FINAL REPORT

SPACE STATION AUXILIARY

THRUST CHAMBER TECHNOLOGY

BY

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONTENTS

ILLUSTRATIONS

TABLE

Foreword

Bell Aerospace Textron submits this Final Report as part of the Space Station Auxiliary Thrust Chamber Technology Program, Contract NAS 3-24883.

The work was conducted under the cognizance of Mr. G. Paul Richter of NASA Lewis Research Center who was the Contract Project Manager. Bell personnel include: John M. Senneff, Program Manager; Arthur M. Gorbaty, Design Leader; and Edgar R. Vollaro, Test Director.

Abstract

A program to design, fabricate and test a 50 lb_f (222 N) thruster was undertaken (Contract NAS 3-24656) to demonstrate the applicability of the "reverse flow" concept as an item of auxiliary propulsion for the Space Station. The thruster was to operate at a mixture ratio (O/F) of 4, be capable of operating for 2 million lb_f-seconds (8.896 million N-seconds) impulse with a chamber pressure of 75 psia (52 N/cm^2) and a nozzle area ratio of 40. A successful demonstration of the (O/F) of 4 thruster, was followed by the design objective of operating at an (O/F) of 8. The demonstration of this thruster resulted in the order of an additional (O/F) of 8 thrust chamber under the present NAS 3-24883 contract. This report is to document the effort to fabricate and test the second (O/F) of 8 thruster on contract NAS 3-24883.

SUMMARY

A program to evaluate a gaseous-hydrogen and gaseous-oxygen-fueled reverse-flow thruster for the Space Station Auxiliary Propulsion System was initially undertaken with the design, fabrication and testing of a 50 lb_f (222N) thrust rocket engine under contract NAS 3-24656. The thruster was designed to operate at 75 psia (52 N/Cm^2) chamber pressure, and a mixture ratio (O/F) of 4 with a 40 to 1 nozzle area ratio. The objective was to demonstrate a duration capability of 2 million lb_f-second (8.896 million N-seconds) total impulse.

The original program included tasks for preliminary and detailed design, fabrication, acceptance testing, duration testing and reporting. Four additional tasks were added to the program when other NASA studies indicated a requirement to operate the thrusters at a mixture ratio of 8 instead of the initially selected mixture ratio of 4. This program was completed and has been reported in NASA CR-179552.

The current program was to duplicate the thrust chamber designed in contract NAS 3-24656 at an (O/F) of 8. The effort included the fabrication and acceptance testing of this thrust chamber. Also included was a task to update the drawings of the original contract which were not completed in the rush to test and evaluate feasible operation at the higher mixture ratio.

The acceptance test of this second thrust chamber was completed and the test results are included in this report. New to this test program were pulse tests (200 milliseconds to 40 milliseconds long), conducted to examine the rapidity of pulses capable with present valve and ignition components. The results of all tests are included in this report.

INTRODUCTION

The manned Space Station will require an Auxiliary Propulsion System (APS) for attitude control, orbit positioning, and docking maneuvers. The selection of an optimum APS for the Space Station is a complicated issue, considering propellant selection, thrust size, and operating conditions. The reverse flow thruster concept has been considered to be a viable candidate for use with the gaseous hydrogen, gaseous oxygen propellant system and a 50 lb_f (222N) thruster was demonstrated during a recently completed NAS 3-24656 contract (NASA CR-179552).

Design details and the testing data to achieve both the r=4 and r=8 thruster designs are reported in NASA CR179552 while additional testing was originally suggested for the present NAS3-24883 contract. Although additional testing was suggested, only those tasks which included the fabrication and acceptance testing of the new thruster were included. This effort did include the update of drawings which were not completed during the rush to demonstrate the r=8 thruster during the NAS 3-24656 contract.

The three tasks agreed on were:

Task I - Thrust Chamber Fabrication

Task II - Proof Testing and Delivery

Task V - Reports

Since this program was essentially one to duplicate the original thruster, the techniques originally used in fabrication and test were duplicated for the second unit. The acceptance test data obtained is included in the appendix of this report.

The 50 lbf Thruster Design

The design of this thruster has been described in detail in NASA CR 179552. Some of that description has been included in this report to add clarity to the tasks reported.

The reverse flow thruster designed for this application is shown in Figure 1. The basic components of this thruster are the spherical chamber (combustor), the vortex oxidizer swirl cup, the nozzle (including the regen-cooled throat and the fuel inlet) and the nozzle extension. Other components include the spark plug igniters (the exciter and lead are now shown) with auxiliary oxidizer cooling and the propellant valves. Photographs of the test hardware in Figure 2 show both the components and the thruster assembly. The drawing list for the r=8 thruster is included as Table 1.

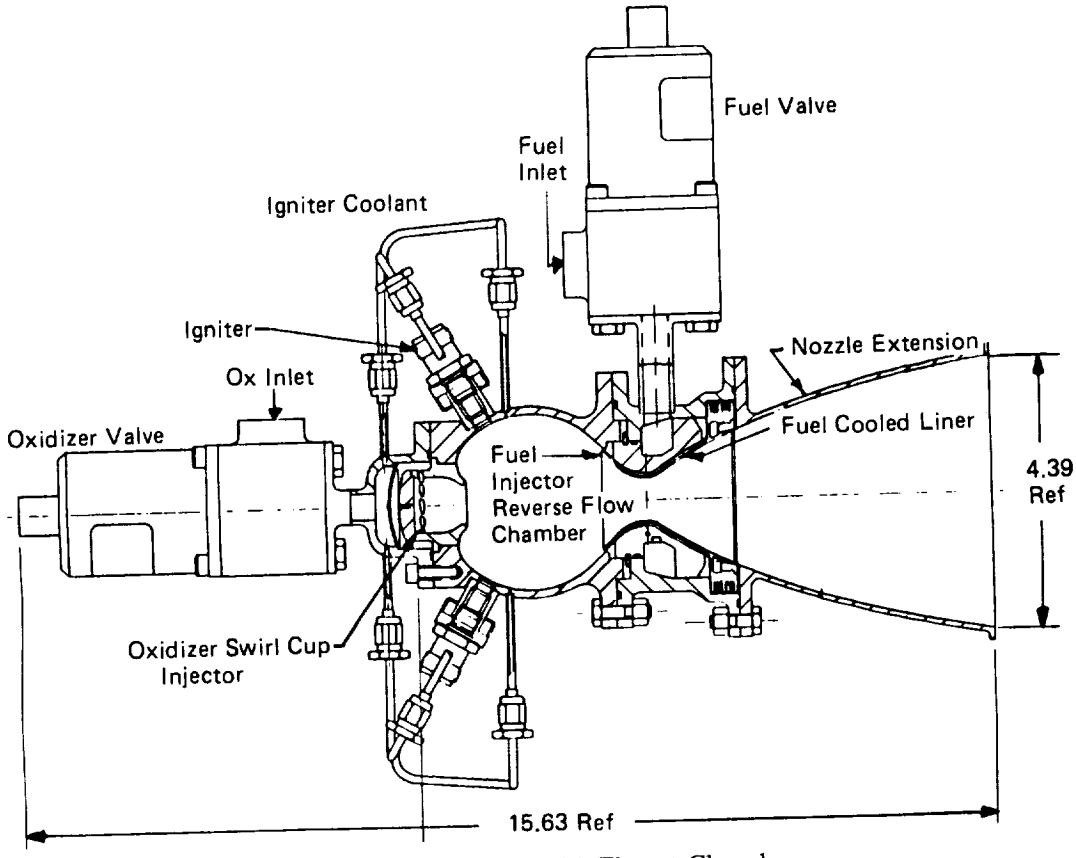
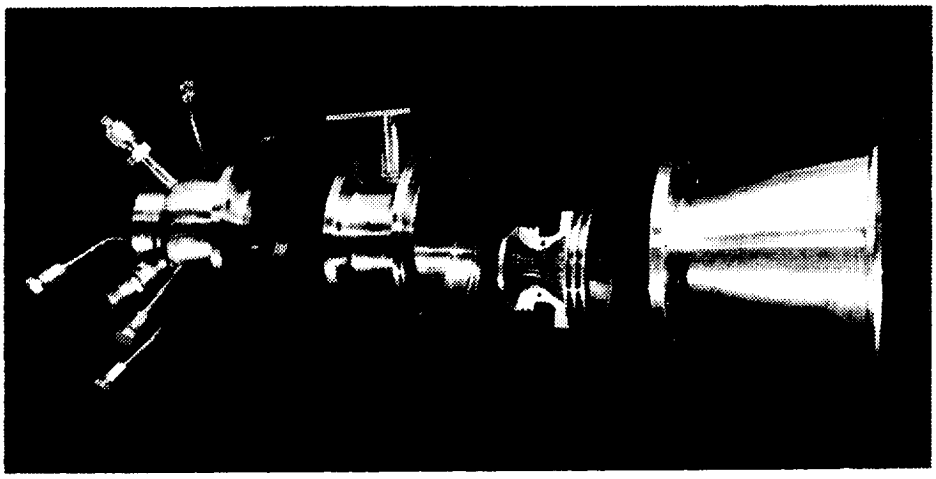


Figure 1. Model 8911 Thrust Chamber



(Exploded View)

(Assembled)

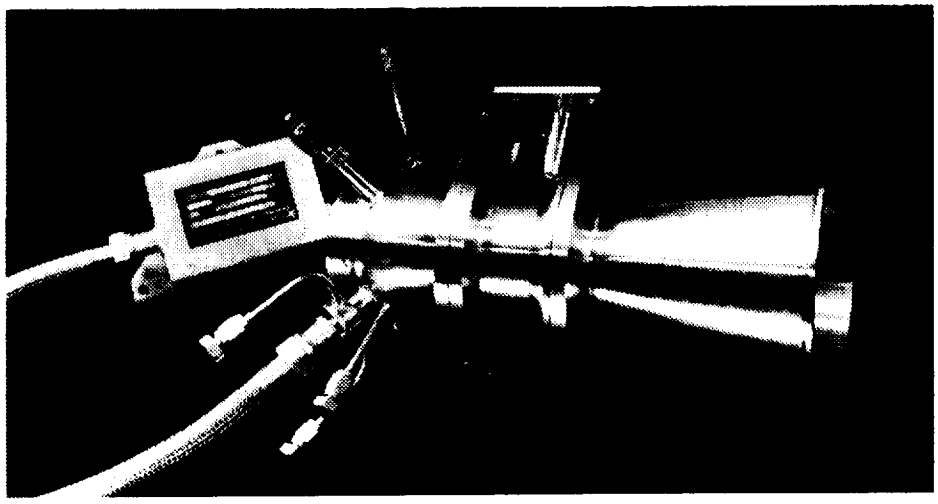


Figure 2. Model 8911 Thruster

TABLE 1. DRAWING LIST

8911-470021	Engine Assembly 50 Lbf - O_2/H_2 M.R. = 8
8911-470002	Nozzle Extension
8911-470003	Coolant/Augmentation Tube Assemblies
8911-470024	Fuel Manifold Assembly
8911-470005	Split Shroud
8911-470006	Nozzle Liner Assembly
8911-470027	Oxidizer Injector Subassembly
8911-470028	Oxidizer Inlet Subassembly
8911-470009	Chamber Subassembly
8911-470030	Chamber Assembly
8911-470011	Igniter Boss Assembly
8911-470012	Adapter, Chamber Pressure (Propellant Valves)
12350	Wright Components Inc.
FHE 297-1	Igniter
45582	Simmonds Exciter

The fuel inlet and nozzle design is shown in Figure 3. The propellant enters the nozzle at midsection and is routed aft to enter both the divergent nozzle film coolant manifold and the nozzle regeneratively-cooled passages. H_2 flows through these cooling passages and out the fuel injection orifices, as indicated in Figure 3 and Figure 4. The fuel then passes openly along the spherical chamber wall until turned into the oxidizer stream at the head of the chamber.

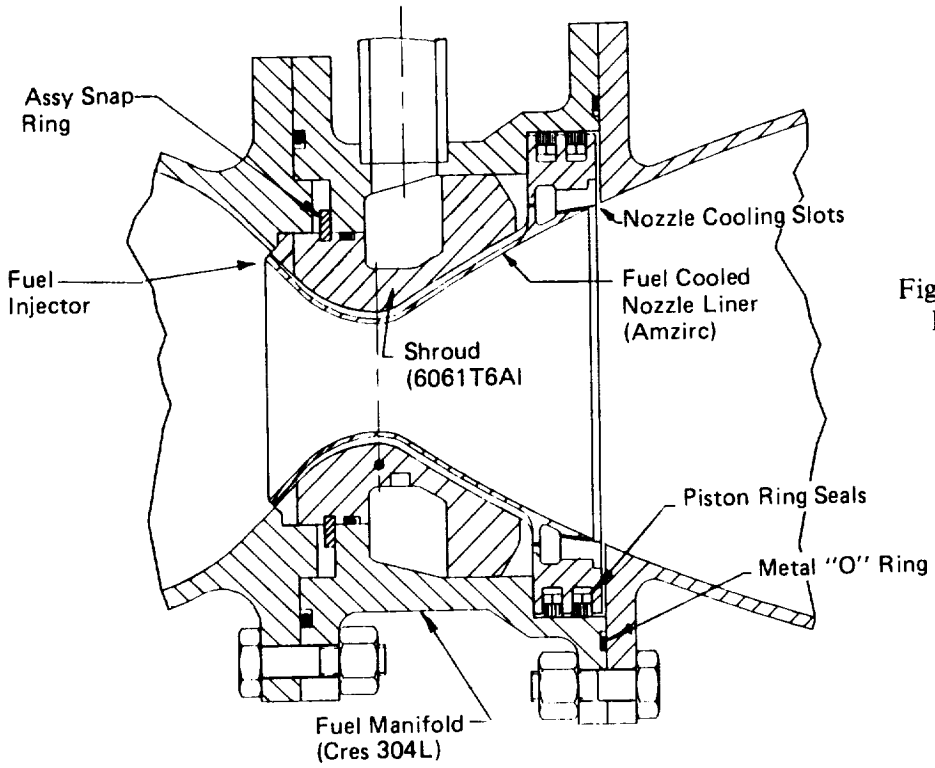


Figure 3. Model 8911 Regeneratively Cooled Nozzle

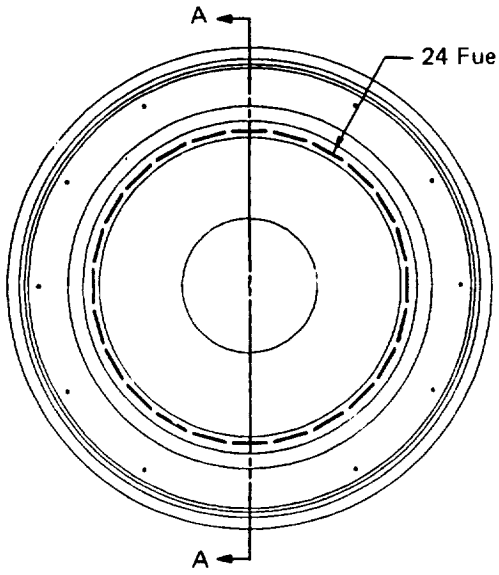


Figure 4. Model 8911 Fuel Injector

The oxidizer flows into the chamber from the valve to the inlet of the vortex cup, through a distribution baffle, and then enters the vortex cup through the swirl orifices and the centerflow orifice. A small amount of oxidizer is drawn from the vortex cup inlet as a spark plug coolant and auxiliary ignition propellant (1/2 percent each igniter).

The construction materials used for this thruster reflect the objective of incorporating low-cost readily-available materials throughout. The thruster has a Type 304 stainless steel oxidizer injector and nozzle holder with Hastelloy X combustion chamber. The throat section (nozzle liner) is fabricated from Amzirc copper and the nozzle shroud (coolant passage closeout) is a wrap-around two-piece Type 6061 aluminum part. The thruster nozzle extension was fabricated from Hastelloy X.

The thruster design parameters are listed in Table 2.

Table 2. Thruster Design Parameters

Mixture Ratio	8
Thrust	~77 lb_f (343 N)
P_c	102 psia (70.3N/cm^2)
ϵ	40:1
Divergent Nozzle Coolant	6% of the fuel
Oxidizer Coolant for Spark Plugs	1.2% each
% Bell (Nozzle)	80%
Chamber L*	30 in.
Ignition Frequency	60 sparks/sec at 70 millijoules
Type Ignition	Capacitive discharge
Spark Plug	Champion FHE 297-1
Valve	Wright PN 12350

Fabrication

One of the benefits of the reverse flow combustor concept is the simple construction techniques used in its fabrication. the uncooled Hastelloy X chamber and related parts, which were the baseline for this program, introduced the temperature limitations related to this material. The oxidizer vortex cup and inlet, and various add-ons such as the spark plug attachments, chamber pressure ports and coolant lines were all fabricated from type 304L stainless steel as was the nozzle manifold assembly.

