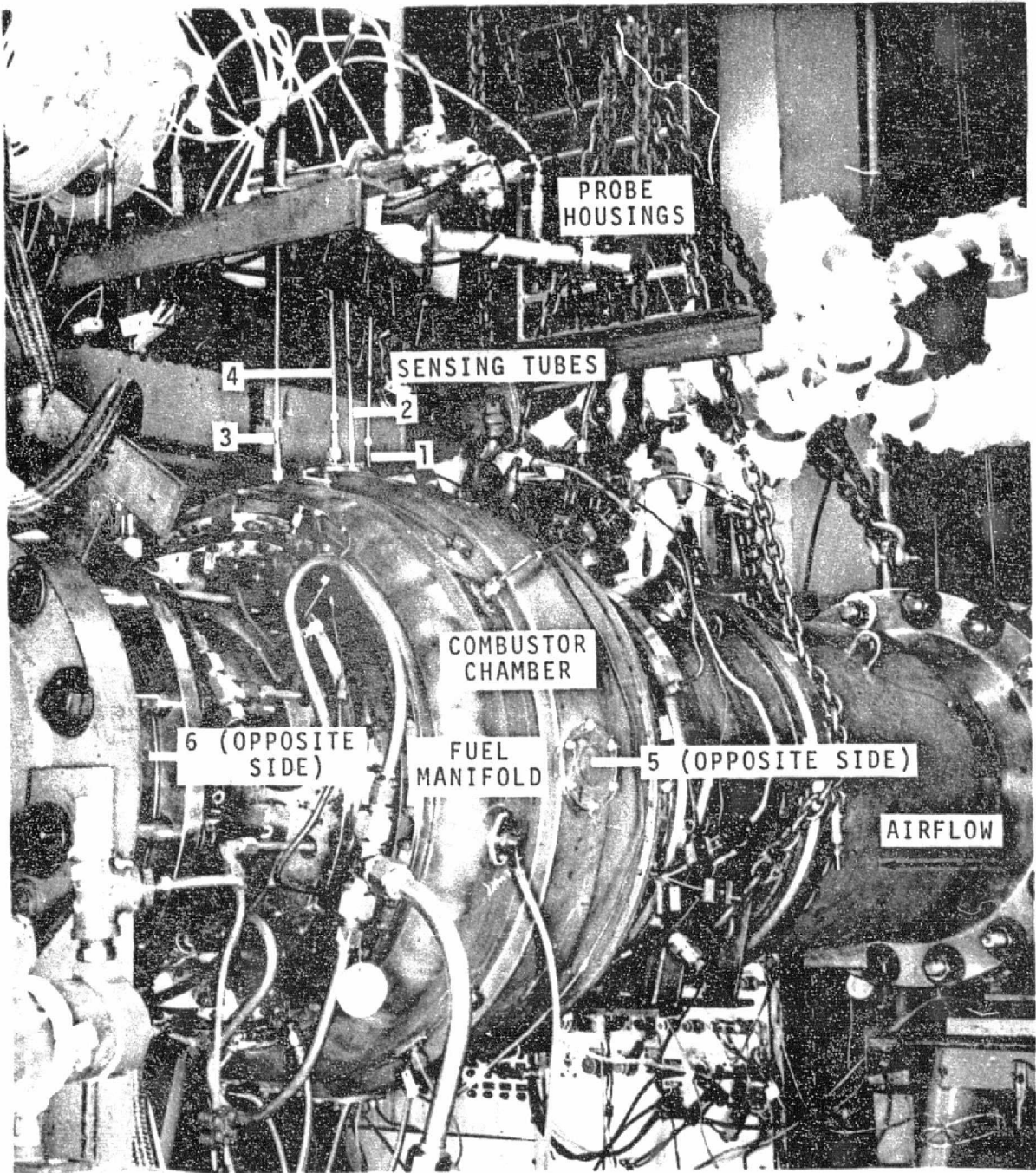


Figure 6. Combustor Test Rig Installed in Testway.

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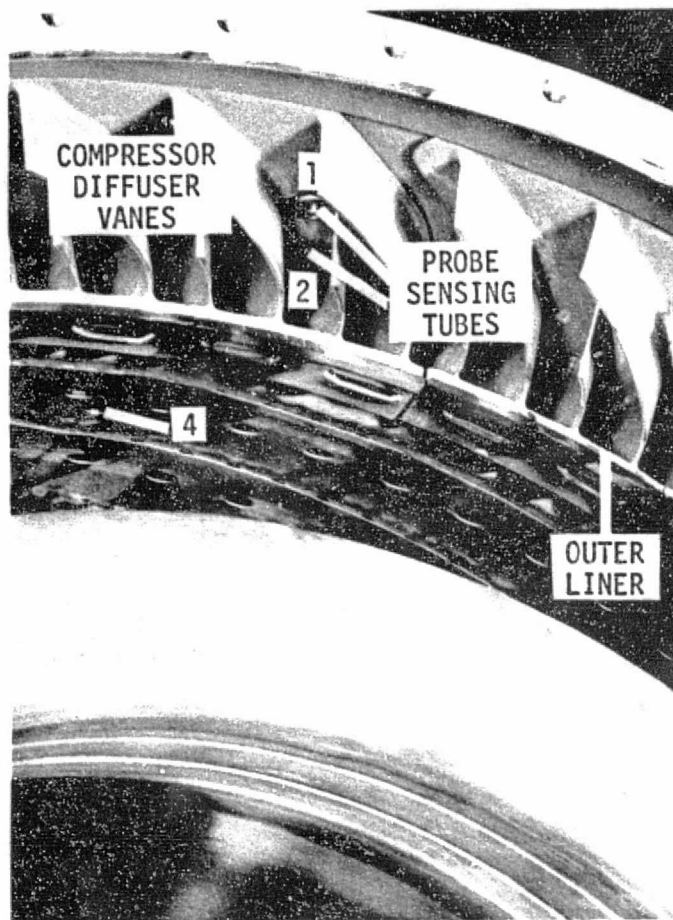


Figure 7. Probe 1, 2, and 4 Locations in the Combustion Chamber.

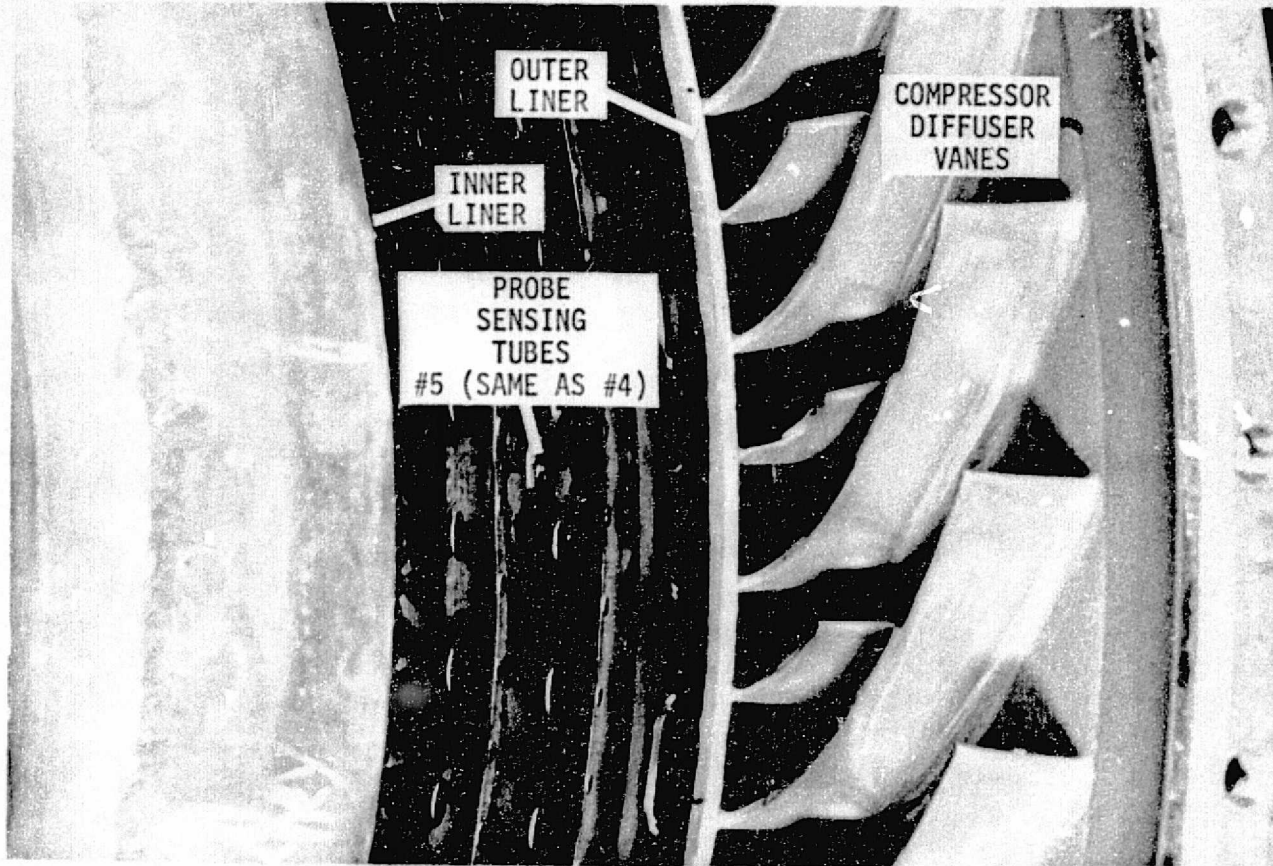


Figure 8. Probe 5 Location in the Combustion Chamber.

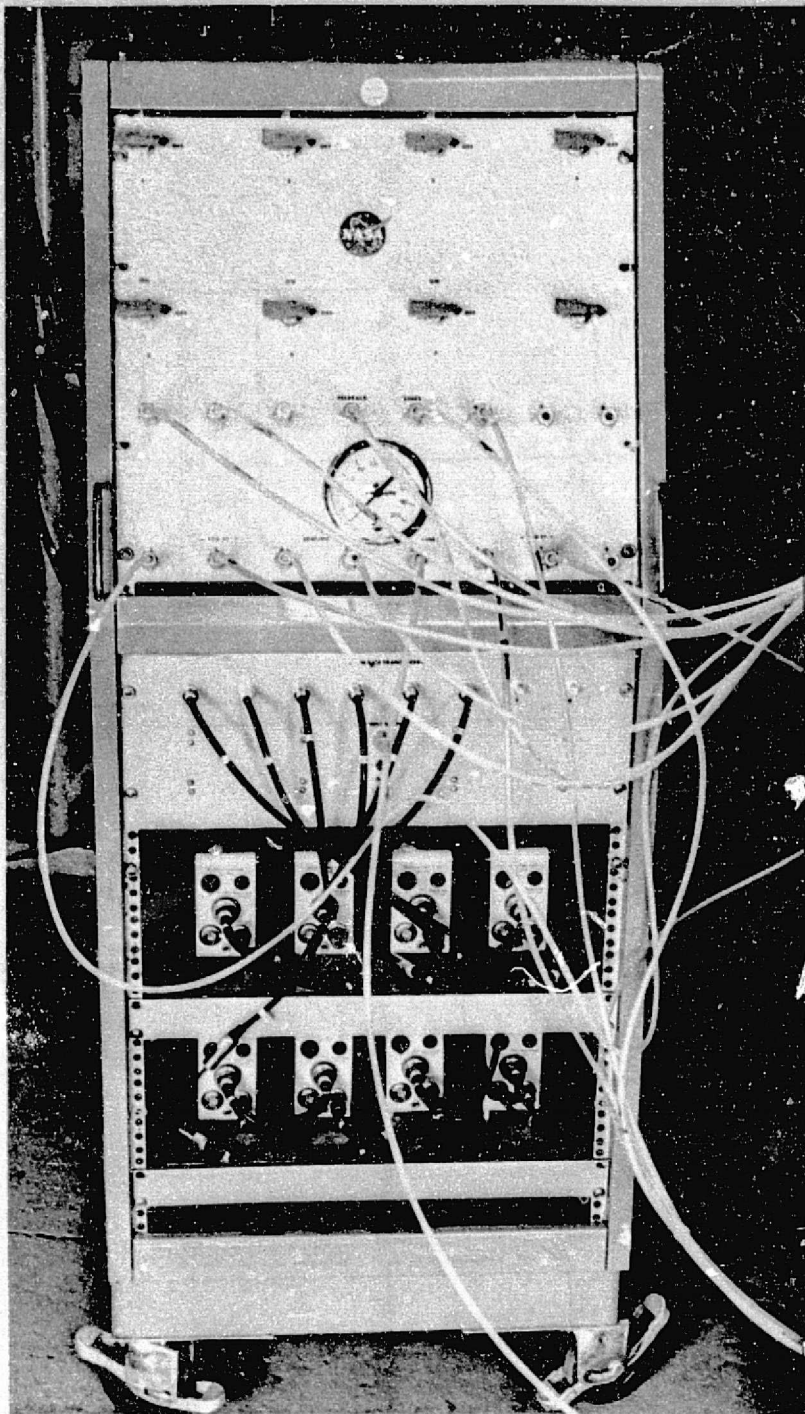


Figure 9. NASA-Furnished Instrumentation Cabinet.

