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(NASA-CR-111230) GEMINI DESIGN APPROVAL TEST PROGRAM. VOLUME 2 - THRUST CHAMBER ASSEMBLIES. BOOK 8 - ONE HUNDRED POUND-THRUST OAMS LONG-DURATION TCA P/N 209301 FINAL REPORT (Rocketdyne) 268 p

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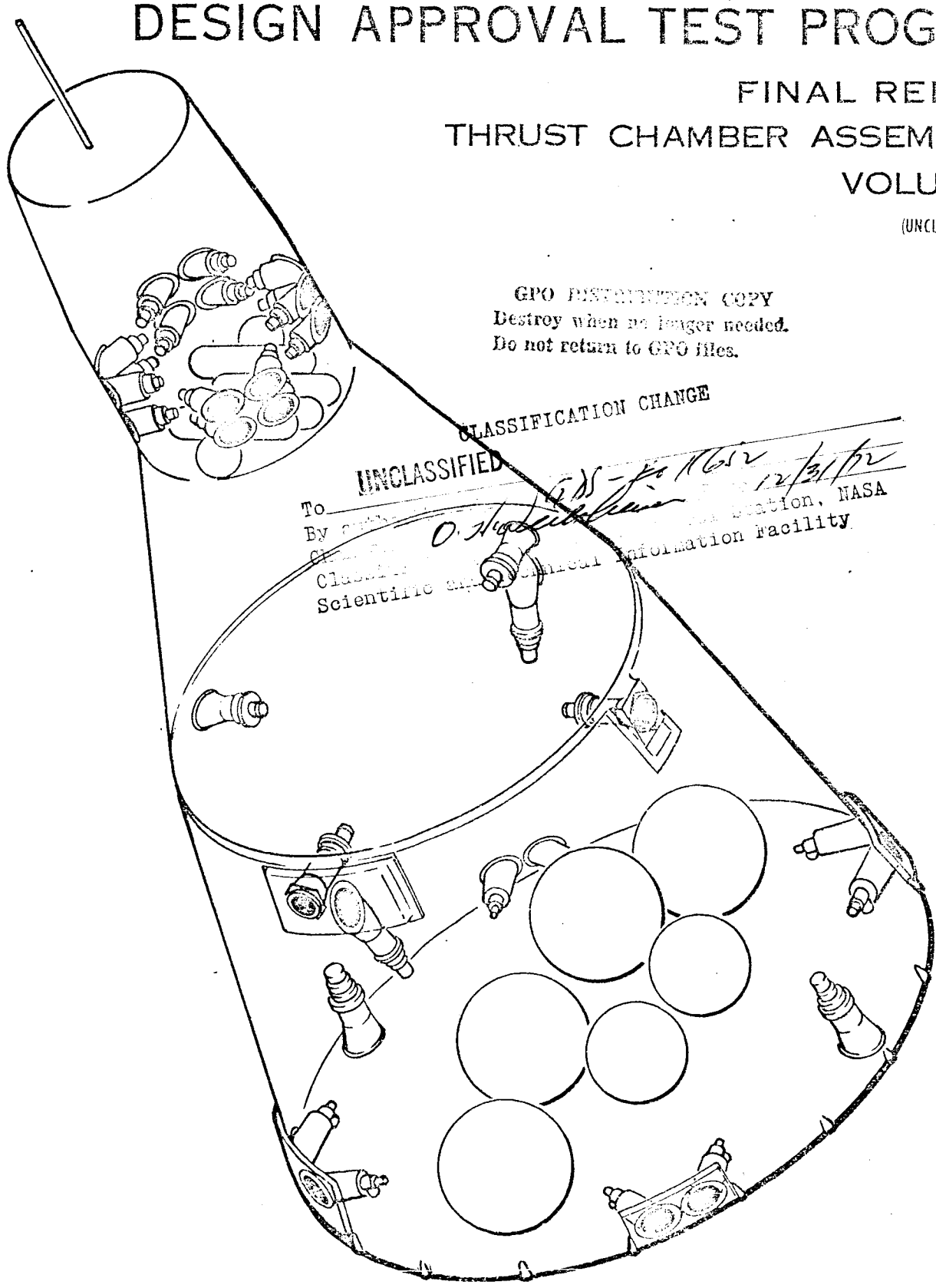
GEMINI

DESIGN APPROVAL TEST PROGRAM

FINAL REPORT
THRUST CHAMBER ASSEMBLIES
VOLUME II

(UNCLASSIFIED TITLE)



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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R-15019-2

(Unclassified Title)

GEMINI DESIGN APPROVAL TEST PROGRAM FINAL REPORT, THRUST CHAMBER ASSEMBLIES, VOLUME II, BOOK 8, 100-POUND-THRUST OAMS LONG-DURATION TCA P/N 209301

~~Group 4~~
~~Downgraded at 3 Year Intervals~~
~~Declassified After 12 Years~~

P.O. Y20161R
G.O. 8645

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NO. OF PAGES 253 & ix

REVISIONS

DATE 20 Sept 1965

DATE	REV. BY	PAGES AFFECTED	REMARKS

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FOREWORD

This report on the Design Approval Testing of the Gemini 100-pound-thrust OAMS Long-Duration Thrust Chamber Assembly was prepared for the McDonnell Aircraft Corporation in accordance with Purchase Order Y20161R.

ABSTRACT

The Design Approval Test program conducted on the Gemini 100-pound-thrust OAMS Long-Duration Thrust Chamber Assembly is described. Test data, photographs of test equipment, and test summaries are included.

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INTRODUCTION AND SUMMARY

The Design Approval Test program for the Gemini 100-pound-thrust Orbit Attitude and Maneuver System (OAMS) Long-Duration Thrust Chamber Assembly (TCA) was conducted in compliance with McDonnell Aircraft Corporation Purchase Order Y20161R.

The objective of the Design Approval Test (DAT) program was to demonstrate compliance of the 100-pound-thrust OAMS Long-Duration TCA with the requirements of McDonnell Aircraft Corporation Specification Control Drawing 52-52701 by conducting a planned series of environmental and operating tests on one TCA.

Two TCA's were required for the program because of the necessity of subjecting a TCA to mechanical shock testing without the McDonnell Aircraft Corporation (MAC) added ablative nozzle extension. The two TCA's were designated Units 1 and 1A for purposes of identification during the program.

During the mission duty cycle test conducted on Unit 1, the nozzle shell temperature exceeded the specification maximum of 500 F. This failure was reported in OFR (FAR) 32690R of Appendix B. No performance degradation or incipient failure was observed during the test.

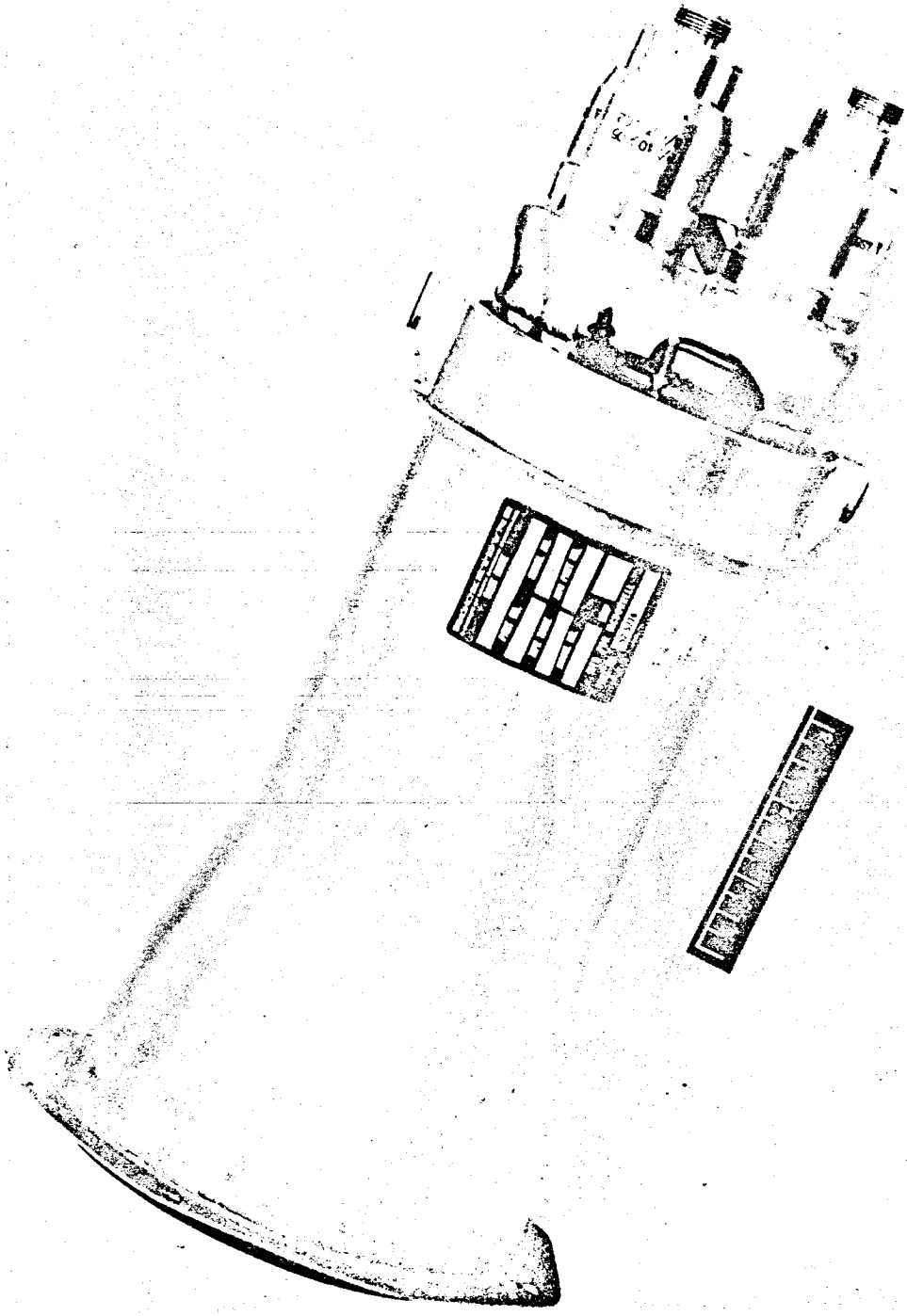
During the postmechanical shock functional test conducted on Unit 1A, the oxidizer valve failed to meet the specification closing response time requirement. This failure was reported in OFR (FAR) 12851R of Appendix B. The valve was subjected to a phosphoric acid flush after which it operated satisfactorily. The mechanical shock test was then rerun and completed successfully. It can be concluded that contamination caused this failure because the performance was within specification limits after the phosphoric acid flush.

Compliance of the 100-pound thrust OAMS Long-Duration TCA with all specification requirements was adequately demonstrated by the Design Approval Test program.

DESCRIPTION OF 100-POUND-THRUST OAMS LONG-DURATION THRUST CHAMBER ASSEMBLY P/N 209301

The 100-pound-thrust Orbit Attitude and Maneuver System (OAMS) Long-Duration Thrust Chamber Assembly (TCA) (Fig. 1 and 2) is a storable liquid, bipropellant, pressure-fed ablation cooled assembly. It is used in the Orbit Attitude and Maneuver System for horizontal and vertical translational maneuver control of the Gemini spacecraft. The thrust level and propellant mixture ratio are controlled by fixed orifices located at the propellant valve inlets. The propellants used are nitrogen tetroxide (NTO) as the oxidizer and monomethylhydrazine (MMH) as the fuel.

The thrust chamber core is made in two segments: the combustion zone segment and the nozzle segment. The combustion zone segment is fabricated from 6-degree oriented (referenced to the TCA centerline) resin impregnated high-silica ablative material. The nozzle segment is fabricated from 0-degree oriented (parallel to the TCA centerline) resin impregnated high-silica ablative material. In addition, the thrust chamber is wrapped with a layer of phenolic bonded asbestos fiber to provide additional sealing capabilities. The bond line between the combustion chamber segment and the nozzle segment is located in a low-pressure, low-stress area aft of the throat insert. Structural support for the thrust chamber body assembly is provided by layers of high-temperature, high-strength glass cloth and filament wound glass roving bonded by phenolic resin. Additional layers of glass roving provide added strength in the injector attachment and throat areas. The thrust chamber body is encased in a stainless-steel shell to provide structural attachment between the thrust chamber assembly and the spacecraft. The combustion chamber of the TCA contains a one-piece JTA graphite liner "backed up" by a 0-degree oriented ablative sleeve. A throat insert of solid silicon carbide is used to resist the erosive effects of the combustion gases.



1HE31-3/1/65-C1A

Figure 1. 100-Pound-Thrust OAMS Long-Duration Thrust Chamber Assembly

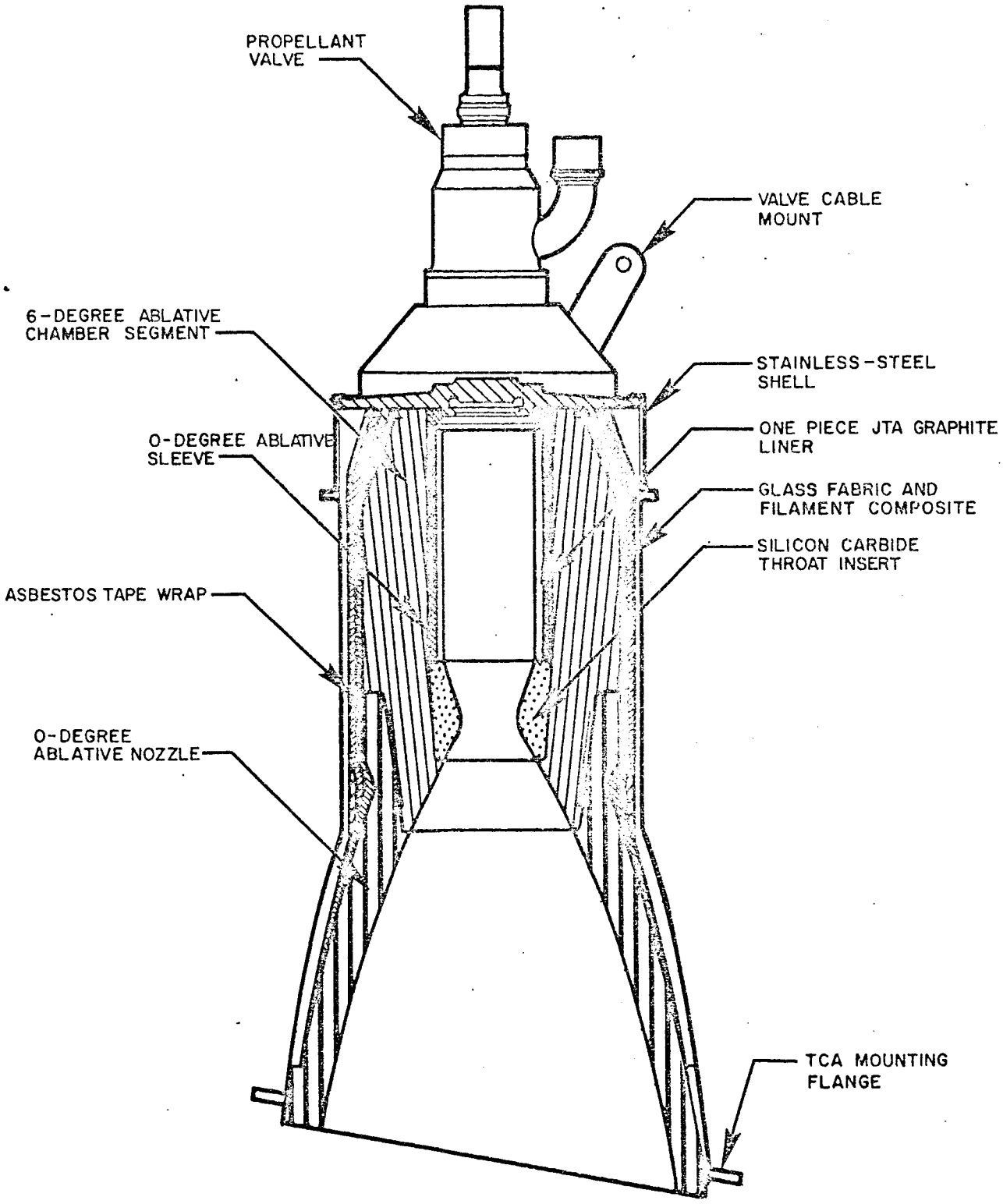


Figure 2. 100-Pound-Thrust OAMS Long-Duration TCA Schematic

The thrust chamber injector is fabricated from stainless steel. It consists of 16 pairs of unlike doublets which impinge on a splash plate providing propellant mixing for high combustion efficiency. In addition, there are extra fuel injection orifices around the periphery to provide boundary layer cooling in the combustion zone.

TCA operation is controlled by two fast acting, electrically operated, solenoid propellant valves (Fig. 3). The valves are attached to a mounting bracket which is in turn attached to the injector plate. The basic propellant valve design embodies a hermetically sealed solenoid. Valve sealing is accomplished through the use of a precision ground ball, attached to the armature, which rests on a Teflon seat in the closed position. A metal stop below the Teflon seat is incorporated to limit the armature stroke. Closing is accomplished through the use of a spring, and sealing force is obtained from the spring and the pressure of propellant acting on the ball.

The long-duration configuration 100-pound-thrust OAMS TCA is essentially the same as the 100-pound-thrust OAMS TCA P/N 207540 configuration, described in Rocketdyne Report R-15019-2, Volume II, Book 4, modified to provide the extended life required during the Gemini spacecraft rendezvous missions. The primary modification made to obtain the extended life capability was the addition of extra fuel injection orifices around the periphery of the thrust chamber injector to provide boundary layer cooling in the combustion zone. Improved propellant valves were also incorporated into this long-duration configuration TCA.

The physical and performance data for this TCA are presented in Table 1.