The most complex portion of this design was the nozzle liner assembly where all the coolant passages were Electric Discharge Machined (EDM'd). The design feature of holding the nozzle near the fuel injection orifices necessitates a holding flange at this location. This holding flange allowed longitudinal thermal expansion of the liner as with the sliding nozzle seal. The complexity existed in the EDM fuel injection slots which required a compound slot profile to transition from the coolant passage end at the chamber periphery. These injection slots were neatly fabricated by rotating the EDM electrode from the flat fuel injection orifices. This copper nozzle is shown in Figure 5, along with the surrounding aluminum closeout. The coolant passages can be seen along the nozzle axis while the fuel injection orifices are at the top of the unit. This construction technique was selected for this technology demonstration to facilitate both design and fabrication. A flight unit would be modified to include an electrodeposited closeout for the coolant passages, in turn allowing a much less complex configuration of the fuel injection orifices.

The final thruster component was the Hastelloy X nozzle extension attached at an area ratio of 10. Hastelloy was selected for the extension so that the possibility of

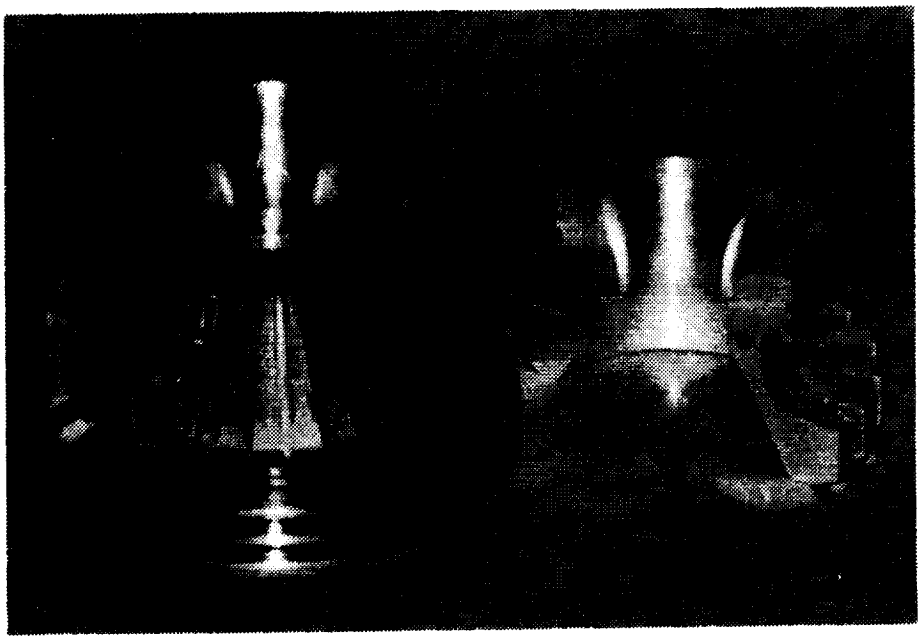


Figure 5. Nozzle Liner with Clamshell Nozzle Shroud

eliminating the nozzle dump coolant could be explored. Due to the press of other objectives, this possibility was not investigated during the program.

The mixture ratio 8 hardware was similar to the original hardware with the only fabrication change being a Hastelloy X chamber incorporated to allow slightly higher chamber temperatures at the higher mixture ratio. The chamber was fabricated on a normal contour lathe and welding the stainless steel 304L chamber accessories presented no problems. The thrust chamber assembly, ready to be mounted in the test cell, is shown in Figure 6.

Test Objectives

The objective of the test program has been outlined in Bell Operational Test Plan, No. 8911-947002, with the test sequence listed in Appendix A of this report.

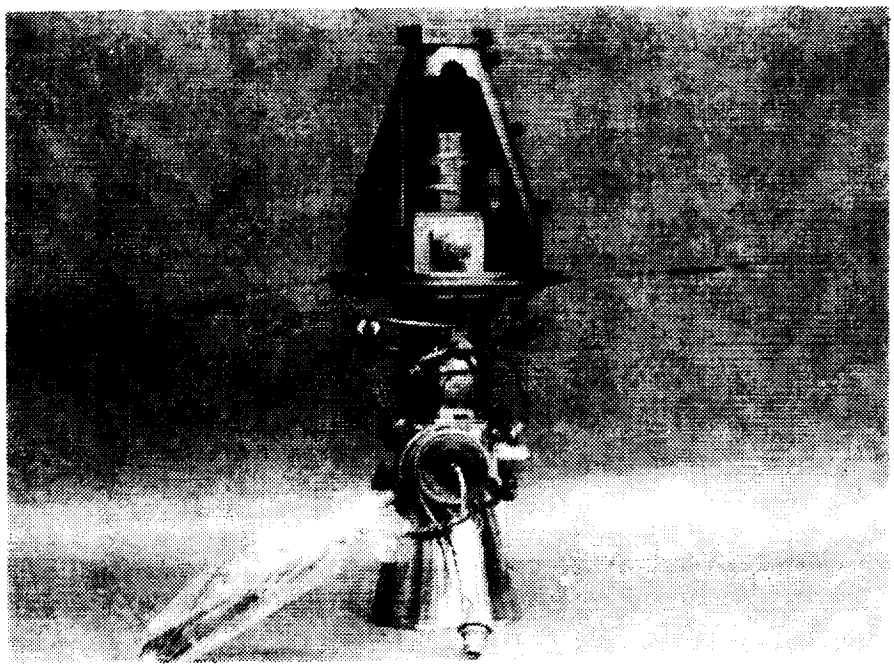


Figure 6. Model 8911 Thrust Chamber Test Assembly

Test Cell and Operation

All fire-testing of the Space Station Auxiliary Thruster was conducted in the Bell Altitude Facility A-2. The test cell used has a nominal altitude capability of 120,000 feet (36576 M) with a duration capability far in excess of 1000 seconds. The Bell altitude facility is operated by a dedicated steam generation system tied in with the factory power plant, providing low-cost operations of almost unlimited duration. The general arrangement of the facility is shown in Figure 7.

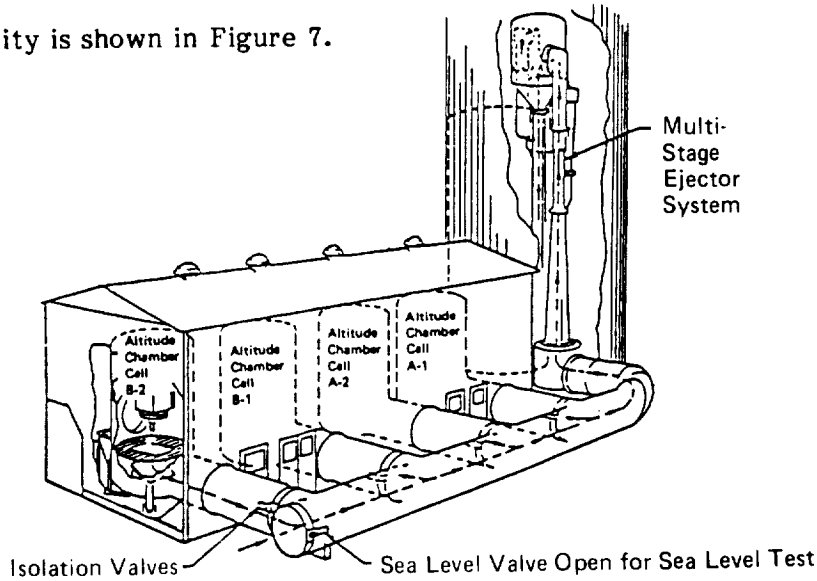


Figure 7. Altitude Test Complex

Operation of any test cell is accomplished by directing steam into one of the three ejectors, each having its own capacity limit. The test cell closure valve is opened to the ejector exhaust system, drawing the cell down to the requisite altitude.

Operation of the thruster is accomplished by a timer panel. The start and shutdown sequence of events to the igniter and valve systems are preplanned and operate in an automatic sequence. For these tests, the fuel valve was sequenced to open one millisecond ahead of the oxidizer valve, although no confirmation measurements were attempted to ascertain the propellant chamber entry sequence. Pulse tests were conducted with equal on and off times.

Ignition was accomplished with the use of an exciter, having an approximate frequency of 60 sparks per second, operating a spark plug installed in the combustor wall. Examination of the start traces showed positive and immediate starts with the first spark after positive oxidizer pressure was identified.

Instrumentation

Normal performance measurement parameters, including thrust, chamber pressure and propellant flow rates, were measured for all tests. Flow rates were measured using temperatures and sonic orifices. Cell instrumentation includes an in-line load cell thrust measuring arrangement where the thrust chamber is mounted vertically and fired in a downward direction. Three stabilizing webs were used on the chamber mount so that thrust alignment was maintained.

Temperatures were measured with thermocouples placed at various positions on the thruster. Since there has been very little precedent for failure criteria for this

type of thrust chamber, thermocouples were placed at various positions on the thrust chamber to establish criteria for the formulation of a more complete heat monitoring arrangement. Thermocouples were placed on the nozzle extension, at the nozzle flange, on one of the lands in the copper nozzle liner, in a coolant passage and on the combustion chamber at a variety of positions. Thermocouple locations are shown in the appendix A of this report.

Test Results and Discussions

The acceptance test series was predefined and consisted of 4 sets of tests. Test sets were designed to examine mixture ratio, chamber pressure, heat rejection (measured hardware temperature) and pulse performance. The tests were performed as predefined with the exception that an added pulse set was completed. The test schedule is noted in Figure A-1 of the Appendix. The test data is included in this Appendix.

The measured specific impulse is shown graphically in Figure 8. It was noted that the recorded specific impulse at a mixture ratio of 8 was approximately the same as for the original thruster tested, thruster No. 1 (contract NAS 3-24656), however, the new thruster, thruster No. 2, appears to have somewhat lower performance at the more fuel rich mixture ratios.

The thrust chamber thermocouples were also examined for comparison to thruster No. 1. The mixture ratio =8 data is noted in Table 3 where it is compared to similar data for the thruster No. 1.

While the average of this data is close for the two thrusters, the circumferential variation of the temperatures is somewhat larger on thruster No. 2.

Additional testing, which might be required to explain this difference, is beyond the scope of the contract.

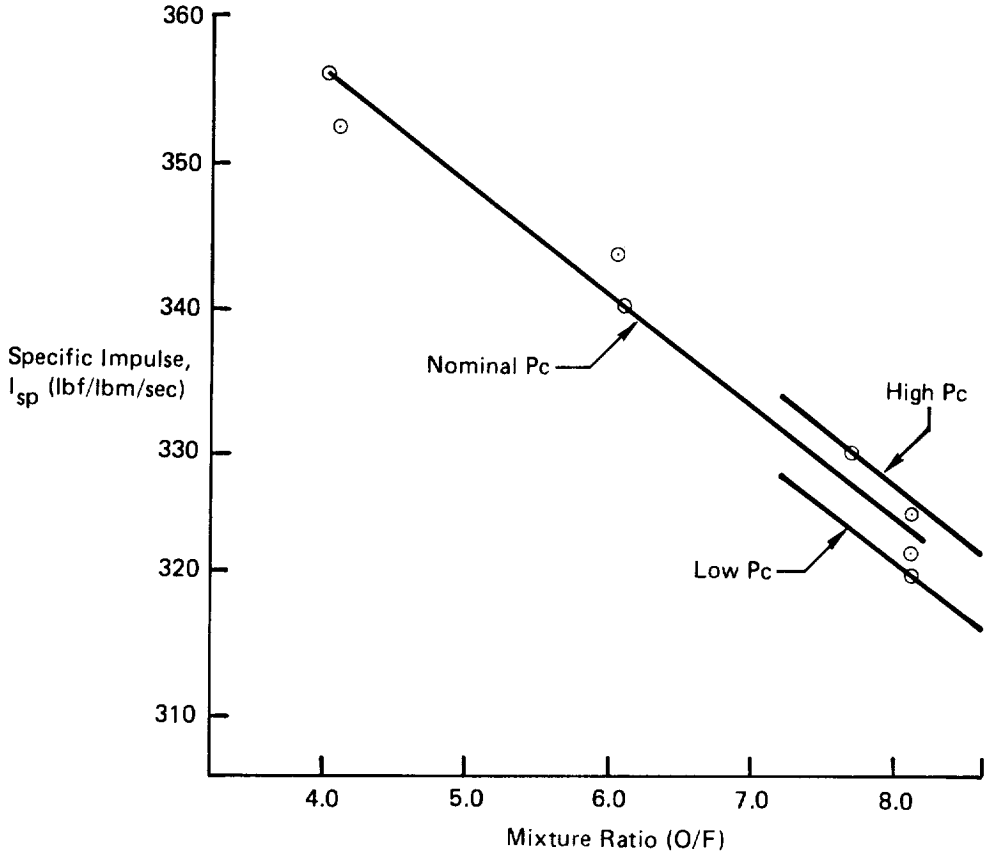


Figure 8. Specific Impulse Vs Mixture Ratio

Table 3. Chamber Temperature Data at 29.4 Seconds.

Thruster No. 2				Thruster No. 1			
Test No.	Mixture Ratio (O/F)	Thermocouple No.	Temperature °F	Test No.	Mixture Ratio (O/F)	Thermocouple No.	Temperature °F
4420	8.104	10	1575.8	4379	7.926	10	1770.2
		11	1909.5			11	1492.9
		20A	1519.8			20A	1731.8
		21A	1773.8			21A	1707.8
		Average	1694.7			Average	1675.7

Pulse Testing

Pulse tests were conducted with thruster No. 2 by the simple expedient of setting on/off times into the run panel and operating for the prescribed 15 pulses. The ignitor system was held in the on position, due to the expediency of wiring the ignition system independently of the timing panel.

The concern for pulse operation was that the combined delays of the propellant valves and the ignition system would be too great to produce 40 millisecond pulses. The result could have been external ignition with some detrimental effects. The 60 millisecond pulses were considered minimum, which the test results confirmed. The 40 millisecond pulses did not ignite until after the valve had closed in 5 of the 15 pulses attempted. The propellant valve timing was originally reported as 30 milliseconds as normal open and close time. The actual time turned out to be closer to 30 milliseconds opening and 15 milliseconds closing, meaning that the on/off time would limit a pulse fluid flowtime to some 15 to 20 milliseconds shorter than the pulse electrical time used.

This condition was not expected to materially affect the longer duration pulses (greater than 60 milliseconds). Pulse data for each of the series conducted is shown in Figures 9, 10, 11 and 12.