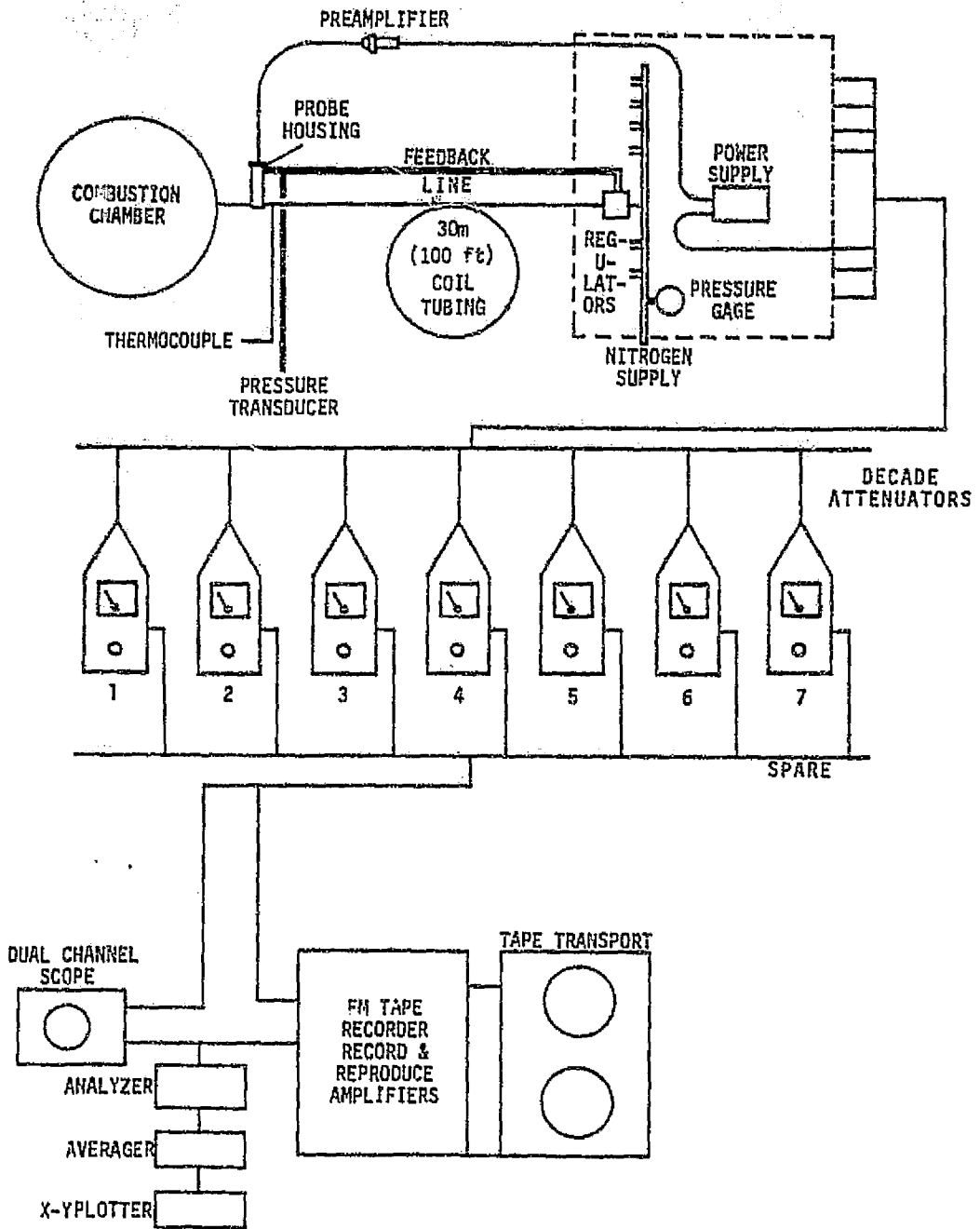


Figure 10. Acoustic Data Acquisition System Schematic.

playing back the recorded signal. Narrow band pressure level plots were generated for a selected channel during the recording phase to verify the quality of recorded signal.

Combustor Rig Instrumentation

The combustor rig was instrumented and connected to the facility data acquisition system. The pressure sensors were connected to a scanning valve arrangement whereby each of the pressure points could be sampled. The automatic data acquisition system then converts these signals into engineering units for instant readout and on punch tape for later analysis. An integration period is used to eliminate system electrical noise and input parameter periodic changes. The following combustor rig parameters were recorded:

1. Combustor inlet total (P_{t3}) and static (P_{s3}) pressure
2. Combustor exit total (P_{tex}) and static (P_{sfl}) pressure
3. Combustor inlet temperature (T_{t3})
4. Airflow rate (W_a)
5. Fuel flow rate (W_f)

The data acquisition system also calculated the fuel-air ratio. The combustor exit total temperature (T_{tex}) was later calculated by using the curves in Reference 4. The ideal exit temperature, determined by entering these curves with the fuel-air ratio and inlet temperature, was then multiplied by a burner efficiency factor of 97.5% to obtain the combustor exit total temperature.

SUMMARY OF TEST PHASE

The combustor rig was assembled, installed in the combustor test facility testway, instrumented, and functionally checked. The acoustic probes were then installed and checked in preparation for running the test rig.

Background Noise Levels

Prior to the installation of the combustor test rig, a spool piece was inserted in the testway to record the facility machinery and duct work induced flow noise. Two probes were installed in the spool piece to record the system background noise. The facility was then operated at the expected operating pressure and airflow rates and recordings of the system noise were made. After the combustor rig was installed, the test facility machinery background noise recordings were made with and without nitrogen purge flow in the wave guides.

The machinery was then started and the duct work aligned to route air to the combustor rig upstream shutoff valve. The air was bled off to the atmosphere through the system surge control valve. The background noise was recorded for this condition. The purpose of these recordings was to verify that the facility machinery and the nitrogen purge system did not contribute significantly to the dynamic pressure levels recorded in the combustor. Figure 11 is a sample of the analysis to determine the contribution of the facility machinery and purge system noise. The figure shows the background noise to be at least 20 dB below the noise generated during combustor operation.

Combustor Operating Points

The upstream and downstream valves were then opened to start the data acquisition phase. A sequence of testing was followed that required the least amount of system changes between test runs. After each test point was established, the system was allowed to stabilize before the acoustic signals were recorded. These dynamic pressure levels recordings consisted of a single segment of tape 2-minutes long. Before going to the next operating point, a narrow band pressure level spectrum was generated from one channel of the just recorded data to check on the condition of the recorded signals.

Combustor rig temperature, pressure, air and fuel flow were monitored to check for system stability and recorded for later analysis.

The tests were divided into six groups of operating points, though not necessarily recorded in that order. The grouping was designed to record the combustor dynamic pressure levels with all but one parameter duplicating the operating conditions of the YF 102 test at LeRC. Group I was the control group and attempted to duplicate the parameters recorded during the YF 102 test at LeRC. Table I contains the parameters monitored for the control group. Group II consisted of a series of tests without combustion, i.e. zero fuel flow, but with the same combustor inlet conditions recorded for the control group. The recorded operating parameters for Group II are listed in Table II. Group III consisted of the operating points predicted by a computer model of the YF 102 engine (Reference 5). The recorded operating parameters are recorded in Table III for this group. Group IV consisted of series of tests during which the airflow was varied about design airflow (Group II). See Table IV for the recorded parameters for this group. Group V consisted of series of runs during which the fuel-air ratio was varied, by varying the fuel flow, about the design conditions. The recorded operating parameters can be found in Table V for this group. The sixth group (Group VI) consisted of series of tests where the combustor inlet temperature were varied. The operating parameters are shown in Table VI for this group.

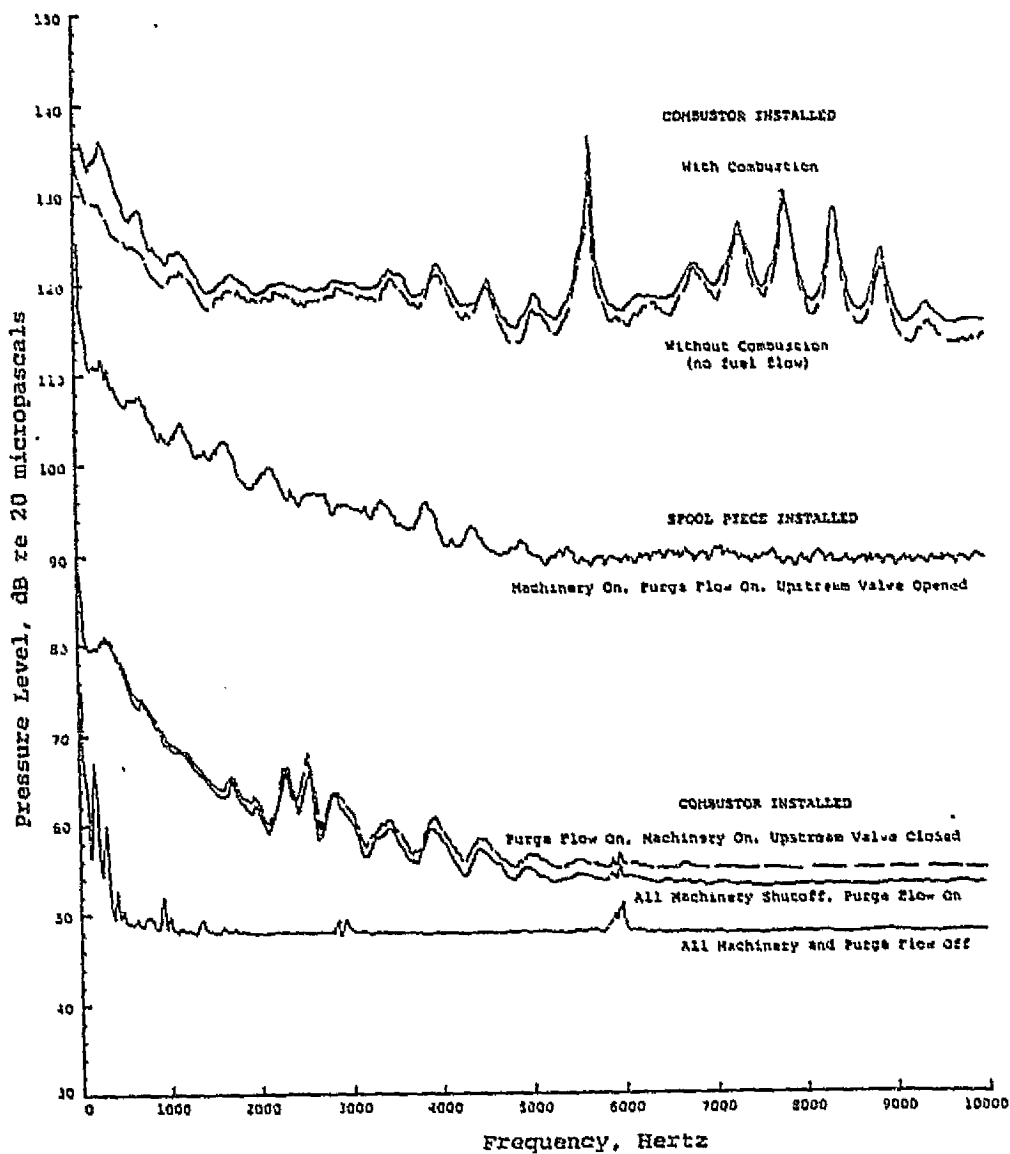


Figure 11. Comparison of Combustor Pressure Levels With Background Noise Levels.