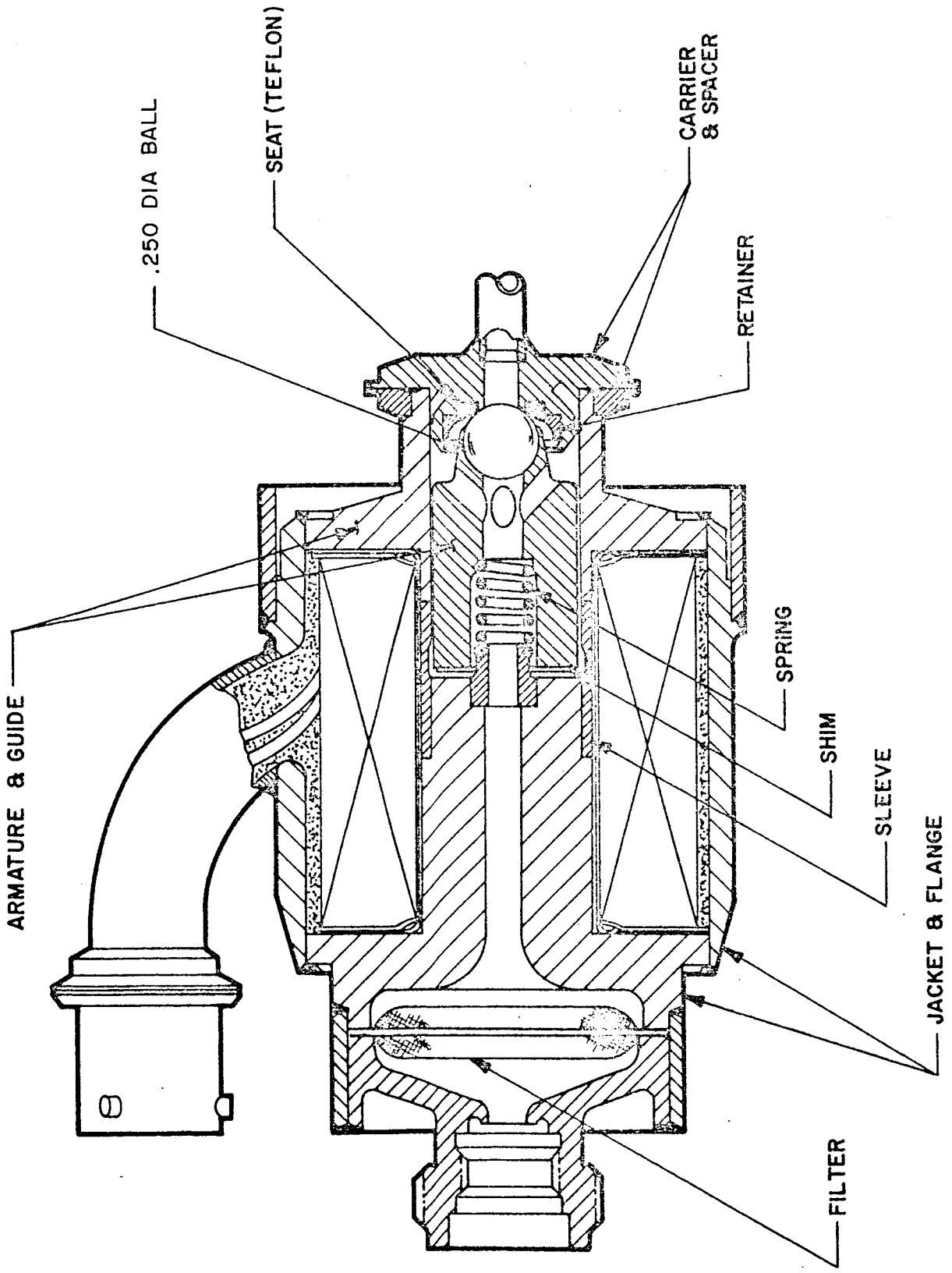


Figure 3. Gemini 100-Pound-Thrust OAMS TCA Propellant Valve

TABLE 1

100-POUND-THRUST OAMS LONG-DURATION TCA, P/N 209301,
PHYSICAL AND PERFORMANCE DATA

Compliance of the Gemini 100-pound-thrust OAMS TCA P/N 209301 with the following physical and performance requirements has been verified by design approval tests.

Physical Data	
Envelope, inches	overall dimensions: length 15.5, forward OD 4.0 and aft OD 5.5
Weight, Nominal, pounds	9.3
Compatibility	nitrogen tetroxide and monomethyl-hydrazine
Materials	
Valve Parts, Internal Exposed	CRES and Teflon
Injector	type 321 CRES
Thrust Chamber Core	ablative and ceramic
Structural Shell and Brackets	type 321 CRES
Performance Data	
Propellants	nitrogen tetroxide and monomethyl-hydrazine
Thrust, Vacuum, Rated, pounds	94.5
Chamber Pressure, Nominal, psia	134.0
Mixture Ratio, Rated, o/f	1.20
Specific Impulse	classified (see Page 9)
Oxidizer, Inlet Pressure, Rated, psia	286

TABLE 1*
(Continued)

Performance Data

Specific Impulse, Nominal, seconds	272

*Classified Parameter

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TABLE 1

(Continued)

Performance Data (Continued)

Fuel Inlet Pressure, Rated, psia	280
Life, Specification Performance MAC Mission Duty Cycle OCM 202, seconds	557
Life, Guaranteed, MAC Mission Duty Cycle OCM 202, seconds	757
Propellant Valve Service Life, cycles	50,000[1]
Propellant Valve Voltage, Nominal, vdc	26.0
Propellant Valve Current, Nominal, amps	0.619
Start Time, Nominal (on signal to 90 percent of thrust), milliseconds, maximum	50
Shutdown Time (with spacecraft electrical circuit; off signal to 2 percent of thrust), milliseconds, maximum	125
Environmental Temperature Range, Operating, F	15 to 200
Environmental Temperature Shock Range, Nonoperating, F	-40 to +185
Vibration Level Random, g rms	9.6
Shock Level (In Shipping Container)	15 g/11 milliseconds
Proof Pressure	480 psig at 68 F

[1]This requirement was verified as reported in Rocketdyne Report R-15019-2, Volume II, Book 3.

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TEST PROGRAM

TEST OUTLINE

Two TCA's, designated Units 1 and 1A, were subjected to the tests outlined below in the order listed.

Unit 1

1. Visual Inspection
   a. Component modification
2. Vibration Test
   a. Propellant valve proof pressure and leakage
   b. Thrust chamber proof pressure and leakage
   c. Propellant valve electrical resistance
   d. Propellant valve dielectric strength
   e. Propellant valve functional
3. Mission Duty Cycle to Guaranteed Life (757 Seconds; 200 F Environment)

Unit 1A

1. Visual Inspection
2. Mechanical Shock Test

a. Propellant valve proof pressure and leakage

b. Thrust chamber proof pressure and leakage

c. Propellant valve electrical resistance

d. Propellant valve dielectric strength

e. Propellant valve functional

TEST UNIT IDENTIFICATION, P/N 209301

Unit 1 S/N 4064104

Unit 1A S/N 4066382

TEST DESCRIPTION AND RESULTS, UNIT 1

VISUAL INSPECTION

Description

Unit 1 was inspected to ensure that it was of the proper configuration, was undamaged, and had been subjected to and passed an acceptance test per Rocketdyne Specification RA0220-408.

The unit was then shipped to McDonnell Aircraft Corporation (MAC) for installation of an aft mounting tab and a nozzle extension per MAC drawing 52-52067. This modification was made so that the TCA would reflect the flight configuration during the subsequent DAT, vibration test.

A potting compound was also added by MAC in the cavity between the thrust chamber body and the CRES shell. Following the return of the unit to Rocketdyne, simulated spacecraft system inlet tube extensions (P/N 99-106715 and 99-106716) were attached to the existing fuel and oxidizer inlet tube stubs. Installation of the tube extensions was accomplished per Rocketdyne Specification RA0607-007, "In-Place Brazing of Tubes and Fittings for Space Engines."

Results

Visual inspection was successfully completed.

VIBRATION TEST

Description

Unit 1 was mounted in MAC-supplied spacecraft bracketry, which in turn was mounted to a rigid test fixture, and installed in the vibration test setup facility. Unit 1 was subjected to random vibration testing along each of the three mutually perpendicular axes. The random vibration time for each axis was 8 minutes less the equalization time required to verify the spectrum shape and tolerance. The maximum allowable equalization time was 20 percent of the vibration time for each axis.

Prior to the start of the random vibration testing in each axis, a sine-wave survey (1 g maximum peak, logarithmic sweep from 5 cps to 2000 cps in 5 minutes) was conducted to calibrate the input and output accelerometers.

The random vibration test was at an overall equivalent level of 9.6 g rms. The vibration frequency was varied from 20 to 2000 cps. The vibration spectrum was as follows:

1. 0.04 to 0.2 g^2/cps from 20 to 100 cps
2. 0.2 g^2/cps from 100 to 400 cps
3. 0.2 to 0.01 g^2/cps from 400 to 600 cps
4. 0.01 g^2/cps from 600 to 2000 cps

Functional and leakage tests were conducted following completion of the vibration testing.

Results

The vibration test was successfully completed. During the postvibration functional tests, both propellant valves exceeded the specification closing time of 75 milliseconds when tested using the simulated spacecraft electrical control circuit which was installed at the request of the customer. Both valves were then tested using the normal acceptance test electrical circuit, and they both closed within the maximum time requirement of 5 milliseconds, thus establishing the fact that the closing time requirements for the respective electrical control circuits were not compatible. Because of the differences between the two electrical control circuits, this was not considered a failure and testing was continued as authorized by Rocketdyne Internal Letter 5388-6147, page 158 of Appendix D.

MISSION DUTY CYCLE TO GUARANTEED LIFE (757 SECONDS)

In preparation for the mission duty cycle (MDC) test on Unit 1, the simulated spacecraft system tube extensions were replaced by inlet tube

adapters (P/N 99-106126). Installation of the adapters was accomplished per Rocketdyne Specification RA0607-009, "In-Place Brazing of Tubes and Fittings for Space Engines."

Description

Unit 1 was installed in the hot-fire test facility and was subjected to a mission duty cycle test (MDC) (MAC MDC OCM 202) to 757 seconds. The first portion of the MDC consisted of a "cape firing cycle" conducted under conditions of local ambient pressure and temperature. Following the "cape firing cycle", the TCA and the test facility propellant supply were conditioned to a temperature of 200 F and held at this temperature for a period of 1 hour prior to start of the second portion of the MDC.

The second portion of the MDC was programmed to consist of the pulses described in Table II, page 240 of Appendix D up to a total accumulated MDC burn time of 757 seconds. Throughout this portion of the test, a black body shield, positioned around the TCA, was maintained at 200 F, the propellants were maintained at 160 F, and a simulated pressure altitude in excess of 100,000 feet was maintained.

Results

The MDC to guaranteed life was adequately completed. As the result of a minor MDC control system tape problem, however, the total accumulated burn time was 749 seconds. This problem was not discovered until the test had been completed. The loss of the 8 seconds of burn time, however, did not significantly alter the results. During the MDC, the TCA shell temperatures exceeded the specification limit of 500 F. This failure was reported in

OFR (FAR) 32690R of Appendix B. The maximum temperature recorded was 850 F. This temperature was measured on the nozzle shell after approximately 548 seconds of burn time. The TCA completed the MDC with no performance degradation or incipient mechanical failure.

Hardware Disposition

Upon completion of the DAT program testing, Unit 1 was transferred to the Design Information Test (DIT) program for further testing.

TEST DESCRPTION AND RESULTS, UNIT 1A

VISUAL INSPECTION

Description

Unit 1A was inspected to ensure that it was of the proper configuration, was undamaged, and had been subjected to and passed an acceptance test per Rocketdyne Specification RA0220-408.

Results

Visual inspection was successfully completed.

MECHANICAL SHOCK TEST

The mechanical shock test was originally scheduled to be conducted on Unit 1. However, since Unit 1 did not represent the "as shipped from Rocketdyne" configuration, having been modified by MAC for the vibration test, and since the objective of the mechanical shock test was to verify the ability of the TCA to withstand shock in the shipping container, the mechanical shock test was conducted on Unit 1A. This was authorized by Rocketdyne Internal Letter 5388-6135, page 183 of Appendix D.

Description

Unit 1A was placed in the standard Rocketdyne shipping container and subjected to three shocks in each direction along each of the three major axes. The shocks were of a 15-g magnitude and 11-millisecond duration. Leakage and functional tests were conducted after completion of the mechanical shock tests.

Results

During the functional tests following the mechanical shock tests, the specification closing time was exceeded by the oxidizer valve. This failure was reported in OFR (FAR) 12851R of Appendix D.

HARDWARE DISPOSITION

Unit 1A was subjected to a phosphoric acid flush, after which it performed within the valve acceptance test closing time requirement of 0.005 second without the simulated spacecraft electrical circuit. The 0.005 second

maximum de-energize time using the normal acceptance test electrical circuit was established as the failure criteria as authorized by Rocketdyne Internal Letter 5388-6189, page 201 of Appendix D. This IL also authorized a rerun of the mechanical shock test using this same TCA.

Results

The mechanical shock test was successfully completed.

HARDWARE DISPOSITION

Upon completion of the DAT program tests, Unit 1A was subjected to additional tests as part of the Design Information Test (DIT) program. Also, the propellant valves from Unit 1A were subjected to a 50,000-cycle valve-service life test as reported in Rocketdyne Report R-15019-2, Volume II, Book 7.

APPENDIX A

APPENDIX A

PHOTOGRAPHS OF TESTS AND TEST EQUIPMENT

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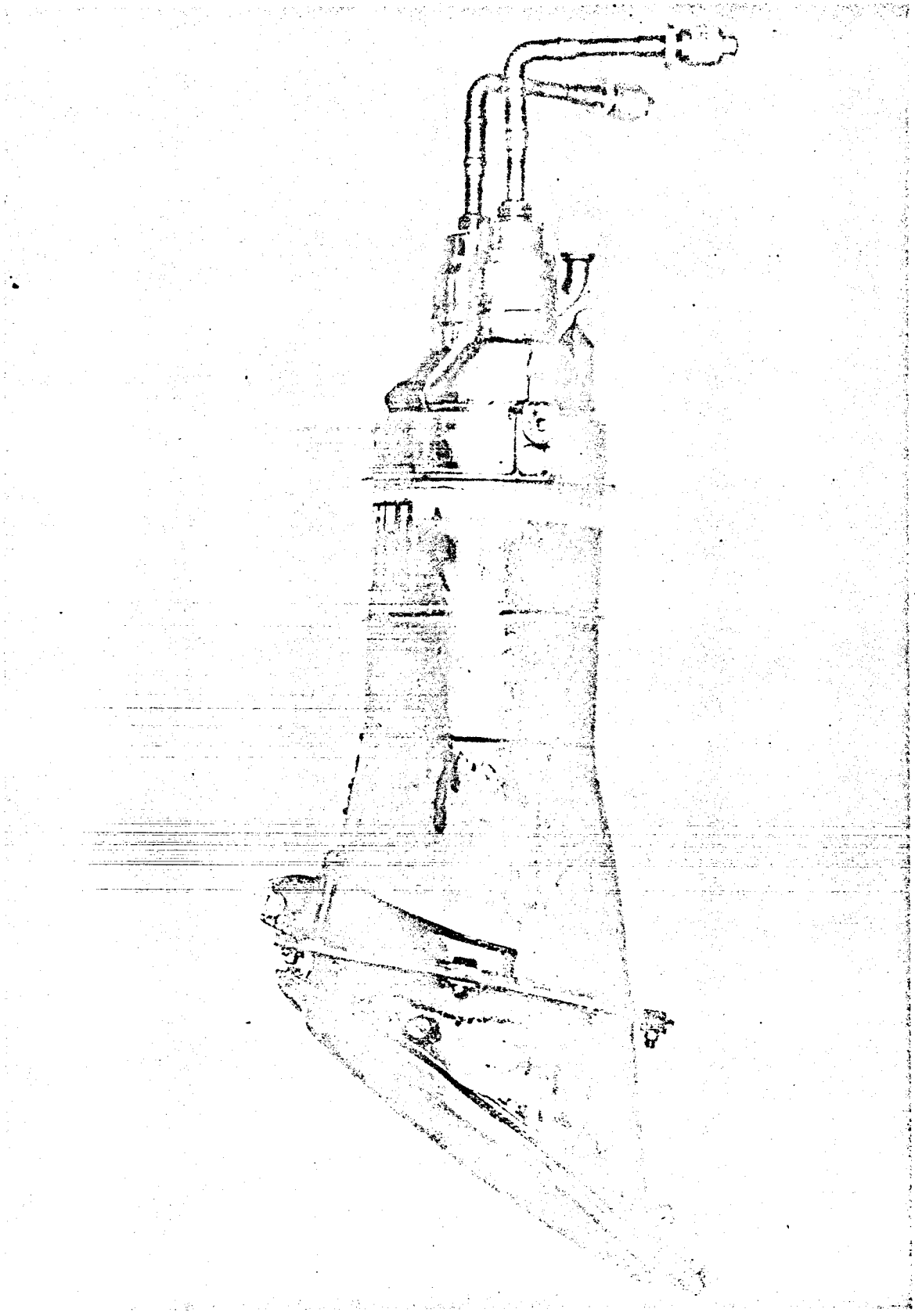

1HD35-4/6/65-S1B*

Figure 4. 100-Pound-Thrust OAMS Long-Duration TCA Unit 1 With MAC Installed Aft Mounting Tab and Nozzle Extension Post-MDC to Guaranteed Life Test

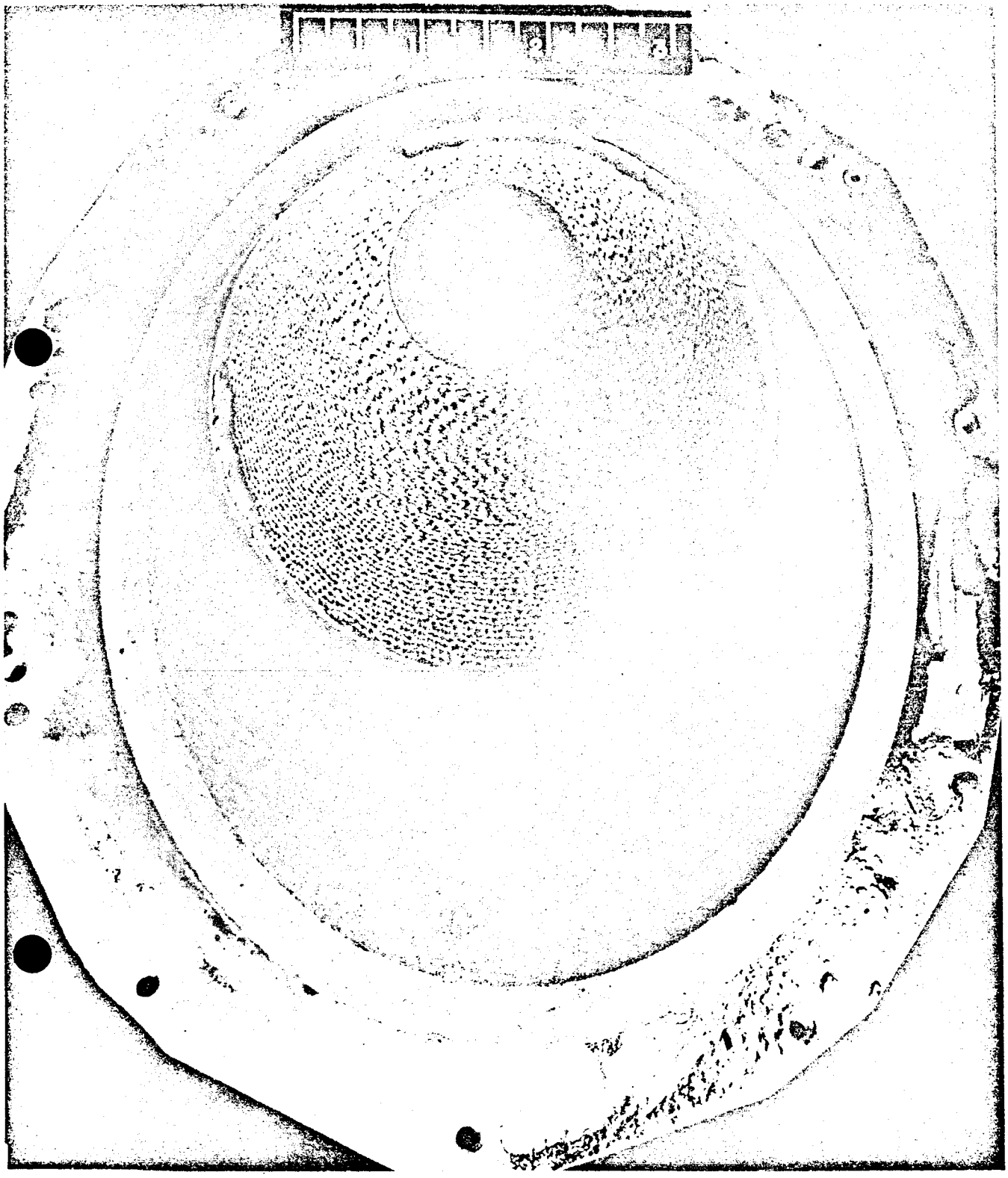

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Figure 5. 100-Pound-Thrust OAMS Long-Duration TCA Unit 1 With MAC Installed Aft Mounting Tab and Nozzle Extension Post-MDC to Guaranteed Life Test