The shorter pulse time effect of ignition and valve timing is shown in the drastic differences between the 40 millisecond pulses (Figure 12). During these pulses, the valve in many cases shut off before any ignition occurred, although ignition occurred in every pulse. This late ignition resulted from the delayed exciter timing when the capacitive discharge systems were in phase with a spark rate of approximately 45 sparks per second or 22 milliseconds between sparks. The 22 millisecond ignition delay is approximately what is seen on the 40 millisecond pulses where the ignition spike occurred

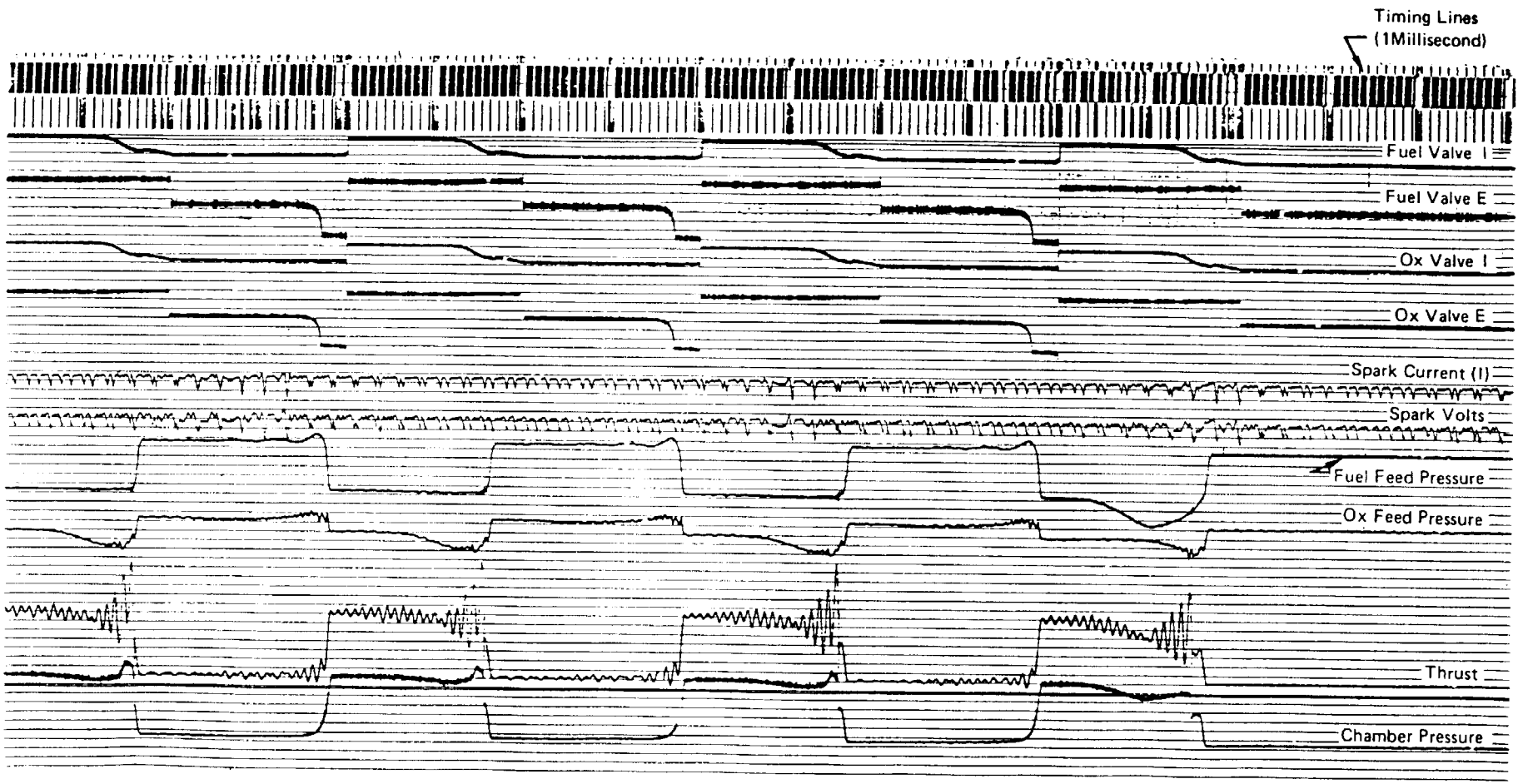


Figure 9. 200 Millisecond Pulses Test No. A2-4421·

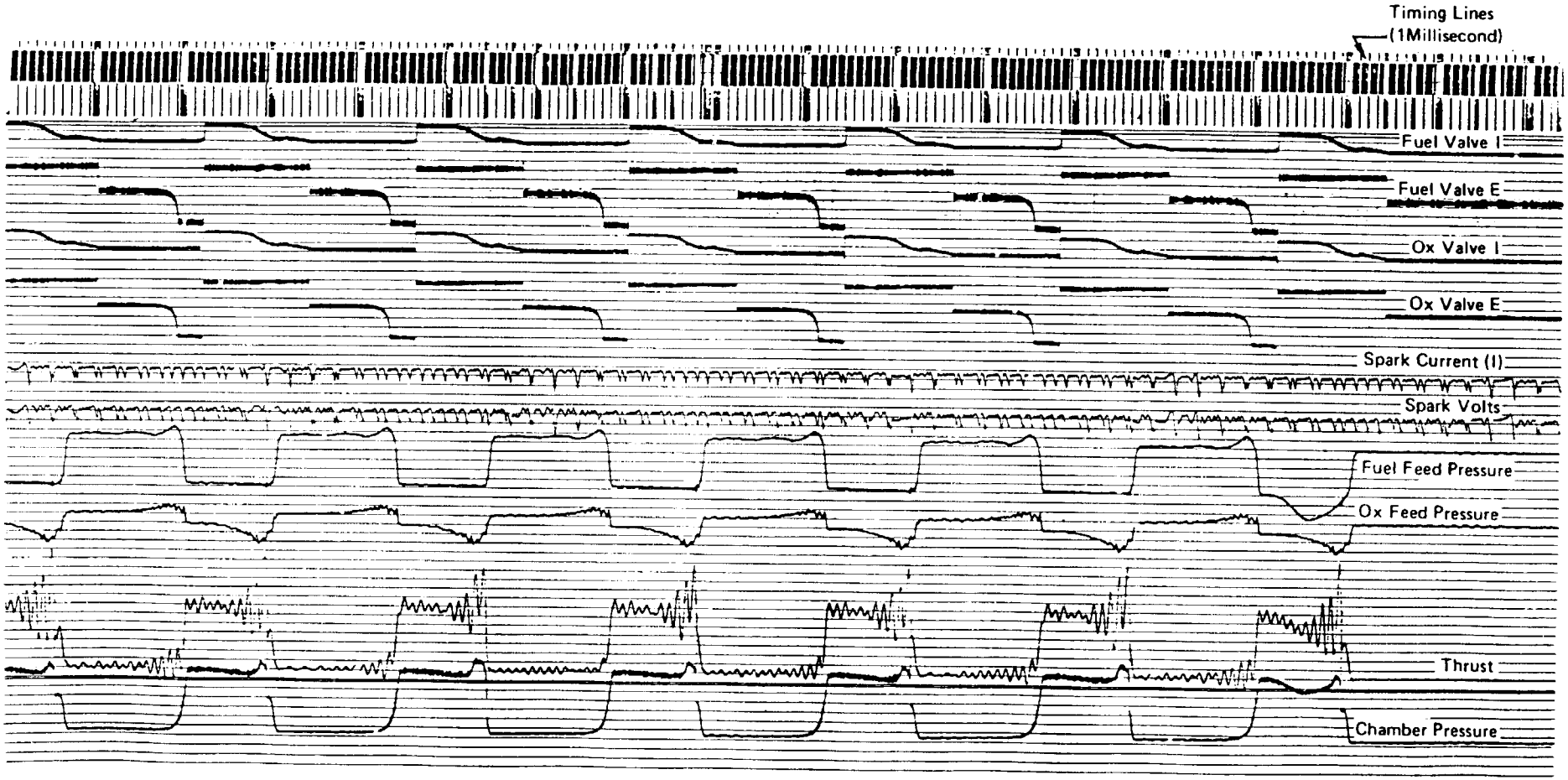


Figure 10. 120 Millisecond Pulses, Test No. A2-4422.

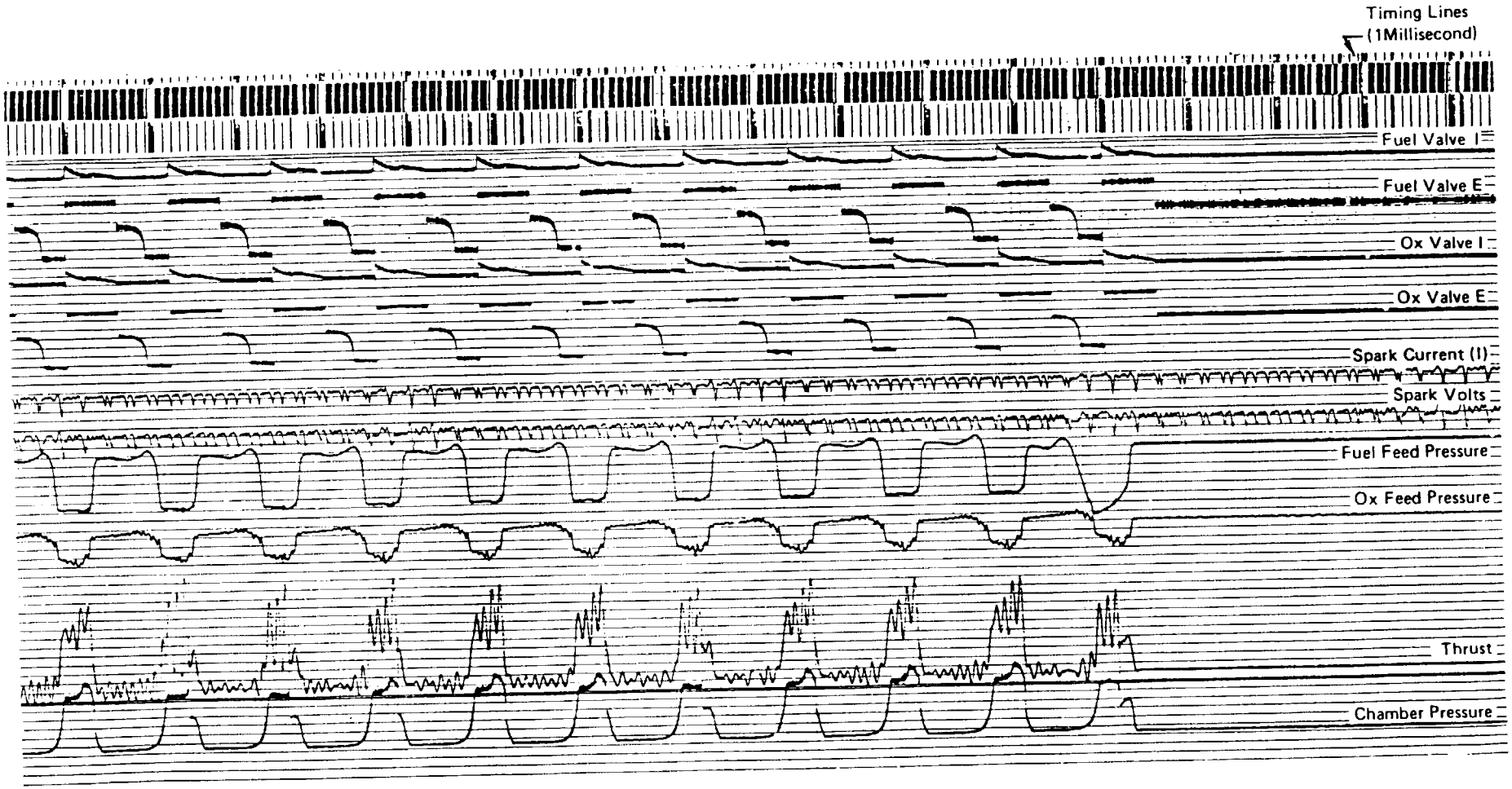


Figure 11. 60 Millisecond Pulses, Test No. A2-4423.

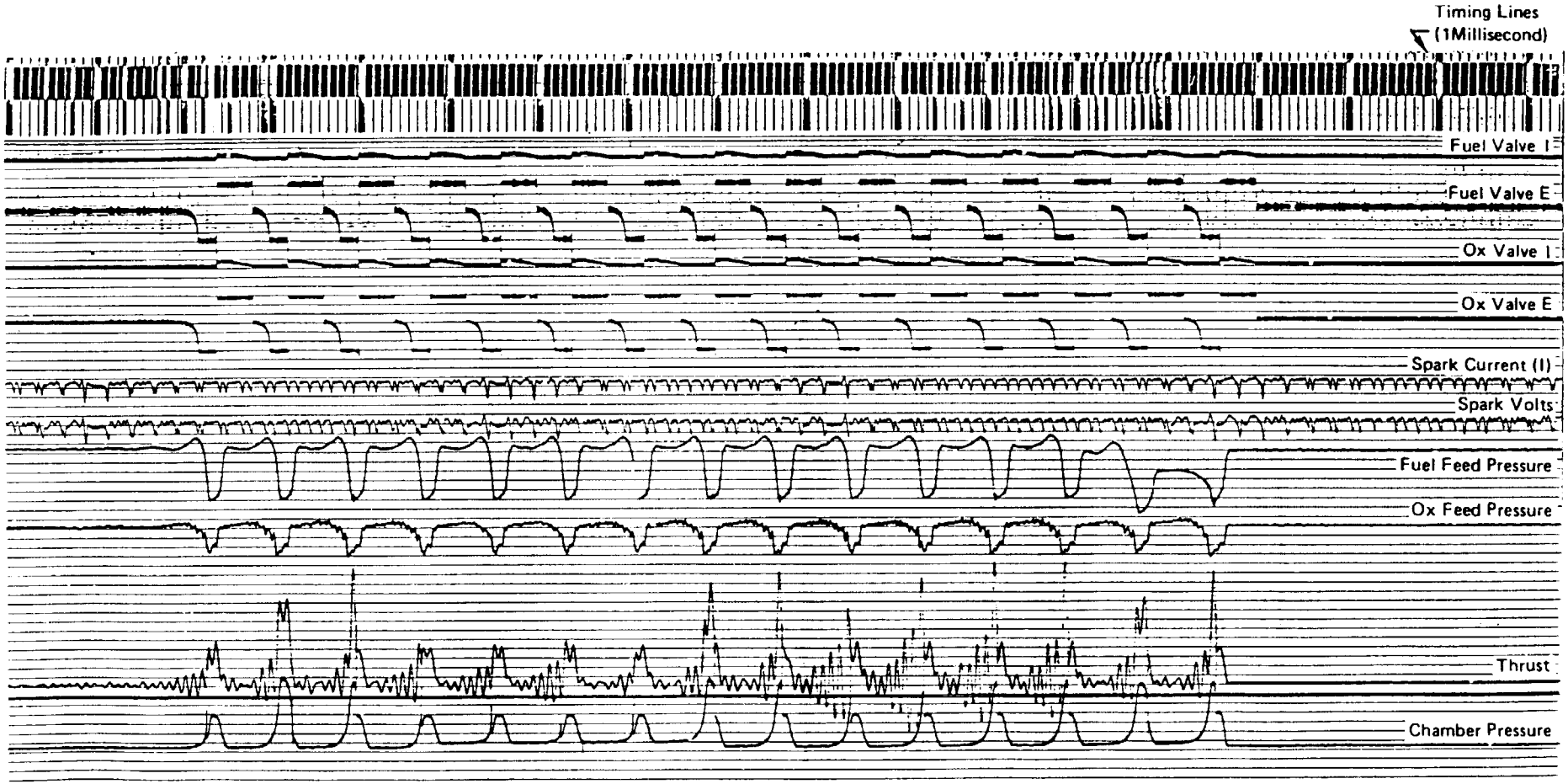


Figure 12. 40 Millisecond Pulses, Test No. A2-4424.

during shutdown. The best pulses resulted, with immediate ignition, when the ignitor fired as the propellants entered the chamber. A more rapid ignitor system is needed if the 40 millisecond pulse is required.

The pulse data are included in the Appendix. These data have been summarized for total impulse for each pulse with mean, minimum and maximum summated. The mean value for the impulse bit is shown graphically in Figure 13.

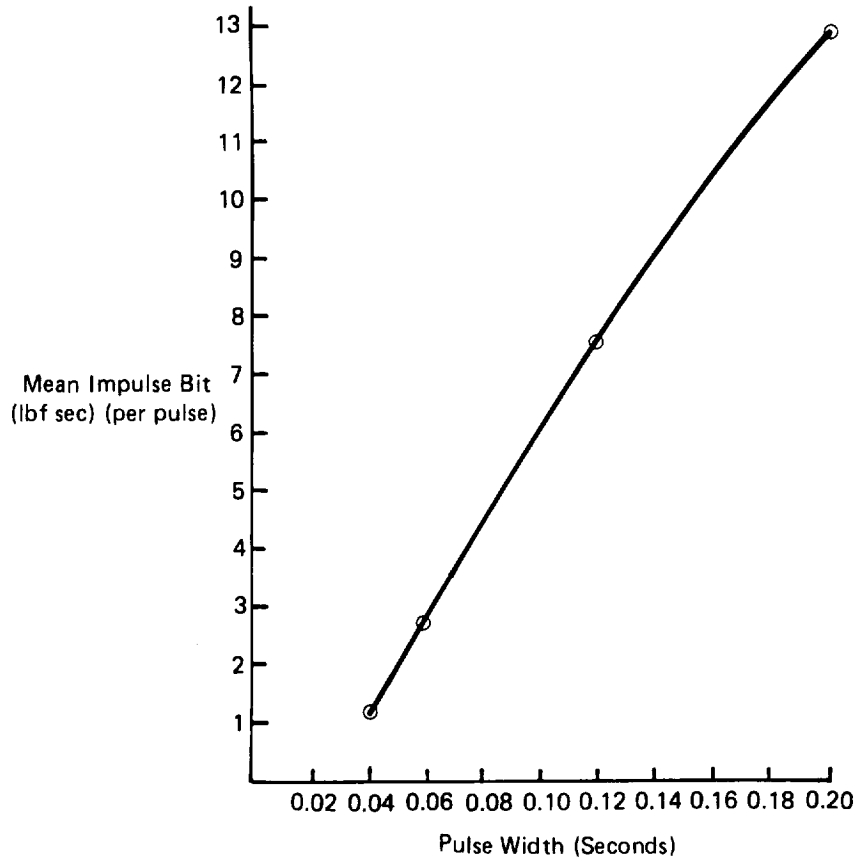


Figure 13. Mean Impulse Bit Vs Pulsewidth

Conclusions

An 8911-470021-1 thruster assembly was fabricated and completed the defined acceptance tests. This thruster demonstrated the capability to operate over an extremely wide range of operating conditions similar to the previously fabricated thruster assembly. Some differences were noted in performance between the original and new thruster, however, the differences are not large enough to be considered to be detrimental to operation.