TABLE I. COMBUSTOR RIG PARAMETERS FOR YF 102 OPERATING POINTS (GROUP I) IN INTERNATIONAL SYSTEM OF UNITS

RUN NO.	P_{t3} k Pascals	P_{s3} kpa	P_{tex} kpa	P_{bfl} kpa	T_{t3} °C	T_{tex} °C	W_a kg/sec	W_f kg/sec	W_f/W_a
2	256.28	252.83	239.93	232.76	132.5	526.8	4.921	179.0	.0101
3	312.40	308.12	292.82	287.30	147.3	550.4	5.903	221.1	.0104
6A	374.04	369.76	353.56	343.56	171.0	600.5	6.483	260.7	.0112
6B	373.62	369.28	353.28	345.08	170.3	618.7	6.400	260.7	.0113
6C	374.17	369.90	353.28	343.84	171.7	600.8	6.475	260.7	.0112
7	448.09	441.74	419.95	408.58	199.3	603.9	8.002	306.5	.0106
10	553.37	545.51	518.83	504.69	231.6	693.1	9.526	422.8	.0123

TABLE I. COMBUSTOR RIG PARAMETERS FOR YF 102 OPERATING
POINTS (GROUP I) IN U. S. CUSTOMARY UNITS

RUN No.	P_{t3} psia	P_{s3} psia	P_{tex} psia	P_{sfl} psia	T_{t3} °F	T_{tex} °F	W_a lb/sec	W_f lb/hr	W_f/W_a
2	37.17	36.67	34.80	33.76	270.5	980.3	10.850	394.6	.0101
3	45.31	44.69	42.47	41.67	297.3	1022.7	13.015	487.5	.0104
6A	54.25	53.63	51.28	49.83	339.8	1112.9	14.293	574.8	.0112
6B	54.19	53.56	51.24	50.05	338.7	1145.7	14.110	574.8	.0113
6C	54.27	53.65	51.24	49.87	341.2	1113.4	14.276	574.8	.0112
7	64.99	64.07	60.91	59.26	390.8	1119.1	17.643	675.7	.0106
10	80.26	79.12	75.25	73.20	448.9	1279.6	21.002	932.1	.0123

TABLE II. COMBUSTOR RIG PARAMETERS FOR ZERO FUEL FLOW OPERATING POINTS (GROUP II) IN INTERNATIONAL SYSTEM OF UNITS

RUN NO.	P_{t3} kpasals	P_{s3} kpa	P_{tex} kpa	P_{sfl} kpa	P_{t3} °C	W_a kg/sec
1	258.13	254.83	244.55	241.10	124.1	4.936
4	312.81	308.47	295.92	292.88	146.5	5.939
5	374.38	370.24	356.94	352.46	171.6	6.443
8	446.91	440.98	422.44	417.61	203.2	7.940
9	554.26	547.09	523.86	518.89	232.4	9.618

TABLE II. COMBUSTOR RIG PARAMETERS FOR ZERO FUEL FLOW
OPERATING POINTS (GROUP II) IN U. S. CUSTOMARY UNITS

RUN No.	P_{t3} psia	P_{s3} psia	P_{tex} psia	P_{sfl} psia	T_{t3} °F	W_a lb/sec
1	37.44	36.96	35.47	34.97	255.4	10.883
4	45.37	44.74	42.92	42.48	295.7	13.095
5	54.30	53.70	51.77	51.12	340.9	14.206
8	64.82	63.96	61.27	60.57	397.8	17.505
9	80.39	79.35	75.98	75.26	450.4	21.205

TABLE III. COMBUSTOR RIG PARAMETERS FOR COMPUTER-DEFINED
OPERATING POINTS (GROUP III) IN INTERNATIONAL SYSTEM OF UNITS

RUN NO.	P_{t3} kpa	P_{s3} kpa	P_{tex} kpa	P_{sfl} kpa	T_{t3} °C	T_{tex} °C	W_a kg/sec	W_f kg/hr	W_f/W_a
19	257.79	254.89	244.14	237.93	186.3	582.1	4.458	188.47	.0117
20	314.47	311.64	299.43	293.09	154.0	606.3	5.183	219.27	.0118
22	375.21	371.55	357.63	349.01	177.6	669.4	5.867	275.38	.0130
23	449.67	445.05	426.85	416.51	206.0	729.8	7.099	357.98	.0140
24	555.85	549.92	526.62	513.52	237.3	813.7	8.696	499.00	.0159

TABLE III. COMBUSTOR RIG PARAMETERS FOR COMPUTER.
DEFINED OPERATING POINTS (GROUP ID) IN U. S.
CUSTOMARY UNITS

RUN No.	P_{t3} psia	P_{s3} psia	P_{tex} psia	P_{tfl} psia	T_{t3} °F	T_{tex} °F	\dot{W}_a lb/sec	\dot{W}_f lb/hr	\dot{W}_f/\dot{W}_a
19	37.39	36.97	35.41	34.51	267.5	1079.7	9.829	415.5	.0117
20	45.61	45.20	43.43	42.51	309.3	1123.4	11.428	483.4	.0118
22	54.42	53.89	51.87	50.62	351.7	1237.0	12.935	507.1	.0130
23	65.22	64.55	61.91	60.41	402.9	1345.7	15.651	789.2	.0140
24	80.62	79.76	76.38	74.48	446.7	1496.7	19.173	100.1	.0159

TABLE IV. COMBUSTOR RIG PARAMETERS FOR OFF-DESIGN AIRFLOW OPERATING POINTS (GROUP IV) IN INTERNATIONAL SYSTEM OF UNITS

RUN NO.	P_{t3} kpa	P_{s3} kpa	P_{tex} kpa	P_{sfl} kpa	T_{t3} °C	T_{tex} °C	W_a kg/sec	W_f kg/hr	W_f/W_a	$\%W_a$ %
14	373.69	371.14	361.97	357.14	176.0	597.3	4.896	195.7	.0111	75.5
21	376.86	373.62	360.80	352.87	172.3	598.1	5.749	229.6	.0111	88.7
15	373.24	367.00	340.80	327.29	177.5	604.7	8.006	324.8	.0113	123.5
16	374.90	371.48	363.90	361.76	171.8	---	4.878	---	---	75.5
17	373.28	366.31	344.39	337.77	172.6	---	8.104	---	---	123.5
26	555.78	549.44	534.96	528.27	228.7	690.8	7.139	315.7	.0123	74.9
27	553.37	549.78	529.10	516.41	228.8	687.1	8.421	369.1	.0122	88.4
25	622.94	618.25	602.39	594.25	243.6	748.4	7.783	379.7	.0136	75.0
30	622.18	618.18	604.18	599.29	245.1	---	7.795	---	---	75.0

TABLE IV. COMBUSTOR RIG PARAMETERS FOR OFF-DESIGN AIRFLOW
OPERATING POINTS (GROUP IV) IN U. S. CUSTOMARY UNITS

RUN No.	P_{t3} psia	P_{s3} psia	P_{tex} psia	P_{sfl} psia	T_{t3} $^{\circ}F$	T_{tex} $^{\circ}F$	W_a lb/sec	W_f lb/hr	W_f/W_a	$\%W_a$ %
14	54.20	53.83	52.50	51.80	348.8	1107.2	10.795	431.5	.0111	75.5
21	54.66	54.19	52.33	51.18	342.2	1108.5	12.675	506.2	.0111	88.7
15	54.28	53.23	49.43	47.17	342.5	1120.5	17.652	716.0	.0113	123.5
16	54.23	53.88	52.78	52.47	341.3	---	10.754	---	---	75.5
17	54.14	53.13	49.95	48.99	342.7	---	17.867	---	---	123.5
26	80.32	79.69	77.59	76.62	443.7	1275.4	15.740	695.9	.0123	74.9
27	80.55	79.74	76.74	74.90	444.0	1268.8	18.566	813.7	.0122	88.4
25	90.35	89.67	87.37	86.19	470.5	1379.2	17.159	837.0	.0136	75.0
30	90.24	89.66	87.63	86.92	473.1	---	17.186	---	---	75.0

TABLE V. COMBUSTOR RIG PARAMETERS FOR OFF-DESIGN FUEL-AIR RATIO
OPERATING POINTS (GROUP V) IN INTERNATIONAL SYSTEM OF UNITS

RUN NO.	P_{t3} kpa	P_{s3} kpa	P_{tex} kpa	P_{sfl} kpa	T_{t3} °C	T_{tex} °C	W_a kg/sec	W_f kg/sec	W_f/W_a	$\%W_f/W_a$ %
12	374.52	370.45	356.04	348.87	172.0	395.2	6.407	129.9	.0056	50
13	373.63	369.28	351.77	319.57	172.1	801.6	6.373	389.5	.0170	152
28	554.61	547.03	522.48	511.72	231.0	473.1	9.491	211.1	.0062	50
29	553.30	545.03	514.90	495.73	229.2	888.4	9.587	629.4	.0182	148

TABLE V. COMBUSTOR RIG PARAMETERS FOR OFF-DESIGN FUEL-AIR RATIO
OPERATING POINTS (GROUP V) IN U. S. CUSTOMARY UNITS

RUN No.	P_{t3} psia	P_{s3} psia	P_{tex} psia	P_{sfl} psia	T_{t3} °F	T_{tex} °F	W_a lb/sec	W_f lb/hr	W_f/W_a	W_f/W_a %
12	54.32	53.73	51.64	50.60	341.7	743.4	14.125	286.5	.0056	50
13	54.19	53.56	51.02	49.35	341.9	1474.8	14.050	858.6	.0170	152
28	80.44	79.34	75.78	74.22	447.8	883.6	20.925	465.4	.0062	50
29	80.25	79.05	74.68	71.90	444.6	1631.2	21.136	1387.5	.0182	148

TABLE VI. COMBUSTOR RIG PARAMETERS FOR OFF-DESIGN INLET TEMPERATURE
OPERATING POINTS (GROUP VI) IN INTERNATIONAL SYSTEM OF UNITS

RUN NO.	P _{t3} kpa	P _{s3} kpa	P _{tex} kpa	P _{sfl} kpa	T _{t3} °C	T _{tex} °C	W _a kg/sec	W _f kg/hr	W _f /W _a	ΔT _{t3} °C
18	374.45	370.45	355.28	346.46	134.0	563.7	6.499	260.6	.0111	-37.0
11	373.48	368.04	349.90	340.11	276.9	650.5	6.486	262.6	.0112	55.9

TABLE VI. COMBUSTOR RIG PARAMETERS FOR OFF-DESIGN INLET
TEMPERATURE OPERATING POINTS (GROUP VI) IN U. S.
CUSTOMARY UNITS

RUN No.	P_{t3} psia	P_{s3} psia	P_{tex} psia	P_{sfl} psia	T_{t3} °F	T_{tex} °F	W_a lb/sec	W_f lb/hr	W_f/W_a	ΔT_{t3} °F
18	54.31	53.73	51.53	50.25	273.3	1046.7	14.329	574.8	.0111	-66.5
11	54.17	53.38	50.75	49.33	440.5	1202.9	14.299	578.9	.0112	100.7

DATA REDUCTION AND ANALYSIS

Description of Data and Reduction Equipment

Reduction to One-Third Octave Band Dynamic Pressure Levels -

The recorded noise signals were played back through a Hewlett-Packard 8054A Real Time Audio Spectrum Analyzer, coupled to a Digital Equipment Corporation PDP-8 Data Processor. The audio spectrum analyzer consists of 36 one-third octave band filter sets and a slow rms detector with characteristics conforming to the requirements set forth in International Electrotechnical Commission Standard "Precision Sound Level Meters" IEC 179 (1973). The dynamic range of the audio spectrum amplifier is 40 dB. An analog-to-digital converter on the data processor translates the output of the audio spectrum amplifier filter sets to equivalent discrete voltage levels with an accuracy equivalent to $\pm .5$ dB. The data processor is programmed to sweep a specific number of one-third octave bands at a rate of 42.8 bands per second for a set number of sweeps. During each sweep the data processor transforms each one-third octave band equivalent dynamic pressure level to a dynamic pressure and stores these values as a running sum for each band. At the end of the set number of sweeps, the program determines the average dynamic pressure, calculates the dynamic pressure level and applies the specific input correction value given for the attenuator settings, all for each one-third octave band. The program then prints out on a teletypewriter and on punch tape the energy average one-third octave band dynamic pressure levels for the record.

Reduction to Narrow Band Dynamic Pressure Levels - The recorded signals were then played back through a Nicolet Scientific UA6B Spectrum Analyzer and Nicolet Scientific 1015 Spectrum Averager and plotted on grid paper by an X-Y recorder. The spectrum analyzer digitizes the input signal and computes the frequency domain transform in 500 discrete lines. The rate of sampling depends upon the band width/sampling duration setting. The spectrum averager computes a running average for each of the 500 discrete lines for each sample sets, the number of samples being predetermined. After the spectrum averaging has been completed, the output feature of the averager is activated to produce an X-Y plot of the stored spectrum average values.

Mode of Analysis

One - Third Octave Band Data - Each probe record for each data point was reduced to obtain the average of 100 one-third octave band dynamic pressure levels. Tabular listing of these data are contained in Appendix A and graphical plots in Appendix B.

These tables and plots represent the average 100 sweeps by the data processor of the real time audio spectrum analyzer. In several instances the spectrum range exceeded the dynamic range of the audio

spectrum analyzer. For these runs, a second pass was required to obtain the spectrum pressure levels below the -40 dB range point. The input attenuator was readjusted to bring the remaining part of the spectrum into the dynamic range of the analyzer.

The tabular listing of the one-third octave band pressure levels were transferred to cards and fed into an IBM 360 computer. Correction values (Table VII) supplied by NASA were then added to these spectra to generate graphical plots of the one-third octave band pressure levels.