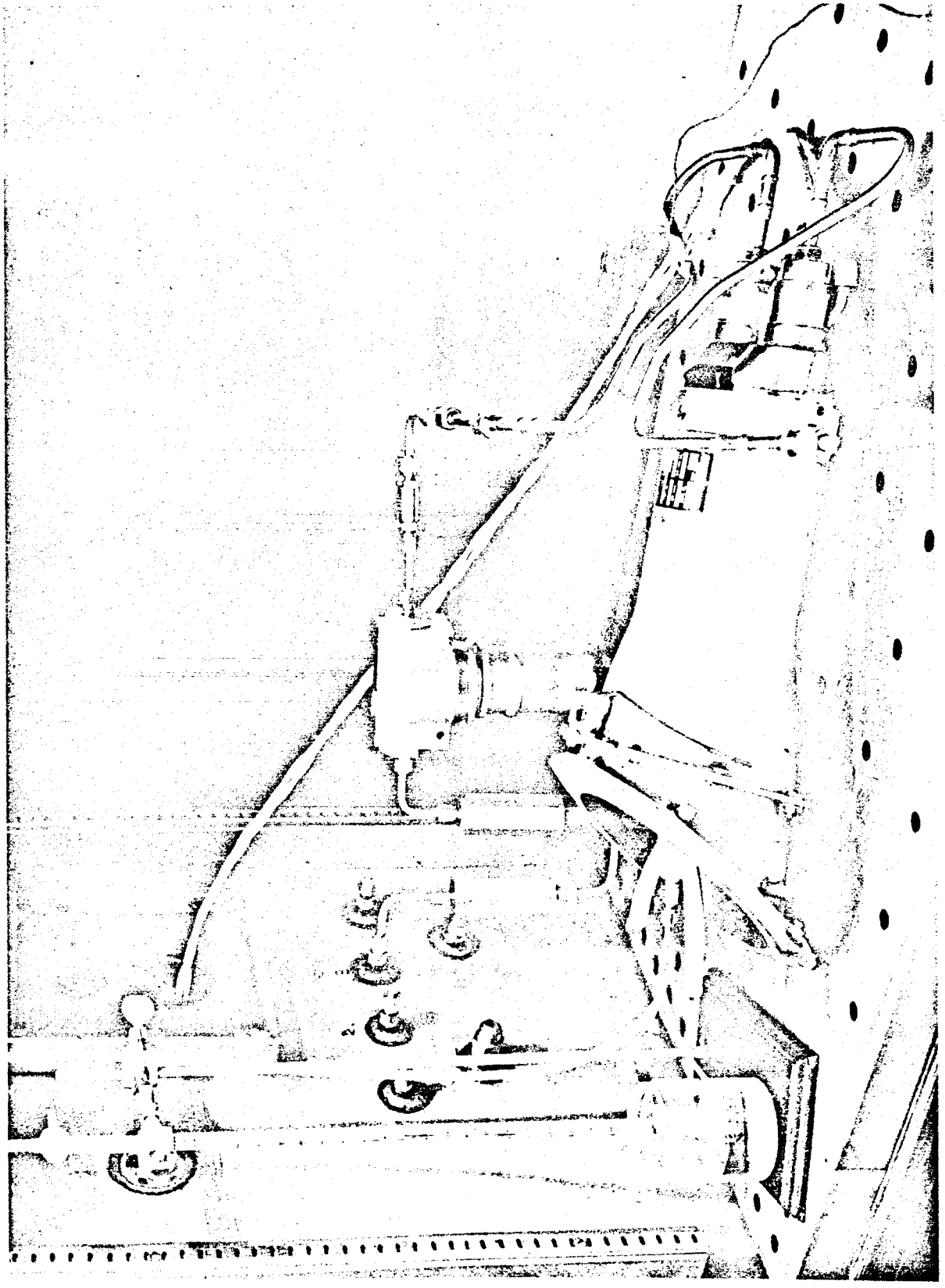

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Figure 6. Proof Pressure and Leakage Test Installation, 100-Pound-Thrust OAMS TCA Unit 1

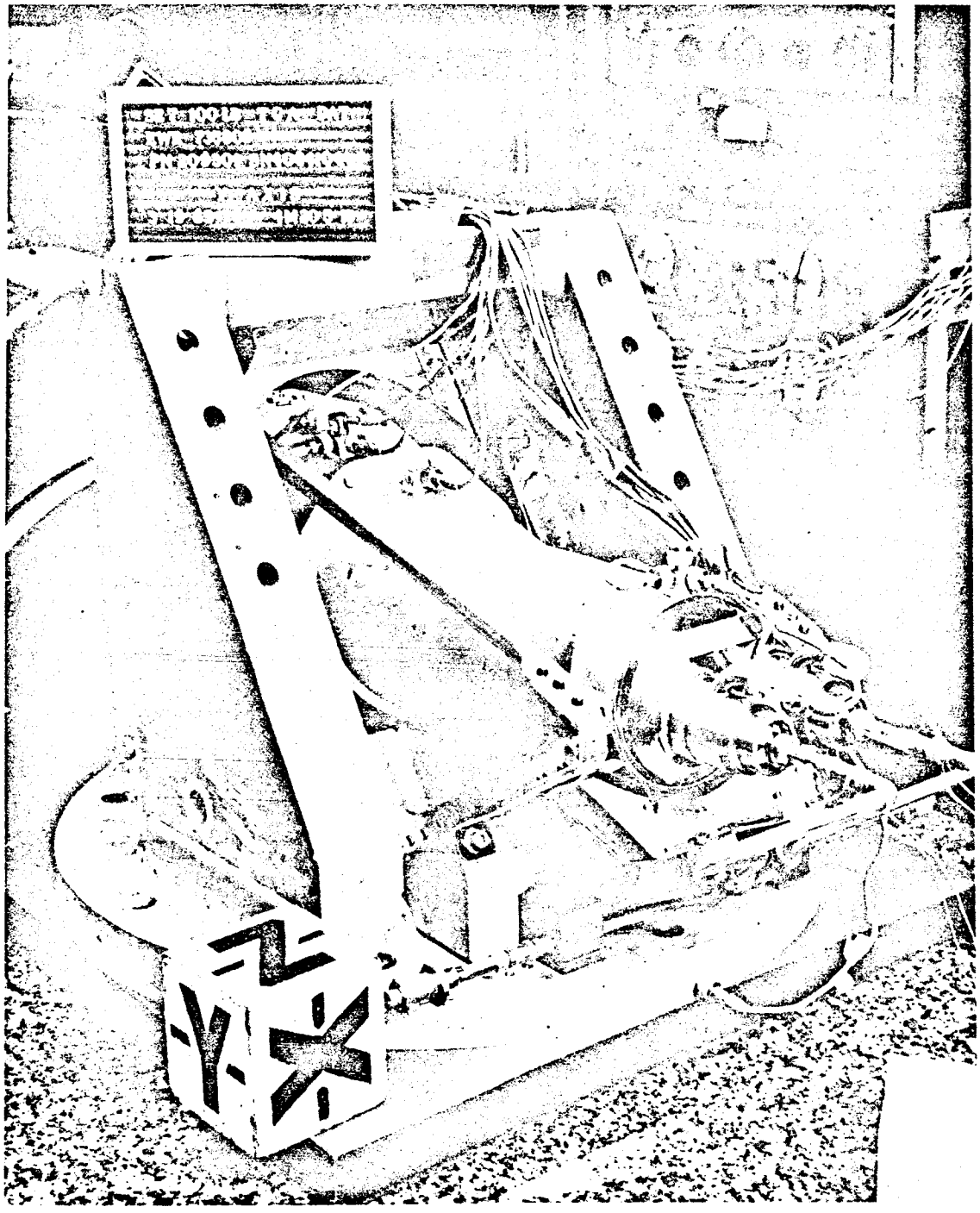

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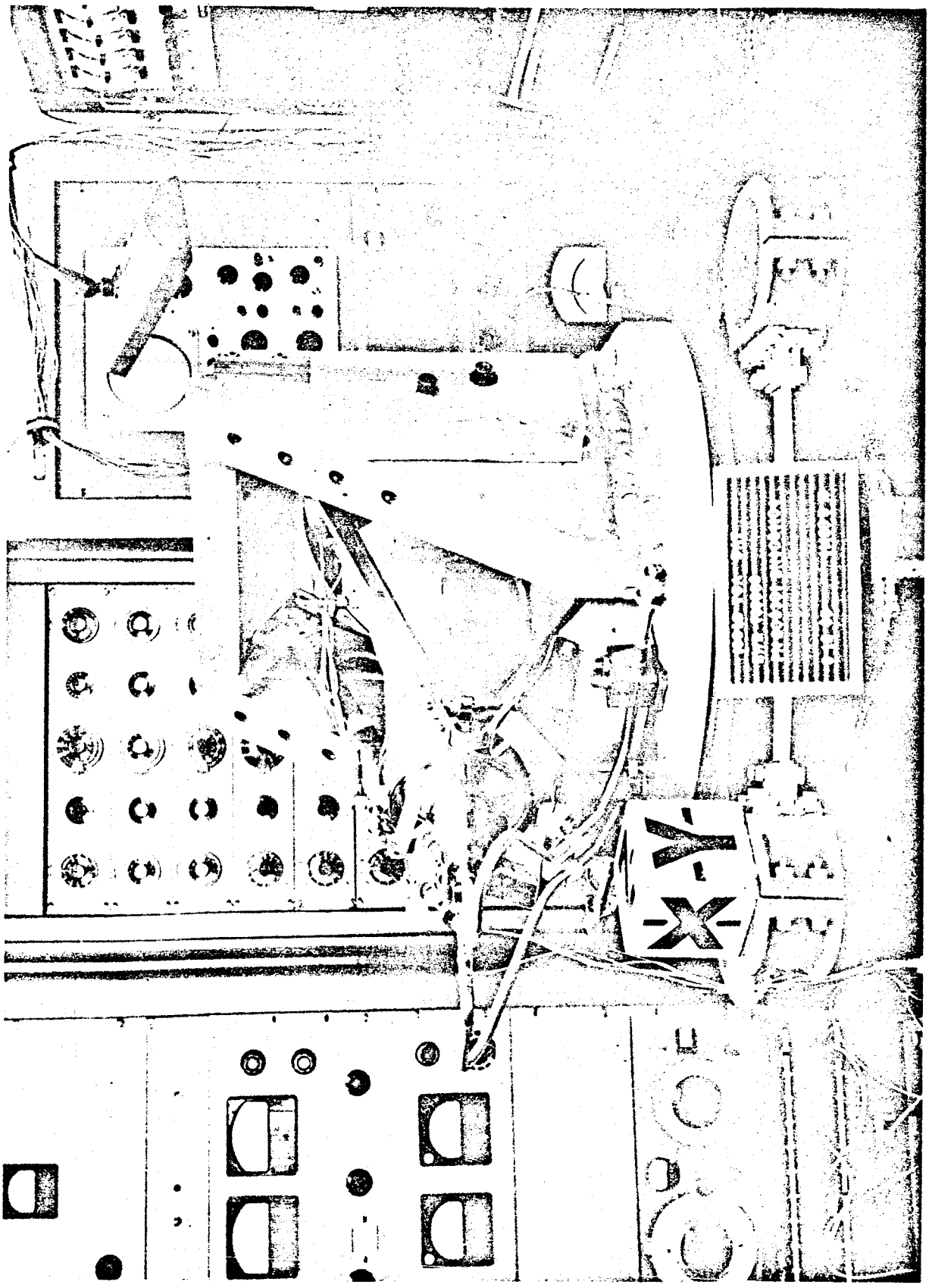
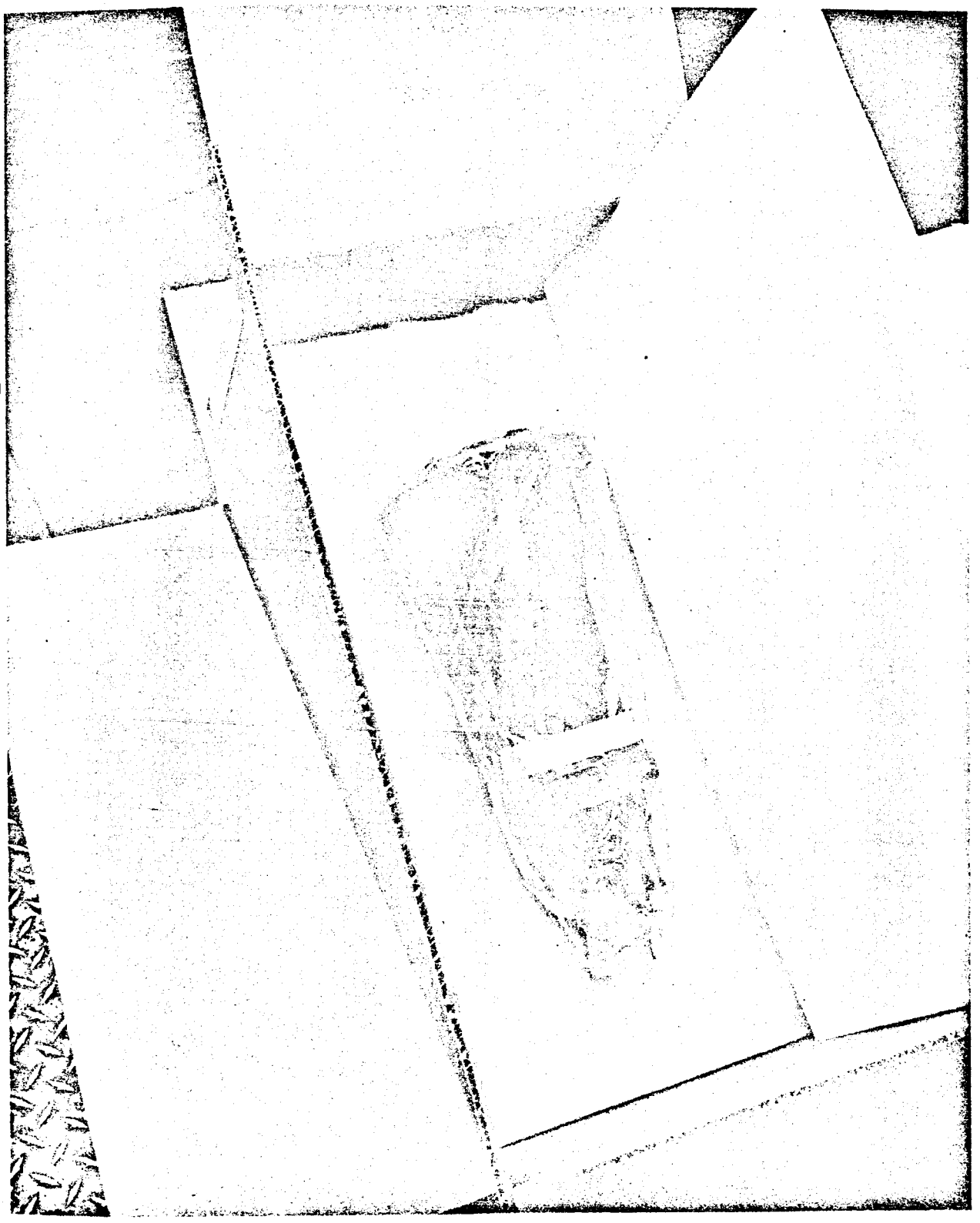
Figure 7. Y-Axis Vibration Test 100-Pound-Thrust OAMS TCA Unit 1



1HD33-3/12/65-C1A

Figure 8. X-Axis Vibration Test Installation, 100-Pound-Thrust OAMS TCA Unit 1



1HD33-5/11/65-C1A

Figure 9. Shipping Container Used in Mechanical Shock Test, 100-Pound-Thrust OAMS TCA Unit 1A

1HD33-5/11/65-C1B

Figure 10. Mechanical Shock Test Installation, 100-Pound-Thrust OAMS TCA Unit 1A

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APPENDIX B

APPENDIX B

OPERATION AND FAILURE REPORTS AND FAILURE ANALYSIS REPORTS

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ROCKETDYNE

FAILURE | OPERATION | PART CHANGE: FAILED ITEM | TIME EXPIRED | T.O. DIRECTED

PROGRAM: CSM | LOCATION: CAPE | DATE: 12 OCT

PART IDENTIFICATION

1 PART NO. 208404	2 PART NAME OXID DOWNLIT VLV		
3 SERIAL NO. 20127	4 MFG. NAME ROCKETDYNE	5 MFR. CODE	6 REF. DESIG.
7 NEXT ASSY PART NO. 208401	8 NEXT ASSY SERIAL 4006882	9 NEXT ASSY NAME TCA	
10 MISSILE SERIAL NO.	11 ENG/AGE MODEL NO. DA7	14 SYSTEM CODE	
12 REJ. TAG NO.	13 ENG/AGE SERIAL NO. SE7	15 COMPONENT CODE	
		16 HARDWARE CODE	

PART DISPOSITION

35
- 1 ☐ REPAIRED IN PLACE
- 2 ☐ REPAIRED & REINSTALLED
- 3 ☐ ADJUSTED
- 4 ☐ ELIMINATED
- 5 ☐ CONDEMNED
- 6 ☐ HOLD FOR REPAIR
- 7 ☐ DEPOT REPAIR
- 8 ☒ FAILURE ANALYSIS
- 9 ☐ USED AS IS

PART REPLACEMENT

36
- 1 ☐ IDENTICAL ITEM
- 2 ☐ SUBSTITUTE PART
- 3 ☒ NONE
- 4 ☐ NONE AVAILABLE

37 REPLACEMENT PART NO.

38 REPLACEMENT SERIAL NO

39 FAILED PART SENT TO: OFR CRTD.

40 | 41

FAILURE/OPERATION DATA

17 FAILURE DATE YR 65 MO 4 DAY 1	18 TEST/OPER. DATE YR 65 MO 3 DAY 31	19 TEST/OPER. NO.	20 ITEMS 1
21 PROCEDURE—SPEC. & PARAGRAPH 209201-001 / 7.1.3			
22 FS	25 FAIL. TYPE	26 FAIL. CODE	27 SECONDS	28 STARTS
23 SV	29 MONTHS	30 INITIAL REPORT NO.	31
24 NC			

32 OPERATION REPORTED OR IN PROGRESS

- A ☐ COMP/ASSY TEST
- B ☐ FINAL ENG. ASSY.
- C ☒ ELEC.-MECH. CHECK
- D ☐ ACCEPT/R&D TEST
- E ☐ STORAGE
- F ☐ SHIPPING
- G ☐ RECEIVING INSP.
- H ☐ MAINTENANCE
- I ☐ LEAK & FUNCTION
- J ☐ SIM. LAUNCH
- K ☐ MISSILE ACCEPT.
- L ☐ STAT. MISS. TEST
- M ☐ PROPEL. LOADING
- N ☐ PERIODIC INSP.