Pulse tests were also conducted on this thruster assembly for the first time with this type of reverse flow thruster. The results were gratifying in that short duration firings (60 milliseconds) produced repetitive pulses and that even shorter pulses are practical with a more rapid spark exciter. This thrust chamber concept (reverse flow) has again shown its adaptability to the Space Station Mission.

Appendix A

Test Data

A. Performance Data

All tests were performed in Test Cell A-2 at a simulated altitude of approximately 100,000 ft. (30480 M). Tests were conducted to a predetermined test schedule as shown in Figure A-1. The thruster was mounted vertically downward in the test cell and the exhaust from the thruster was directed into a steam ejector. Performance measurements were recorded on FM tape with data points processed at requested intervals. The primary performance measurements of thrust, chamber pressure and flows were recorded using a transducer incorporated in-line load cell, a Taber Model 2210 pressure transducer, and with pre-calibrated cavitating venturies for the respective flow measurements.

The accompanying data sheets are a summation of all data taken through the program. The performance data summaries have been compiled to include the performance as recorded.

The data sheets are mostly self-explanatory except for several 0.0 values that are consistently recorded as the result of unedited values from a previous printout form. Appropriate temperature data for each run are also included. Chromel-Alumel thermocouples were used for all the temperature values.

ACCEPTANCE TESTS

A. Mixture Ratio Series

Test	P_c (psia)	r (O/F)	Duration (sec)
1	102	4.0	5
2	102	6.0	5
3	102	8.0	5

B. Chamber Pressure Series

Test	P_c (psia)	r (O/F)	Duration (sec)
1	102	8.0	5
2	75	8.0	5
3	125	8.0	5

C. Heat Rejection Series

Test	P_c (psia)	r (O/F)	Duration (sec)
1	102	4.0	30
2	102	6.0	30
3	102	8.0	30

D. Pulse Series

Test	No. Pulses	P_c (psia)	r (O/F)	Pulse Duration (sec)
1	15	102	8.0	0.200
2	15	102	8.0	0.120
3	15	102	8.0	0.060
4	15	102	8.0	0.040

Figure A-1. Test Schedule - NAS 3-24883

B. Pulse Test Data

The pulse tests were conducted with an on/off timer which gave equal on/off times. The data included is a computer program completed summary of the impulse of each pulse, with a mean and the deviation noted.

C. Thermocouple Installation

The location of the temperature measuring thermocouples installed on the test hardware is shown in Figure A-2. The thermocouple numbers shown correspond to the numbers on the test data sheets. Thermocouples T20 and T21 were not recorded due to instrument limitations. The two internal thermocouples installed were to measure a nozzle land temperature (NLT) and the H_2 gas, fuel coolant temperature (FCT) at the exit of the regenerative portion of the cooled nozzle. This installation was made by inserting .014 inch coaxial thermocouples through the fuel manifold and cementing the thermocouples in place.

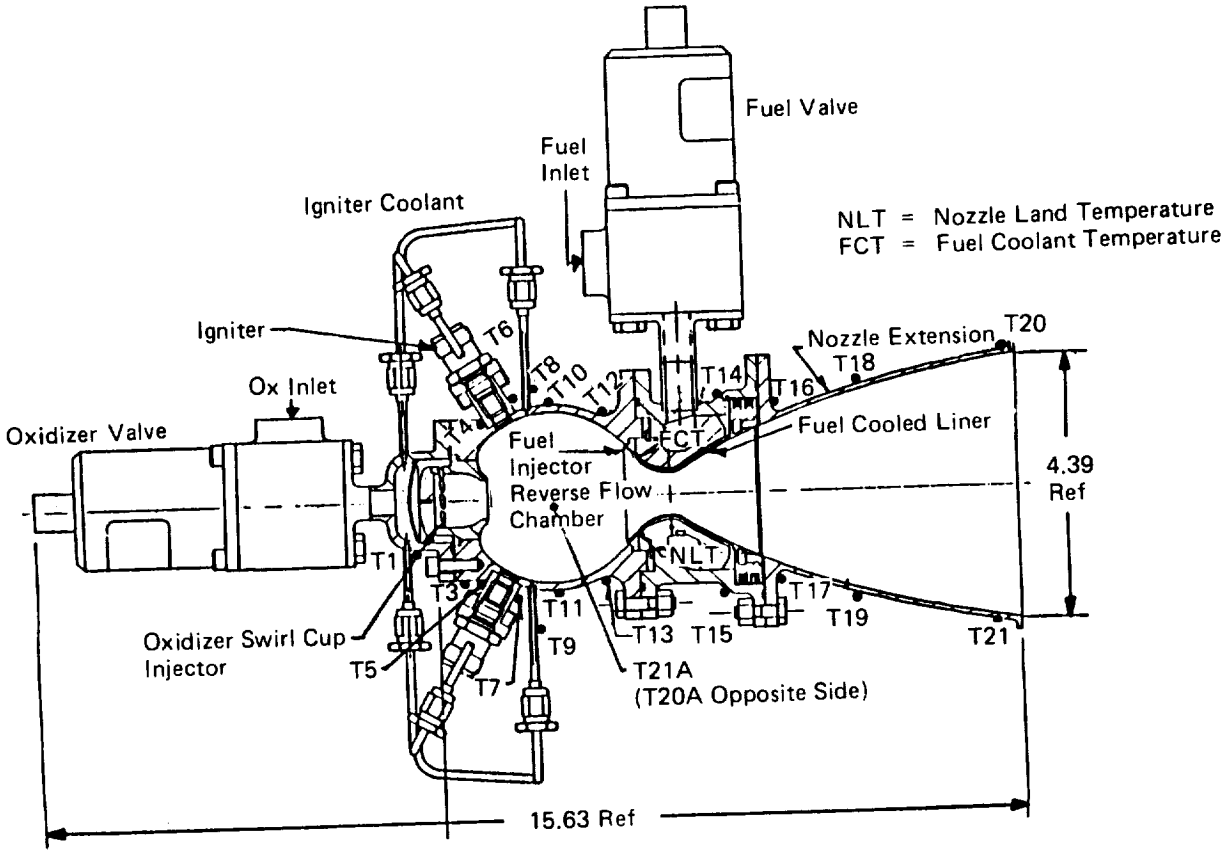


Figure A-2. Model 8911 Health Monitoring Thermocouple Locations

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P716 REV.01/08/86 MODEL 8911 - PRELIMINARY TEST REPORT - 50 LB. O2/H2 ENGINE S/N 2 PAGE OF

TESTS 4412 - 4417 CELL A-2 DATE 02/18/87 - 02/18/87 TEST REF. 911-E-001

TEST HARDWARE AND PROPELLANT NOMINALS

T/C AT(AMB) .37720 IN2
T/C AE(AMB) 15.136 IN2

FSG NOM (60/60) 0.0
OSG NOM (60/60) 0.0
FUEL NOM .0 LBS/SEC
OXID NOM .0 LBS/SEC

CHAMBER S/N
INJECTOR S/N
F/OX VALVE S/N /

PERFORMANCE TEST. DATA SUMMARY

TEST NO.	DUR SEC	DATA PNT	MEASURED ****PC**** PRESS SEC PSIA	ROUG PERC	***RATIO*** TEST	COR	WTOT LB/SEC	C* FT/S	***F INF*** TEST LBS	COR LBS	**ISP INF** TEST SEC	COR SEC	CF INF	DFP PSIA	FFP PSIA	DFT DEG.FAHR	FFT	TOTAL IMPULSE LB-SEC	DPO COR PSID	DPF COR PSID	PA PSIA
4412	5.0	1.0	101.0	0.0	4.191	0.0	.198680	6172.	68.45	0.0	344.5	0.0	1.798	394.	297.	76.	83.	0.0	0.0	0.0	0.042
		2.0	102.1	0.0	4.167	0.0	.198983	6231.	69.26	0.0	348.1	0.0	1.799	394.	298.	77.	80.	0.0	0.0	0.0	0.036
		3.0	102.9	0.0	4.139	0.0	.199311	6273.	69.85	0.0	350.5	0.0	1.799	395.	299.	77.	73.	0.0	0.0	0.0	0.032
		4.0	103.5	0.0	4.110	0.0	.199584	6299.	70.26	0.0	352.0	0.0	1.800	395.	300.	77.	66.	0.0	0.0	0.0	0.028
		4.4	103.6	0.0	4.100	0.0	.199689	6300.	70.31	0.0	352.1	0.0	1.800	395.	300.	77.	63.	0.0	0.0	0.0	0.027
4413	5.0	1.0	101.8	0.0	6.139	0.0	.210705	5868.	70.13	0.0	332.8	0.0	1.827	446.	231.	79.	85.	0.0	0.0	0.0	0.040
		2.0	102.6	0.0	6.130	0.0	.210827	5912.	70.92	0.0	336.4	0.0	1.832	446.	232.	80.	84.	0.0	0.0	0.0	0.034
		3.0	103.1	0.0	6.108	0.0	.210937	5936.	71.33	0.0	338.2	0.0	1.834	446.	233.	80.	81.	0.0	0.0	0.0	0.031
		4.0	103.6	0.0	6.078	0.0	.211021	5961.	71.70	0.0	339.8	0.0	1.835	446.	233.	80.	76.	0.0	0.0	0.0	0.028
		4.4	103.7	0.0	6.066	0.0	.211077	5966.	71.79	0.0	340.1	0.0	1.836	446.	233.	80.	74.	0.0	0.0	0.0	0.028
4414	5.0	1.0	102.3	0.0	8.218	0.0	.224950	5521.	71.43	0.0	317.5	0.0	1.852	493.	195.	80.	78.	0.0	0.0	0.0	0.039
		2.0	102.7	0.0	8.194	0.0	.225027	5541.	71.90	0.0	319.5	0.0	1.857	493.	196.	81.	77.	0.0	0.0	0.0	0.034
		3.0	103.0	0.0	8.173	0.0	.225131	5558.	72.20	0.0	320.7	0.0	1.858	494.	196.	81.	74.	0.0	0.0	0.0	0.031
		4.0	103.3	0.0	8.151	0.0	.225287	5570.	72.42	0.0	321.5	0.0	1.858	494.	196.	81.	71.	0.0	0.0	0.0	0.028
		4.4	103.5	0.0	8.142	0.0	.225358	5576.	72.51	0.0	321.7	0.0	1.858	494.	196.	81.	70.	0.0	0.0	0.0	0.028
4415	5.0	1.0	103.1	0.0	8.176	0.0	.224034	5589.	71.91	0.0	321.0	0.0	1.849	490.	195.	81.	78.	0.0	0.0	0.0	0.037
		2.0	103.2	0.0	8.157	0.0	.224111	5592.	72.23	0.0	322.3	0.0	1.856	491.	196.	81.	77.	0.0	0.0	0.0	0.033
		3.0	103.5	0.0	8.138	0.0	.224105	5605.	72.43	0.0	323.1	0.0	1.856	491.	197.	81.	76.	0.0	0.0	0.0	0.030
		4.0	103.8	0.0	8.120	0.0	.224388	5618.	72.66	0.0	323.8	0.0	1.856	491.	197.	82.	73.	0.0	0.0	0.0	0.028
		4.4	103.9	0.0	8.112	0.0	.224483	5620.	72.69	0.0	323.8	0.0	1.855	491.	197.	82.	72.	0.0	0.0	0.0	0.027
4416	5.0	1.0	75.4	0.0	8.135	0.0	.164829	5554.	52.22	0.0	316.8	0.0	1.837	362.	145.	80.	80.	0.0	0.0	0.0	0.035
		2.0	75.5	0.0	8.132	0.0	.164985	5561.	52.50	0.0	318.2	0.0	1.842	362.	145.	80.	81.	0.0	0.0	0.0	0.029
		3.0	75.7	0.0	8.127	0.0	.165070	5573.	52.66	0.0	319.0	0.0	1.843	362.	145.	80.	80.	0.0	0.0	0.0	0.026
		4.0	75.9	0.0	8.114	0.0	.165106	5587.	52.79	0.0	319.7	0.0	1.843	362.	146.	80.	79.	0.0	0.0	0.0	0.024
		4.4	76.0	0.0	8.108	0.0	.165129	5589.	52.80	0.0	319.7	0.0	1.842	362.	146.	80.	78.	0.0	0.0	0.0	0.023
4417	5.0	1.0	122.9	0.0	7.817	0.0	.264032	5653.	86.69	0.0	328.3	0.0	1.870	577.	240.	83.	83.	0.0	0.0	0.0	0.037
		2.0	123.3	0.0	7.804	0.0	.264370	5666.	87.05	0.0	329.3	0.0	1.871	578.	240.	84.	82.	0.0	0.0	0.0	0.033
		3.0	123.5	0.0	7.778	0.0	.264571	5671.	87.18	0.0	329.5	0.0	1.871	578.	241.	85.	78.	0.0	0.0	0.0	0.031
		4.0	123.7	0.0	7.743	0.0	.264710	5678.	87.30	0.0	329.8	0.0	1.870	578.	241.	85.	74.	0.0	0.0	0.0	0.029
		4.4	123.9	0.0	7.728	0.0	.264790	5684.	87.40	0.0	330.1	0.0	1.870	578.	241.	85.	72.	0.0	0.0	0.0	0.028

BELL AEROSPACE TEXTRON

P716 REV.01/08/86 MODEL 8911 - PRELIMINARY TEST REPORT - 50 LB. O2/H2 ENGINE S/N 2 PAGE OF

BAROMETRIC PRESSURE	14.51	PSIA
TIME OF RUN	0932	HRS
LENGTH OF RUN	5.0	SEC
FUEL SP.GR. 60/60	0.0	MMH
OXID SP.GR. 60/60	0.0	N204
FUEL TRIM ORIFICE		
OXID TRIM ORIFICE		

T/C	AT 0.37720	IN2
T/C	AE 15.1360	IN2
FUEL	NOM 0.0	LBS/SEC
OXID	NOM 0.0	LBS/SEC
FSG	NOM 0.0	
OSG	NOM 0.0	

MODEL NO	8911
TEST DATE	02/18/87
TEST CELL	A-2
TEST NO	4412
T/C S/N	
INJ S/N	
F/OX VAL S/N	/

EXTRA PARAMETERS

PARAMETER	SYMBOL	UNITS	STATIC	1.0	2.0	3.0	4.0	4.4
62. CELL AMBIENT TEMPERATURE	TAMB	DEG.FAHR	92.0	91.5	90.9	90.5	90.4	90.3
63. FUEL CAVITY TEMP.	FCT	DEG.FAHR	76.6	200.6	268.3	295.3	301.3	300.6
64. NOZZLE LAND TEMP.	NLT	DEG.FAHR	72.5	390.9	425.2	443.4	452.0	453.3
65. SKIN TEMP. NO. 1	SKNT1	DEG.FAHR	78.8	78.8	78.8	78.8	78.8	78.8
66.			0.0	0.0	0.0	0.0	0.0	0.0
67. SKIN TEMP. NO. 3	SKNT3	DEG.FAHR	86.1	86.0	86.3	87.8	93.4	97.4
68. SKIN TEMP. NO. 4	SKNT4	DEG.FAHR	90.9	153.3	223.8	287.0	341.3	361.9
69. SKIN TEMP. NO. 5	SKNT5	DEG.FAHR	98.6	141.3	195.4	252.2	307.8	329.1
70. SKIN TEMP. NO. 6	SKNT6	DEG.FAHR	97.8	124.8	161.4	200.7	256.3	279.6
71. SKIN TEMP. NO. 7	SKNT7	DEG.FAHR	98.5	126.0	164.9	208.3	269.5	296.5
72. SKIN TEMP. NO. 8	SKNT8	DEG.FAHR	87.6	89.9	89.9	90.0	90.4	90.7
73. SKIN TEMP. NO. 9	SKNT9	DEG.FAHR	86.4	88.4	88.4	88.9	90.8	92.2
74. SKIN TEMP. NO. 10	SKNT10	DEG.FAHR	83.6	141.7	317.8	488.5	627.1	674.2
75. SKIN TEMP. NO. 11	SKNT11	DEG.FAHR	85.1	161.7	451.6	714.9	919.2	986.2
76. SKIN TEMP. NO. 12	SKNT12	DEG.FAHR	77.5	95.3	181.8	276.0	349.9	374.0
77. SKIN TEMP. NO. 13	SKNT13	DEG.FAHR	77.5	82.7	121.9	201.0	280.9	309.2
78. SKIN TEMP. NO. 14	SKNT14	DEG.FAHR	74.1	74.1	74.7	75.6	76.9	77.5
79. SKIN TEMP. NO. 15	SKNT15	DEG.FAHR	76.4	76.5	77.0	77.9	79.5	80.2
80. SKIN TEMP. NO. 16	SKNT16	DEG.FAHR	76.9	76.7	76.9	77.3	77.8	78.2
81. SKIN TEMP. NO. 17	SKNT17	DEG.FAHR	74.7	74.7	74.7	74.8	75.2	75.3
82. SKIN TEMP. NO. 18	SKNT18	DEG.FAHR	72.7	86.6	124.7	166.6	210.8	229.6
83. SKIN TEMP. NO. 19	SKNT19	DEG.FAHR	74.9	90.9	131.0	174.4	220.9	239.8
84. SKIN TEMP. NO. 20	SKNT20	DEG.FAHR	73.9	98.0	139.6	180.1	222.8	240.1
85. SKIN TEMP. NO. 21A	SKNT21A	DEG.FAHR	79.1	161.6	406.5	594.4	755.3	809.4