Narrow Band Data - Narrow band pressure levels were obtained for each probe and run point. Narrow band, 0 to 2000 hertz, data are contained in Appendix G. The narrow band X-Y plots represent the spectrum average of 256 samples of 500, 40 hertz wide bands.

Allowance for Correlation Analysis

The data was recorded on 25.4 mm (1-inch) magnetic tape to facilitate correlation analysis. All probes used the same head stack on the tape recorder. In addition, a 1000 Hz signal was simultaneously placed on each channel to allow any head skew error between the record and playback tape recorders to be determined.

TABLE VII. LIST OF ONE-THIRD OCTAVE BAND PRESSURE
LEVEL CORRECTION FACTORS

Combustion Chamber Inlet Pressure	257.9-312.3 kpa (37.4-45.3) psia	373.6 kpa (54.2) psia	447.5-555.0-620.5 kpa (64.9-80.5-90.0) psia
Frequency, Hz	Correction Factors, dB re 20 micropascals		
50	3.7	4.2	4.7
63	3.7	4.2	4.7
80	3.7	4.2	4.7
100	3.7	4.2	4.7
125	3.4	3.9	4.4
160	2.8	3.3	3.8
200	1.8	2.3	2.8
250	.9	1.4	1.9
315	.7	1.2	1.7
400	1.4	1.9	2.4
500	1.6	2.1	2.6
630	.5	1.0	1.5
800	2.3	2.8	3.3
1000	2.9	3.4	3.9
1250	2.8	3.3	3.8
1600	3.7	4.2	4.7
2000	4.0	4.5	5.0
2500	3.2	3.7	4.2
3150	2.9	3.4	3.9
4000	3.5	3.9	4.5

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2. Reshotko, M., et al, CORE NOISE MEASUREMENTS ON A YF 102 TURBOFAN ENGINE, American Institute of Astronautics and Aeronautics (AIAA) 77-21.
3. Karchmer A. and Reshotko, M., CORE NOISE SOURCE DIAGNOSTICS ON A TURBOFAN ENGINE USING CORRELATION AND COHERENCE TECHNIQUES, NASA Technical Memorandum TM X-73535 (1976).
4. Huntly, S.C., IDEAL TEMPERATURE RISE DUE TO CONSTANT-PRESSURE COMBUSTION OF A JP-4 FUEL, NASA RME 55G27a (1955).
5. YF 102 Performance Deck, File No. 10.01.113.07, December 21, 1976.

APPENDIX A
TABLES OF 1/3 OCTAVE BAND
PRESSURE LEVELS

Group I (Table I)	Runs 2, 3, 6A, 6B, 6C, 7, and 10
Group II (Table II)	Runs 1, 4, 5, 8, and 9
Group III (Table III)	Runs 19, 20, 22, 23, and 24
Group IV (Table IV)	Runs 14, 21, 15, 16, 17, 26, 27, 25, and 30
Group V (Table V)	Runs 12, 13, 28, and 29
Group VI (Table VI)	Runs 18 and 11

YF 102 OPERATING POINTS

GROUP 1

RUN NUMBER 2

INLET PRESS=256.3 KPA(37.2 PSIA), COMB EXIT TEMP=526.8 DEG C(980. DEG F),
 AIR FLOW=4.92 KG/SEC(10.9 #/SEC), FUEL FLOW=179. KG/HR(395. #/HR)

FREQ HZ	PROBE NO.	1	2	3	4	5	6
ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS							
50.0		133.3	130.5	126.3	132.8	130.5	141.8
63.0		133.0	129.5	126.2	133.6	132.0	140.7
80.0		135.4	134.2	134.1	137.8	137.3	140.3
100.0		136.2	134.9	135.9	140.6	140.0	141.9
125.0		135.9	135.1	136.7	140.4	139.7	143.5
160.0		133.6	131.9	132.8	137.4	136.8	146.9
200.0		133.6	132.6	134.6	138.4	138.1	146.0
250.0		134.1	133.9	136.3	139.6	139.9	138.2
315.0		136.3	137.0	139.5	142.6	143.2	143.5
400.0		136.2	137.2	140.2	143.8	144.0	139.7
500.0		134.6	135.4	138.2	141.9	141.8	139.6
630.0		132.6	133.6	136.7	141.7	141.8	139.9
800.0		132.8	133.9	138.8	143.4	143.6	140.0
1000.0		131.5	133.7	137.1	139.6	140.8	141.1
1250.0		131.3	134.2	135.8	138.8	140.2	142.6
1600.0		130.6	133.3	133.7	137.6	139.0	141.2
2000.0		131.9	132.6	132.8	137.7	138.7	142.8
2500.0		131.5	130.7	132.2	137.6	137.3	144.2
3150.0		132.2	132.9	132.8	137.4	136.8	142.8
4000.0		132.1	136.3	132.4	136.1	135.3	141.6
OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS							
		147.6	148.0	149.0	153.0	153.1	155.8

YF 102 OPERATING POINTS
GROUP I

RUN NUMBER 3

INLET PRESS=312.4 KPA(45.3 PSIA), COMB EXIT TLMP=550.4 DEG C(1023. DEG F),
AIR FLOW=5.90 KG/SEC(13.0 #/SEC), FUEL FLOW=221. KG/HR(486. #/HR)

FREQ HZ	PROBE NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		133.2	130.7	126.4	132.6	132.6	132.7
63.0		133.4	130.4	127.0	134.2	134.4	131.6
80.0		135.6	134.7	134.3	138.3	138.8	130.3
100.0		136.4	135.2	135.7	140.4	140.9	131.7
125.0		137.3	136.7	136.4	141.9	142.4	135.1
160.0		134.9	133.5	134.6	139.1	139.5	138.7
200.0		135.2	134.3	136.8	140.5	141.3	138.4
250.0		135.8	135.6	138.4	141.6	142.8	129.9
315.0		138.4	139.2	142.4	145.2	145.7	134.9
400.0		138.7	139.0	142.4	145.7	146.7	131.9
500.0		136.6	137.3	140.4	143.8	144.5	130.4
630.0		134.4	135.3	138.1	142.7	144.0	131.3
800.0		134.6	135.5	140.5	144.8	145.6	131.3
1000.0		133.0	135.0	138.6	141.0	142.9	133.0
1250.0		132.9	135.6	137.8	140.3	142.4	134.8
1600.0		131.8	134.4	135.4	138.7	141.1	132.8
2000.0		133.1	132.9	134.4	138.5	140.8	134.8
2500.0		132.9	132.2	133.8	137.9	139.3	136.8
3150.0		133.0	134.2	134.4	137.8	138.0	135.8
4000.0		133.9	137.9	134.3	136.7	136.9	138.5

OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS
149.0 146.5 150.9 154.4 155.4 148.0

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VF 102 OPERATING POINTS

GROUP 1

RUN NUMBER 6A

INLET PRESS=374.0 KPA(54.3 PSIA), (DDB EXIT TEMP=600.5 DEG C(1113. DEG F),
 AIR FLOW=6.48 KG/SEC(14.3 #/SEC), FUEL FLOW=261. KG/HR(575. #/HR)

FREQ HZ	PRLBL NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		133.8	0.0	127.8	139.7	133.6	134.8
63.0		133.7	0.0	127.7	139.9	135.4	133.4
80.0		136.4	0.0	135.7	141.9	140.1	131.6
100.0		137.6	0.0	137.5	143.2	142.3	131.8
125.0		138.9	0.0	140.7	144.4	144.4	136.2
160.0		136.6	0.0	137.2	142.1	141.8	140.0
200.0		136.4	0.0	138.4	142.6	143.0	140.7
250.0		137.4	0.0	140.6	143.8	144.5	132.9
315.0		139.3	0.0	143.4	145.8	146.5	135.6
400.0		140.1	0.0	144.1	146.8	148.1	134.5
500.0		138.1	0.0	142.1	145.2	145.9	130.7
630.0		135.5	0.0	139.3	143.6	145.2	132.3
800.0		136.1	0.0	141.4	145.5	146.5	132.8
1000.0		134.3	0.0	139.8	141.8	144.0	132.2
1250.0		134.3	0.0	139.8	141.2	143.8	135.6
1600.0		133.0	0.0	136.9	139.2	142.3	132.8
2000.0		134.3	0.0	135.8	139.0	141.7	133.7
2500.0		134.2	0.0	135.1	138.7	140.1	134.3
3150.0		135.4	0.0	135.8	138.8	138.9	134.9
4000.0		136.2	0.0	135.7	137.9	137.7	134.5
		OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		150.5	0.0	152.4	156.0	156.7	148.5

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YF 102 OPERATING POINTS

GRUPL 1

RUN NUMBER 6E

INLET PRESS=373.6 KPA(54.2 PSIA), COMB EXIT TEMP=618.7 DEG C(1146. DEG F),
 AIR FLOW=6.40 KG/SEC(14.1 #/SEC), FUEL FLOW=201. KG/HR(575. #/HR)

FREQ HZ	PRUPE NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		133.7	130.2	126.7	140.6	132.6	133.8
63.0		133.8	129.8	127.2	140.9	134.4	132.9
80.0		136.1	134.8	134.8	142.2	139.1	130.3
100.0		137.2	136.3	136.3	143.0	141.2	130.5
125.0		136.4	138.3	139.6	143.9	143.4	134.8
160.0		136.6	135.9	136.6	142.3	141.1	138.8
200.0		136.2	136.2	137.7	142.3	142.1	140.4
250.0		137.5	138.1	139.6	143.4	143.9	132.2
315.0		139.4	140.4	142.5	145.1	145.7	134.7
400.0		140.0	141.0	143.9	145.7	147.1	133.9
500.0		138.0	138.6	141.6	144.6	145.3	129.3
630.0		135.5	136.4	138.8	142.8	144.7	131.2
800.0		136.5	137.6	140.9	144.8	146.6	131.1
1000.0		134.2	136.7	139.4	140.9	143.6	130.2
1250.0		134.5	137.4	139.2	139.8	143.5	134.0
1600.0		133.2	135.7	136.1	137.1	141.2	131.5
2000.0		133.8	134.5	134.8	136.4	139.7	130.2
2500.0		133.7	133.4	134.0	136.3	136.9	129.0
3150.0		135.7	137.3	135.1	137.6	137.9	129.2
4000.0		136.8	141.6	135.4	138.1	138.6	130.2
		OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		150.5	151.5	151.8	155.5	155.9	147.0

YF 102 OPERATING POINTS

GROUP I

RUN NUMBER 6C

INLET PRESS=374.2 KPA(54.3 PSIA), COMB EXIT TEMP=600.8 DEG C(1113. DEG F),

AIR FLOW=6.48 KG/SEC(14.3 #/SEC), FUEL FLOW=261. KG/HR(575. #/HR)

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FREQ HZ	PROBE NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		133.4	129.9	126.1	138.4	132.4	133.6
63.0		133.6	129.7	126.2	138.6	133.8	132.8
80.0		136.1	134.8	134.3	140.9	138.6	130.5
100.0		137.2	136.4	136.3	142.1	140.9	130.3
125.0		138.5	138.4	139.6	143.5	143.1	134.7
160.0		136.7	136.3	136.7	141.9	141.0	139.0
200.0		136.2	136.3	137.7	142.1	141.7	140.7
250.0		137.5	138.4	140.1	143.3	143.8	132.5
315.0		139.3	140.7	142.7	144.9	145.5	135.1
400.0		140.1	141.2	143.0	145.8	147.1	134.5
500.0		136.0	138.9	141.6	144.4	144.9	129.7
630.0		135.5	136.7	136.8	142.8	144.2	132.3
800.0		136.4	137.7	141.0	144.8	146.3	132.1
1000.0		134.3	136.8	139.3	140.8	143.1	131.9
1250.0		134.4	137.5	139.3	139.8	143.2	136.3
1600.0		133.0	135.6	136.2	137.0	140.9	132.9
2000.0		133.6	135.1	134.8	136.4	139.5	135.3
2500.0		133.4	133.6	134.2	136.5	136.8	135.8
3150.0		135.7	137.5	135.3	137.7	137.7	137.6
4000.0		137.1	141.9	135.7	138.6	138.4	138.4
		OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		150.5	151.7	151.8	155.1	155.7	148.7

YF 102 OPERATING POINTS

GRUP I

RUN NUMBER 7

INLET PRESS=448.1 KPA(65.0 PSIA), COMB EXIT TEMP=603.9 DEG C(1119. DEG F),
 AIR FLOW=8.00 KG/SEC(17.6 #/SEC), FUEL FLOW=306. KG/HR(676. #/HR)