33

34 TIME PERIOD (ACCEPT/R&D/STATIC TEST ONLY)
- 1 ☐ PRE-TEST
- 2 ☐ TEST
- 3 ☐ POST-TEST

REPORTED BY

42 NAME F. A. COLE	43 GROUP 3[illegible]7	44 SUPPLEMENT SHEET 1 ☐ YES 2 ☒ NO
45 APPROVED BY [illegible]	46 ACTIVITY	47 STAND AREA

ANALYSIS ASSIGNED TO

48 NAME IARIA	49 GROUP 3[illegible]	50 CODE A[illegible]	51 PART REQ. ☐ YES ☐ NO
DATE REPORT RECEIVED 52 65 4 1 YR MO DAY		DATE REPORT SUBMITTED 53 YR MO DAY	
RELIABILITY ONLY	54 TEST/OPER. NO.	55 / 2	57 NTH CODE 58 TAPE CODE

DESCRIPTION OF FAILURE

WHEN? WHERE? HOW MUCH? CAUSE? EFFECT? CORRECTIVE ACTION?

1 OXIDIZER VALVE DROPOUT TIME WAS . 35

36 30 SECONDS. MAXIMUM ALLOWABLE IS .07 70 71 TEST/OPER NO. 77 78 79 80 12 OCT A

1 5 SECONDS. THIS OCCURED ON POST DEC 35

36 MANUAL SHOCK FUNCTIONALS. 70 78 B

1 35

36 70 78 C

1 35

36 70 78 D

1 35

36 70 78 E

1 34

36 REF. OFR | 42 REF. OFR | 46 REF. OFR | 54 FAILED DETAIL PART NO. 70 78 F

RELIABILITY ANALYSIS USE ONLY

1 IDENTIFICATION | TEST TYPE | 10 GRO.P RESP. CODE | 16 PA. CODE | EF | AP | CF | FC | 24 LEAK | CONTAM. | 30 PROP. SYSTEM 35

36 NTH | COMP | 40 ASSY | RS-2 | CD | 46 | 65 DELETE 70 78 G

1 REPLACEMENT PART NO. | 15 REPLACEMENT S/N | 22 NAME | 25 TYPE | 31 MFR. 35

36 INSTALLATION PART NO. R-15019-2 | 50 CONFIG. CODE | 57 NAME | 60 GR. RESP. | CH | CL | M | R 78 80

2 APRIL BROCK

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

FAILURE ANALYSIS REPORT

• ANALYST FILL OUT COVER SHEET ONLY

OFR IDENTIFICATION

OFR NO.	OFR BY (NAME)	DEPT. & GROUP	LOCATION	FAILURE DATE
12851R	R. A. Cole	896-388	Canoga	4/1/65

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
409404	9371228	Oxid. Valve Assy.	Rocketdyne
ENG/AGE MODEL NO.	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	
SE-7 DAT			

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	REV. DATE
F. J. Iaria	896-394	5/6/65	5/6	

FAILURE ANALYSIS

IF ANALYSIS APPLIES TO MORE THAN ONE OFR, INSERT ALL APPLICABLE OFR NUMBERS IN THIS SPACE:

1. HISTORY 2. ANALYSIS 3. CONCLUSIONS 4. CORRECTIVE ACTION
• STATE ITEM NUMBER AND DESCRIBE • USE EXTRA SHEETS IF NECESSARY
• BE SPECIFIC IN CORRECTIVE ACTION STATEMENT AND STATE EFFECTIVITY DATE AND/OR ENGINE SERIAL NUMBER WHERE APPLICABLE

1. The oxidizer valve drop out time was 0.130 seconds. The maximum allowable is 0.075 seconds. This failure occurred during the functional test following the mechanical shock test of DAT Spec. 209301-401. This valve was a component part of TCA P/N 209301, S/N 4066382.

2. Immediately after the failure was noted, the valve assembly was retested using the procedure of RA0206-202 Para. 4.5 as opposed to the procedure of the DAT specification 209301-401. The reading obtained was 0.016 seconds. The difference between these readings (0.130 seconds for the DAT test) is the result of the circuitry involved. The valve assembly specification uses "raw" DC in order to obtain an absolute valve timing, whereas the DAT specification simulates the circuitry of the Gemini Spacecraft. Maximum de-energize time is 0.005 sec. per RA0206-202; maximum de-energize time per 209301-401 is 0.075 seconds.

Upon receipt of the TCA, P/N 209301, S/N 4066382, tests per RA0206-202 Para. 4.5 and 4.6 were performed with the following results:

Drop out currents - 0.028 amps.
De-energize time - 0.0085 seconds
Pull-in current at 300 psig - 0.28 amps
Energize time - 0.021 seconds

Specification limits of RA0206-202 for these tests are as follows:

Drop out current - 0.025 amps. (min)
De-energize time - 0.005 seconds (max)
Pull-in current at 300 psig - 0.36 amps (max)
Energize time - 0.023 seconds (max)

THIS REPORT WILL BE HELD OPEN PENDING COMPLETION OF POST DAT TEARDOWN AND ANALYSIS.

FAILURE ANALYSIS REJECTED
5/20/65
5/20/65
RELIABILITY DEPT. 261
McDONNELL AIRCRAFT CORP.

12851R

REF: OFR 12851R

2. Analysis (cont'd)

The TCA was then flushed with phosphoric acid and retested with the following results:

Drop out current - 0.035 amps.
De-energize time - 0.0048 seconds
Pull-in current at 300 psig - 0.32 amps.
Energize time - 0.0215 seconds

The TCA was returned to the DAT unit.

3. Conclusions

No conclusion for the cause of failure has been reached because the valve was not available for comprehensive analysis. At the direction of the Project Office the TCA with the subject valve attached was returned to the DAT program (Ref. IL 5388-1065).

4. Corrective Action

No corrective action can be taken because the cause of failure was not determined.

Addendum 1

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

FAILURE ANALYSIS REPORT

• ANALYST FILL OUT COVER SHEET ONLY

OFR IDENTIFICATION

OFR NO.	OFR BY (NAME)	DEPT. & GROUP	LOCATION	FAILURE DATE
12851R	R. A. Cole	896-388	Canoga	4-1-65

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
409404	9371228	Oxid. Valve Assy	Rocketdyne
ENG/AGE MODEL NO.	EN/AGE SERIAL NO.	TEST/OPERATION NO.	
SE-7 DAT		209301-401	Para. 7.1.3

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
F. J. Iaria	896-394	8-25-65	J. Browning 9/16	

FAILURE ANALYSIS

IF ANALYSIS APPLIES TO MORE THAN ONE OFR, INSERT ALL APPLICABLE OFR NUMBERS IN THIS SPACE:

1. HISTORY 2. ANALYSIS 3. CONCLUSIONS 4. CORRECTIVE ACTION
• STATE ITEM NUMBER AND DESCRIBE • USE EXTRA SHEETS IF NECESSARY
• BE SPECIFIC IN CORRECTIVE ACTION STATEMENT AND STATE EFFECTIVITY DATE AND/OR ENGINE SERIAL NUMBER WHERE APPLICABLE.

1. The following data was obtained after submittal of the subject FAR:

Upon return of TCA P/N 209301, S/N 4066382, to the DAT Program after the phosphoric acid flush, the Mechanical Shock Test of DAT Spec. 209301-401 was repeated. After successful completion of this test, proved by the "within specification" performance during the valve functional tests, the TCA was subjected to a hot fire calibration and a steady state hot fire test of 2000 seconds duration as part of the TCA DIT Program.

Following the hot fire test the valves were removed from the TCA and subjected to a 50,000 cycle Service Life Test per DAT Specification 209310-401. The functional tests performed on the valves following the completion of the Service Life Tests were successfully completed.

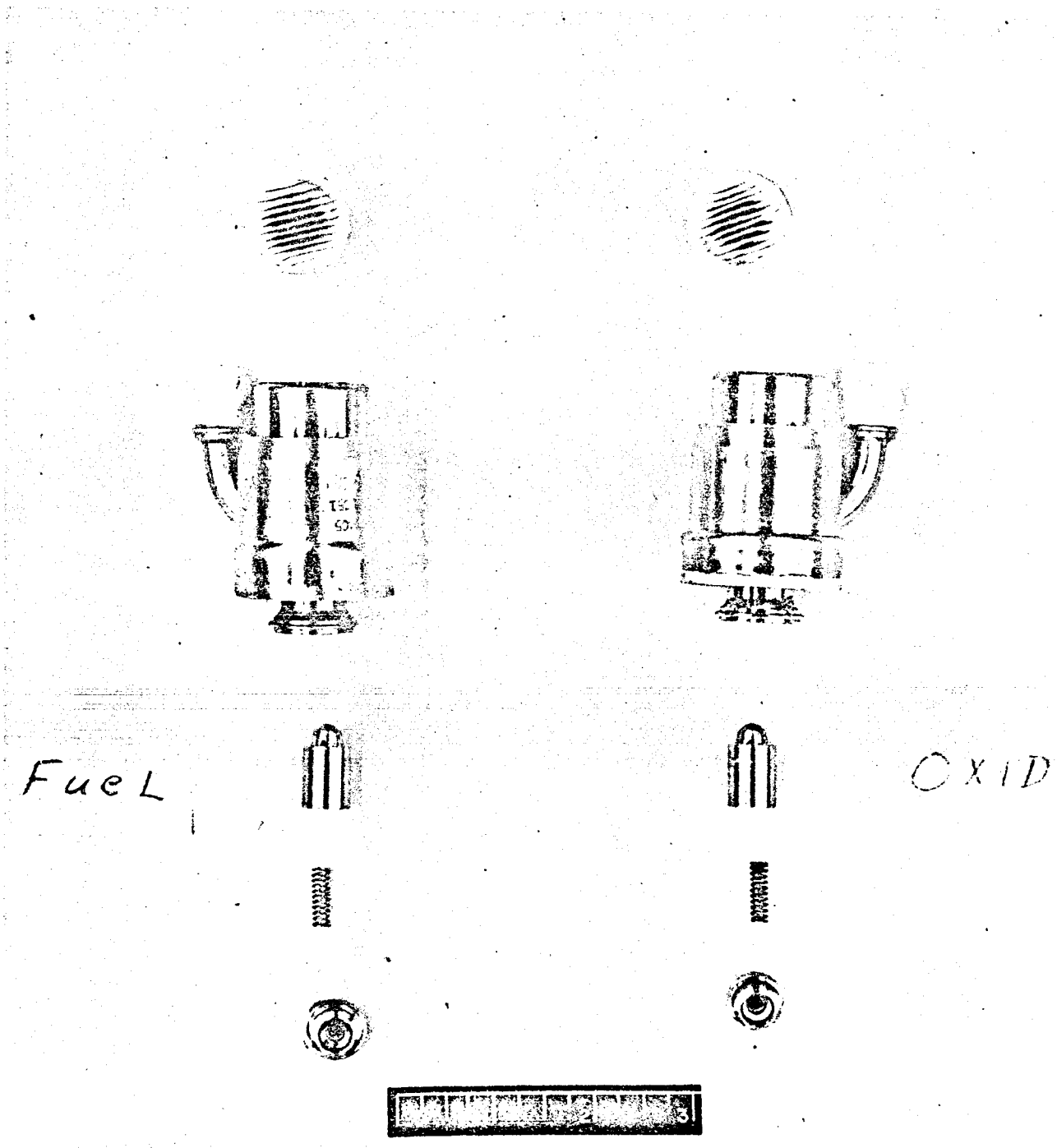
The valves were disassembled and inspected. Some slight wear marks were seen on the armature assembly, but these do not appear to have been severe enough to cause any difficulty. See attached photo.

Previous valves with the same failure mode have been disassembled and analyzed. The failure cause was determined to be either particulate contamination or solvated iron residue or both. It can be concluded that contamination caused this failure because the performance was within specification after the phosphoric acid flush. The phosphoric acid flush procedure utilizes fluid media that removes particulate contamination and chemically attacks the solvated iron deposits which when combined with flow results in their removal.

NOTE: THIS AMENDMENT TO FAR 12851R WAS SUBMITTED TO THE MCDONNELL AIRCRAFT CORPORATION IN REPLY TO THE REJECTION OF THE FIRST SUBMITTAL.

OFR NO. 12851R

FORM 609 P-2 REV. 2-62



1HE65-9/1/65-C1D

☒ FAILURE ☐ OPERATION — PART CHANGE: ☒ FAILED ITEM ☐ TIME EXPIRED ☐ T.O. DIRECTED — PROGRAM: SE 7 DA 7 — LOCATION: CZ-2 — № 32690R

PART IDENTIFICATION

1 PART NO. 209301	2 PART NAME 100 LB TCA-OAMS		
3 SERIAL NO. 404104	4 MFR. NAME ROCKETDYNE	5 MFR. CODE 07101	6 REF. DESIG.
7 NEXT ASSY PART NO. NONE	8 NEXT ASSY SERIAL NONE	9 NEXT ASSY NAME NONE	
10 MISSILE SERIAL NO.	11 ENG/AGE MODEL NO. SE 7	14 SYSTEM CODE	
12 REJ. TAG NO.	13 ENG/AGE SERIAL NO. DA 7	15 COMPONENT CODE	
		16 HARDWARE CODE	

PART DISPOSITION

35
- 1 ☐ REPAIRED IN PLACE
- 2 ☐ REPAIRED & RE-INSTALLED
- 3 ☐ ADJUSTED
- 4 ☐ ELIMINATED
- 5 ☐ CONDEMNED
- 6 ☐ HOLD FOR REPAIR
- 7 ☐ DEPOT REPAIR
- 8 ☐ FAILURE ANALYSIS
- 9 ☑ USED AS IS

PART REPLACEMENT

36
- 1 ☐ IDENTICAL ITEM
- 2 ☐ SUBSTITUTE PART
- 3 ☒ NONE
- 4 ☐ NONE AVAILABLE

37 REPLACEMENT PART NO.

38 REPLACEMENT SERIAL NO.

39 FAILED PART SENT TO:

40

41

FAILURE/OPERATION DATA

17 FAILURE DATE 1964 DAY 12	18 TEST/OPER. DATE 1964-5	19 TEST/OPER. NO. 958/200	20 ITEMS 1
21 PROCEDURE—SPEC. & PARAGRAPH 209301-401 / 7.1.4			
22 FS	25 FAIL. TYPE	26 FAIL. CODE	27 SECONDS 291 / 28 STARTS 20
23 V	29 MONTHS	30 INITIAL REPORT NO.	31
24 NC			

32 OPERATION REPORTED OR IN PROGRESS

- A ☐ COMP/ASSY TEST
- B ☐ FINAL ENG. ASSY.
- C ☐ ELEC.-MECH. CHECK
- D ☐ ACCEPT/R&D TEST
- E ☐ STORAGE
- F ☐ SHIPPING
- G ☐ RECEIVING INSP.
- H ☐ MAINTENANCE
- I ☐ LEAK & FUNCTION
- J ☐ SIM. LAUNCH
- K ☐ MISSILE ACCEPT.
- L ☒ STAT. MISS. TEST
- M ☐ PROPEL. LOADING
- N ☐ PERIODIC INSP.

33

34 TIME PERIOD (ACCEPT/R&D/STATIC TEST ONLY)
- 1 ☐ PRE-TEST
- 2 ☒ TEST
- 3 ☐ POST-TEST

REPORTED BY

42 NAME R.H. COLE	43 GROUP 388	44 SUPPLEMENT SHEET 1 ☐ YES 2 ☐ NO
45 APPROVED BY [illegible]	46 ACTIVITY B9	47 STAND/AREA 956

ANALYSIS ASSIGNED TO

48 NAME LEONARD	49 GROUP 394	50 CODE A8	51 PART REQ. ☑ YES ☐ NO
DATE REPORT RECEIVED 52 YR. MO. DAY	DATE REPORT DISTRIBUTED 53 YR. MO. DAY		
ITEM USE ONLY	54 TEST/OPER. NO.	55 1 / 56 2	57 NTH CODE / 58 TAPE CODE

DESCRIPTION OF FAILURE

WHEN? WHERE? HOW MUCH? CAUSE? EFFECT? COMMENTS?

DUE · REMARKS 4-27

35 ⊙100 LB OAMS GEMINI TCA, DAT UNIT N
36 O. 1 FAILED TO MEET THE SKIN TEMPER
37 ATURE REQUIREMENT DURING THE OCM 20
38 3 MDC. MAXIMUM TEMPERATURE OCCURRED
39 ON NOZZLE, 9 IN. FROM INJECTOR, (LO
40 NG SIDE) AND EXCEEDED THE LIMIT OF
41 500 DEGREES AFTER 291 SECONDS BURN
42 TIME. NO INCIPIENT MECHANICAL FAILU
43 RE WAS OBSERVED DURING THE REMAIND
44 ER OF THE MDC. NOZZLE EVENTUALLY RE
45 ACHED 850 DEG. AFTER 527 SEC.

70 71 TEST/OPER. NO. 77 78 79 80
958020 0 A
78 B
78 C
78 D
78 E
78 F
78 G

36 REF. OFR 32688R	42 REF. OFR	48 REF. OFR	54 FAILED DETAIL PART NO.

RELIABILITY ANALYSIS USE ONLY

1 IDENTIFICATION	TEST TYPE	10 GROUP RESP. CODE	16 PA. CODE	EF	AP	CF	FC	24 LEAK	CONTAM.	30 PROP. SYSTEM 35
36 NTH	COMP. 40 ASSY	RG-2	CD	46						65 DELETE 70

1 REPLACEMENT PART NO.	15 REPLACEMENT S/N	22 NAME	25 TYPE	31 MFR. 35	
36 INSTALLATION PART NO.	50 CONFIG. CODE	57 NAME	60 GR. RESP.	CH CL M R	

38

R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

FAILURE ANALYSIS REPORT

• ANALYST FILL OUT COVER SHEET ONLY

OFR IDENTIFICATION

OFR NO.	OFR BY (NAME)	(DEPT & GROUP)	LOCATION	FAILURE DATE
32690R	R. A. Cole	896-388	CTL III - SSFL	12 April 1965

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
209301	406410L	100 lb. TCA - OAMS	Rocketdyne
ENG/AGE MODEL NO.	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	
SE-7	DAT	958/200	

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL
R. L. Garber RLG	896-335	5/14/65	J. Bowling 5/14

FAILURE ANALYSIS

IF ANALYSIS APPLIES TO MORE THAN ONE OFR, INSERT ALL APPLICABLE OFR NUMBERS IN THIS SPACE:

1. HISTORY 2. ANALYSIS 3. CONCLUSIONS 4. CORRECTIVE ACTION
• STATE ITEM NUMBER AND DESCRIBE • USE EXTRA SHEETS IF NECESSARY
• BE SPECIFIC IN CORRECTIVE ACTION STATEMENT AND STATE EFFECTIVITY DATE AND/OR ENGINE SERIAL NUMBER WHERE APPLICABLE

1. History:

Gemini 100 lb. TCA P/N 209301, S/N 406410L was tested on 5 April 1965 in a Mission Duty Cycle to Guaranteed Life per DAT Specification 209301-401, paragraph 7.1.L. The MDC used was OCM-202. The test was No. 200, Test Cell 39 K, CTL III, at SSFL. Pressure altitudes above 100,000 feet were maintained throughout the MDC. The TCA was mounted within one of the "Tri-Mod." test positions with a "heat shield" positioned around the TCA to eliminate blowback and recirculation of the exhaust products affecting the capability of the TCA to reject the internally generated heat loads solely by radiation. Additionally, a temperature conditioning system consisting of metal coils, within which was circulated the temperature conditioning fluid, was mounted within the "heat shield" with the coils being positioned around the TCA (Ref. Fig. 1). The coils and interior of the "heat shield" were painted black. The TCA and environment were conditioned to 200 F ± 10 F by circulating hot water with the coil system. This temperature level was maintained for a minimum of 60 min. prior to start of the MDC per the DAT specification. Propellants were conditioned to 160 F ± 10 F as measured at the propellant valve inlets, again as required by the DAT specification.