BELL AEROSPACE TEXTRON

P716 REV.01/08/86 MODEL 8911 - PRELIMINARY TEST REPORT - 50 LB. O2/H2 ENGINE S/N 2 PAGE OF

BAROMETRIC PRESSURE	14.51	PSIA
TIME OF RUN	1031	HRS
LENGTH OF RUN	5.0	SEC
FUEL SP.GR. 60/60	0.0	MMH
OXID SP.GR. 60/60	0.0	N2O4
FUEL TRIM ORIFICE		
OXID TRIM ORIFICE		

T/C	AT 0.37720	IN2
T/C	AE 15.1360	IN2
FUEL	NOM 0.0	LBS/SEC
OXID	NOM 0.0	LBS/SEC
FSG	NOM 0.0	
OSG	NOM 0.0	

MODEL NO	8911
TEST DATE	02/18/87
TEST CELL	A-2
TEST NO	4413
T/C S/N	
INJ S/N	
F/UX VAL S/N	/

EXTRA PARAMETERS

PARAMETER	SYMBOL	UNITS	STATIC	1.0	2.0	3.0	4.0	4.4
62. CELL AMBIENT TEMPERATURE	TAMB	DEG.FAHR	93.7	93.5	93.0	92.8	92.6	92.6
63. FUEL CAVITY TEMP.	FCT	DEG.FAHR	121.2	299.3	397.8	437.4	452.2	454.5
64. NOZZLE LAND TEMP.	NLT	DEG.FAHR	117.8	530.9	591.0	620.3	634.5	635.9
65. SKIN TEMP. NO. 1	SKNT1	DEG.FAHR	101.1	101.1	101.0	100.7	100.5	100.4
66.			0.0	0.0	0.0	0.0	0.0	0.0
67. SKIN TEMP. NO. 3	SKNT3	DEG.FAHR	104.1	104.1	104.4	105.8	110.3	113.6
68. SKIN TEMP. NO. 4	SKNT4	DEG.FAHR	97.4	146.1	201.4	256.3	306.5	324.9
69. SKIN TEMP. NO. 5	SKNT5	DEG.FAHR	103.4	129.4	162.6	194.1	232.2	248.5
70. SKIN TEMP. NO. 6	SKNT6	DEG.FAHR	103.5	120.6	149.0	179.3	218.6	237.6
71. SKIN TEMP. NO. 7	SKNT7	DEG.FAHR	101.8	121.5	150.4	182.0	229.6	252.6
72. SKIN TEMP. NO. 8	SKNT8	DEG.FAHR	97.5	99.0	98.4	98.0	97.9	98.2
73. SKIN TEMP. NO. 9	SKNT9	DEG.FAHR	97.5	98.9	98.5	98.6	99.9	101.0
74. SKIN TEMP. NO. 10	SKNT10	DEG.FAHR	109.7	164.3	354.1	540.9	693.8	745.0
75. SKIN TEMP. NO. 11	SKNT11	DEG.FAHR	109.6	184.9	472.6	749.7	977.3	1053.6
76. SKIN TEMP. NO. 12	SKNT12	DEG.FAHR	117.2	141.6	237.2	344.9	429.4	456.7
77. SKIN TEMP. NO. 13	SKNT13	DEG.FAHR	119.3	124.3	169.4	255.3	339.6	369.9
78. SKIN TEMP. NO. 14	SKNT14	DEG.FAHR	117.1	117.1	116.8	116.0	115.3	115.1
79. SKIN TEMP. NO. 15	SKNT15	DEG.FAHR	119.2	119.2	118.6	117.9	117.4	117.6
80. SKIN TEMP. NO. 16	SKNT16	DEG.FAHR	117.1	116.7	117.0	117.1	117.9	118.3
81. SKIN TEMP. NO. 17	SKNT17	DEG.FAHR	114.5	114.5	114.5	114.6	115.0	115.2
82. SKIN TEMP. NO. 18	SKNT18	DEG.FAHR	95.3	114.8	166.9	227.1	288.2	311.9
83. SKIN TEMP. NO. 19	SKNT19	DEG.FAHR	97.5	117.6	167.1	222.4	278.7	300.6
84. SKIN TEMP. NO. 20A	SKNT20A	DEG.FAHR	114.1	213.3	469.8	687.2	854.2	908.3
85. SKIN TEMP. NO. 21A	SKNT21A	DEG.FAHR	112.3	200.6	467.3	685.6	870.1	931.2

BELL AEROSPACE TEXTRON

PAGE OF

P716 REV.01/08/86 MODEL 8911 - PRELIMINARY TEST REPORT - 50 LB. O2/H2 ENGINE S/N 2

BAROMETRIC PRESSURE	14.51	PSIA	T/C AT 0.37720	IN2	MODEL NO 8911
TIME OF RUN	1037	HRS	T/C AE 15.1360	IN2	TEST DATE 02/18/87
LENGTH OF RUN	5.0	SEC	FUEL NOM 0.0	LBS/SEC	TEST CELL A-2
FUEL SP.GR. 60/60	0.0	MMH	OXID NOM 0.0	LBS/SEC	TEST NO 4414
OXID SP.GR. 60/60	0.0	N2O4	FSG NOM 0.0		T/C S/N
FUEL TRIM ORIFICE			OSG NOM 0.0		INJ S/N
OXID TRIM ORIFICE					F/OX VAL S/N

EXTRA PARAMETERS

PARAMETER	SYMBOL	UNITS	STATIC	1.0	2.0	3.0	4.0	4.4
62. CELL AMBIENT TEMPERATURE	TAMB	DEG.FAHR	95.7	95.3	94.7	94.5	94.5	94.5
63. FUEL CAVITY TEMP.	FCT	DEG.FAHR	228.9	393.8	501.3	540.4	549.9	552.7
64. NOZZLE LAND TEMP.	NLT	DEG.FAHR	222.9	714.4	763.2	788.3	805.8	809.9
65. SKIN TEMP. NO. 1	SKNT1	DEG.FAHR	199.1	198.6	197.8	196.4	195.1	194.3
66.			0.0	0.0	0.0	0.0	0.0	0.0
67. SKIN TEMP. NO. 3	SKNT3	DEG.FAHR	272.8	272.3	272.1	273.3	278.1	281.5
68. SKIN TEMP. NO. 4	SKNT4	DEG.FAHR	251.8	281.5	324.1	366.1	407.2	423.8
69. SKIN TEMP. NO. 5	SKNT5	DEG.FAHR	272.4	284.3	303.7	326.8	354.9	367.4
70. SKIN TEMP. NO. 6	SKNT6	DEG.FAHR	260.5	267.0	282.8	310.9	349.0	366.3
71. SKIN TEMP. NO. 7	SKNT7	DEG.FAHR	273.3	280.7	299.2	331.0	375.6	395.9
72. SKIN TEMP. NO. 8	SKNT8	DEG.FAHR	220.5	217.0	211.0	205.5	201.0	199.4
73. SKIN TEMP. NO. 9	SKNT9	DEG.FAHR	238.9	235.2	229.9	225.5	223.0	222.9
74. SKIN TEMP. NO. 10	SKNT10	DEG.FAHR	281.3	356.9	564.0	762.7	924.8	980.3
75. SKIN TEMP. NO. 11	SKNT11	DEG.FAHR	294.8	371.3	647.1	911.3	1125.6	1195.6
76. SKIN TEMP. NO. 12	SKNT12	DEG.FAHR	252.8	284.7	395.9	508.7	595.8	624.2
77. SKIN TEMP. NO. 13	SKNT13	DEG.FAHR	258.9	264.2	309.7	387.9	466.8	495.6
78. SKIN TEMP. NO. 14	SKNT14	DEG.FAHR	209.6	209.4	207.5	203.9	199.6	198.0
79. SKIN TEMP. NO. 15	SKNT15	DEG.FAHR	214.2	213.9	211.8	208.5	204.6	203.0
80. SKIN TEMP. NO. 16	SKNT16	DEG.FAHR	209.3	209.2	209.2	209.2	209.4	209.6
81. SKIN TEMP. NO. 17	SKNT17	DEG.FAHR	206.8	206.7	206.8	206.9	207.3	207.5
82. SKIN TEMP. NO. 18	SKNT18	DEG.FAHR	298.2	320.8	374.2	431.6	488.9	511.6
83. SKIN TEMP. NO. 19	SKNT19	DEG.FAHR	297.9	321.2	371.0	421.4	471.7	492.0
84. SKIN TEMP. NO. 20A	SKNT20A	DEG.FAHR	296.6	395.6	642.7	843.5	1000.3	1051.3
85. SKIN TEMP. NO. 21A	SKNT21A	DEG.FAHR	293.9	392.4	668.5	909.8	1100.4	1161.9

BELL AEROSPACE TEXTRON

2716 REV.01/08/86 MODEL 8911 - PRELIMINARY TEST REPORT - 50 LB. O2/H2 ENGINE S/N 2 PAGE OF

BAROMETRIC PRESSURE	14.51	PSIA	T/C AT	0.37720	IN2	MODEL NO	8911
TIME OF RUN	1045	HRS	T/C AE	15.1360	IN2	TEST DATE	02/18/87
LENGTH OF RUN	5.0	SEC	FUEL NOM	0.0	LBS/SEC	TEST CELL	A-2
FUEL SP.GR. 60/60	0.0	MMH	OXID NOM	0.0	LBS/SEC	TEST NO	4415
OXID SP.GR. 60/60	0.0	N2O4	FSG NOM	0.0		T/C S/N	
FUEL TRIM ORIFICE			OSG NOM	0.0		INJ S/N	
OXID TRIM ORIFICE						F/OX VAL S/N	/

EXTRA PARAMETERS

PARAMETER	SYMBOL	UNITS	STATIC	1.0	2.0	3.0	4.0	4.4
62. CELL AMBIENT TEMPERATURE	TAMB	DEG.FAHR	96.1	95.8	95.4	95.1	95.1	95.1
63. FUEL CAVITY TEMP.	FCT	DEG.FAHR	329.5	455.5	523.5	550.2	562.2	565.0
64. NOZZLE LAND TEMP.	NLT	DEG.FAHR	325.3	780.4	818.4	832.1	840.9	843.3
65. SKIN TEMP. NO. 1	SKNT1	DEG.FAHR	258.7	257.7	256.1	254.1	251.9	250.9
66.			0.0	0.0	0.0	0.0	0.0	0.0
67. SKIN TEMP. NO. 3	SKNT3	DEG.FAHR	320.5	320.3	320.2	321.5	326.8	330.4
68. SKIN TEMP. NO. 4	SKNT4	DEG.FAHR	310.4	339.0	379.9	420.4	460.7	476.7
69. SKIN TEMP. NO. 5	SKNT5	DEG.FAHR	321.3	334.5	354.1	376.5	404.0	416.4
70. SKIN TEMP. NO. 6	SKNT6	DEG.FAHR	319.7	327.1	342.3	370.0	408.7	426.2
71. SKIN TEMP. NO. 7	SKNT7	DEG.FAHR	320.3	328.4	345.9	377.9	422.1	442.2
72. SKIN TEMP. NO. 8	SKNT8	DEG.FAHR	263.3	260.1	253.7	247.8	243.0	241.5
73. SKIN TEMP. NO. 9	SKNT9	DEG.FAHR	268.8	265.2	259.9	255.5	254.0	254.0
74. SKIN TEMP. NO. 10	SKNT10	DEG.FAHR	333.1	418.0	636.3	836.8	995.6	1049.1
75. SKIN TEMP. NO. 11	SKNT11	DEG.FAHR	335.0	419.9	704.0	964.2	1169.4	1236.2
76. SKIN TEMP. NO. 12	SKNT12	DEG.FAHR	332.7	368.5	481.8	589.2	669.1	694.5
77. SKIN TEMP. NO. 13	SKNT13	DEG.FAHR	335.1	341.0	386.7	460.4	532.5	558.4
78. SKIN TEMP. NO. 14	SKNT14	DEG.FAHR	317.0	316.8	313.5	306.4	297.9	294.2
79. SKIN TEMP. NO. 15	SKNT15	DEG.FAHR	317.4	316.8	313.3	307.1	299.3	296.1
80. SKIN TEMP. NO. 16	SKNT16	DEG.FAHR	317.4	317.0	317.0	316.9	317.0	317.0
81. SKIN TEMP. NO. 17	SKNT17	DEG.FAHR	313.4	313.4	313.4	313.4	313.7	313.8
82. SKIN TEMP. NO. 18	SKNT18	DEG.FAHR	366.2	389.0	441.0	496.3	551.9	574.1
83. SKIN TEMP. NO. 19	SKNT19	DEG.FAHR	372.8	397.5	447.5	498.6	549.6	570.2
84. SKIN TEMP. NO. 20A	SKNT20A	DEG.FAHR	345.1	468.5	710.5	908.5	1059.9	1109.0
85. SKIN TEMP. NO. 21A	SKNT21A	DEG.FAHR	342.3	451.9	739.8	980.3	1165.9	1225.4

BAROMETRIC PRESSURE	14.51	PSIA
TIME OF RUN	1058	HRS
LENGTH OF RUN	5.0	SEC
FUEL SP.GR. 60/60	0.0	MMH
OXID SP.GR. 60/60	0.0	N2O4
FUEL TRIM ORIFICE		
OXID TRIM ORIFICE		