FREQ HZ	PROBE NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		135.5	132.9	130.4	140.7	135.0	145.9
63.0		135.7	132.0	129.1	141.2	136.4	145.2
80.0		137.8	135.9	135.9	142.9	140.4	142.3
100.0		139.3	138.0	138.2	144.2	142.8	142.7
125.0		140.2	139.5	141.1	145.5	145.0	146.7
160.0		139.0	137.9	138.5	144.0	142.9	150.7
200.0		138.7	138.0	139.6	144.5	144.2	152.6
250.0		139.6	140.0	141.9	145.9	146.1	144.8
315.0		141.5	142.6	145.0	147.9	148.4	146.9
400.0		142.4	143.5	145.2	148.3	149.4	146.5
500.0		140.4	141.0	143.4	147.1	147.8	141.8
630.0		138.0	138.8	141.1	145.3	146.9	144.2
800.0		138.9	140.0	142.9	147.3	149.0	143.8
1000.0		136.5	138.6	141.2	143.6	146.0	142.6
1250.0		137.2	139.7	141.8	143.1	146.3	146.9
1600.0		135.4	138.3	139.1	140.4	144.4	144.4
2000.0		136.0	137.7	137.8	139.6	142.8	143.2
2500.0		136.3	136.1	137.2	139.4	140.9	142.2
3150.0		137.8	139.2	138.6	140.7	141.5	142.4
4000.0		136.9	143.4	139.5	141.3	142.1	143.0
		OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		152.5	153.7	153.9	157.7	158.4	159.5

YF 102 OPERATING POINTS

GRUPL I

RUN NUMBER 10

INLET PRESS=553.4 KPA(80.3 PSIA), COMB EXIT TEMP=693.1 DEG C(1280. DEG F),
 AIR FLOW=5.53 KG/SEC(21.0 #/SEC), FUEL FLOW=423. KG/HR(932. #/HR)

FREQ HZ	PROBE NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		137.2	134.2	131.5	141.7	136.2	137.5
63.0		137.4	133.5	130.3	142.0	136.9	137.6
80.0		139.0	136.8	136.4	143.5	141.4	134.5
100.0		141.1	139.9	139.8	145.3	144.3	134.4
125.0		141.6	140.9	142.3	146.7	146.4	137.5
160.0		140.9	140.3	141.0	145.6	145.0	141.6
200.0		140.2	139.6	140.6	145.3	145.2	144.8
250.0		141.4	142.0	143.8	147.4	147.9	139.1
315.0		142.6	143.8	145.8	148.6	149.6	136.7
400.0		144.5	145.8	147.1	149.8	151.0	139.7
500.0		142.4	143.0	145.1	148.8	149.4	133.3
630.0		139.5	140.6	143.0	147.0	148.4	136.2
800.0		140.4	141.7	144.3	148.9	150.5	136.9
1000.0		138.2	140.6	142.7	145.8	147.7	133.6
1250.0		139.2	141.9	143.9	145.5	148.4	139.2
1600.0		137.3	140.5	141.3	142.8	146.2	136.7
2000.0		137.9	139.8	139.8	141.9	144.7	135.3
2500.0		138.4	138.2	139.2	141.6	142.8	134.8
3150.0		140.2	141.3	140.6	142.9	143.6	135.2
4000.0		141.7	145.7	141.7	143.7	144.4	135.6
		OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		155.0	156.3	155.6	159.2	160.0	151.3

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ZERO FUEL FLOW OPERATING POINTS
 GROUP II
 RUN NUMBER 1
 INLET PRESS=256.1 KPA(37.4 PSIA), COMB EXIT TEMP=124.1 DEG C(255. DEG F),
 AIR FLOW=4.94 KG/SEC(10.9 #/SEC), FUEL FLOW= C. KG/HR(C. #/HR)

FREQ HZ	PROB NO.	1	2	3	4	5	6
		CNE-THIRD	OCTAVE BAND	PRESSURE	LEVEL DB RE.	20 MICRO-PASCALS	
50.0		132.1	129.1	123.3	133.1	131.1	122.5
63.0		132.2	126.4	122.7	133.6	131.5	120.5
80.0		132.4	128.7	124.3	133.8	132.2	119.3
100.0		132.3	128.4	123.5	134.4	132.7	118.1
125.0		132.2	128.6	124.0	134.9	133.2	120.3
160.0		131.9	128.7	124.8	135.5	134.2	118.9
200.0		131.4	128.7	125.3	136.0	134.4	114.7
250.0		131.1	129.7	127.4	137.1	135.3	117.6
315.0		130.7	130.3	128.0	137.6	135.5	115.5
400.0		130.6	131.1	129.0	137.9	135.7	119.0
500.0		130.2	131.2	129.9	137.6	135.9	118.9
630.0		130.2	131.5	131.3	137.8	136.6	116.2
800.0		130.8	132.3	132.3	137.8	137.7	120.1
1000.0		130.1	132.6	131.8	136.5	137.7	117.2
1250.0		130.6	132.3	132.1	136.4	138.5	119.2
1600.0		130.0	132.7	131.6	135.9	138.4	119.7
2000.0		131.2	132.1	131.7	136.4	137.4	121.1
2500.0		130.9	130.4	131.3	136.1	135.3	120.9
3150.0		132.0	133.1	132.0	136.1	134.7	121.6
4000.0		132.1	136.5	131.7	135.2	133.2	124.3
		OVERALL PRESSURE	LEVEL, DB	RE 20 MICRO-PASCALS			
		145.4	141.6	143.2	149.5	141.8	134.5

ZERO FUEL FLOW OPERATING POINTS

GROUP II

RUN NUMBER 4

INLET PRESS=312.8 KPA(45.4 PSIA), COMB EXIT TEMP=146.5 DEG C(296. DEG F),
 AIR FLOW=5.94 KG/SEC(13.1 #/SEC), FUEL FLOW= 0. KG/HR(0. #/HR)

FREQ HZ	PRBL NO.	1	2	3	4	5	6
ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS							
50.0		132.8	130.4	124.9	134.0	133.5	124.6
63.0		132.6	129.4	123.4	134.3	134.1	122.6
80.0		133.0	130.1	126.2	134.6	134.4	121.7
100.0		132.7	129.9	125.2	135.3	134.6	121.3
125.0		133.0	129.6	124.9	135.4	134.9	122.2
160.0		132.9	129.8	125.9	136.1	135.5	122.0
200.0		132.4	129.6	126.5	136.5	135.9	118.0
250.0		132.2	130.7	128.6	137.2	136.9	120.5
315.0		132.1	131.3	129.5	137.9	137.3	117.7
400.0		132.3	132.4	130.2	138.5	137.8	121.2
500.0		131.8	132.5	131.1	138.1	137.7	122.5
630.0		131.7	132.7	132.4	138.4	138.0	121.0
800.0		132.2	133.7	133.7	138.7	139.0	127.0
1000.0		131.3	133.8	133.1	137.4	139.0	125.2
1250.0		131.4	134.7	133.6	137.8	140.1	127.1
1600.0		131.1	134.1	133.2	137.3	139.7	129.1
2000.0		132.6	133.6	133.5	137.8	139.2	133.0
2500.0		132.4	131.8	133.2	137.7	136.5	134.2
3150.0		133.4	134.0	134.1	137.6	135.3	136.9
4000.0		133.8	137.7	134.1	136.7	134.5	140.1
AVER. ALL PRESSURE LEVEL, DB RE 20 MICROPASCALS							
		140.8	147.3	144.8	150.4	150.4	144.3

ZERO FUEL FLOW OPERATING POINTS

GRUPE II

RUN NUMBER 6

INLET PRESS=374.4 KPA(54.3 PSIA), COMB EXIT TEMP=171.6 DEG C(341. DEG F),
 AIR FLOW=6.44 KC/SEC(14.2 #/SEC), FUEL FLOW= 0. KG/HR(0. #/HR)

FREQ HZ	PROBE NO.	1	2	3	4	5	6
ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS							
50.0		132.8	0.0	124.4	123.0	134.7	124.4
63.0		133.3	0.0	125.0	114.2	135.2	121.7
80.0		133.6	0.0	123.9	138.7	135.7	121.5
100.0		133.6	0.0	126.4	137.8	136.3	120.5
125.0		133.5	0.0	125.7	139.5	136.4	121.5
160.0		133.3	0.0	126.0	136.0	136.9	122.9
200.0		132.8	0.0	125.6	141.4	137.5	117.2
250.0		132.5	0.0	126.4	132.3	138.3	120.6
315.0		132.9	0.0	129.1	139.4	138.7	117.9
400.0		133.4	0.0	131.2	138.8	139.1	121.1
500.0		133.4	0.0	131.4	139.0	139.1	123.7
630.0		132.0	0.0	131.0	135.4	139.4	121.6
800.0		134.0	0.0	135.1	139.5	140.3	126.4
1000.0		133.6	0.0	135.3	139.8	140.3	125.5
1250.0		132.7	0.0	134.0	138.7	141.4	126.0
1600.0		132.3	0.0	134.3	138.9	141.0	128.4
2000.0		133.0	0.0	134.5	139.2	140.2	130.6
2500.0		133.2	0.0	133.7	142.3	137.6	133.4
3150.0		133.9	0.0	133.9	116.3	136.5	134.2
4000.0		132.7	0.0	135.7	136.7	135.6	129.2
OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS							
		147.7	0.0	145.6	151.7	151.8	143.3

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REF FUEL FLOW OPERATING POINTS

RUN NUMBER 8

INLET PRESS=446.9 KPA(64.6 PSIA), COMB EXIT TEMP=203.2 DEG C(398 F),
 AIR FLOW=7.94 M³/SEC(17.5 M³/SEC), FULL FLOW= 0. KG/HR(0. #/MIN)

FREQ HZ	PRCEN NO.	1	2	3	4	5	6	
		ONE-THIRD	OCTAVE	BAND	PRESSURE	LEVEL DB	RE. 20 MICROPASCALS	
50.0		134.8	131.6	128.4	137.7	136.7	126.8	
63.0		134.9	130.9	126.4	137.7	136.9	125.2	
80.0		135.0	131.7	128.1	138.3	137.6	124.5	
100.0		135.0	132.2	128.2	138.9	137.9	123.7	
125.0		135.9	132.1	127.3	139.4	138.3	123.5	
160.0		136.0	132.7	128.4	140.6	138.9	125.7	
200.0		135.8	133.0	128.7	141.5	139.3	119.9	
250.0		135.8	133.9	130.7	142.6	140.4	123.3	
315.0		135.9	134.6	132.4	143.4	141.1	120.7	
400.0		136.2	135.7	132.8	143.6	141.5	122.1	
500.0		135.8	135.7	133.7	142.6	141.1	126.0	
630.0		135.5	136.2	135.0	142.1	141.5	125.5	
800.0		136.2	137.7	136.2	142.0	142.9	125.8	
1000.0		135.1	137.4	136.1	140.4	142.4	126.0	
1250.0		135.5	138.4	136.6	140.2	144.0	123.9	
1600.0		134.6	137.8	136.3	139.1	143.4	126.7	
2000.0		135.5	137.3	136.5	138.8	142.2	126.4	
2500.0		135.7	138.7	136.5	139.0	138.6	126.4	
3150.0		137.5	138.9	138.2	140.9	139.0	127.2	
4000.0		136.6	140.9	139.2	141.6	139.7	131.0	
		OVERALL PRESSURE LEVEL, DB			RE 20 MICROPASCALS			
		150.3	151.5	148.0	154.2	153.9	139.9	

LEFL FUEL FLOW OPERATING PRINTS

GROUP II

RUN NUMBER 9

INLET PRESS=554.3 KPA(80.4 PSIA), COMB EXIT TEMP=232.4 DEG C(450. DEG F),
 AIR FLOW=9.62 KG/SEC(21.2 #/SEC), FUEL FLOW= C. KG/HR(D. #/HR)

FREQ HZ	PROB L.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		135.8	133.1	129.2	138.4	137.7	128.6
63.0		130.1	132.5	127.3	138.9	138.1	126.6
80.0		130.6	133.2	128.8	139.4	138.7	125.4
100.0		137.3	133.9	129.4	139.7	139.3	125.0
125.0		137.1	133.8	128.4	139.9	139.5	124.2
160.0		137.4	134.3	129.1	141.0	140.1	127.0
200.0		137.2	134.3	129.7	141.8	140.8	121.5
250.0		137.2	135.2	131.7	143.4	141.9	124.5
315.0		137.5	136.3	133.7	144.3	142.4	122.6
400.0		137.9	137.3	134.0	144.9	142.7	123.2
500.0		137.4	137.4	134.8	144.2	142.3	128.5
630.0		137.0	137.7	136.1	143.5	142.9	127.7
800.0		138.0	139.5	137.6	143.7	144.2	126.3
1000.0		136.7	139.1	137.3	141.9	143.6	127.0
1250.0		137.3	140.2	138.2	142.1	145.5	124.2
1600.0		136.1	139.6	137.7	140.9	145.4	127.1
2000.0		137.1	139.2	138.0	140.7	144.4	126.8
2500.0		137.5	137.5	137.9	140.9	141.6	125.9
3150.0		139.1	140.0	139.7	142.7	141.8	127.1
4000.0		140.4	144.1	140.8	143.5	142.3	129.2
		OVI FUEL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		150.7	153.5	149.3	155.5	155.6	140.9