The TCA completed 732.8 seconds of MDC accumulated hot fire time; test control was by means of the SE6/7 Tape Control Console, using a magnetic tape programmed for the OCM-202 MDC. Actual hot-fire time accumulated in OCM-202 should be 741 seconds; the difference between actual and desired MDC hot fire time is due to the inadvertent use of an R & D magnetic tape instead of the DAT tape for control of the test. Previously the TCA had accumulated 10.0 seconds hot fire calibration time at the N.F.L. and 6.1 seconds of ambient cape cycle hot fire time. Therefore, total hot fire time on this TCA through the MDC was 748.9 seconds. Though this is 8.1 seconds less than the specification guaranteed life of 757 seconds the difference in total accumulated burn time is not believed to significantly alter the analysis.

Item 51
52-52701

FAILURE ANALYSIS ACCEPTED
W. Parker 6/1/65
Failure Analysis 6/1/65

OFR NO. 32690R

R-15019-2

FORM 609 P-2 REV. 2-62

RELIABILITY DEPT. 261
McDONNELL AIRCRAFT CORP.

p. 1 of 9

1. History (Cont'd.)

The TCA failed skin temperature requirements per Specification 209301-401, Table II when the thermocouple recording the temperature at a point on the "long" side of the nozzle 9" down from the injector (Reference Fig. 3) indicated a temperature over 500 F at approximately 29.0 minutes elapsed MDC time. At this point total accumulated burn time on the TCA was 197 seconds. Specification requirements are that skin temperature not exceed 500 F before guaranteed life (757 seconds accumulated burn time) is reached. Time-temperature data for the nozzle station and other points, as recorded during MDC testing is given in Fig. 2 and 3.

2. Analysis:

The TCA was examined posttest, both visually and by radiographic photography. The visual examination showed no evidence of significant deterioration or physical damage to any of the components of the Rocketdyne P/N 209301 TCA. The throat insert and combustion chamber liner were clean and free of any cracks or chips. There was evidence of some deposition of bonding resin on the outside of the splash plate of the injector on the "hot" side but there was no plugging of any of the film coolant holes noted (Ref. - Fig. 5). Only slight superficial discoloration of the chamber exterior was evident and was due to the melting of the surface of insulation on adjacent instrumentation wiring which was then deposited on the surface of the TCA.

The TCA had been sent to McDonnell for modification to conform to McDonnell drawing 52-52067 which involves filling the gap between the ablative and shell with TR69F epoxy resin and the addition of a McDonnell nozzle extension P/N 52-52068 consisting of an ablative insert to match the nozzle mold line which in turn is mounted with a steel extension which attaches to the Rocketdyne TCA flange. Visual examination of the TCA revealed the TR69F resin to have come out in patches from the area between the TCA nozzle ablative material and the McDonnell ablative nozzle insert with the consequent exposure of the McDonnell steel nozzle extension to the hot exhaust gasses. The area on the extension where the gasses impinged had turned blue on the outside of the extension shell. Additionally there was a possibility that hot gas had leaked out of the TCA-to-extension joint due to deterioration of the DC-325 high temperature resin used as a flexible gasketing and sealing agent in this area. Examination of the x-rays shows:

1) Some delamination in the 0° nozzle material.

2) There was some slight separation in the combustion chamber area between the asbestos wrap and combustion chamber billet and between the asbestos and outer glass wrap but maximum gap noticed was only 0.002 - 0.003 and extended over a small contact area.

3) There was no evidence of slipping along the combustion chamber to nozzle bond line; at the lower lock; or at the injector to ablative bond joint.

In general, the TCA showed excellent structural integrity remaining with no evidence of imminent structural failure.

2. Analysis: (Cont'd.)

Previous testing, performed prior to initiation of long duration OAMS DAT TCA testing, and utilizing a "slave" 25# OAMS TCA of the 208905 configuration tested to portions of OCA-III, showed that the heat shield design, as finally employed in DAT testing effectively eliminated exhaust gas recirculation with its accompanying adverse effect on TCA skin temperatures during duty cycle testing. During this facility checkout program thermocouples were mounted on both the TCA skin and glasswrap and in the test facility between the TCA and temperature conditioning coils. Time-temperature data gathered during checkout tests showed the following:

1) The temperature of the glass wrap remained higher than the shell throughout the MDC, indicating the absence of convective heating from re-circulated exhaust products to the TCA.

2) The smooth and gradual variation of the facility thermocouple further verified the absence of undesirable convective heating from hot exhaust products to the TCA.

The effect of the heat shield as finally utilized for DAT Testing therefore was to have the TCA enclosed essentially in a black body cavity with the cavity temperature, i.e. environmental temperature, adjustable to any desired level by means of the liquid conditioning coils which for the particular test under discussion was 200 F ± 10 F.

The nozzle station thermocouple (on the long side of the shell 1" above the TCA flange) went beyond specification temperature of 500 F at approximately 29.0 minutes elapsed MDC time (total accumulated burn time at this point being 197 sec.), and reached a peak temperature of 850 F at 41 min. elapsed MDC time (total accumulated burn time at this point being 548 secs.).

An analysis was performed and the following two reasons were determined to be possible explanations for the high temperature at the nozzle station:

1) While the charring of the ablative is in progress, the temperature at the char front can be assumed to be approximately constant, therefore the skin temperature at any location will be a function of the thickness of the virgin material available at that location which serves as an insulation as well as a heat sink. Normally for weight saving reasons the ablative thickness is reduced toward the nozzle exit. However, the char depth does not decrease in the same ratio as the ablative thickness. Hence, the virgin material left after charring varies along the chamber and is minimum in thickness somewhere near ϵ = 40:1 where skin temperature registered the highest value.

2) The second reason for the high nozzle skin temperature in a BLC chamber is the increase in adiabatic temperature of the combustion gasses near the boundary layer toward the nozzle outlet. Figure 4 shows a typical variation of the adiabatic temperature of the boundary layer coolant; also shown is the temperature distribution within the ablative from the injector end to the throat section. The distribution indicates the throat and the skin near the throat are mainly cooled by the longitudinal conduction through the ablative to the boundary layer coolant. The radiation cooling from the skin surface only amounts to 10 to 20% of the total cooling needed in the throat region. In the nozzle section, even though the adiabatic temperature of the boundary layer coolant gas in the supersonic region increases slowly and the heat transfer coefficient is lower than in the throat region, there is much less longitudinal conduction to cool the nozzle than is available in the throat region. This results in higher skin temperature in the nozzle, than in the throat region.

2. Analysis: (Cont'd.)

Comparison of the posttest condition of the subject TCA with the posttest condition of the long life Design Verification Test TCA's, one of which was run to 2300 seconds accumulated MDC burn time and the other to 758 seconds accumulated MDC burn time (as reported in I.L. 5335-2214, SEM 3390-4013), shows no significant differences.

Though the DVT TCA's were tested in the large altitude facility at Cell 39, CTL-III, SSFL, where the presence of some convective cooling during testing has been determined as being possible, it is felt that the only significant difference in test results is the noted difference in skin temperature. The portion of this difference attributable to injector differences and the portion attributable to test facility configuration is difficult to determine with any accuracy. In addition, the condition of the McDonnell nozzle extension posttest indicates the possibility of hot gas leakage, inherent in the design and actual attachment of the extension to the Rocketdyne supplied TCA, adversely affecting skin temperature on the nozzle due to direct longitudinal conduction both through the McDonnell applied TR69F potting resin and along the TCA-nozzle extension skin when the hot exhaust products impinged on the TCA-nozzle shell.

3. Conclusions:

The ability of the 209301 long life 100 lb. OAMS TCA to meet its functional requirements with the requisite amount of structural strength throughout its operational life has been amply demonstrated both in R & D tests (i.e. the DVT Program mentioned above) and in the subject DAT MDC. The over-temperature condition is not felt as being detrimental to thrust chamber life since it does not indicate impending burn through of the TCA shell as was true in the S/C 2-3 design 100 lb. OAMS TCA P/N 207540 where the combustion chamber material was oriented at 90° to the TCA longitudinal axis.

The appearance of the McDonnell supplied nozzle extension posttest indicates the need for further investigation by McDonnell as to the suitability of the present nozzle extension design to meet MDC requirements when operating with the Rocketdyne supplied TCA.

4. Corrective Action:

No corrective action required.

TRI-MOD FACILITY

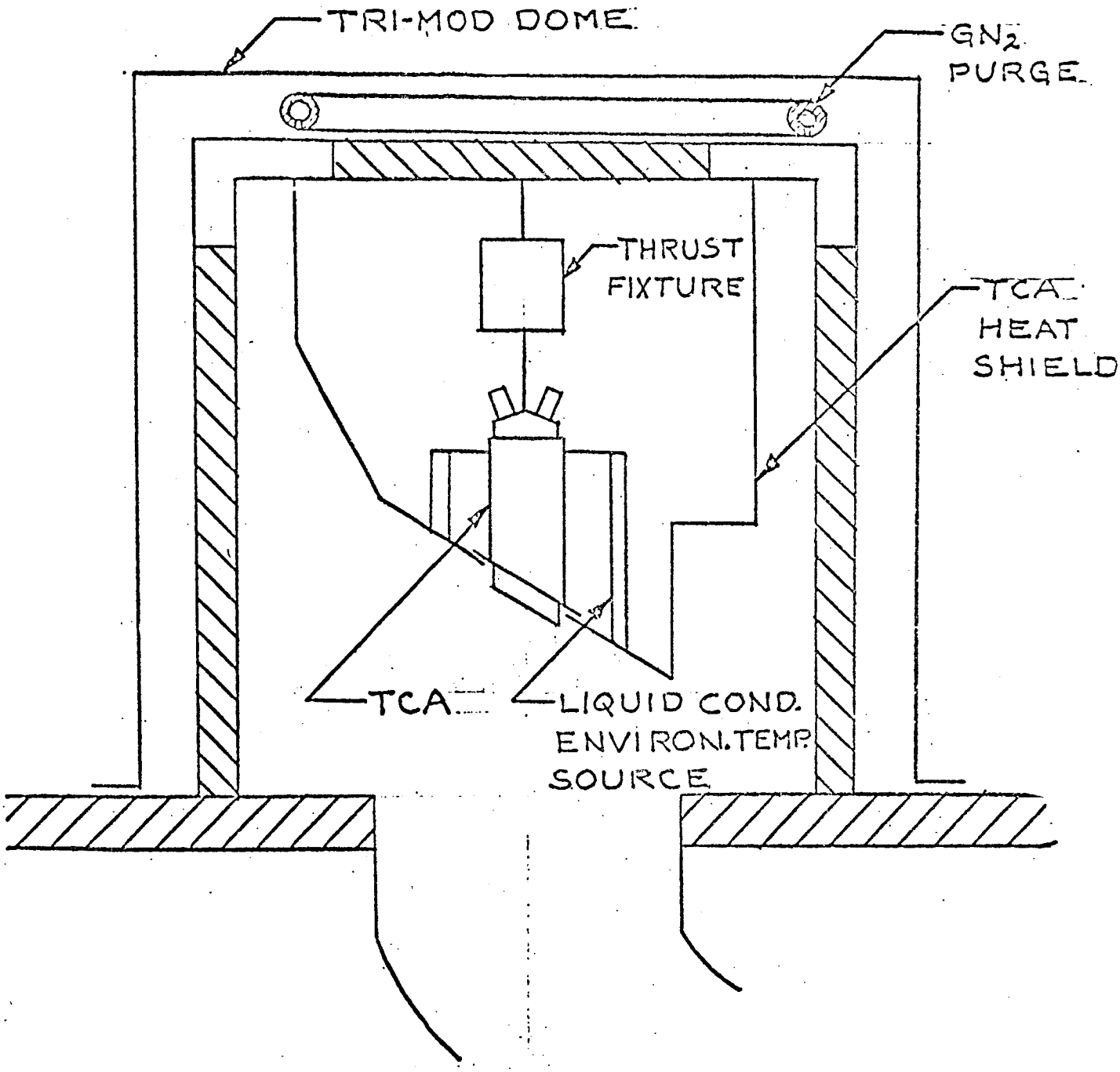


Figure 1
32690F

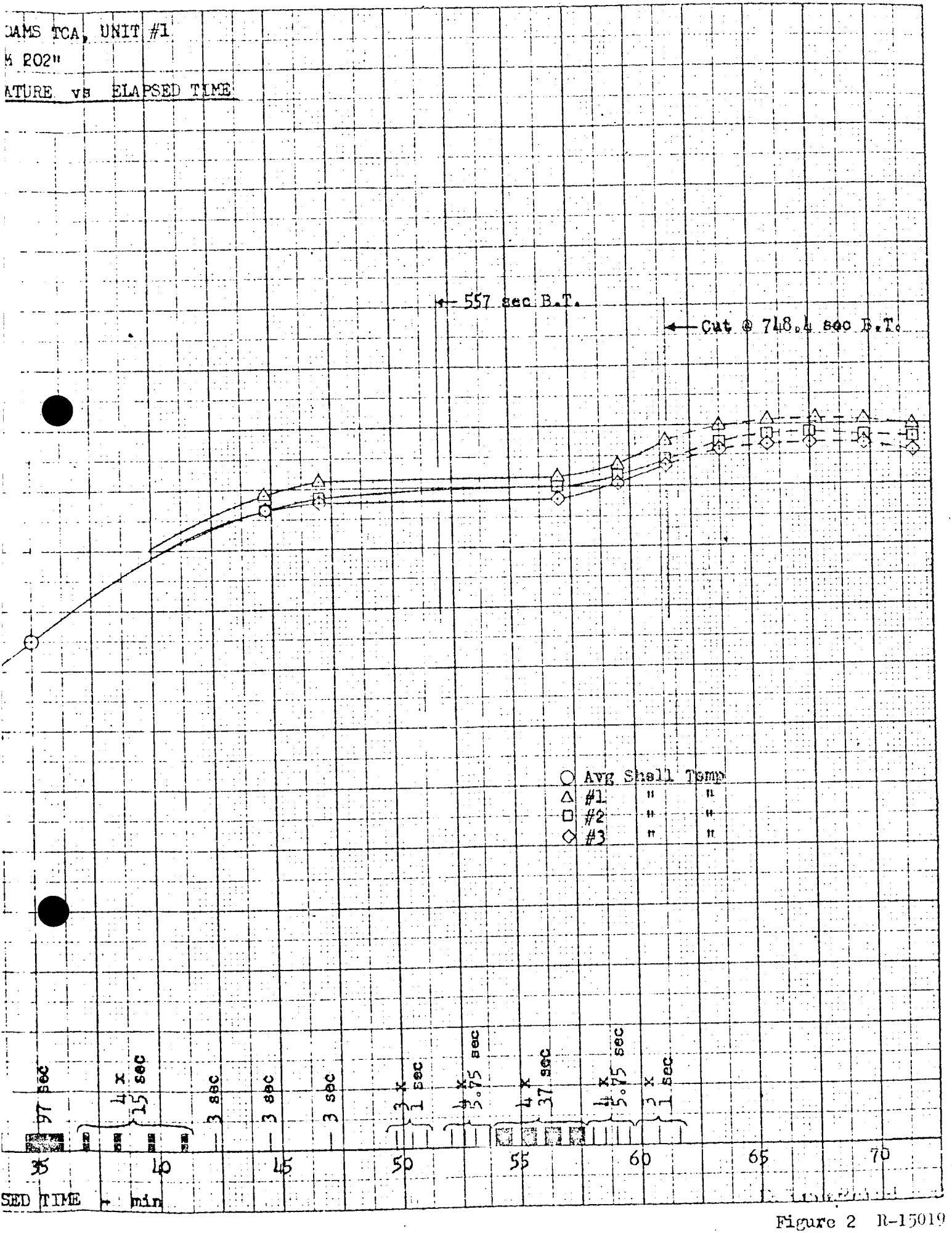
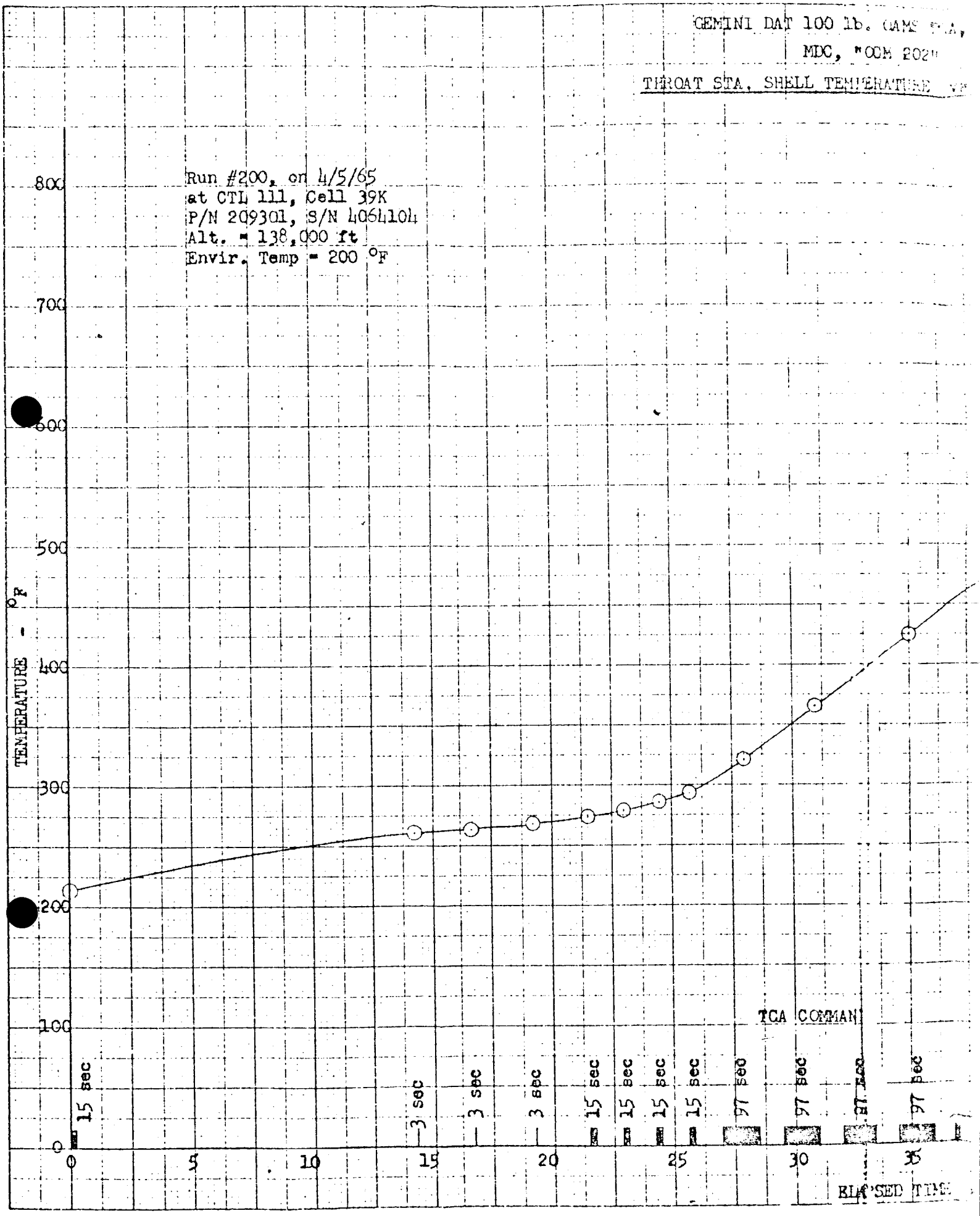
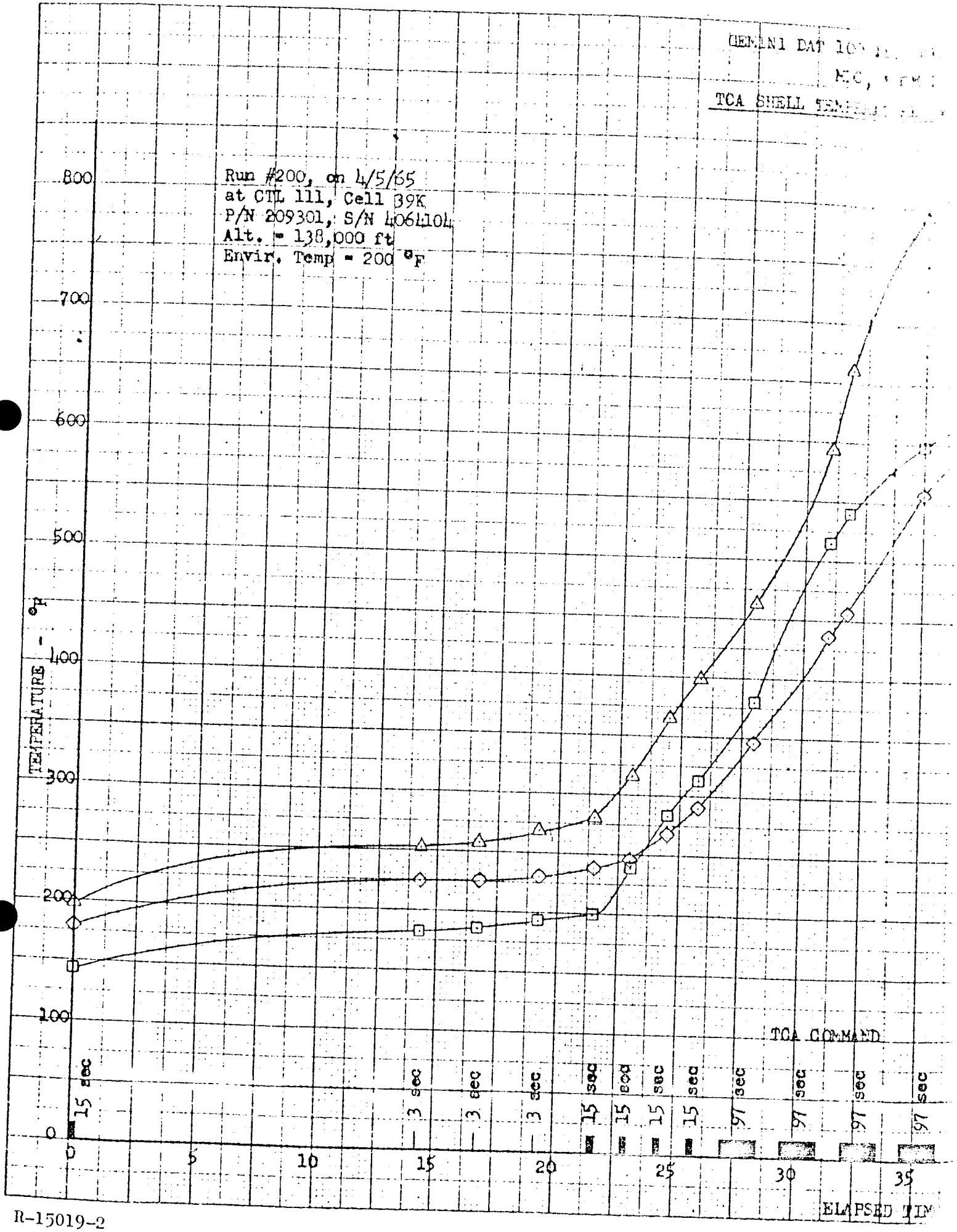