T/C	AT 0.37720	IN2
T/C	AE 15.1360	IN2
FUEL	NOM 0.0	LBS/SEC
OXID	NOM 0.0	LBS/SEC
FSG	NOM 0.0	
OSG	NOM 0.0	

MODEL NO	8911
TEST DATE	02/18/87
TEST CELL	A-2
TEST NO	4416
T/C S/N	
INJ S/N	
F/OX VAL S/N	

EXTRA PARAMETERS

PARAMETER	SYMBOL	UNITS	STATIC	1.0	2.0	3.0	4.0	4.4
62. CELL AMBIENT TEMPERATURE	TAMB	DEG.FAHR	96.7	96.5	96.0	95.6	95.4	95.4
63. FUEL CAVITY TEMP.	FCT	DEG.FAHR	378.5	495.7	570.5	599.3	614.7	619.8
64. NOZZLE LAND TEMP.	NLT	DEG.FAHR	374.9	817.3	860.2	879.5	887.9	890.3
65. SKIN TEMP. NO. 1	SKNT1	DEG.FAHR	267.4	266.5	265.5	263.6	262.0	261.3
66.			0.0	0.0	0.0	0.0	0.0	0.0
67. SKIN TEMP. NO. 3	SKNT3	DEG.FAHR	313.4	313.2	313.1	314.2	318.4	321.3
68. SKIN TEMP. NO. 4	SKNT4	DEG.FAHR	307.1	326.7	356.2	386.7	418.1	430.8
69. SKIN TEMP. NO. 5	SKNT5	DEG.FAHR	312.9	321.0	334.4	350.8	371.7	381.2
70. SKIN TEMP. NO. 6	SKNT6	DEG.FAHR	320.0	323.9	334.0	354.5	385.7	400.0
71. SKIN TEMP. NO. 7	SKNT7	DEG.FAHR	312.8	316.8	328.6	352.1	387.7	404.[illegible]
72. SKIN TEMP. NO. 8	SKNT8	DEG.FAHR	269.5	266.9	262.6	258.9	255.8	255.[illegible]
73. SKIN TEMP. NO. 9	SKNT9	DEG.FAHR	270.6	268.5	265.3	262.9	262.0	262.5
74. SKIN TEMP. NO. 10	SKNT10	DEG.FAHR	339.0	410.3	601.7	787.5	944.4	998.7
75. SKIN TEMP. NO. 11	SKNT11	DEG.FAHR	336.2	418.1	647.1	880.6	1075.5	1141.5
76. SKIN TEMP. NO. 12	SKNT12	DEG.FAHR	363.7	396.9	503.6	607.9	688.9	715.4
77. SKIN TEMP. NO. 13	SKNT13	DEG.FAHR	368.3	373.7	414.6	482.4	551.3	576.8
78. SKIN TEMP. NO. 14	SKNT14	DEG.FAHR	368.8	368.4	365.3	358.7	350.2	346.7
79. SKIN TEMP. NO. 15	SKNT15	DEG.FAHR	368.3	367.8	365.3	359.8	352.6	349.5
80. SKIN TEMP. NO. 16	SKNT16	DEG.FAHR	366.1	365.2	365.4	365.7	366.0	366.1
81. SKIN TEMP. NO. 17	SKNT17	DEG.FAHR	362.5	362.4	362.4	362.5	362.7	362.8
82. SKIN TEMP. NO. 18	SKNT18	DEG.FAHR	348.0	362.6	397.4	436.5	478.0	494.7
83. SKIN TEMP. NO. 19	SKNT19	DEG.FAHR	359.6	378.3	416.3	454.8	494.1	510.0
84. SKIN TEMP. NO. 20A	SKNT20A	DEG.FAHR	353.6	459.3	674.8	861.6	1011.6	1063.3
85. SKIN TEMP. NO. 21A	SKNT21A	DEG.FAHR	349.6	458.3	701.2	924.3	1106.8	1167.5

BELL AEROSPACE TEXTRON

P716 REV.01/08/86 MODEL 8911 - PRELIMINARY TEST REPORT - 50 LB. O2/H2 ENGINE S/N 2 PAGE OF

BAROMETRIC PRESSURE	14.51	PSIA	T/C AT 0.37720 IN2	MODEL NO	8911
TIME OF RUN	1115	HRS	T/C AE 15.1360 IN2	TEST DATE	02/18/87
LENGTH OF RUN	5.0	SEC	FUEL NOM 0.0 LBS/SEC	TEST CELL	A-2
FUEL SP.GR. 60/60	0.0	MMH	OXID NOM 0.0 LBS/SEC	TEST NO	4417
OXID SP.GR. 60/60	0.0	N204	FSG NOM 0.0	T/C S/N	
FUEL TRIM ORIFICE			OSG NOM 0.0	INJ S/N	
OXID TRIM ORIFICE				F/OX VAL S/N	/

EXTRA PARAMETERS

PARAMETER	SYMBOL	UNITS	STATIC	1.0	2.0	3.0	4.0	4.4
62. CELL AMBIENT TEMPERATURE	TAMB	DEG.FAHR	97.5	97.2	97.0	96.9	96.8	96.8
63. FUEL CAVITY TEMP.	FCT	DEG.FAHR	391.5	488.8	512.4	507.0	506.3	507.5
64. NOZZLE LAND TEMP.	NLT	DEG.FAHR	387.9	802.1	819.0	822.2	820.6	820.4
65. SKIN TEMP. NO. 1	SKNT1	DEG.FAHR	266.6	266.2	264.7	262.4	260.1	234.5
66.			0.0	0.0	0.0	0.0	0.0	0.0
67. SKIN TEMP. NO. 3	SKNT3	DEG.FAHR	307.0	307.0	306.8	308.9	315.6	319.9
68. SKIN TEMP. NO. 4	SKNT4	DEG.FAHR	301.2	338.9	391.4	441.6	488.4	506.1
69. SKIN TEMP. NO. 5	SKNT5	DEG.FAHR	305.7	324.8	353.2	383.9	418.7	433.6
70. SKIN TEMP. NO. 6	SKNT6	DEG.FAHR	314.9	324.2	345.9	382.0	429.2	450.3
71. SKIN TEMP. NO. 7	SKNT7	DEG.FAHR	305.9	314.7	338.9	379.5	432.7	456.4
72. SKIN TEMP. NO. 8	SKNT8	DEG.FAHR	270.9	267.4	262.0	257.5	253.8	252.8
73. SKIN TEMP. NO. 9	SKNT9	DEG.FAHR	270.8	267.8	263.7	260.9	260.1	260.9
74. SKIN TEMP. NO. 10	SKNT10	DEG.FAHR	339.6	440.2	684.5	898.0	1060.2	1111.8
75. SKIN TEMP. NO. 11	SKNT11	DEG.FAHR	336.2	438.6	760.2	1037.1	1238.1	1304.2
76. SKIN TEMP. NO. 12	SKNT12	DEG.FAHR	372.8	414.2	532.3	634.6	705.3	726.5
77. SKIN TEMP. NO. 13	SKNT13	DEG.FAHR	378.5	385.6	434.5	509.5	578.1	601.9
78. SKIN TEMP. NO. 14	SKNT14	DEG.FAHR	380.4	379.6	373.8	363.5	350.9	345.7
79. SKIN TEMP. NO. 15	SKNT15	DEG.FAHR	379.6	378.4	373.1	363.5	351.9	346.9
80. SKIN TEMP. NO. 16	SKNT16	DEG.FAHR	373.4	373.0	373.2	373.2	373.2	373.2
81. SKIN TEMP. NO. 17	SKNT17	DEG.FAHR	369.7	369.7	369.6	369.7	370.2	370.4
82. SKIN TEMP. NO. 18	SKNT18	DEG.FAHR	326.8	351.9	410.2	476.0	543.4	570.3
83. SKIN TEMP. NO. 19	SKNT19	DEG.FAHR	338.4	368.2	426.9	487.7	550.2	575.3
84. SKIN TEMP. NO. 20A	SKNT20A	DEG.FAHR	355.8	501.1	762.5	964.7	1107.5	1151.9
85. SKIN TEMP. NO. 21A	SKNT21A	DEG.FAHR	351.8	486.3	807.3	1055.4	1232.4	1288.1

BELL AEROSPACE TEXTRON

P716 REV.01/08/86 MODEL 8911 - PRELIMINARY TEST REPORT - 50 LB. O2/H2 ENGINE S/N 2 PAGE OF

TESTS 4418 - 4420 CELL A-2 DATE 02/18/87 - 02/18/87 TEST REF. 911-E-001

CHAMBER S/N
INJECTOR S/N
F/OX VALVE S/N

TEST HARDWARE AND PROPELLANT NOMINALS
T/C AT(AMB) .37720 IN2
T/C AE(AMB) 15.136 IN2

FSG NUM (60/60) 0.0
OSG NUM (60/60) 0.0
FUEL NOM .0 LBS/SEC
OXID NOM .0 LBS/SEC

PERFORMANCE TEST. DATA SUMMARY

TEST NO.	DUR SEC	MEASURED DATA PNT	****PC**** PRESS PSIA	ROUG PERC	***RATIO*** TEST	COR	WTOT LB/SEC	C* FT/S	***F INF*** TEST LBS	COR LBS	**ISP INF** TEST SEC	COR SEC	CF INF	OFP PSIA	FFP PSIA	OFT DEG.FAHR	FFT	TOTAL IMPULSE LB-SEC	DPO COR PSID	DPF COR PSID	PA PSIA
4418	30.0	1.0	104.4	0.0	4.107	0.0	.196127	6456.	70.97	0.0	361.9	0.0	1.802	390.	298.	82.	82.	0.0	0.0	0.0	0.035
		2.0	104.0	0.0	4.093	0.0	.196551	6427.	70.82	0.0	360.3	0.0	1.805	390.	299.	82.	79.	0.0	0.0	0.0	0.030
		3.0	103.9	0.0	4.070	0.0	.196832	6410.	70.86	0.0	360.0	0.0	1.808	390.	299.	81.	74.	0.0	0.0	0.0	0.027
		4.0	103.3	0.0	4.046	0.0	.197095	6368.	70.63	0.0	358.4	0.0	1.812	390.	300.	81.	67.	0.0	0.0	0.0	0.025
		5.0	103.1	0.0	4.025	0.0	.197338	6344.	70.54	0.0	357.4	0.0	1.814	390.	300.	81.	62.	0.0	0.0	0.0	0.023
		10.0	103.6	0.0	3.982	0.0	.198073	6356.	70.44	0.0	355.6	0.0	1.802	390.	299.	80.	48.	0.0	0.0	0.0	0.020
		15.0	104.3	0.0	3.983	0.0	.198803	6373.	70.90	0.0	356.6	0.0	1.802	389.	298.	76.	45.	0.0	0.0	0.0	0.019
		20.0	104.8	0.0	4.003	0.0	.199777	6369.	71.32	0.0	357.0	0.0	1.805	390.	298.	71.	44.	0.0	0.0	0.0	0.019
		29.4	105.3	0.0	4.046	0.0	.201471	6346.	71.68	0.0	355.8	0.0	1.805	390.	299.	61.	45.	0.0	0.0	0.0	0.019
4419	30.0	1.0	104.9	0.0	6.098	0.0	.210507	6053.	72.66	0.0	345.2	0.0	1.836	445.	231.	79.	75.	0.0	0.0	0.0	0.034
		2.0	104.7	0.0	6.087	0.0	.210554	6042.	72.68	0.0	345.2	0.0	1.840	445.	232.	79.	75.	0.0	0.0	0.0	0.030
		3.0	104.8	0.0	6.071	0.0	.210667	6042.	72.64	0.0	344.8	0.0	1.837	445.	232.	78.	73.	0.0	0.0	0.0	0.028
		4.0	104.8	0.0	6.049	0.0	.210815	6038.	72.47	0.0	343.8	0.0	1.833	444.	232.	78.	69.	0.0	0.0	0.0	0.026
		5.0	105.0	0.0	6.025	0.0	.210953	6043.	72.47	0.0	343.5	0.0	1.830	444.	232.	78.	65.	0.0	0.0	0.0	0.024
		10.0	105.4	0.0	5.952	0.0	.211743	6045.	72.53	0.0	342.5	0.0	1.824	444.	232.	77.	51.	0.0	0.0	0.0	0.021
		15.0	105.7	0.0	5.949	0.0	.212751	6035.	72.69	0.0	341.7	0.0	1.823	444.	232.	72.	46.	0.0	0.0	0.0	0.020
		20.0	106.4	0.0	5.976	0.0	.213977	6042.	73.34	0.0	342.8	0.0	1.827	444.	232.	66.	44.	0.0	0.0	0.0	0.020
		29.4	107.3	0.0	6.039	0.0	.216022	6034.	74.25	0.0	343.7	0.0	1.834	444.	232.	57.	44.	0.0	0.0	0.0	0.020
4420	30.0	1.0	101.5	0.0	8.203	0.0	.223464	5519.	70.57	0.0	315.8	0.0	1.842	492.	194.	83.	88.	0.0	0.0	0.0	0.039
		2.0	101.9	0.0	8.190	0.0	.223447	5538.	70.79	0.0	316.8	0.0	1.842	493.	195.	84.	88.	0.0	0.0	0.0	0.034
		3.0	102.2	0.0	8.174	0.0	.223536	5553.	70.93	0.0	317.3	0.0	1.840	493.	196.	85.	87.	0.0	0.0	0.0	0.030
		4.0	102.7	0.0	8.151	0.0	.223712	5578.	71.21	0.0	318.3	0.0	1.838	493.	196.	85.	84.	0.0	0.0	0.0	0.028
		5.0	103.1	0.0	8.121	0.0	.223903	5594.	71.38	0.0	318.8	0.0	1.835	493.	197.	85.	80.	0.0	0.0	0.0	0.027
		10.0	104.4	0.0	8.009	0.0	.225250	5629.	72.09	0.0	320.0	0.0	1.831	494.	198.	82.	61.	0.0	0.0	0.0	0.023
		15.0	105.2	0.0	7.998	0.0	.226969	5628.	72.71	0.0	320.4	0.0	1.833	494.	198.	76.	52.	0.0	0.0	0.0	0.022
		20.0	105.7	0.0	8.029	0.0	.228734	5612.	73.36	0.0	320.7	0.0	1.840	494.	198.	68.	47.	0.0	0.0	0.0	0.022
		29.4	106.3	0.0	8.104	0.0	.231288	5580.	74.24	0.0	321.0	0.0	1.852	494.	198.	57.	44.	0.0	0.0	0.0	0.022

BAROMETRIC PRESSURE	14.51	PSIA
TIME OF RUN	1132	HRS
LENGTH OF RUN	30.0	SEC
FUEL SP.GR. 60/60	0.0	MMH
OXID SP.GR. 60/60	0.0	N2O4
FUEL TRIM ORIFICE		
OXID TRIM ORIFICE		

T/C AT	0.37720	IN2
T/C AE	15.1360	IN2
FUEL NOM	0.0	LBS/SEC
OXID NOM	0.0	LBS/SEC
FSG NOM	0.0	
OSG NOM	0.0	

MODEL NO	8911
TEST DATE	02/18/87
TEST CELL	A-2
TEST NO	4418
T/C S/N	
INJ S/N	
F/OX VAL S/N	

EXTRA PARAMETERS

PARAMETER	SYMBOL	UNITS	STATIC	1.0	2.0	3.0	4.0	5.0	10.0	15.0
62. CELL AMBIENT TEMPERATURE	TAMB	DEG.FAHR	97.8	97.4	97.1	96.9	96.6	96.5	96.6	96.6
63. FUEL CAVITY TEMP.	FCT	DEG.FAHR	387.4	385.4	375.7	365.8	361.4	355.7	334.8	309.1
64. NOZZLE LAND TEMP.	NLT	DEG.FAHR	383.9	590.4	568.1	548.4	533.4	521.6	502.2	497.5
* 65. SKIN TEMP. NO. 1	SKNT1	DEG.FAHR	0.0	0.0	0.0	68.8	42.8	61.3	247.9	209.7
66.			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
67. SKIN TEMP. NO. 3	SKNT3	DEG.FAHR	307.1	307.1	307.1	309.5	316.5	328.9	453.9	600.7
68. SKIN TEMP. NO. 4	SKNT4	DEG.FAHR	300.9	348.2	403.1	449.7	487.3	521.6	644.4	732.4
69. SKIN TEMP. NO. 5	SKNT5	DEG.FAHR	304.8	335.2	378.0	416.9	453.3	490.0	666.1	798.5
70. SKIN TEMP. NO. 6	SKNT6	DEG.FAHR	313.9	329.5	359.2	398.0	442.9	488.2	651.1	746.7
71. SKIN TEMP. NO. 7	SKNT7	DEG.FAHR	304.8	318.6	347.4	389.0	440.7	496.9	746.4	868.0
72. SKIN TEMP. NO. 8	SKNT8	DEG.FAHR	270.7	269.4	265.9	262.7	260.3	259.1	275.3	308.7
73. SKIN TEMP. NO. 9	SKNT9	DEG.FAHR	270.8	269.6	267.0	265.1	264.9	267.8	330.2	411.6
74. SKIN TEMP. NO. 10	SKNT10	DEG.FAHR	337.3	403.8	581.2	729.4	834.8	909.4	1029.2	1080.5
*75. SKIN TEMP. NO. 11	SKNT11	DEG.FAHR	334.0	419.3	656.7	870.4	1037.4	1167.1	1498.2	1479.4
76. SKIN TEMP. NO. 12	SKNT12	DEG.FAHR	369.2	392.9	462.8	517.7	552.3	574.2	591.1	594.3
77. SKIN TEMP. NO. 13	SKNT13	DEG.FAHR	374.8	378.3	405.9	447.6	488.9	527.7	670.1	676.1
78. SKIN TEMP. NO. 14	SKNT14	DEG.FAHR	377.4	376.7	370.8	359.1	344.5	328.8	252.5	198.3
79. SKIN TEMP. NO. 15	SKNT15	DEG.FAHR	376.3	375.5	369.2	357.6	343.0	327.0	248.0	190.0
80. SKIN TEMP. NO. 16	SKNT16	DEG.FAHR	371.8	371.4	371.4	371.4	371.4	371.3	362.9	352.3
81. SKIN TEMP. NO. 17	SKNT17	DEG.FAHR	368.6	368.3	368.3	368.5	368.5	368.4	360.6	351.1
82. SKIN TEMP. NO. 18	SKNT18	DEG.FAHR	327.3	342.0	380.3	422.6	464.3	503.5	673.7	837.2
83. SKIN TEMP. NO. 19	SKNT19	DEG.FAHR	339.7	359.2	403.3	449.6	495.6	538.2	724.9	902.7
84. SKIN TEMP. NO. 20A	SKNT20A	DEG.FAHR	353.1	461.2	676.2	844.8	966.8	1057.6	1232.1	1220.2
85. SKIN TEMP. NO. 21A	SKNT21A	DEG.FAHR	348.9	448.3	664.3	830.7	946.7	1026.6	1164.5	1154.6

DATA N.G.