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COMPUTER DEFINED OPERATING POINTS

DECEL III

RUN NUMBER 19

INLET PRESS=257.8 KPA (37.4 PSIA), COMB EXIT TEMP=582.1 DEG C (1080. DEG F),
 AIR FLOW=4.46 KG/SEC (9.8 #/SEC), FUEL FLOW=1.8. KG/HR (4.16. #/HR)

FREQ HZ	Point No.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		131.6	127.2	121.9	133.6	128.2	130.1
63.0		131.6	127.2	123.7	134.3	130.4	128.2
80.0		132.2	132.2	131.7	136.9	135.4	128.2
100.0		134.6	133.3	133.7	135.0	138.1	128.3
125.0		135.9	135.1	135.9	139.8	139.1	131.3
160.0		132.5	121.6	131.8	137.8	136.3	134.8
200.0		132.5	132.5	133.3	137.8	137.1	135.9
250.0		133.7	134.4	135.8	139.5	139.3	127.8
315.0		135.3	136.5	127.7	140.8	140.8	131.5
400.0		135.5	136.7	138.7	142.0	142.4	129.6
500.0		133.7	134.8	137.4	140.9	140.6	126.6
630.0		131.4	132.5	134.5	135.8	140.0	128.7
800.0		131.6	133.1	137.3	141.4	142.1	128.7
1000.0		130.2	132.1	135.1	137.1	138.8	128.8
1250.0		128.9	132.1	134.0	135.8	138.1	132.1
1600.0		129.2	131.4	131.1	133.6	135.9	128.8
2000.0		129.5	130.7	129.9	133.4	134.3	131.6
2500.0		129.5	129.4	129.3	133.4	131.4	132.3
3150.0		131.5	132.7	129.7	124.6	132.6	133.4
4000.0		132.7	138.1	129.4	135.2	133.2	136.5
		OVIATE PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		140.5	147.7	147.4	151.4	151.2	145.1

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COMPUTER DEFINED OPERATING POINTS

ORLEF III

RUN NUMBER 20

INLET PRESS=314.5 KPA(45.6 PSIA), COMB EXIT TEMP=606.3 DEG C(1123. DEG F),
 AIR FLOW=5.18 KG/SEC(11.4 #/SEC), FULL FLOW=239. KG/HR(483. #/HR)

FREQ HZ	PRFLE NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		135.3	128.8	123.3	135.4	129.6	131.1
63.0		135.0	128.6	124.3	135.8	131.5	129.7
80.0		135.0	133.4	132.7	138.4	136.5	128.5
100.0		135.7	134.4	134.4	139.8	138.8	128.0
125.0		137.0	136.9	137.9	141.4	141.0	132.4
160.0		134.4	133.9	134.0	139.5	138.4	136.2
200.0		134.0	134.0	134.7	139.4	139.0	137.8
250.0		135.1	135.9	137.1	140.7	140.7	129.4
315.0		137.0	138.3	139.7	142.2	142.5	132.6
400.0		137.8	138.9	140.6	143.4	144.3	131.6
500.0		135.4	136.6	138.9	142.0	142.3	127.4
630.0		135.2	134.4	135.8	140.6	141.6	129.4
800.0		133.6	135.1	138.6	142.4	143.5	129.8
1000.0		131.5	134.7	136.6	138.2	140.5	129.2
1250.0		131.7	135.0	136.1	137.0	140.3	133.0
1600.0		130.9	133.2	133.0	134.5	138.1	129.7
2000.0		131.2	132.4	131.6	134.2	136.5	132.1
2500.0		130.9	131.0	130.9	134.3	133.5	132.4
3150.0		133.2	135.8	131.6	135.6	134.5	134.4
4000.0		134.5	139.6	131.4	136.4	135.3	136.1
		OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		144.3	149.3	149.0	152.7	152.9	146.0

COMPUTER DEFINED OPERATING POINTS
GROUP III

RUN NUMBER 22

INLET PRESS=375.2 KPA(54.4 PSIA), COMB EXIT TEMP=669.4 DEG C(1237. DEG F),
AIR FLOW=5.87 KG/SEC(12.9 #/SEC), FUEL FLOW=275. KG/HR(607. #/HR)

FREQ HZ	PRIME NL.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		134.1	130.1	125.1	135.9	131.3	133.6
63.0		133.5	129.5	125.2	136.4	132.9	132.3
80.0		135.5	133.4	133.2	138.8	137.5	130.2
100.0		137.0	136.1	136.0	141.2	140.4	129.6
125.0		138.6	138.9	140.1	143.6	143.5	133.9
160.0		136.6	136.5	137.2	141.6	141.2	137.8
200.0		135.4	135.6	136.9	141.0	141.0	140.7
250.0		137.2	138.2	139.9	143.0	143.3	134.1
315.0		138.1	139.6	141.3	143.9	144.2	133.1
400.0		139.8	140.9	142.6	145.2	146.1	135.3
500.0		137.1	138.2	141.3	144.0	144.2	128.7
630.0		134.6	135.9	138.1	142.5	143.2	131.8
800.0		135.4	136.9	140.6	144.2	145.2	132.0
1000.0		133.4	136.0	138.9	140.5	142.4	130.1
1250.0		133.6	136.5	138.9	139.5	142.2	136.7
1600.0		132.0	134.6	135.2	136.6	139.5	132.6
2000.0		132.3	133.8	133.8	136.3	137.9	135.7
2500.0		132.3	133.0	133.1	135.3	135.1	136.8
3150.0		134.5	136.6	133.8	137.5	136.0	138.3
4000.0		136.3	141.3	133.6	131.3	136.9	139.6
		LEVEL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		149.7	150.9	151.2	154.5	154.8	148.5

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COMPUTER DEFINED OPERATING POINTS

GROUP III

RUN NUMBER 23

INLET PRESS=449.7 KPA(65.2 PSIA), COMB EXIT TEMP=729.8 DEG C(1346. DEG F),
 AIR FLOW=7.10 KG/SEC(15.7 #/SEC), FUEL FLOW=358. KG/HR(789. #/HR)

FREQ HZ	PRBE NO.	1	2	3	4	5	6
		ONE-THIRD	OCTAVE	BAND	PRESSURE	LEVEL DB	RE. 20 MICROPASCALS
50.0		135.3	132.1	127.6	138.6	134.3	135.6
63.0		135.3	131.3	126.7	136.8	134.6	135.4
80.0		137.1	135.3	134.1	141.0	139.2	132.4
100.0		139.3	138.5	137.8	143.4	142.4	132.0
125.0		140.5	140.7	141.9	145.6	145.4	135.6
160.0		139.4	139.5	140.2	144.3	143.9	140.0
200.0		138.1	138.2	139.3	143.3	143.3	143.6
250.0		140.1	141.1	142.8	145.8	146.2	138.9
315.0		140.5	142.0	143.7	146.2	146.7	133.5
400.0		142.3	143.7	144.6	147.3	148.6	138.0
500.0		139.6	140.7	143.7	146.3	146.8	131.5
630.0		137.1	138.4	140.8	144.7	145.9	134.3
800.0		138.0	139.5	142.3	146.3	147.7	134.3
1000.0		135.9	138.4	141.3	143.2	145.1	132.1
1250.0		136.4	139.3	142.1	142.6	145.4	138.6
1600.0		134.3	137.4	138.3	139.3	142.5	135.4
2000.0		135.0	136.7	136.7	138.7	140.9	136.3
2500.0		134.9	135.3	135.9	138.7	138.3	137.4
3150.0		137.1	139.0	136.9	140.0	139.2	139.5
4000.0		139.4	143.9	137.3	141.0	140.2	140.8
OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS							
		152.2	153.6	153.6	156.8	157.4	150.9

COMPUTER DEFINED OPERATING POINTS

GROUP III

RUN NUMBER 24

INLET PRESS=555.9 KPA(80.6 PSIA), COMB EXIT TEMP=813.7 DEG C(1497. DEG F),

AIR FLOW=8.70 KG/SEC(19.2 #/SEC), FUEL FLOW=499. KG/HR(*** #/HR)

FREQ HZ	PROBE NO.	1	2	3	4	5	6
ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS							
50.0		137.1	134.2	129.3	141.0	135.9	137.0
63.0		137.1	133.3	127.9	141.0	135.6	137.7
80.0		138.4	138.2	134.8	142.5	140.1	135.0
100.0		140.7	140.0	139.3	145.0	143.7	134.4
125.0		141.8	141.7	142.9	147.0	146.6	136.8
160.0		141.5	141.7	142.6	146.3	146.0	141.4
200.0		139.8	139.9	140.8	144.8	144.8	145.6
250.0		141.8	142.9	144.6	147.5	148.1	143.0
315.0		142.1	143.6	145.3	147.6	148.3	134.2
400.0		143.9	145.5	146.1	148.7	150.1	140.1
500.0		141.7	142.9	145.6	148.2	148.8	134.5
630.0		139.3	140.8	143.2	146.4	148.1	136.7
800.0		139.8	141.6	143.7	147.6	149.7	137.0
1000.0		138.0	140.6	143.3	145.4	147.5	134.9
1250.0		138.7	141.7	144.4	144.7	148.0	139.3
1600.0		136.4	139.7	140.6	141.1	144.9	137.9
2000.0		137.0	139.1	138.9	140.4	143.3	135.8
2500.0		136.8	137.2	138.1	140.1	140.9	135.3
3150.0		139.1	140.7	139.3	141.6	141.8	137.1
4000.0		141.2	145.4	140.0	142.5	142.7	137.9
OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS							
		154.2	155.7	155.5	158.5	159.3	152.1

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OFF DESIGN AIR FLOW OPERATING POINTS

GROUP IV

RUN NUMBER 14

INLET PRESS=373.7 KPA(54.2 PSIA), COMB EXIT TEMP=597.3 DEG C(1107. DEG F),
 AIR FLOW=4.90 KG/SEC(10.8 #/SEC), FUEL FLOW=196. KG/HR(432. #/HR)

FREQ HZ	PROBE NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		131.3	126.8	122.7	133.9	128.8	129.4
63.0		130.8	126.4	123.8	134.4	130.0	129.3
80.0		133.6	132.2	132.7	137.4	135.5	127.5
100.0		134.8	133.8	134.5	139.0	138.0	126.4
125.0		135.8	135.9	137.5	140.6	140.2	130.4
160.0		132.7	132.4	133.1	138.0	136.8	133.6
200.0		131.5	131.5	132.7	137.7	136.6	135.7
250.0		133.0	133.8	135.4	139.3	138.5	127.7
315.0		135.6	136.9	138.6	141.0	140.9	132.3
400.0		137.7	138.8	140.5	142.3	143.0	130.9
500.0		133.4	134.6	137.3	140.7	140.5	124.7
630.0		132.0	133.1	134.5	138.9	139.0	127.9
800.0		132.5	133.9	137.0	140.4	141.4	127.4
1000.0		129.9	132.4	135.0	136.7	138.2	125.0
1250.0		130.3	132.7	134.7	135.8	137.6	129.1
1600.0		129.0	130.9	131.9	133.8	135.2	126.4
2000.0		128.8	130.4	130.4	133.7	132.7	126.2
2500.0		129.3	130.1	129.0	133.4	130.2	124.7
3150.0		131.2	134.0	128.4	134.6	131.0	125.1
4000.0		133.1	139.1	128.1	134.6	132.1	124.9
		OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		146.5	147.7	147.9	151.3	151.0	142.8

OFF DESIGN AIR FLOW OPERATING POINTS

GROUP IV

RUN NUMBER 21

INLET PRESS=376.9 KPA(54.7 PSIA), COMB EXIT TEMP=598.1 DEG C(1109. DEG F),
 AIR FLOW=5.75 KG/SEC(12.7 #/SEC), FUEL FLOW=230. KG/HR(506. #/HR)