Figure 2 R-15019
32690R


GEMINI DAT 100 lb. OAMS
MDC, "OCM 202"
THROAT STA. SHELL TEMPERATURE
Run #200, on 4/5/65
at CTL 111, Cell 39K
P/N 209301, S/N 4064104
Alt. = 138,000 ft
Envir. Temp = 200 °F
TEMPERATURE - °F
800
700
600
500
400
300
200
100
0
15 sec
3 sec
3 sec
3 sec
15 sec
15 sec
15 sec
15 sec
97 sec
97 sec
97 sec
97 sec
TCA COMMAN
0
5
10
15
20
25
30
35
ELAPSED TIME


GEMINI DAT
TCA SHELL TEM
Run #200, on 4/5/65
at CTL 111, Cell 39K
P/N 209301, S/N 4064104
Alt. = 138,000 ft
Envir. Temp = 200 °F
TEMPERATURE - °F
800
700
600
500
400
300
200
100
0
TCA COMMAND
15 sec
3 sec
3 sec
3 sec
15 sec
15 sec
15 sec
15 sec
97 sec
97 sec
97 sec
97 sec
0
5
10
15
20
25
30
35
ELAPSED TIM

R-15019-2

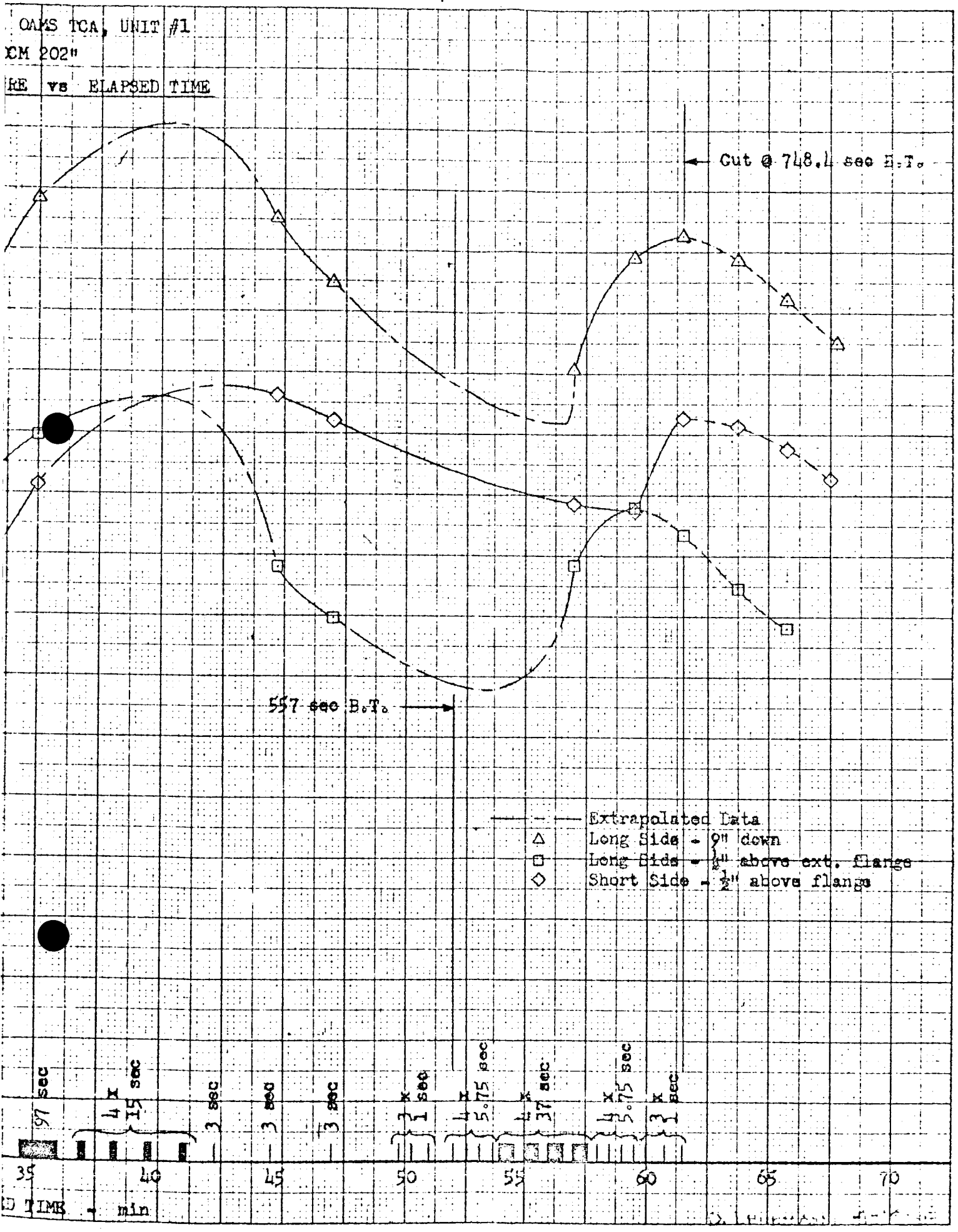
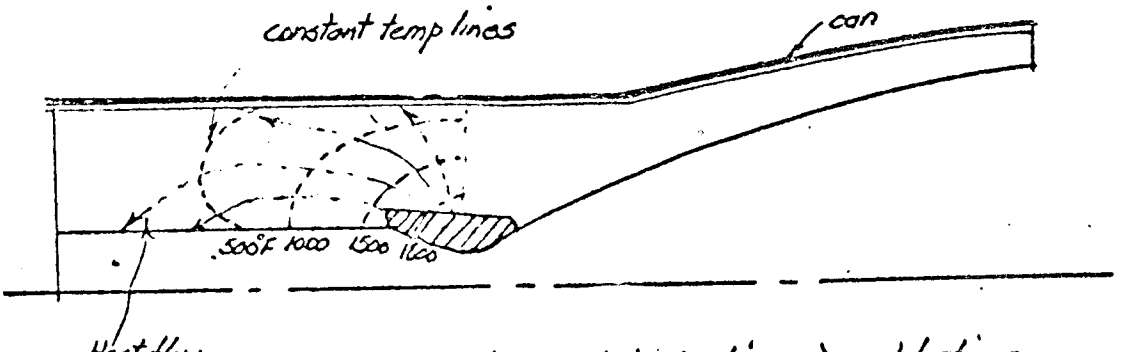
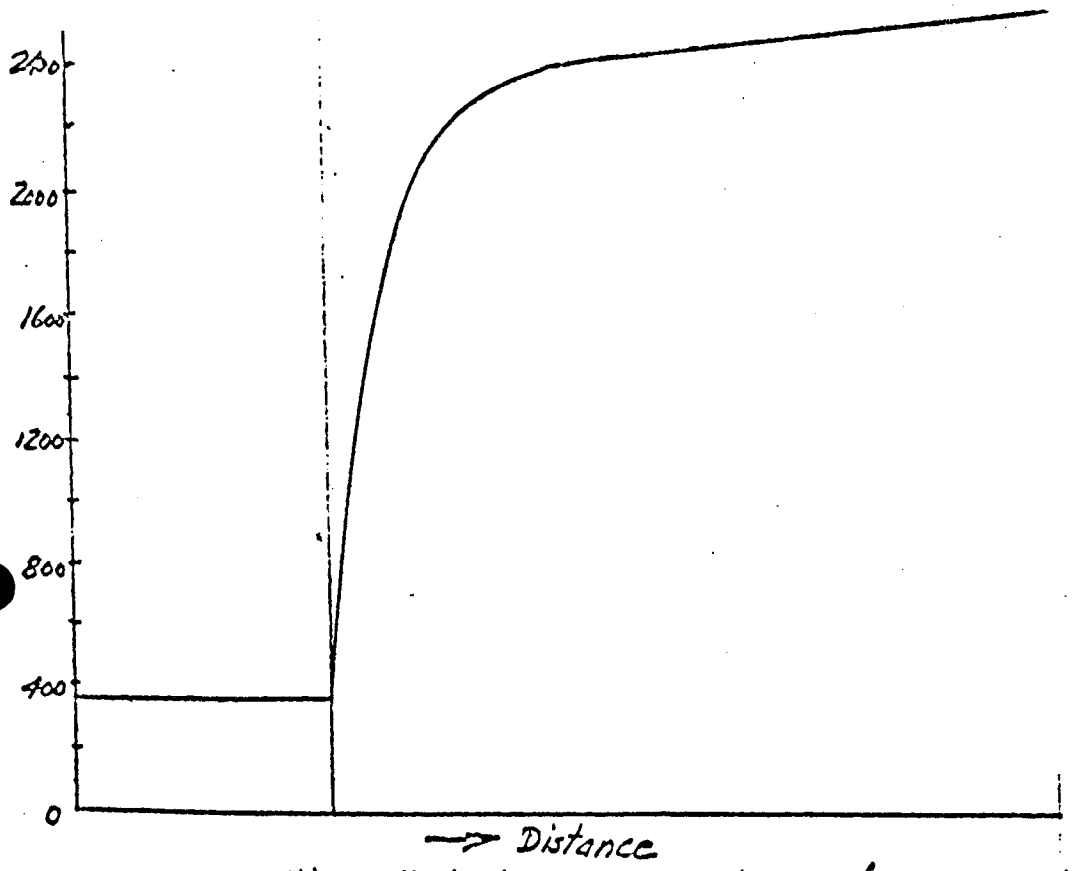


Figure 3
32690R



(a) Temperature Distribution in ablative (from injector and to throat)



(b) Adiabatic temperature of B.L. coolant gas

R-15019-2

Figure 4

32690R

ATTACH SHEET FOR FORM R-71-R-4 # 0251123

P/N 209301 DAT S/N 4064104

P/NAME THRUST CHAMBER ASSY 100LB. SE-7 DRAWN BY R.D. GIESLER 4-26-65

SKETCH IS OF INJECTOR AS SEEN FROM EXIT END OF THE TCA.

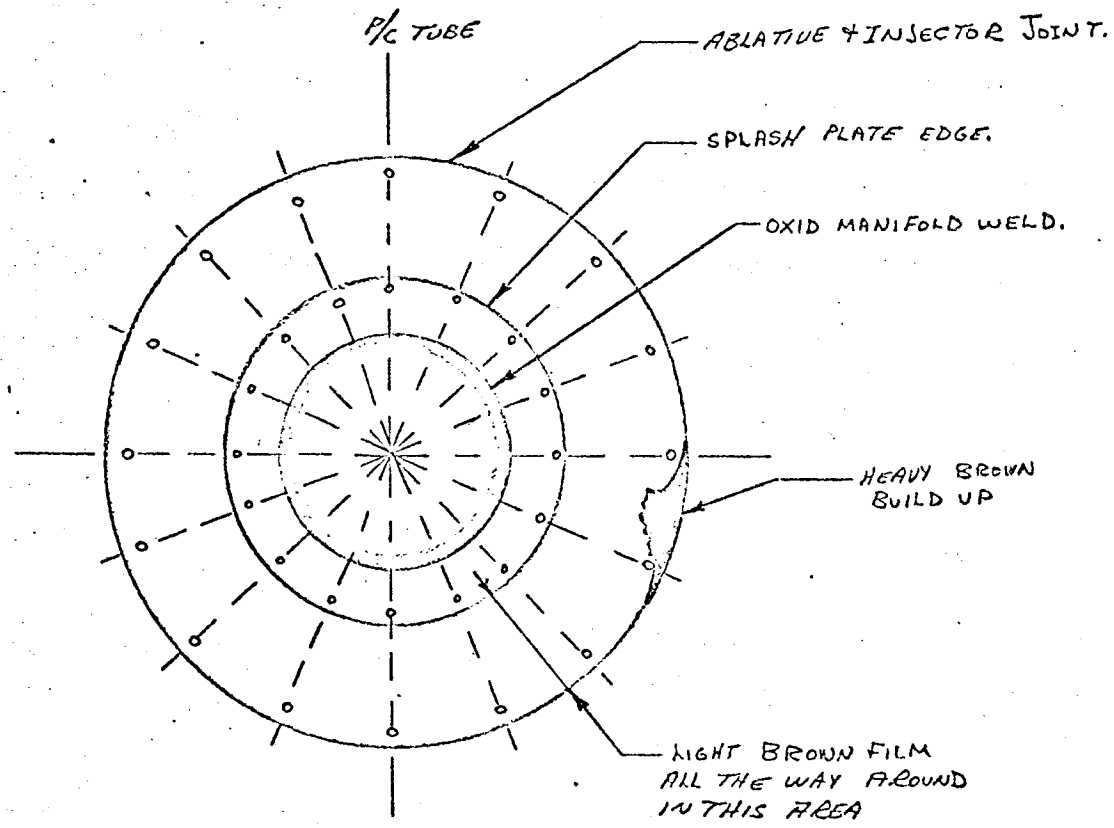


Figure 5
32690R

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APPENDIX C

APPENDIX C

MODULE/COMPONENT LOG BOOK AND ACCEPTANCE TEST DATA

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[redacted]

SCD52-52701-285

"CERTIFICATION IS HEREBY GIVEN THAT THE DELIVERABLE END ITEM COVERED BY THIS LOG BOOK WAS MANUFACTURED, INSPECTED AND TESTED IN ACCORDANCE WITH PRESCRIBED DRAWINGS, SPECIFICATION AND QUALITY ASSURANCE PROVISIONS. INSPECTION AND TEST RECORDS ARE ON FILE VERIFYING COMPLIANCE WITH APPLICABLE DRAWINGS AND SPECIFICATIONS, EXCEPT AS NOTED HEREIN"

LOG BOOK ACCEPTANCE DAT UNIT #046

SPACE ENGINES ENGINEERING	SPACE ENGINES QUALITY CONTROL	McDONNELL QUALITY REPRESENTATIVE	GOV'T INSPECTION AGENCY QUALITY REPRESENTATIVE
[signature]	S. H. [signature]	C. W. Michaelis	[signature]
DATE 19 JAN. 1965	DATE 19 JAN. 1965	DATE 19 Jan 1965	DATE 19 JAN 1965

CONTENTS

SECTION I – DELIVERABLE END ITEM ASSEMBLY LOG

RECORDS CONTAINED IN THIS SECTION ARE PERTINENT TO THE DELIVERABLE END ITEM ACCEPTANCE AND ALSO INCLUDE MODEL CONFIGURATION DATA, PERTINENT DETAILS OF SHORT SHIPMENTS, COMPONENT VARIATIONS, AGE SENSITIVE PARTS RECORD, WEIGHT AND SERIALIZATION RECORDS.

SECTION II – ACCEPTANCE TEST LOG

RECORDS OF ASSEMBLY ACCEPTANCE TESTS ARE PRESENTED IN THIS SECTION WITH PERFORMANCE DATA AND SUMMARY DATA ON INSPECTIONS AND ACCEPTANCE.