BELL AEROSPACE TEXTRON

P716 REV.01/08/86 MODEL 8911 - PRELIMINARY TEST REPORT - 50 LB. O2/H2 ENGINE S/N 2 PAGE OF

BAROMETRIC PRESSURE	14.51	PSIA
TIME OF RUN	1132	HRS
LENGTH OF RUN	30.0	SEC
FUEL SP.GR. 60/60	0.0	MMH
OXID SP.GR. 60/60	0.0	N2O4
FUEL TRIM ORIFICE		
OXID TRIM ORIFICE		

T/C	AT 0.37720	IN2
T/C	AE 15.1360	IN2
FUEL	NOM 0.0	LBS/SEC
OXID	NOM 0.0	LBS/SEC
FSG	NOM 0.0	
OSG	NOM 0.0	

MODEL NO	8911
TEST DATE	02/18/87
TEST CELL	A-2
TEST NO	4418
T/C S/N	
INJ S/N	
F/OX VAL S/N	/

EXTRA PARAMETERS

PARAMETER	SYMBOL	UNITS	STATIC	20.0	29.4
62. CELL AMBIENT TEMPERATURE	TAMB	DEG.FAHR	97.8	96.9	97.1
63. FUEL CAVITY TEMP.	FCT	DEG.FAHR	387.4	299.3	294.1
64. NOZZLE LAND TEMP.	NLT	DEG.FAHR	383.9	497.6	493.6
* 65. SKIN TEMP. NO. 1	SKNT1	DEG.FAHR	0.0	0.0	0.0
66.			0.0	0.0	0.0
67. SKIN TEMP. NO. 3	SKNT3	DEG.FAHR	307.1	717.7	860.2
68. SKIN TEMP. NO. 4	SKNT4	DEG.FAHR	300.9	793.9	867.9
69. SKIN TEMP. NO. 5	SKNT5	DEG.FAHR	304.8	875.4	952.2
70. SKIN TEMP. NO. 6	SKNT6	DEG.FAHR	313.9	809.2	877.1
71. SKIN TEMP. NO. 7	SKNT7	DEG.FAHR	304.8	922.3	971.0
72. SKIN TEMP. NO. 8	SKNT8	DEG.FAHR	270.7	339.5	381.2
73. SKIN TEMP. NO. 9	SKNT9	DEG.FAHR	270.8	462.7	504.7
74. SKIN TEMP. NO. 10	SKNT10	DEG.FAHR	337.3	1097.9	1109.7
75. SKIN TEMP. NO. 11	SKNT11	DEG.FAHR	334.0	1420.0	1358.7
76. SKIN TEMP. NO. 12	SKNT12	DEG.FAHR	369.2	590.8	587.7
77. SKIN TEMP. NO. 13	SKNT13	DEG.FAHR	374.8	650.1	614.2
78. SKIN TEMP. NO. 14	SKNT14	DEG.FAHR	377.4	167.9	139.8
79. SKIN TEMP. NO. 15	SKNT15	DEG.FAHR	376.3	159.7	136.3
80. SKIN TEMP. NO. 16	SKNT16	DEG.FAHR	371.8	339.1	314.5
81. SKIN TEMP. NO. 17	SKNT17	DEG.FAHR	368.6	339.9	322.2
82. SKIN TEMP. NO. 18	SKNT18	DEG.FAHR	327.3	978.7	1170.6
83. SKIN TEMP. NO. 19	SKNT19	DEG.FAHR	339.7	1048.4	1252.7
84. SKIN TEMP. NO. 20A	SKNT20A	DEG.FAHR	353.1	1185.4	1155.0
85. SKIN TEMP. NO. 21A	SKNT21A	DEG.FAHR	348.9	1140.1	1125.7

* DATA N.G.

BELL AEROSPACE TEXTRON

P716 REV.01/08/86 MODEL 8911 - PRELIMINARY TEST REPORT - 50 LB. O2/H2 ENGINE S/N 2 PAGE OF

BAROMETRIC PRESSURE	14.51	PSIA	T/C AT 0.37720 IN2	MODEL NO	8911
TIME OF RUN	1150	HRS	T/C AE 15.1360 IN2	TEST DATE	02/18/87
LENGTH OF RUN	30.0	SEC	FUEL NOM 0.0 LBS/SEC	TEST CELL	A-2
FUEL SP.GR. 60/60	0.0	MMH	OXID NOM 0.0 LBS/SEC	TEST NO	4419
OXID SP.GR. 60/60	0.0	N204	FSG NOM 0.0	T/C S/N	
FUEL TRIM ORIFICE			OSG NOM 0.0	INJ S/N	
OXID TRIM ORIFICE				F/OX VAL S/N	/

EXTRA PARAMETERS

PARAMETER	SYMBOL	UNITS	STATIC	1.0	2.0	3.0	4.0	5.0	10.0	15.0
62. CELL AMBIENT TEMPERATURE	TAMB	DEG.FAHR	98.4	98.2	97.8	97.5	97.5	97.5	97.5	97.5
63. FUEL CAVITY TEMP.	FCT	DEG.FAHR	356.3	426.5	454.1	459.7	454.9	453.0	439.7	438.0
64. NOZZLE LAND TEMP.	NLT	DEG.FAHR	353.0	716.9	724.1	724.6	722.3	719.6	713.4	699.2
* 65. SKIN TEMP. NO. 1	SKNT1	DEG.FAHR	0.0	0.0	0.0	0.0	0.0	0.0	277.5	263.0
66.			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
67. SKIN TEMP. NO. 3	SKNT3	DEG.FAHR	332.8	332.6	332.7	334.3	340.0	352.0	470.3	620.3
68. SKIN TEMP. NO. 4	SKNT4	DEG.FAHR	323.5	354.9	397.7	442.3	484.5	523.6	679.5	782.2
69. SKIN TEMP. NO. 5	SKNT5	DEG.FAHR	328.6	347.9	378.0	407.0	437.8	471.8	641.9	781.6
70. SKIN TEMP. NO. 6	SKNT6	DEG.FAHR	333.7	342.8	362.4	393.7	433.4	476.9	669.8	787.6
71. SKIN TEMP. NO. 7	SKNT7	DEG.FAHR	325.9	333.5	352.0	383.5	428.4	481.6	739.3	905.3
72. SKIN TEMP. NO. 8	SKNT8	DEG.FAHR	280.8	279.7	275.7	271.9	268.9	267.3	284.3	321.8
73. SKIN TEMP. NO. 9	SKNT9	DEG.FAHR	279.6	278.1	275.2	273.0	272.7	275.2	338.2	430.7
74. SKIN TEMP. NO. 10	SKNT10	DEG.FAHR	337.7	414.9	620.3	795.3	920.5	1011.9	1214.4	1260.9
75. SKIN TEMP. NO. 11	SKNT11	DEG.FAHR	336.9	422.3	662.4	897.3	1090.6	1237.5	1609.3	1719.6
76. SKIN TEMP. NO. 12	SKNT12	DEG.FAHR	345.1	377.0	477.1	563.1	617.1	650.6	709.2	719.7
77. SKIN TEMP. NO. 13	SKNT13	DEG.FAHR	348.0	352.5	386.1	440.9	499.2	552.1	700.0	756.4
78. SKIN TEMP. NO. 14	SKNT14	DEG.FAHR	348.9	348.2	343.5	334.3	323.1	310.9	253.0	209.6
79. SKIN TEMP. NO. 15	SKNT15	DEG.FAHR	349.1	348.2	343.8	335.5	325.1	314.0	259.5	215.3
80. SKIN TEMP. NO. 16	SKNT16	DEG.FAHR	350.2	349.4	349.4	349.4	349.4	349.2	346.7	340.9
81. SKIN TEMP. NO. 17	SKNT17	DEG.FAHR	347.4	347.0	346.9	346.9	347.0	347.3	347.5	345.0
82. SKIN TEMP. NO. 18	SKNT18	DEG.FAHR	341.6	360.3	406.9	458.4	510.5	561.8	792.6	976.5
83. SKIN TEMP. NO. 19	SKNT19	DEG.FAHR	353.9	377.4	427.7	479.3	530.3	580.9	828.6	1048.6
84. SKIN TEMP. NO. 20A	SKNT20A	DEG.FAHR	348.7	461.5	689.4	874.2	1007.0	1101.3	1286.9	1322.7
85. SKIN TEMP. NO. 21A	SKNT21A	DEG.FAHR	345.1	451.8	683.1	884.1	1044.7	1164.1	1438.3	1502.5

* DATA N.G.

BELL AEROSPACE TEXTRON

P716 REV.01/08/86 MODEL 8911 - PRELIMINARY TEST REPORT - 50 LB. O2/H2 ENGINE S/N 2 PAGE OF

BAROMETRIC PRESSURE	14.51	PSIA	T/C	AT 0.37720	IN2	MODEL NO	8911
TIME OF RUN	1150	HRS	T/C	AE 15.1360	IN2	TEST DATE	02/18/87
LENGTH OF RUN	30.0	SEC	FUEL	NOM 0.0	LBS/SEC	TEST CELL	A-2
FUEL SP.GR. 60/60	0.0	MMH	OXID	NOM 0.0	LBS/SEC	TEST NO	4419
OXID SP.GR. 60/60	0.0	N2O4	FSG	NOM 0.0		T/C S/N	
FUEL TRIM ORIFICE			OSG	NOM 0.0		INJ S/N	
OXID TRIM ORIFICE						F/OX VAL S/N	/

EXTRA PARAMETERS

PARAMETER	SYMBOL	UNITS	STATIC	20.0	29.4
62. CELL AMBIENT TEMPERATURE	TAMB	DEG.FAHR	98.4	97.9	98.0
63. FUEL CAVITY TEMP.	FCT	DEG.FAHR	356.3	443.8	441.0
64. NOZZLE LAND TEMP.	NLT	DEG.FAHR	353.0	689.8	688.7
* 65. SKIN TEMP. NO. 1	SKNT1	DEG.FAHR	0.0	0.0	0.0
66.			0.0	0.0	0.0
67. SKIN TEMP. NO. 3	SKNT3	DEG.FAHR	332.8	755.9	941.8
68. SKIN TEMP. NO. 4	SKNT4	DEG.FAHR	323.5	846.9	922.2
69. SKIN TEMP. NO. 5	SKNT5	DEG.FAHR	328.6	887.1	1010.2
70. SKIN TEMP. NO. 6	SKNT6	DEG.FAHR	333.7	854.9	921.3
71. SKIN TEMP. NO. 7	SKNT7	DEG.FAHR	325.9	1001.5	1096.1
72. SKIN TEMP. NO. 8	SKNT8	DEG.FAHR	280.8	354.4	393.2
73. SKIN TEMP. NO. 9	SKNT9	DEG.FAHR	279.6	507.0	592.2
74. SKIN TEMP. NO. 10	SKNT10	DEG.FAHR	337.7	1263.0	1264.0
75. SKIN TEMP. NO. 11	SKNT11	DEG.FAHR	336.9	1733.3	1706.9
76. SKIN TEMP. NO. 12	SKNT12	DEG.FAHR	345.1	720.0	721.8
77. SKIN TEMP. NO. 13	SKNT13	DEG.FAHR	348.0	774.5	777.2
78. SKIN TEMP. NO. 14	SKNT14	DEG.FAHR	348.9	180.5	156.4
79. SKIN TEMP. NO. 15	SKNT15	DEG.FAHR	349.1	184.8	161.0
80. SKIN TEMP. NO. 16	SKNT16	DEG.FAHR	350.2	334.1	321.7
81. SKIN TEMP. NO. 17	SKNT17	DEG.FAHR	347.4	340.8	333.9
82. SKIN TEMP. NO. 18	SKNT18	DEG.FAHR	341.6	1124.7	1323.0
83. SKIN TEMP. NO. 19	SKNT19	DEG.FAHR	353.9	1229.2	1491.2
84. SKIN TEMP. NO. 20A	SKNT20A	DEG.FAHR	348.7	1344.0	1336.6
85. SKIN TEMP. NO. 21A	SKNT21A	DEG.FAHR	345.1	1489.1	1464.1

* DATA N.G.

BELL AEROSPACE TEXTRON

P716 REV.01/08/86 MODEL 8911 - PRELIMINARY TEST REPORT - 50 LB. O2/H2 ENGINE S/N 2 PAGE OF

BAROMETRIC PRESSURE	14.51	PSIA
TIME OF RUN	1339	HRS
LENGTH OF RUN	30.0	SEC
FUEL SP.GR. 60/60	0.0	MMH
OXID SP.GR. 60/60	0.0	N204
FUEL TRIM ORIFICE		
OXID TRIM ORIFICE		

T/C	AT 0.37720	IN2
T/C	AE 15.1360	IN2
FUEL	NOM 0.0	LBS/SEC
OXID	NOM 0.0	LBS/SEC
FSG	NOM 0.0	
OSG	NOM 0.0	

MODEL NO	8911
TEST DATE	02/18/87
TEST CELL	A-2
TEST NO	4420
T/C S/N	
INJ S/N	
F/OX VAL S/N	/

EXTRA PARAMETERS

PARAMETER	SYMBOL	UNITS	STATIC	1.0	2.0	3.0	4.0	5.0	10.0	15.0
62. CELL AMBIENT TEMPERATURE	TAMB	DEG.FAHR	101.2	100.8	100.2	100.0	99.9	99.9	99.9	100.5
63. FUEL CAVITY TEMP.	FCT	DEG.FAHR	121.0	318.1	427.3	482.2	509.9	527.8	552.8	560.2
64. NOZZLE LAND TEMP.	NLT	DEG.FAHR	117.1	649.5	725.8	761.9	787.9	802.5	828.4	839.9
65. SKIN TEMP. NO. 1	SKNT1	DEG.FAHR	110.2	110.4	110.1	110.1	109.7	109.5	108.1	106.2
66.			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
67. SKIN TEMP. NO. 3	SKNT3	DEG.FAHR	111.1	111.1	111.2	112.2	116.3	125.2	244.6	417.6
68. SKIN TEMP. NO. 4	SKNT4	DEG.FAHR	101.9	140.2	184.0	233.6	280.5	325.3	524.5	682.0
69. SKIN TEMP. NO. 5	SKNT5	DEG.FAHR	108.4	130.1	159.2	182.9	214.0	249.1	441.8	618.8
70. SKIN TEMP. NO. 6	SKNT5	DEG.FAHR	107.6	121.8	144.6	171.6	207.4	256.2	525.4	716.6
71. SKIN TEMP. NO. 7	SKNT7	DEG.FAHR	106.9	119.2	144.3	174.8	217.3	272.6	571.3	790.5
72. SKIN TEMP. NO. 8	SKNT8	DEG.FAHR	99.7	101.6	100.8	100.4	100.4	101.4	132.8	196.1
73. SKIN TEMP. NO. 9	SKNT9	DEG.FAHR	100.3	100.7	99.8	100.0	101.6	105.7	182.2	309.6
74. SKIN TEMP. NO. 10	SKNT10	DEG.FAHR	112.6	187.7	415.9	642.2	829.9	983.9	1384.2	1514.8
75. SKIN TEMP. NO. 11	SKNT11	DEG.FAHR	112.8	181.2	448.9	725.0	962.0	1150.6	1654.0	1824.9
76. SKIN TEMP. NO. 12	SKNT12	DEG.FAHR	118.1	143.7	274.8	408.5	512.6	592.9	783.8	838.5
77. SKIN TEMP. NO. 13	SKNT13	DEG.FAHR	119.9	124.0	161.4	240.4	330.6	409.3	645.6	744.1
78. SKIN TEMP. NO. 14	SKNT14	DEG.FAHR	117.0	117.1	116.6	116.2	116.1	116.6	124.3	129.6
79. SKIN TEMP. NO. 15	SKNT15	DEG.FAHR	118.9	118.9	118.5	118.2	118.5	119.6	130.7	138.6
80. SKIN TEMP. NO. 16	SKNT16	DEG.FAHR	116.5	116.1	116.2	116.5	117.0	118.2	131.0	148.3
81. SKIN TEMP. NO. 17	SKNT17	DEG.FAHR	114.0	113.9	113.9	114.2	114.7	115.6	128.2	146.9
82. SKIN TEMP. NO. 18	SKNT18	DEG.FAHR	94.8	113.4	162.2	219.0	279.6	339.7	645.2	913.9
83. SKIN TEMP. NO. 19	SKNT19	DEG.FAHR	97.4	117.7	167.7	223.6	281.9	339.4	615.7	876.3
84. SKIN TEMP. NO. 20A	SKNT20A	DEG.FAHR	116.7	220.4	484.6	708.0	887.5	1031.3	1375.6	1470.8
85. SKIN TEMP. NO. 21A	SKNT21A	DEG.FAHR	114.9	213.2	499.8	765.2	980.8	1150.2	1579.8	1719.0