FREQ HZ	PRUBE NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		133.0	128.8	123.4	133.9	130.5	132.3
63.0		133.2	129.0	124.8	135.1	132.3	130.3
80.0		135.4	134.0	133.5	138.3	137.4	129.5
100.0		136.7	135.8	135.6	140.3	139.9	128.4
125.0		137.8	137.9	138.9	142.1	142.1	132.9
160.0		135.4	135.0	135.3	140.0	139.5	136.6
200.0		134.3	134.4	135.3	139.7	139.6	138.7
250.0		135.6	136.5	137.8	141.4	141.4	130.3
315.0		137.4	138.9	140.5	143.0	143.3	133.8
400.0		139.3	140.5	142.1	144.6	145.3	133.2
500.0		136.0	137.2	139.8	143.0	143.0	127.5
630.0		134.1	135.4	136.9	141.8	142.0	130.2
800.0		134.9	136.4	139.4	143.2	144.1	130.2
1000.0		132.6	135.2	137.5	139.3	141.1	129.5
1250.0		132.6	135.6	137.3	138.5	140.8	133.6
1600.0		131.5	133.8	134.2	136.0	138.5	130.4
2000.0		131.6	133.0	132.9	135.9	136.7	133.1
2500.0		131.6	132.1	132.1	135.8	133.8	133.5
3150.0		133.7	135.9	132.7	137.0	134.7	135.9
4000.0		135.3	140.5	132.3	137.6	135.5	136.7
		OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		146.3	150.0	150.0	153.5	153.7	146.8

OFF DESIGN AIR FLOW OPERATING POINTS

GROUP IV

RUN NUMBER 15

INLET PRESS=374.2 KPA(54.3 PSIA), COMB EXIT TEMP=604.7 DEG C(1121. DEG F),
 AIR FLOW=8.01 KG/SEC(17.7 #/SEC), FUEL FLOW=325. KG/HR(716. #/HR)

FREQ HZ	PROBE NO.	1	2	3	4	5	6
ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS							
50.0		136.8	134.1	131.3	139.8	136.1	134.6
63.0		136.8	132.9	128.8	139.9	136.7	135.2
80.0		138.4	136.3	135.9	142.0	140.9	134.3
100.0		139.6	137.7	137.4	143.0	142.8	134.4
125.0		140.0	138.8	139.7	143.9	144.1	137.0
160.0		138.9	137.4	137.6	142.5	142.6	141.7
200.0		139.5	139.0	140.4	144.2	145.2	143.4
250.0		140.1	140.4	142.2	145.0	146.9	136.2
315.0		142.8	144.0	146.4	148.6	151.0	137.5
400.0		142.7	143.7	145.7	148.7	150.6	136.8
500.0		140.6	141.0	143.2	146.6	148.5	132.8
630.0		138.2	138.8	141.4	144.3	147.5	134.2
800.0		138.8	139.8	144.1	147.2	150.2	135.6
1000.0		136.9	139.0	141.5	143.2	147.0	133.7
1250.0		137.4	140.0	141.8	142.7	147.1	137.7
1600.0		135.9	138.9	139.2	139.6	145.2	136.2
2000.0		136.4	138.7	138.1	138.6	143.9	135.2
2500.0		136.9	137.0	137.6	138.0	142.3	134.2
3150.0		138.4	139.7	138.9	138.7	143.4	134.8
4000.0		139.0	143.6	139.8	139.1	143.8	135.0
OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS							
		153.6	154.1	154.4	157.2	159.5	150.2

OFF DESIGN AIR FLOW OPERATING POINTS

GROUP IV

RUN NUMBER 16

INLET PRESS=373.9 KPA(54.2 PSIA), COMB EXIT TEMP=171.8 DEG C(341. DEG F),
 AIR FLOW=4.88 KG/SEC(10.8 #/SEC), FUEL FLOW= 0. KG/HR(0. #/HR)

FREQ HZ	PROBE NO.	1	2	3	4	5	6
ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS							
50.0		130.6	125.4	119.5	131.5	129.1	117.9
63.0		130.3	125.2	119.4	131.9	129.4	116.7
80.0		130.3	125.9	121.2	132.5	130.0	114.4
100.0		130.3	126.6	121.7	133.5	130.9	113.4
125.0		129.6	126.9	122.3	134.1	131.1	116.1
160.0		129.3	127.3	123.3	135.1	131.9	118.6
200.0		128.7	127.5	123.6	135.5	132.1	118.1
250.0		128.5	128.4	125.5	136.4	132.7	115.4
315.0		128.4	129.1	126.9	136.5	133.2	113.2
400.0		128.3	129.7	127.6	136.2	133.7	116.1
500.0		127.7	129.2	128.3	135.3	133.5	119.3
630.0		128.0	129.6	129.1	135.2	134.5	112.6
800.0		129.0	131.7	129.9	135.3	136.2	117.2
1000.0		127.4	130.9	129.0	133.7	135.4	116.7
1250.0		128.5	131.4	129.3	133.9	136.0	117.4
1600.0		128.2	130.4	128.6	133.5	134.0	119.6
2000.0		128.1	129.8	128.6	133.7	131.0	120.3
2500.0		128.7	129.6	127.7	133.2	127.4	120.8
3150.0		130.8	133.7	127.4	134.1	128.3	120.9
4000.0		132.9	138.7	126.9	133.5	129.9	123.5
OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS							
		143.3	144.8	140.1	147.7	145.9	132.5

OFF DESIGN AIR FLOW OPERATING POINTS

GROUP IV

RUN NUMBER 17

INLET PRESS=373.3 KPA(54.1 PSIA), COMB EXIT TEMP=172.6 DEG C(343. DEG F),

AIR FLOW=8.10 KG/SEC(17.9 #/SEC), FUEL FLOW= 0. KG/HR(0. #/HR)

FREQ HZ	PROBE NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		135.2	132.7	129.6	140.2	136.9	127.9
63.0		135.7	131.9	126.5	140.4	137.3	125.6
80.0		136.2	132.5	128.9	140.5	137.7	124.5
100.0		136.7	133.0	128.5	140.6	138.1	124.5
125.0		136.7	132.9	127.5	140.9	138.3	124.3
160.0		136.8	133.5	128.0	141.5	139.1	124.9
200.0		136.5	133.5	128.5	141.7	139.8	120.4
250.0		136.5	134.5	130.9	142.7	141.1	123.2
315.0		136.5	135.2	132.1	142.8	141.7	121.0
400.0		137.0	136.0	132.7	143.0	142.0	123.3
500.0		136.7	136.3	133.7	142.3	141.6	127.3
630.0		136.4	136.7	135.0	141.8	142.3	124.7
800.0		137.2	138.3	136.4	141.8	143.4	127.3
1000.0		136.1	138.1	136.4	140.2	142.6	125.7
1250.0		136.4	139.0	137.2	139.9	143.7	124.6
1600.0		135.3	138.6	136.9	138.3	144.0	125.8
2000.0		135.8	138.3	136.9	137.5	143.2	126.0
2500.0		136.7	136.8	136.8	137.1	141.4	125.6
3150.0		138.0	139.1	138.4	138.9	141.7	126.5
4000.0		138.5	142.9	139.6	140.1	142.2	128.1
		OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		151.9	152.0	148.4	154.3	154.7	139.8

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OFF DESIGN AIR FLOW OPERATING POINTS

GROUP IV

RUN NUMBER 26

INLET PRESS=553.8 KPA(80.3 PSIA), COMB EXIT TEMP=690.8 DEG C(1275. DEG F),
 AIR FLOW=7.14 KG/SEC(15.7 #/SEC), FUEL FLOW=316. KG/HR(696. #/HR)

FREQ HZ	PROBE NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		133.7	130.4	125.2	134.8	132.4	135.0
63.0		133.7	130.0	125.7	135.5	133.4	133.3
80.0		135.9	134.5	133.8	139.1	138.4	131.8
100.0		136.9	138.6	138.2	142.6	142.2	129.1
125.0		139.4	139.8	141.4	144.9	144.8	134.2
160.0		138.1	138.4	139.4	142.9	142.8	138.1
200.0		135.7	135.6	136.8	141.1	140.9	141.3
250.0		137.5	138.4	140.3	143.7	143.5	135.6
315.0		128.8	140.2	142.1	144.7	144.7	133.9
400.0		142.8	144.4	145.3	147.3	147.7	137.8
500.0		138.1	139.1	141.7	145.5	145.0	128.8
630.0		135.9	137.5	139.1	144.1	143.4	131.4
800.0		137.1	138.7	140.9	145.4	145.5	132.0
1000.0		134.0	136.8	139.1	142.2	142.7	129.0
1250.0		134.7	137.4	140.2	141.8	142.9	134.5
1600.0		133.1	135.7	136.9	139.2	140.2	131.5
2000.0		133.2	134.9	135.4	139.0	138.1	132.0
2500.0		133.0	134.0	134.2	138.5	135.3	131.6
3150.0		135.4	137.4	134.6	139.3	136.1	133.4
4000.0		138.1	142.9	134.1	140.0	137.2	134.1
		OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		150.5	152.3	152.3	155.8	155.6	148.0

OFF DESIGN AIR FLOW OPERATING POINTS

GROUP IV

RUN NUMBER 27

INLET PRESS=555.4 KPA(80.6 PSIA), COMB EXIT TEMP=687.1 DEG C(1269. DEG F),
 AIR FLOW=8.42 KG/SEC(18.6 #/SEC), FUEL FLOW=369. KG/HR(814. #/HR)

FREQ HZ	PROBE NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		136.2	132.9	127.7	140.1	134.4	136.5
63.0		136.2	132.5	127.4	140.4	135.3	135.4
80.0		137.6	135.7	134.4	142.1	139.6	132.9
100.0		140.0	139.3	138.6	144.2	143.1	131.7
125.0		140.7	140.5	141.7	145.8	145.5	135.8
160.0		139.6	139.5	140.1	144.3	143.9	139.8
200.0		138.2	137.9	138.7	143.4	143.2	143.2
250.0		139.6	140.4	142.1	145.4	145.6	137.3
315.0		140.7	142.2	143.9	146.3	147.0	135.3
400.0		143.5	145.0	145.7	148.0	149.3	138.8
500.0		140.8	141.6	143.9	146.6	147.4	131.2
630.0		137.8	139.3	141.2	144.8	145.1	134.1
800.0		139.2	140.8	142.6	146.5	148.1	134.0
1000.0		136.6	139.2	141.3	143.1	145.4	131.9
1250.0		137.3	140.3	142.3	142.8	146.0	137.4
1600.0		135.5	138.6	139.2	139.6	143.4	134.4
2000.0		136.1	137.8	137.8	138.9	141.8	134.1
2500.0		135.8	136.1	137.0	138.8	139.2	133.7
3150.0		138.1	139.4	138.2	140.0	140.0	135.1
4000.0		140.5	144.4	138.8	141.3	141.1	135.6
		OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		153.1	154.4	154.0	157.2	157.8	149.8

OFF DESIGN AIR FLOW OPERATING POINTS

GROUP IV

RUN NUMBER 25

INLET PRESS=622.9 KPA(90.4 PSIA), COMB EXIT TEMP=748.4 DEG C(1379. DEG F),

AIR FLOW=7.78 KG/SEC(17.2 #/SEC), FUEL FLOW=380. KG/HR(837. #/HR).

FREQ HZ	PROBE NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		134.5	131.3	126.4	135.6	132.8	146.1
63.0		134.4	130.9	126.1	136.1	134.0	144.6
80.0		136.3	134.8	134.0	139.4	138.7	143.8
100.0		140.2	139.9	139.4	143.7	143.4	141.2
125.0		140.4	140.9	142.4	145.8	145.8	144.9
160.0		139.7	140.2	141.2	144.3	144.3	148.6
200.0		136.7	136.7	137.9	141.7	141.7	151.1
250.0		139.0	139.9	141.6	144.6	144.3	149.3
315.0		139.5	140.9	142.4	145.0	145.2	142.7
400.0		143.6	145.2	145.9	147.9	148.1	149.0
500.0		139.3	140.3	142.9	146.4	145.9	140.9
630.0		136.8	138.5	140.0	144.9	144.2	142.8
800.0		137.9	139.6	141.6	146.2	146.3	143.7
1000.0		135.0	137.7	140.0	143.3	143.8	140.8
1250.0		135.6	138.4	141.2	142.7	143.9	145.5
1600.0		133.9	136.6	137.7	139.9	140.8	143.4
2000.0		134.0	135.6	136.3	139.8	138.8	142.6
2500.0		133.8	134.8	135.0	139.3	135.9	142.5
3150.0		136.4	138.3	135.3	140.1	136.9	143.6
4000.0		139.2	143.8	134.8	140.7	137.9	144.6
		OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		151.8	153.3	153.2	156.6	156.4	158.9

OFF DESIGN AIR FLOW OPERATING POINTS

GROUP IV

RUN NUMBER 30

INLET PRESS=622.2 KPA(90.2 PSIA), COMB EXIT TEMP=245.1 DEG C(473. DEG F),
 AIR FLOW=7.80 KG/SEC(17.2 #/SEC), FUEL FLOW= 0. KG/HR(0. #/HR)