GENERAL INFORMATION

THIS LOG BOOK IS PROVIDED FOR SERVICE USE IN RECORDING PERTINENT HISTORICAL DATA AND ALL CHANGES FROM THE ORIGINAL CONFIGURATION. IT IS REQUESTED THIS LOG BOOK ACCOMPANY THE DELIVERABLE END ITEM WHEN TRANSFERRED BETWEEN ROCKETDYNE AND USING AGENCIES.

GROUP-4
Downgraded at 3 year intervals;
declassified after 12 years

ROCKETDYNE – SPACE ENGINES
A DIVISION OF NORTH AMERICAN AVIATION, INC.

LOG BOOK SPECIFICS

McDONNELL	ITEM	ROCKETDYNE
	LOG BOOK DATE	19 JAN 65
	DWG CHG LTR	DNA
Y20161R	CONTRACT NO.	
	GEN ORDER NO.	5252
SCD52-52701-285	SPEC NO.	
DNA	SERIAL NO.	4064104
52-52701-285	PART NO.	209301

THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18 U.S.C., SECTIONS 793 AND 794. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

SE 7 DELIVERABLE END ITEM – LOG BOOK IDENTIFICATION | PART NAME THRUST CHAMBER, 100 LB., ASSY OF | 1.0

[redacted]

DELIVERABLE END ITEM

THIS LOG BOOK CONTAINS INFORMATION PERTINENT TO THE DELIVERABLE END ITEM AS SPECIFIED HEREIN BY SERIAL NUMBER AND PART NUMBER. IT IS NECESSARY THAT ALL ENTRIES BE WRITTEN IN INK OR TYPED FOR PERMANENT RECORD. ENTRIES SUCH AS SERIALIZATION, WEIGHT, APPLICABLE MCR'S, ACCEPTANCE TEST DATA AND CALIBRATION DATA WILL BE ENTERED BY ROCKETDYNE AT THE TIME OF DELIVERY.

IT IS REQUESTED THAT THIS LOG BOOK ACCOMPANY THIS DELIVERABLE END ITEM IF THE ITEM IS RETURNED TO ROCKETDYNE FOR REPAIR, MODIFICATION OR RETEST. ROCKETDYNE WILL THEN ENTER REPAIR, MODIFICATION AND RETEST DATA IN THIS LOG BOOK.

THE FORMAT OF PAGES IN THIS LOG BOOK SHALL NOT BE REVISED WITHOUT OBTAINING APPROVAL OF ROCKETDYNE SPACE ENGINES PROGRAM OFFICE, QUALITY CONTROL, AND THE CUSTOMER REPRESENTATIVE.

DATE	PROGRAM OFFICE	QUALITY ASSURANCE	PURCHASER
4 NOV 64	H. E. McCravey	Wm E Reitz	J. E. Euler

52-52701-285 PART NO. 209301

PART NAME THRUST CHAMBER, 100 LB., ASSY OF 2.0

R-15019-2

1.0 LOG BOOK IDENTIFICATION

2.0 FOREWORD

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4.2 MCR VERIFICATION

4.3 VARIATION LOG

4.4 REPLACEMENT LOG

5.0 COMPONENT ACCEPTANCE TEST LOG--SECTION II

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5.1.1 COMPONENT ACCEPTANCE TEST

5.1.2 COMPONENT ACCEPTANCE TEST

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5.1.5 COMPONENT ACCEPTANCE TEST

5.2 CALIBRATED PERFORMANCE DATA

5.2.1 CALIBRATED PERFORMANCE DATA

5.2.2 CALIBRATED PERFORMANCE DATA

5.3 INFORMATION--CONTAMINATION

SECTION I

	52-52701-285 PART NO. 209301	
SE-7 MODULE / COMPONENT ASSEMBLY LOG	PART NAME THRUST CHAMBER, 100 LB., ASSY OF	4.0

R-15019-2

IND. NO.	PART NUMBER	REV. LTR.	PART NAME	SERIAL NO.	AGE CONTROL DATE OF MFG.	INSP.
1	209301	DNA	THRUST CHAMBER, 100 LB., ASSY OF	4064104	3Q64	ANR 208
2	209302	DNA	BODY, THRUST CHAMBER, ASSY OF	4064089	3Q64	ANR 208
2	209411	DNA	SHELL, THRUST CHAMBER, ASSY OF	8500902		ANR 208
3	209304	DNA	INJECTOR, THRUST CHAMBER, ASSY OF	4065375		ANR 208
2	409404	DNA	VALVE, OXIDIZER, T/C, ASSY OF	9371280		ANR 208
2	409405	DNA	VALVE, FUEL, T/C, ASSY OF	9362063		ANR 208

M NASA 136

DNA SERIAL NO. 4064104

52-52701-285 PART NO. 209301

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

4.1

SE-7 CONFIGURATION & SERIALIZATION LOG

MCR / ECP NO.	DATE	TITLE	DATE	INSP.
SE6-062	6 JAN 64	COMPONENT CLEANING; PROVISION FOR	19 JAN 65	ANR 721
SE6-064	30 JUL 63	TCA, ACCEPTANCE TESTS; REVISION OF	19 JAN 65	ANR 721
SE6-075	4 JAN 65	MAC REPORT 8518, INCORPORATION OF	19 JAN 65	ANR 721
SE6-080	28 DEC 63	THRUST CHAMBER ASSEMBLIES, FABRICATION MATERIAL; APPROVAL OF	19 JAN 65	ANR 721
SE6-085	8 DEC 64	CUSTOMER TEST SURVEILLANCE; REQUIREMENT FOR	19 JAN 65	ANR 721
SE6-133	4 JAN 65	TCA PROPELLANT VALVES; ADDITIONAL REQUIREMENTS FOR	19 JAN 65	ANR 721
SE6-139	15 APR 64	PLACEMENT OF HAYNES STELLITE #3 SAND CAST ON APPROVED MATERIAL LIST	19 JAN 65	ANR 721
SE6-179	16 JAN 64	TUBE STUBS; MARKING OF	19 JAN 65	ANR 721
SE6-231	5 JAN 65	AMENDMENT NO. 1, TO SPEC. RA0103-002; INCORPORATION OF	19 JAN 65	ANR 721
SE7-041	15 APR 64	85# AND 100# THRUST CHAMBER ASSEMBLIES, PROPELLANT VALVES, INLET TUBES, MATERIAL; CHANGE TO 304L BAR PER QQ-S-763	19 JAN 65	ANR 721
SE7-079	4 DEC 64	OAMS'S TCA'S; REDESIGN OF	19 JAN 65	ANR 721
SE7-089	4 DEC 64	100 LB. TCA MOUNTING POINTS; CHANGES TO	19 JAN 65	ANR 721

R-15019-2

	DNA	SERIAL NO.	4064104
	52-52701-285	PART NO.	209301
SE-7 DELIVERABLE END ITEM-MCR VERIFICATION	PART NAME THRUST CHAMBER, 100 LB., ASSY OF		4.2

MR NO.	PART OR COMP. INVOLVED	PART NUMBER	SERIAL NUMBER	BRIEF DESCRIPTION OF VARIATION AND MATERIAL REVIEW BOARD DISPOSITION	INSP.
600N-5 # C37736 R-15019-2	100 LB., TCA, ASSY OF	209301	4064104	DISCREPANCY: THE FUEL VALVE ORIFICE HOUSING HAS THE EXTERNAL THREADS AT THE TOP OF THE HOLDER CHEWED UP BY THE TORCH WELD JIG HOLDING DETAIL. THE FUSD AND OXID INLET FITTINGS SHOW METAL CHIPS FROM THE TORCH WELD JIG. DISPOSITION: REWORKED PER 600N-5 #C37736.	ANR 721
MAC MRR #71118	100 LB., TCA ASSY OF	209301	4064104	DISCREPANCY: THE FOLLOWING TCA COMPLIES TO RA0220-408 AMEND. #2 WITH THE FOLLOWING EXCEPTIONS: CONDITION A: TCA'S FLUSHED FOR FIVE MINUTES PRIOR TO DECONTAMINATION. NOT PER SPEC. PARA. 4.13. CONDITION B: BOTH ELECTRICAL CONNECTORS NOT SWAB PASSIVATED PER SPEC., PARA 4.13.31. REF: 600-N-C41543 DISPOSITION: ACCEPTABLE FOR USE PER MAC MRR #71118	ANR 721
MAC MRR #71184	100 LB., TCA ASSY OF	209301	4064104	DISCREPANCY: CONDITION A: 1 PC. REF: RA0220-408 #3 PARA. 4.13. TIME BETWEEN HOT-FIRE AND DECONTAMINATION. MAXIMUM TIME IS 12 HOURS. ACTUAL TIME WAS TWENTY-EIGHT (28) HOURS. REF: 600-N-C41600 DISPOSITION: REWORK PER MAC MRR #71184	ANR 721

DNA SERIAL NO. 4064104
52-52701-285 PART NO. 209301

SE-7 DELIVERABLE END ITEM — VARIATION LOG

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

4.3

PART NO.	PART NAME	SERIAL NO.	REASON FOR REPLACEMENT	REPLACED BY PART NO.	REPLACED BY SERIAL NO.	INSP.
			NONE THIS DATE - 19 JAN 65			

R-15019-2

	DNA 52-52701-285	SERIAL NO.	4064104
		PART NO.	209301
SE-7 DELIVERABLE END ITEM--REPLACEMENT LOG	PART NAME THRUST CHAMBER, 100 LB., ASSY OF		4.4

SECTION II

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
ELECTRICAL RESISTANCE TESTS---TCA PROPELLANT VALVES	4.2				
BODY TEMPERATURE					
OXIDIZER	4.2.4	DEGREES F	70 ± 5	70	ANR 208
FUEL	4.2.11	DEGREES F	70 ± 5	70	ANR 208
COIL RESISTANCE					
OXIDIZER	4.2.5	OHMS	42 + 2 - 3	41.11	ANR 208
FUEL	4.2.11	OHMS	42 + 2 - 3	41.26	ANR 208
CONTINUITY RESISTANCE					
OXIDIZER	4.2.9	OHMS	1.0 MAX.	.010	ANR 208
FUEL	4.2.11	OHMS	1.0 MAX.	.030	ANR 208
DIELECTRIC STRENGTH TEST--PROPELLANT VALVES	4.3				
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICROAMPS	500 MAX.	56	ANR 208
FUEL	4.3.11	MICROAMPS	500 MAX.	55	ANR 208
PROOF PRESSURE TEST--TCA PROPELLANT VALVES	4.4				
VALVES PRESSURIZED FOR NOT LESS THAN 3 MINUTES					
OXIDIZER					
STEP I	4.4.3	PSIG	500 ± 10	VERIFIED	ANR 208
STEP II	4.4.5	PSIG	500 ± 10	VERIFIED	ANR 208

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-408	N/C	#2	DNA 52-52701-285	SERIAL NO. 4064104 PART NO. 209301	
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 100 LB. ASSY OF		5.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE TEST--TCA PROPELLANT VALVES (CONTINUED)	4.4				
FUEL					
STEP I	4.4.7	PSIG	500±10	VERIFIED	ANR 208
STEP II	4.4.7	PSIG	500±10	VERIFIED	ANR 208
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION					
OXIDIZER					
STEP I	4.4.4	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
STEP II	4.4.5	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
FUEL					
STEP I	4.4.7	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
STEP II	4.4.7	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
PROOF PRESSURE AND LEAKAGE TEST--THRUST CHAMBER	4.5				
PROOF PRESSURE TEST					
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES AT	4.5.7	PSIG	392 ± 10	VERIFIED	ANR 208
LEAKAGE TEST	4.5.7	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	NONE ALLOWED	NONE DETECTED	ANR 208

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SPECIFICATION NUMBER RA0220-408	REVISION N/C	AMENDMENT #2	DNA 52-52701-285	SERIAL NO. 4064104 PART NO. 209301
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 100 LB., ASSY OF	5.1.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
FUNCTIONAL TEST--TCA PROPELLANT VALVES	4.6				
OPENING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.021 MAX.	.0175	ANR 208
FUEL	4.6.8	SEC.	0.021 MAX.	.0170	ANR 208
CLOSING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.005 MAX.	.0035	ANR 208
FUEL	4.6.10	SEC.	0.005 MAX.	.0033	ANR 208
CLOSING DROP OUT VOLTAGE					
OXIDIZER	4.6.17	VOLT (DC)	1 MIN.	2.2	ANR 208
FUEL	4.6.13	VOLT (DC)	1 MIN.	2.0	ANR 208
LOAD ANALYSIS TEST	4.6				
FUEL VALVE STEADY STATE CURRENT AT	4.6.24				
20 ± .5 VOLTS	4.6.24	AMPS	DNA	.48	ANR 208
26 ± .5 VOLTS	4.6.25	AMPS	DNA	.62	ANR 208
33 ± .5 VOLTS	4.6.25	AMPS	DNA	.78	ANR 208
OXIDIZER VALVE STEADY STATE CURRENT AT	4.6.28				
20 ± .5 VOLTS	4.6.28	AMPS	DNA	.49	ANR 208
26 ± .5 VOLTS	4.6.28	AMPS	DNA	.62	ANR 208
33 ± .5 VOLTS	4.6.28	AMPS	DNA	.79	ANR 208

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SPECIFICATION NUMBER RA0220-408	REVISION N/C	AMENDMENT #2	DNA 52-52701-285	SERIAL NO. 4064104 PART NO. 209301
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 100 LB., ASSY OF	5.1.2

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
R-15019-2 *LEAKAGE TEST -TCA PROPELLANT VALVES	4.7				
SEAT LEAKAGE RATE					
OXIDIZER	4.7.17	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 208
FUEL	4.7.22	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 208
*PRE-TEST DATA					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.1.3	LB.	DNA	9.37	ANR 208
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	4.439	ANR 208
THROAT DIAMETER					
SECTION A-A		INCH	DNA	.708	ANR 208
B-B		INCH	DNA	.708	ANR 208
C-C		INCH	DNA	.708	ANR 208
D-D		INCH	DNA	.708	ANR 208
** POST HOT-FIRE DATA					
PROOF PRESSURE TEST					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.14.1	LB.	DNA	9.39	ANR 208
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES					NASA

SPECIFICATION NUMBER	REVISION	AMENDMENT
*RA0220-408	N/C	#2
*B*RA0220-408	N/C	#3

DNA SERIAL NO. 4064104

52-52701-285 PART NO. 209301

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
POST HOT-FIRE DATA (CONTINUED)					
PROOF PRESSURE TEST	4.14.5	PSIG	392 ± 10	392	ANR 208
LEAKAGE TEST THRUST CHAMBER	4.14.5	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.14.5	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
LEAKAGE TEST--TCA PROPELLANT VALVES					
SEAT LEAKAGE RATE					
OXIDIZER	4.14.5	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 208
FUEL	4.14.5	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 208
LEAK TEST--WELDED JOINTS					
LEAK TEST					
PRESSURIZED INLET TUBE WITH GASEOUS HELIUM					
OXIDIZER	4.14.6	PSIG	500 ± 10	VERIFIED	ANR 208
FUEL	4.14.9	PSIG	500 ± 10	VERIFIED	ANR 208
JOINT LEAKAGE RATE					
OXIDIZER	4.14.7	SCC/SEC	10^{-6} MAX.	LESS THAN 10^{-6}	ANR 208
FUEL	4.14.9	SCC/SEC	10^{-6} MAX.	LESS THAN 10^{-6}	ANR 208

SPECIFICATION NUMBER RA0220-408	REVISION N/C	AMENDMENT #3	DNA SERIAL NO. 4064104
			52-52701-285 PART NO. 209301
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 100 LB., ASSY OF 5.1.4

R-15019-2

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAK TEST--WELDED JOINTS (CONTINUED)					
INSPECTED VISUALLY FOR CLEANLINESS, CORROSION DETERIORATION, DAMAGE OR DEFORMATION	4.14.10	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
THROAT DIAMETER (DELIVERED CONDITION)	4.15.1				
SECTION A-A		INCH	DNA	.708	ANR 208
B-B		INCH	DNA	.708	ANR 208
C-C		INCH	DNA	.708	ANR 208
D-D		INCH	DNA	.708	ANR 208
DRY WEIGHT (DELIVERABLE CONDITION)	4.15.2	LB.	DNA	9.37	ANR 208
(EXCLUDING PROTECTIVE COVERS & CLOSURES)					
INSPECTED VISUALLY FOR CLEANLINESS, CORROSION, DETERIORATION, DAMAGE OR DEFORMATION	4.15.3	DNA	NONE ALLOWED	NONE DETECTED	ANR 208

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0220-408	N/C	#3	DNA	SERIAL NO. 4061104
			52-52701-285	PART NO. 209301

SE-7 COMPONENT ACCEPTANCE TEST

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

5.1.5

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 391 TEST DATA	RUN 392 TEST DATA	RUN 418 TEST DATA	RUN 419 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	NFL	NFL	NFL	NFL	
CELL LOCATION	-	-	1-A	1-A	1-A	1-A	
CELL NUMBER	-	-	379	379	379	379	
TEST DATE	-	-	22 Nov64	22 Nov 64	2 Dec 64	2 Dec 64	
TEST DURATION	SEC.	4 min	4.0	4.0	4.0	4.0	
ENVIRONMENTAL Pc	PSIA	0.16 MAX	.06610	.06652	.06720	.06720	
AMBIENT PRESSURE	PSIA	DNA	12.26	12.26	11.99	11.99	
AMBIENT TEMPERATURE	°F	DNA	49.0	49.0	40.0	40.0	
TIME OF DATA SLICE-START	SEC.	DNA	3.8	3.8	3.8	3.8	
TIME OF DATA SLICE-END	SEC.	DNA	3.8	3.8	3.8	3.8	
OXIDIZER TEMPERATURE	°F	DNA	51.4	60.0	52.8	54.4	
FUEL TEMPERATURE	°F	DNA	49.7	57.0	57.7	58.7	
OXIDIZER DENSITY	LB/FT^3	DNA	91.73	91.06	91.57	91.45	
FUEL DENSITY	LB/FT^3	DNA	55.14	54.92	54.90	54.87	

SPECIFICATION NUMBER	REVISION	AMENDMENT	DNA	SERIAL NO. 4064104
RAO-220-408	NC	+2	52-52701-285	PART NO. 209301
SE- 7 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER, 100 LB., ASSY OF	5.2

R-15019-2

GROUP 4
Downgraded at 3 year intervals:
Declassified after 12 years

CONFIDENTIAL

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CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 391 TEST DATA	RUN 392 TEST DATA	RUN 418 TEST DATA	RUN 419 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	NFL	NFL	NFL	NFL	
OXIDIZER INLET PRESSURE	PSIA	286 ± 10	286.1	286.1	291.0	289.9	
FUEL INLET PRESSURE	PSIA	280 ± 10	285.4	284.9	283.4	282.9	
OXIDIZER FLOWRATE	LB/SEC	DNA	.1914	.1908	.1940	.1937	
FUEL FLOWRATE	LB/SEC	DNA	.1569	.1574	.1575	.1571	
THRUST	LB.	DNA	97.3	97.2	97.4	97.0	
MIXTURE RATIO	O/F	DNA	1.22	1.21	1.23	1.23	
SPECIFIC IMPULSE	SEC	DNA	279.	279.	277.	277.	
INJECTOR END Pc	PSIA	DNA	137.7	137.5	138.6	138.6	
CHARACTERISTIC VELOCITY	FT/SEC	DNA	5008.	5002.	4993.	5003.	
THROAT DIAMETER	INCH	DNA	.708	.708	.708	.708	
FUEL ORIFICE DIAMETER	INCH	DNA	.09372	.09372	.09372	.09372	
OXIDIZER ORIFICE DIAMETER	INCH	DNA	.08235	.08235	.08235	.08235	
TCA FIRING TIME (TOTAL)	SEC	32 MAX.	4.0	8.0	12.0	16.0	
OXIDIZER SAMPLE NUMBER	-	-	365.	365.	371.	371.	
FUEL SAMPLE NUMBER	-	-	362.	362.	372.	372.	