BELL AEROSPACE TEXTRON

P716 REV.01/08/86 MODEL 8911 - PRELIMINARY TEST REPORT - 50 LB. O2/H2 ENGINE S/N 2 PAGE OF

BAROMETRIC PRESSURE	14.51	PSIA	T/C	AT 0.37720	IN2	MODEL NO	8911
TIME OF RUN	1339	HRS	T/C	AE 15.1360	IN2	TEST DATE	02/18/87
LENGTH OF RUN	30.0	SEC	FUEL	NOM 0.0	LBS/SEC	TEST CELL	A-2
FUEL SP.GR. 60/60	0.0	MMH	OXID	NOM 0.0	LBS/SEC	TEST NO	4420
OXID SP.GR. 60/60	0.0	N204	FSG	NOM 0.0		T/C S/N	
FUEL TRIM ORIFICE			OSG	NOM 0.0		INJ S/N	
OXID TRIM ORIFICE						F/OX VAL S/N	

EXTRA PARAMETERS

PARAMETER	SYMBOL	UNITS	STATIC	20.0	29.4
62. CELL AMBIENT TEMPERATURE	TAMB	DEG.FAHR	101.2	100.8	101.3
63. FUEL CAVITY TEMP.	FCT	DEG.FAHR	121.0	564.0	566.4
64. NOZZLE LAND TEMP.	NLT	DEG.FAHR	117.1	844.6	848.6
65. SKIN TEMP. NO. 1	SKNT1	DEG.FAHR	110.2	105.0	104.0
66.			0.0	0.0	0.0
67. SKIN TEMP. NO. 3	SKNT3	DEG.FAHR	111.1	577.6	809.2
68. SKIN TEMP. NO. 4	SKNT4	DEG.FAHR	101.9	796.3	932.2
69. SKIN TEMP. NO. 5	SKNT5	DEG.FAHR	108.4	757.7	931.4
70. SKIN TEMP. NO. 6	SKNT6	DEG.FAHR	107.6	838.7	964.4
71. SKIN TEMP. NO. 7	SKNT7	DEG.FAHR	106.9	934.2	1084.5
72. SKIN TEMP. NO. 8	SKNT8	DEG.FAHR	99.7	262.2	345.6
73. SKIN TEMP. NO. 9	SKNT9	DEG.FAHR	100.3	414.1	540.7
74. SKIN TEMP. NO. 10	SKNT10	DEG.FAHR	112.6	1554.9	1575.8
75. SKIN TEMP. NO. 11	SKNT11	DEG.FAHR	112.8	1884.4	1909.5
76. SKIN TEMP. NO. 12	SKNT12	DEG.FAHR	118.1	860.1	882.3
77. SKIN TEMP. NO. 13	SKNT13	DEG.FAHR	119.9	795.6	843.8
78. SKIN TEMP. NO. 14	SKNT14	DEG.FAHR	117.0	131.8	131.7
79. SKIN TEMP. NO. 15	SKNT15	DEG.FAHR	118.9	141.8	142.9
80. SKIN TEMP. NO. 16	SKNT16	DEG.FAHR	116.5	164.6	187.0
81. SKIN TEMP. NO. 17	SKNT17	DEG.FAHR	114.0	165.9	194.9
82. SKIN TEMP. NO. 18	SKNT18	DEG.FAHR	94.8	1130.0	1411.4
83. SKIN TEMP. NO. 19	SKNT19	DEG.FAHR	97.4	1106.5	1430.1
84. SKIN TEMP. NO. 20A	SKNT20A	DEG.FAHR	116.7	1500.9	1519.8
85. SKIN TEMP. NO. 21A	SKNT21A	DEG.FAHR	114.9	1754.0	1773.8

CELL = A-2 4421 DATE = 02/18/87

TOTAL IMPULSE

PULSE NO.	PC	FA	FB	AVG F	ON TIME	OFF TIME	OFP	FFP	PA
1	6.78296	11.50262	11.51332	11.50797	0.200	0.0	552.7	341.2	0.0422
2	7.28537	12.82031	12.83449	12.82740	0.200	0.200	566.0	352.3	0.0557
3	7.37450	12.90637	12.91613	12.91125	0.200	0.200	567.7	352.1	0.0615
4	7.43036	13.10325	13.11339	13.10831	0.200	0.200	567.5	355.5	0.0631
5	7.34861	13.20057	13.20461	13.20258	0.200	0.200	567.0	356.2	0.0636
6	7.34529	13.16827	13.17160	13.16993	0.200	0.200	567.1	356.5	0.0644
7	7.43941	12.97334	12.97752	12.97543	0.200	0.200	567.3	356.4	0.0655
8	7.30737	12.87279	12.87783	12.87531	0.200	0.200	567.3	356.4	0.0660
9	7.35808	13.13913	13.14455	13.14184	0.200	0.200	567.4	356.7	0.0668
10	7.35633	13.17255	13.17675	13.17464	0.200	0.200	567.4	356.6	0.0675
11	7.27715	12.68180	12.68954	12.68567	0.200	0.200	567.4	356.8	0.0676
12	7.34518	13.03629	13.04215	13.03922	0.200	0.200	567.5	356.7	0.0684
13	7.35717	13.15719	13.15911	13.15814	0.200	0.200	567.7	356.6	0.0690
14	7.36847	12.90651	12.91031	12.90841	0.200	0.200	567.7	357.1	0.0693
15	7.07207	12.48339	12.48435	12.48386	0.200	0.200	567.7	357.2	0.0697
SUM ITOT=	109.44823	193.12422	193.21559	193.16988					
OVERALL SUM ITOT =				193.16988					
MEAN=	7.29655	12.87496	12.88104	12.87800	0.200	0.200			
MIN=	6.78296	11.50262	11.51332	11.50797					
MAX=	7.43941	13.20057	13.20461	13.20258					
SIGMA=	0.16533	0.43067	0.42940	0.43003					
SAMPLES=	15	15	15	15					

SUM X= 0.10944830322255620 03 0.19312433910369870 03 0.19321566295623780 03 0.19316995239257810 03
SUM X**2= 0.79897808837890620 03 0.24890640106201170 04 0.24914008941650390 04 0.24902310333251950 04
PULSES OMITTED FROM STATISTICS= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

Symbol		Units
PC	=	Impulse PC = Chamber Pressure x Throat Area x Time, = lb-sec
FA	=	Thrust Bridge A, lb-sec
FB	=	Thrust Bridge B, lb-sec
AVG F	=	Thrust Average, lb-sec
ON TIME	=	sec
OFF TIME	=	sec
OFP	=	Oxidizer Feed Pressure, psia
FFP	=	Fuel Feed Pressure, psia
PA	=	Test Cell Pressure, psia

CELL = A-2 4422 DATE = 02/13/87

TOTAL IMPULSE

PULSE NO.	PC	FA	FB	AVG F	ON TIME	OFF TIME	OFP	FFP	PA
1	3.90248	6.41752	6.42528	6.42140	0.120	0.0	552.1	338.2	0.0411
2	4.20153	7.30581	7.31446	7.31013	0.120	0.120	555.2	345.5	0.0487
3	4.04201	7.18165	7.19151	7.18658	0.121	0.119	554.1	352.9	0.0558
4	4.19831	7.24225	7.24889	7.24557	0.120	0.119	554.5	356.5	0.0602
5	4.18371	7.45988	7.46410	7.46199	0.120	0.120	554.7	356.7	0.0623
6	4.02973	7.09324	7.10172	7.09748	0.120	0.120	554.7	357.2	0.0632
7	3.95686	6.87467	6.88349	6.87908	0.120	0.120	554.8	357.3	0.0629
8	4.16380	7.34993	7.35843	7.35418	0.120	0.120	554.7	357.3	0.0631
9	4.17742	7.35901	7.36610	7.36256	0.120	0.120	554.8	357.2	0.0628
10	4.11788	7.32865	7.33527	7.33196	0.120	0.120	555.1	357.4	0.0628
11	4.23771	7.40544	7.41095	7.40820	0.120	0.120	554.8	357.4	0.0646
12	4.19537	7.51140	7.51696	7.51418	0.120	0.120	555.0	357.4	0.0655
13	4.15871	7.30477	7.31073	7.30775	0.120	0.120	554.9	357.4	0.0638
14	4.14773	7.33927	7.39342	7.39135	0.120	0.120	554.9	357.6	0.0649
15	4.17822	7.44749	7.45119	7.44934	0.120	0.120	555.1	357.6	0.0645
SUM ITOT=	61.89136	108.67088	108.77243	108.72163					
OVERALL SUM ITOT =				108.72163					
MEAN=	4.12610	7.24473	7.25150	7.24812	0.120	0.120			
MIN=	3.90248	6.41752	6.42528	6.42140					
MAX=	4.23771	7.51140	7.51696	7.51418					
SIGMA=	0.09811	0.27926	0.27828	0.27877					
SAMPLES=	15	15	15	15					

SUM X= 0.618914729164672D 02 0.108670979499816D 03 0.108772500991821 3D 03 0.108721736907959 0D 03
SUM X**2= 0.255505062103271 5D 03 0.788388395874023 40 03 0.789847961425781 20 03 0.789115707397460 9D 03
PULSES OMITTED FROM STATISTICS= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

Symbol		Units
PC	=	Impulse PC = Chamber Pressure x Throat Area x Time, = lb-sec
FA	=	Thrust Bridge A, lb-sec
FB	=	Thrust Bridge B, lb-sec
AVG F	=	Thrust Average, lb-sec
ON TIME	=	sec
OFF TIME	=	sec
OFP	=	Oxidizer Feed Pressure, psia
FFP	=	Fuel Feed Pressure, psia
PA	=	Test Cell Pressure, psia

CELL = A-2 4423 DATE = 02/18/87

PULSE NO.	TOTAL IMPULSE PC	FA	FB	AVG F	ON TIME	OFF TIME	OFP	FFP	PA
1	1.41306	2.14872	2.14927	2.14900	0.060	0.060	550.7	341.6	0.0402
2	1.78571	2.98248	2.99352	2.98300	0.060	0.060	585.9	353.7	0.0402
3	1.70557	2.91373	2.91593	2.91483	0.060	0.060	576.5	353.8	0.0461
4	1.68744	2.91327	2.91752	2.91540	0.060	0.060	581.8	352.6	0.0500
5	1.44589	2.41688	2.42108	2.41898	0.060	0.060	581.2	353.0	0.0522
6	1.64953	2.85438	2.85946	2.85692	0.060	0.060	580.7	353.4	0.0534
7	1.70788	2.96970	2.97516	2.97243	0.060	0.060	580.6	357.0	0.0551
8	1.60911	2.79730	2.79323	2.79027	0.060	0.060	581.5	357.8	0.0562
9	1.43907	2.40843	2.41362	2.41103	0.060	0.060	581.2	357.9	0.0565
10	1.49211	2.50122	2.50774	2.50448	0.060	0.060	580.3	357.9	0.0563
11	1.69282	2.94465	2.94985	2.94725	0.060	0.059	581.2	357.7	0.0559
12	1.60774	2.79493	2.79903	2.79698	0.061	0.059	581.1	358.7	0.0558
13	1.57231	2.70472	2.70761	2.70617	0.061	0.059	581.4	358.7	0.0563
14	1.31776	2.15572	2.15907	2.15740	0.061	0.059	581.1	358.6	0.0559
15	1.57995	2.70185	2.70448	2.70316	0.061	0.059	580.9	358.9	0.0557
SUM ITOT=	23.70590	40.19794	40.25652	40.22720					
OVERALL SUM ITOT =				40.22720					
MEAN=	1.58040	2.67987	2.68377	2.68182	0.060	0.060			
MIN=	1.31776	2.14872	2.14927	2.14900					
MAX=	1.78571	2.98248	2.98352	2.98300					
STGMA=	0.13294	0.23570	0.28601	0.23585					
SAMPLES=	15	15	15	15					

SUM X= 0.237059497933252D 02 0.401979980468750D 02 0.402565793991088D 02 0.402272853851318D 02
SUM X**2= 0.377122211456298D 02 0.108368050575256D 03 0.109184669494628D 03 0.109026276588435D 03
PULSES OMITTED FROM STATISTICS= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

Symbol		Units
PC	=	Impulse PC = Chamber Pressure x Throat Area x Time, = lb-sec
FA	=	Thrust Bridge A, lb-sec
FB	=	Thrust Bridge B, lb-sec
AVG F	=	Thrust Average, lb-sec
ON TIME	=	sec
OFF TIME	=	sec
OFP	=	Oxidizer Feed Pressure, psia
FFP	=	Fuel Feed Pressure, psia
PA	=	Test Cell Pressure, psia

CELL = A-2 4424 DATE = 02/18/87

TOTAL IMPULSE

PULSE NO.	PC	FA	FB	AVG F	ON TIME	OFF TIME	OFP	FFP	PA
1	0.75794	1.15140	1.15262	1.15201	0.040	0.040	551.3	340.6	0.0399
2	0.84682	1.20125	1.20121	1.20123	0.040	0.040	564.6	263.7	0.0402
3	0.71677	1.09351	1.09738	1.09545	0.040	0.040	547.6	335.7	0.0402
4	0.69789	1.07869	1.08242	1.08055	0.040	0.040	554.5	377.4	0.0422
5	0.58691	0.86866	0.86864	0.86865	0.040	0.040	553.9	371.1	0.0444
6	0.51653	0.72379	0.72558	0.72468	0.040	0.040	555.2	373.8	0.0468
7	0.71202	1.13120	1.13565	1.13342	0.040	0.040	557.7	371.9	0.0486
8	0.88048	1.29790	1.30033	1.29911	0.040	0.040	554.9	372.8	0.0492
9	0.70191	0.62508	0.62656	0.62582	0.040	0.040	553.9	373.5	0.0488
10	0.69779	0.62784	0.62929	0.62856	0.040	0.040	555.1	372.4	0.0493
11	0.70007	0.64119	0.64318	0.64218	0.040	0.040	560.4	372.3	0.0504
12	0.64104	0.71587	0.71852	0.71720	0.040	0.040	559.1	372.5	0.0523
13	0.72736	1.19133	1.19569	1.19351	0.040	0.039	558.3	372.9	0.0535
14	0.95651	1.41679	1.41882	1.41780	0.041	0.039	552.9	374.4	0.0530
15	0.43755	0.61273	0.61639	0.61456	0.041	0.039	548.0	374.9	0.0525
SUM ITOT=	10.47750	14.37722	14.41228	14.39475					
OVERALL SUM ITOT =				14.39475					
MEAN=	0.69850	0.95848	0.96082	0.95965	0.040	0.040			
MIN=	0.43755	0.61273	0.61639	0.61456					
MAX=	0.88048	1.41679	1.41882	1.41780					
SIGMA=	0.12010	0.28041	0.28062	0.28052					
SAMPLES=	15	15	15	15					

SUM X= 0.1047750824689965D 02 0.1437722021341324D 02 0.1441228371858597D 02 0.1439474773406982D 02
SUM X**2= 0.7520486056804657D 01 0.1488114380836487D 02 0.1495007926225662D 02 0.1491557639837265D 02
PULSES OMITTED FROM STATISTICS= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

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OF POOR QUALITY

Symbol		Units
PC	=	Impulse PC = Chamber Pressure x Throat Area x Time, = lb-sec
FA	=	Thrust Bridge A, lb-sec
FB	=	Thrust Bridge B, lb-sec
AVG F	=	Thrust Average, lb-sec
ON TIME	=	sec
OFF TIME	=	sec
OFP	=	Oxidizer Feed Pressure, psia
FFP	=	Fuel Feed Pressure, psia
PA	=	Test Cell Pressure, psia