FREQ HZ	PROBE NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		132.8	129.0	122.7	135.9	133.2	123.2
63.0		132.5	128.8	122.9	136.5	133.7	122.4
80.0		133.1	129.2	124.4	136.9	134.2	120.0
100.0		133.6	130.1	125.4	137.9	135.2	118.9
125.0		133.4	130.3	125.6	138.4	135.4	119.4
160.0		133.2	131.0	126.6	139.4	136.0	125.0
200.0		133.0	131.0	127.2	139.4	136.2	117.9
250.0		132.9	131.9	128.9	140.0	136.7	120.6
315.0		133.1	133.1	130.8	140.1	137.5	119.2
400.0		133.3	133.9	131.5	139.9	138.2	119.4
500.0		132.6	133.7	132.1	138.6	137.8	123.2
630.0		132.4	134.0	133.1	138.0	138.4	124.2
800.0		133.6	136.2	134.4	138.6	140.6	123.4
1000.0		132.1	135.5	133.4	136.5	140.2	127.0
1250.0		132.9	136.1	134.2	136.7	141.3	122.0
1600.0		132.5	135.3	133.4	135.5	139.9	128.2
2000.0		132.8	134.5	133.8	136.0	137.2	128.6
2500.0		132.6	133.7	133.6	135.8	133.6	129.6
3150.0		135.3	137.4	134.2	137.2	134.0	129.7
4000.0		137.7	142.2	133.4	138.6	135.4	133.2
		OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		147.7	149.3	144.9	151.3	150.6	140.1

OFF DESIGN FUEL TO AIR RATIO OPERATING POINTS
 GROUP V RUN NUMBER 12
 INLET PRESS=374.5 KPA(54.3 PSIA), COMB EXIT TEMP=395.2 DEG C(743. DEG F),
 AIR FLOW=6.41 KG/SEC(14.1 #/SEC), FUEL FLOW=130. KG/HR(287. #/HR)

FREQ HZ	PRUEE NO.	1	2	3	4	5	6
ONE-THIRD OCTAVE BAND FRESSURE LEVEL DB RE. 20 MICROPASCALS							
50.0		133.3	129.4	125.0	141.2	132.0	128.3
63.0		133.3	128.9	124.1	140.7	133.0	127.8
80.0		134.1	131.2	129.7	141.0	135.1	126.8
100.0		134.6	132.1	130.6	140.9	136.2	127.1
125.0		134.7	132.6	132.1	140.6	137.0	129.3
160.0		133.9	131.8	129.7	139.9	136.2	133.7
200.0		133.6	132.4	131.5	139.6	137.4	131.6
250.0		134.3	134.0	134.3	140.4	139.1	125.5
315.0		137.4	138.4	139.8	143.3	144.1	132.3
400.0		137.1	138.1	138.7	142.6	143.9	126.4
500.0		134.7	135.5	136.2	140.5	141.7	127.5
630.0		134.7	135.8	136.7	141.2	142.6	126.1
800.0		134.9	136.6	137.1	141.6	143.4	128.1
1000.0		133.6	136.1	137.2	139.1	141.9	131.2
1250.0		133.6	136.9	137.0	138.3	142.2	131.1
1600.0		132.9	135.7	135.4	136.2	140.9	128.8
2000.0		133.6	134.8	134.3	136.0	139.3	128.8
2500.0		133.4	133.2	133.7	135.8	136.4	127.8
3150.0		135.6	137.1	135.0	137.2	137.6	127.1
4000.0		136.5	141.2	135.1	137.7	138.1	126.9
OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS							
		146.9	150.0	148.4	153.5	153.3	142.7

OFF DESIGN FULL TO AIR WATER OPERATING POINTS

GROUP V

RUN NUMBER 13

INLET PRESS=373.6 KPA (54.2 PSIA), COMB EXIT TEMP=801.6 DEG C (1475. DEG F),
 AIR FLOW=6.37 KG/SEC (14.1 #/SEC), FUEL FLOW=30.9 KG/HR (68.9 #/HR)

FREQ HZ	PRUEL NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		134.2	130.7	127.5	137.1	133.3	133.6
63.0		134.2	129.9	126.3	137.1	133.6	135.2
80.0		136.0	134.3	134.2	139.7	138.6	133.1
100.0		137.4	136.0	136.3	141.6	140.9	131.5
125.0		139.3	139.4	140.9	144.3	144.0	134.5
160.0		139.5	138.6	139.9	143.7	143.6	139.7
200.0		137.5	137.4	139.2	142.6	142.7	143.8
250.0		139.7	140.7	142.8	145.6	145.4	139.8
315.0		139.9	141.3	143.3	145.8	146.2	132.2
400.0		140.3	141.4	143.0	146.1	147.2	136.8
500.0		138.3	139.2	142.6	145.6	145.9	131.4
630.0		136.1	137.0	140.2	144.5	145.9	133.4
800.0		136.7	137.6	141.6	145.7	147.0	133.7
1000.0		135.1	137.1	141.4	143.4	145.1	131.7
1250.0		135.0	137.0	141.2	142.2	144.8	135.4
1600.0		133.2	135.9	136.5	139.3	142.0	134.0
2000.0		133.7	135.2	134.9	138.7	140.0	132.6
2500.0		133.0	133.6	134.0	138.5	137.7	132.1
3150.0		133.7	137.8	135.1	139.6	138.7	132.7
4000.0		137.4	142.7	135.2	139.6	139.2	132.6
		OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		151.7	152.3	152.8	156.1	156.8	149.3

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OFF DESIGN FUEL TO AIR RATIO OPERATING POINTS

GROUP Y

RUN NUMBER 26

INLET PRESS=554.6 KPA (80.4 PSIA), COMB EXIT TEMP=473.1 DEG C (884. DEG F),
 AIR FLOW=9.49 KG/SEC (20.9 #/SEC), FUEL FLOW=211. KG/HR (465. #/HR)

FREQ HZ	PRBL NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		135.4	132.6	128.1	130.6	134.9	133.2
63.0		136.0	132.4	127.0	131.9	136.1	131.4
80.0		137.4	134.9	132.5	136.2	138.6	130.9
100.0		138.9	137.1	135.5	138.9	141.0	130.3
125.0		138.4	136.5	136.0	139.4	141.4	133.4
160.0		138.0	135.7	133.9	137.1	140.0	137.3
200.0		137.9	136.2	135.6	138.6	141.5	137.8
250.0		138.0	137.3	137.7	140.0	143.1	128.8
315.0		140.6	141.7	143.6	145.0	147.9	137.2
400.0		142.7	144.0	145.1	146.9	149.2	132.7
500.0		139.6	140.0	140.6	143.0	146.3	131.8
630.0		138.7	139.8	141.1	142.7	146.4	132.0
800.0		140.1	141.5	141.8	144.8	147.8	132.7
1000.0		137.7	139.9	140.7	141.4	145.6	135.2
1250.0		137.9	140.7	141.4	140.9	146.4	136.5
1600.0		136.5	139.7	139.7	138.3	145.1	134.1
2000.0		137.0	139.2	138.8	137.4	143.8	134.5
2500.0		137.1	137.3	137.9	136.5	141.5	134.2
3150.0		138.8	139.9	139.0	137.2	142.3	135.2
4000.0		140.6	144.5	139.5	138.7	143.2	135.7
		CYCLE PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		152.9	154.5	152.8	154.2	157.6	147.8

OFF DESIGN FUEL TO AIR RATIO OPERATING POINTS

GROUP V

RUN NUMBER 29

INLET PRESS=553.3 KPA(80.3 PSIA), COMB EXIT TEMP=885.4 DEG C(1631. DEG F),
AIR FLOW=9.59 KG/SEC(21.1 #/SEC), FUEL FLOW=629. KG/HR(**** #/HR)

FREQ HZ	PROB NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		136.0	134.6	131.4	136.0	136.4	136.6
63.0		138.5	133.7	128.8	135.8	136.7	137.6
80.0		139.2	136.3	134.7	139.4	140.2	137.6
100.0		141.7	140.5	139.7	143.4	144.3	135.9
125.0		142.3	141.9	142.6	145.6	146.6	137.6
160.0		142.6	142.6	143.2	145.7	146.6	142.1
200.0		141.2	141.1	142.0	144.4	145.7	146.8
250.0		143.4	144.4	145.6	147.6	149.4	145.4
315.0		144.2	145.8	147.1	148.7	150.7	136.6
400.0		145.0	146.6	147.0	149.2	151.3	141.4
500.0		142.9	144.0	146.5	148.6	150.1	136.9
630.0		140.9	142.2	145.0	146.9	149.5	138.3
800.0		141.3	143.0	145.1	148.0	151.3	139.4
1000.0		140.2	142.8	144.6	146.5	149.7	137.6
1250.0		140.4	143.6	145.7	145.9	149.8	140.9
1600.0		138.3	141.9	142.2	141.9	147.1	140.2
2000.0		138.8	141.3	140.3	140.8	145.8	138.2
2500.0		138.6	139.0	139.6	139.9	143.5	137.6
3150.0		140.5	142.0	140.7	141.2	144.7	139.3
4000.0		143.4	147.6	141.6	142.5	145.6	140.3
		OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		156.3	157.7	156.7	158.5	160.9	153.7

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OFF DESIGN COMBUSTOR INLET TEMPERATURE OPERATING POINTS

GROUP VI

RUN NUMBER 18

INLET PRESS=374.5 KPA(54.3 PSIA), COMB EXIT TEMP=563.7 DEG C(1047. DEG F),

AIR FLOW=6.50 KG/SEC(14.3 #/SEC), FUEL FLOW=261. KG/HR(575. #/HR)

FREQ HZ	PROBE NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		133.4	129.7	125.9	136.2	131.6	134.0
63.0		133.7	129.9	128.0	137.4	134.1	132.0
80.0		136.7	135.7	135.8	140.3	139.2	130.4
100.0		137.2	136.3	137.1	141.9	141.3	130.4
125.0		139.0	139.1	140.3	143.4	143.2	135.1
160.0		136.3	135.9	136.8	141.7	141.1	139.8
200.0		136.4	136.8	138.4	142.2	142.3	140.7
250.0		137.6	138.4	140.3	143.5	143.8	131.3
315.0		139.4	140.9	142.7	145.2	145.5	135.3
400.0		139.8	141.0	143.3	146.1	147.0	133.4
500.0		137.6	138.5	141.0	144.1	144.4	130.2
630.0		135.4	136.4	138.3	143.2	143.9	131.6
800.0		135.7	137.0	140.9	144.7	145.7	131.6
1000.0		133.8	136.3	139.0	140.4	142.4	131.3
1250.0		133.4	136.6	137.8	139.0	142.0	134.1
1600.0		132.6	134.9	134.9	136.8	140.0	131.6
2000.0		133.0	134.1	133.7	136.4	138.2	132.1
2500.0		132.9	132.9	133.2	136.4	135.4	131.5
3150.0		135.2	137.2	134.3	137.7	136.5	133.4
4000.0		136.4	141.6	134.3	138.3	137.1	133.2
		OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		150.3	151.5	151.7	155.0	155.4	147.6

OFF DESIGN COMBUSTOR INLET TEMPERATURE OPERATING POINTS
 GROUP VI RUN NUMBER 11
 INLET PRESS=373.5 KPA(54.2 PSIA), COMB EXIT TEMP=650.5 DEG C(1203. DEG F),
 AIR FLOW=6.49 KG/SEC(14.3 #/SEC), FUEL FLOW=263. KG/HR(579. #/HR)

FREQ HZ	PROBE NO.	1	2	3	4	5	6
		ONE-THIRD OCTAVE BAND PRESSURE LEVEL DB RE. 20 MICROPASCALS					
50.0		134.7	131.7	127.6	128.4	132.6	133.1
63.0		135.0	131.1	126.3	130.0	134.1	133.1
80.0		136.1	133.6	132.8	135.6	138.0	130.5
100.0		137.7	136.2	135.8	138.8	140.5	130.8
125.0		138.1	137.2	138.3	140.9	142.6	134.3
160.0		136.9	135.9	136.1	138.8	140.9	137.8
200.0		136.3	135.5	136.1	138.9	141.3	140.2
250.0		136.9	137.3	138.6	140.6	143.3	133.3
315.0		138.4	139.7	141.7	143.2	145.3	133.9
400.0		140.0	141.3	142.8	144.5	147.1	134.9
500.0		138.1	138.7	140.9	142.9	145.6	129.5
630.0		135.6	136.7	138.8	140.3	144.6	131.1
800.0		136.6	137.9	140.3	143.2	146.5	131.4
1000.0		134.4	136.7	138.6	139.5	143.8	130.1
1250.0		135.0	137.8	139.8	139.4	144.5	135.0
1600.0		133.2	136.5	137.1	135.5	142.6	132.3
2000.0		133.9	136.1	135.8	134.3	141.1	130.9
2500.0		134.2	134.3	135.1	134.2	139.2	129.9
3150.0		135.5	136.9	136.4	135.0	139.8	129.8
4000.0		136.4	140.6	136.9	136.1	140.4	130.6
		OVERALL PRESSURE LEVEL, DB RE 20 MICROPASCALS					
		150.4	151.6	151.3	152.8	156.1	147.0