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RAO 220-408	NC	+2	DNA	SERIAL NO.	406412
			52-52701-285	PART NO.	209301

67 SE- 7 (REA) CALIBRATED PERFORMANCE DATA — PART NAME THRUST CHAMBER, 100 LB., ASSY OF — 5.2.2

CONFIDENTIAL

THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18, U.S.C., SECTIONS 793 AND 794. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

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GROUP 4
Downgraded at 3 year intervals;
Declassified after 12 years

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CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 391 TEST DATA	RUN 392 TEST DATA	RUN 418 TEST DATA	RUN 419 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	NFL	NFL	NFL	NFL	
ADJUST TO STANDARD CONDITIONS	-	-	-	-	-	-	
THRUST	LB.	94.5 ± 4.7	97.5	97.6	96.9	96.7	
MIXTURE RATIO	O/F	1.20 ± .05	1.23	1.23	1.22	1.22	
SPECIFIC IMPULSE	SEC	DNA	283.	283.	279.	279.	
INJECTOR END Pc	PSIA	DNA	136.4	136.5	136.4	136.7	
CHARACTERISTIC VELOCITY	FT/SEC	DNA	5020.	5015.	4980.	4993.	
ADJUST TO RATED CONDITIONS	-	-	-	-	-	-	
THRUST	LB.	94.5	94.5	94.5	94.5	94.5	
MIXTURE RATIO	O/F	1.20	1.20	1.20	1.20	1.20	
SPECIFIC IMPULSE	SEC	260 MIN.	281.	281.	278.	278.	

R-15019-2

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RAO 220-408	NC	#2	DNA	SERIAL NO. 4064104
RAO220-444	NC	#1	52-52701-285	PART NO. 209301

SE- 7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

5.2.2

~~CONFIDENTIAL~~

R-15019-2

THE FOLLOWING IS INFORMATION RELATIVE TO THE CLEANLINESS LEVEL OF THE PROPELLANT UTILIZED IN THE HOT-FIRE ACCEPTANCE TEST OF THE THRUST CHAMBER ASSEMBLY.

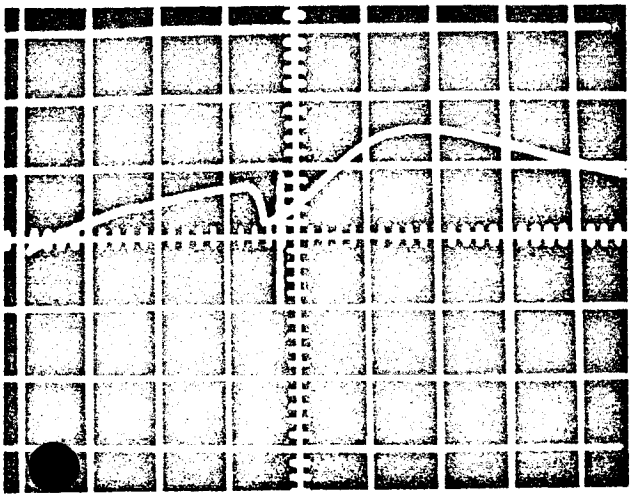
THE INFLUENT PARTICULATE COUNT OF THE PROPELLANT WAS:

		LIMITS	ACTUAL COUNT MMH - FUEL	ACTUAL COUNT NTO - OXID
	< 10	*	DNA	DNA
	10 - 25	100	98	57
	25 - 50	20	11	7
	50 - 100	5	1	0
	100 - 300	1	0	0
	300 - 1000	0	0	0
	> 1000	0	0	0
FIBERS	300 - 3000	0	0	0
FIBERS	> 3000	0	0	0

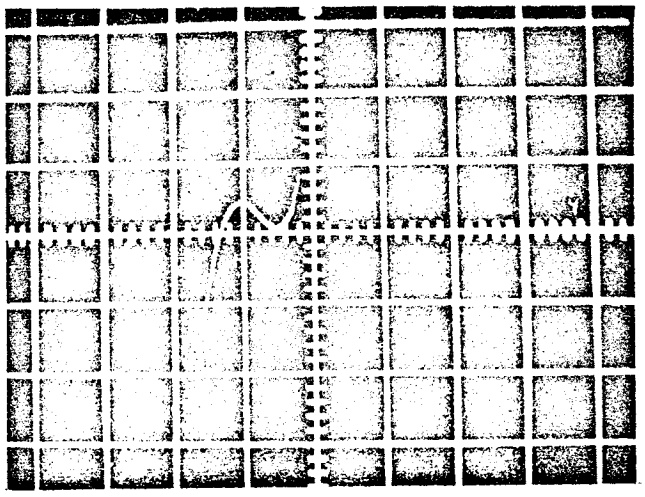
* NOTE: " NOT TO BE COUNTED BUT NO SLURRY OF FINE PARTICLES WHICH COVERS MORE THAN AN ESTIMATED 5 PERCENT OF THE TOTAL EFFECTIVE FILTER AREA SHALL BE ALLOWED." AT THE DISCRETION OF QUALITY ASSURANCE, A WEIGHT DETERMINATION OF TOTAL CONTAMINATION MAY BE MADE AS A REFEREE TEST IN BORDERLINE CASES. THE MAXIMUM ALLOWABLE WEIGHT OF CONTAMINANTS SHALL BE 0.001 GRAM (1 MG).

CLASS 4

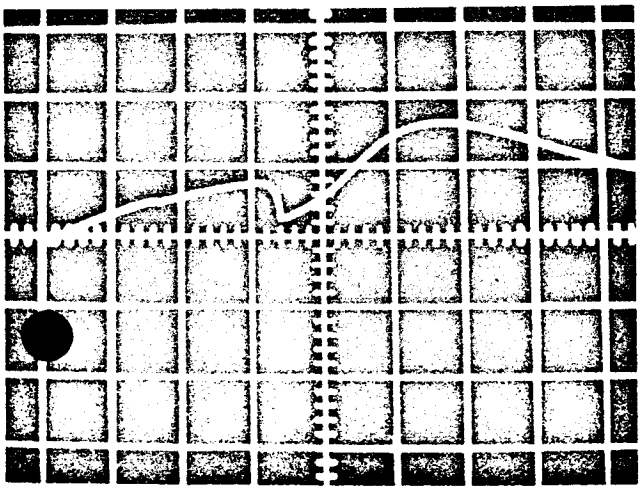
INSP. ANR 208



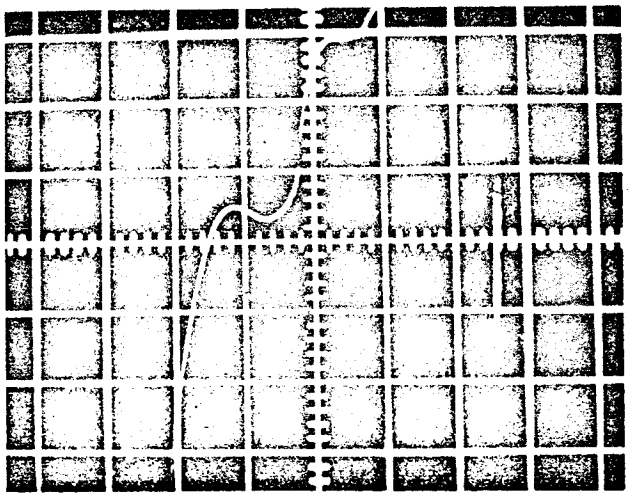
OXIDIZER VALVE OPENING
CURRENT TRACE AT 26 VDC
VERTICAL 50M/VOLT/CM
HORIZONTAL .005 M/SEC./CM
ENGINE P/N 209301
ENGINE S/N 406410A



OXIDIZER VALVE CLOSING
CURRENT TRACE AT 26 VDC
VERTICAL 10M/VOLT/CM
HORIZONTAL .001M/SEC./CM
ENGINE P/N 209301
ENGINE S/N 406410A



FUEL VALVE OPENING
CURRENT TRACE AT 26 VDC
VERTICAL 50M/VOLT/CM
HORIZONTAL .005M/SEC./CM
ENGINE P/N 209301
ENGINE S/N 406410A



FUEL VALVE CLOSING
CURRENT TRACE AT 26 VDC
VERTICAL 10M/VOLT/CM
HORIZONTAL .001M/SEC./CM
ENGINE P/N 209301
ENGINE S/N 406410A

R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC.

MODULE & COMPONENT LOG

SUPPLIER NAME: NAA LAD

P.O. NO.: (28-1281) Y 20161R

DATE OF MFG.: 9-4-4 AND/OR CURE DATE: DNA

EXPECTED LIFE: 1. ELAPSED OPER. TIME: DNA 2. ELAPSED CYCLES: DNA 3. CALENDAR LIFE: DNA

KEEP TIME IN MINUTES AND SECONDS AND/OR CYCLES

PART NAME: Valve Dry Fuel ROCKETDYNE PART NO.: 409405 SUPPLIER PART NO.: DNA SERIAL NUMBER: 9362063 SYSTEM NAME: ~~DNA~~ GAMS

TCA S/N 406 4104

RA 0206-202

YEAR 1964 MO.-DAY	TIME START	TIME STOP	TIME SUB-TOTAL	TIME TOTAL	CYCLES START	CYCLES STOP	CYCLES SUB-TOTAL	CYCLES TOTAL	*HISTORY	STAMP OR INITIALS
9-4	0	30	30	30 Min	0	300	300	300	Teflon Seat Forming 4.2	
9-4	0	14	14	44 Min	0	0	0	300	Internal Leakage 4.3	
9-4	0	0	0	44 min	0	2	2	302	Stroke Check 4.4	
9-4	0	0	0	44 min	0	2	2	304	Drop Out Current 4.5	
9-4	0	0	0	44 min	0	2	2	306	De-Energize Time 4.5	
9-4	0	0	0	44 min	0	4	4	310	Pull In Current 4.6	
9-4	0	0	0	44 min	0	2	2	312	Energize Time 4.6	
9-4	0	0	0	44 min	0	1	1	313	Pressure Drop 4.7	
9-5	0	3	3	47 min	0	0	0	313	Proof Pressure 4.9	
9-5	0	0	0	47 min	0	100	100	413	Cycle Test 4.10	
9-5	0	0	0	47 min	0	2	2	415	Stroke Check 4.11	
9-5	0	0	0	47 min	0	2	2	417	Pull-in Current 4.12	
9-5	0	0	0	47 min	0	4	4	421	Energize Time 4.12	
9-8	0	3	3	50 Min	0	0	0	421	Proof Pressure 4.14	
9/8	0	0	0	50 min	0	1	1	422	Pressure Drop 4.15	
9/8	0	14	14	64 min	0	0	0	422	Internal leakage 4.16	
9/8	0	10	10	74 min	0	0	0	422	Flushing 4.19.1	
9/8	0	15	15	89 min	0	0	0	422	Drying 4.19.2	

THIS ASSY INSTALLED ON P/N 209301, S/N 406410F TCA

*ENTER INFORMATION SUCH AS, BUT NOT LIMITED TO: ENVIRONMENT WHEN OTHER THAN AMBIENT; TYPE OF TESTS PERFORMED; MALFUNCTION HISTORY OF A PART, COMPONENT, SUB-SYSTEM OR SYSTEM; SERIAL NUMBERS OF ANY PARTS OR COMPONENTS REMOVED AND THEIR REPLACEMENTS; REMOVALS AND REASONS FOR SAME, INCONSISTENCIES OF A SYSTEM; AND THE SPACECRAFT NUMBER TO WHICH THIS ITEM HAS BEEN OR IS NOW ASSIGNED TO.

FORM 620-S NEW 2-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

MODULE & COMPONENT LOG

SUPPLIER NAME [illegible]

P.O. NO. [illegible]

DATE OF MFG. 1-65 AND/OR CURE DATE 3-64

EXPECTED LIFE: 1. ELAPSED OPER. TIME 400 S 2. ELAPSED CYCLES [illegible] 3. CALENDAR LIFE 48 MONTHS

KEEP TIME IN MINUTES AND SECONDS. AND/OR CYCLES 52-52701-285

PART NAME [illegible] ROCKETDYNE PART NO. [illegible] SUPPLIER PART NO. [illegible] SERIAL NUMBER 405404 SYSTEM NAME CAMS

YEAR / MO-DAY	TIME START	CYCLE STOP	MANUAL SUB-TOTAL	AUTO TOTAL	TIME START	CYCLE STOP	MANUAL SUB-TOTAL	AUTO TOTAL	*HISTORY	STAMP
								15	[illegible]	[illegible]
									Accum Time: 91 min.	(ANR 53)
			Accumulated History						Accum Cycles: 424	(ANR 53)
			From Component Logs.						Fuel Valve [illegible]	[illegible]
									Accum Time: 99 min	(ANR 53)
									Accum Cycles: 422	[illegible]
									Leak & Functional [illegible]	(ANR 53)
11-[illegible]	0	30	30	30 min	0	2	2	2	Purge Valves [illegible]	[illegible]
11-[illegible]	0	12	12	42	0	2	2	4	Leak Test Welds [illegible]	(ANR 53)
11-10	0	10	10	[illegible]	0	2	2	6	[illegible]	[illegible]
11-12	0	10	10	[illegible]	0	2	2	8	[illegible]	(ANR 53)
11-[illegible]	-	6	6	[illegible]	-	—	-	8	[illegible] Resist. 4.2.1	[illegible]
11-13	0	[illegible]	2	44	-	-	—	8	[illegible] 4.2.1	(ANR 53)
11-13	0	11	11	[illegible]	0	5	5	13	Proof Press 4.4.1-4.5.12	[illegible]
11-13	0	50	50	138	0	40	40	53	Fuel Test 4.6.1 - 4.6.29	[illegible]
11-13	0	10	10	146	0	6	6	[illegible]	[illegible] 4.7.1 - 4.7.23	(ANR 53)
			[illegible]		Calibration		[illegible]		DC-410 [illegible]	
11-14	0	45	45	193	0	9	9	[illegible]	Calibrate (Oxid) 4.2	[illegible]
11-[illegible]	[illegible]	35	35	[illegible]	0	7	7	75	Calibrate (Fuel) 4.3	(ANR 53)

*ENTER INFORMATION SUCH AS, BUT NOT LIMITED TO: ENVIRONMENT WHEN OTHER THAN AMBIENT, TYPE OF TESTS PERFORMED, MALFUNCTION HISTORY OF PART, COMPONENT, SUB-SYSTEM OR SYSTEM, SERIAL NUMBERS OF ANY PARTS OR COMPONENTS REMOVED AND THEIR REPLACEMENTS, REMOVALS AND REASONS FOR SAME, INCONSISTENCIES OF A SYSTEM AND THE SPACECRAFT NUMBER TO WHICH THIS ITEM HAS BEEN OR IS NOW ASSIGNED.

NASA

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YEAR / MO—DAY	TIME START	CYCLES STOP	MANUAL SUB-TOTAL	AUTO TOTAL	TIME START	CYCL. STOP	MANUAL SUB-TOTAL	AUTO TOTAL	*HISTORY	STAMP
11-14	0	19	19	[illegible]	0	2	2	77	PRESTART CHECK 4.4	53
				HOT	SIDE	CHECK	FOR	[illegible]	220-40B AC AND HZ.	ANR 53
11-21	1520	1530	10 [illegible]	[illegible]	0	1	1	79	FUEL & LUBRICATION 4.9.1-4.9.6	ANR 53
11-22	1615	1725	70 [illegible]	[illegible]	0	0	0	78	ACTUAL 4.9.6.7	ANR 53
[illegible]	1648	[illegible]	4500	[illegible]	0	1	1	79	HOT FIRE 4.9.6.9	53
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	1	1	80	HOT FIRE FAILED [illegible] 4.9.6.9	ANR 53
11-[illegible]	1920	1920	2 [illegible]	[illegible]	0	4	4	84	PUMP 4.9.6.10-4.9.6.11	53
11-23	9:00	9:01	5 [illegible]	[illegible]	0	1	1	85	PROOF FLUSH	ANR 53
11-23	9:00	9:23	23 [illegible]	[illegible]	0	36	36	121	DECONTAMINATE 4.13	53
11-24	0240	0300	20 [illegible]	[illegible]	0	1	1	122	[illegible] CHECK 4.9.1.1	ANR 53
12-2	0530	0530	0 [illegible]	[illegible]	0	0	0	122	ACTUAL 4.9.6.7	[illegible]
12-2	0410	[illegible]	40 [illegible]	[illegible]	0	1	1	123	HOT FIRE 4.9.6.9	53
12-2	0420	0420	0500	[illegible]	0	1	1	124	HOT FIRE 4.9.6.9	ANR 53
12-2	0425	0500	35 [illegible]	[illegible]	0	4	4	128	PUMP 4.9.10-4.9.11	[illegible]
12-2	0527	0532	5 [illegible]	[illegible]	0	1	1	129	PROOF FLUSH	ANR 53
12-2	0535	0558	23 [illegible]	[illegible]	0	36	36	165	DECONTAMINATE 4.13	ANR 53
				RST	HOT	SIDE	TEST	[illegible]	220-40B AC AND HZ	[illegible]
12-12	0	30	30 [illegible]	[illegible]	0	0	3	167	PROOF PRESS TEST 4.8.[illegible]	[illegible]
12-12	0	5	5	[illegible]	0	2	2	169	PROOF PRESS TEST 4.8.[illegible]	ANR 53
12-[illegible]	0	5	5	[illegible]	0	3	3	172	LEAK TEST 4.[illegible]	[illegible]
12-13	0	5	5	[illegible]	0	3	3	175	LEAK TEST 4.14.9	ANR 53
	[illegible]	TEST	HOT	SIDE	TEST	HOLD	SECONDS		ANR 53	
		ANR 53 [illegible]	HOT	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					PRO	[illegible]	DEB	15	CHECK ALL SING TIME REP	
1-14	0	6	6	[illegible]	0	5	5	180	PROOF-40B [illegible] 4.6.10	[illegible]
									[illegible]	[illegible]

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FORM 620-S REV. 8/64 (BACK)

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ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

MODULE & COMPONENT LOG

SUPPLIER NAME: NAA LAD

P.O. NO.: (2E-1281) Y20161R

DATE OF MFG.: 9-9-4 AND/OR CURE DATE: DNA

EXPECTED LIFE: 1. ELAPSED OPER TIME: DNA 2. ELAPSED CYCLES: DNA 3. CALENDAR LIFE: DNA

KEEP TIME IN MINUTES AND SECONDS AND/OR CYCLES

PART NAME: Valve Asy OXID ROCKETDYNE PART NO.: 409404 SUPPLIER PART NO.: DNA TCA S/N 4064104 SERIAL NUMBER: 9371280 SYSTEM NAME: OAMS

YEAR 1964 MO-DAY	TIME START	TIME STOP	TIME SUB-TOTAL	TIME TOTAL	CYCLES START	CYCLES STOP	CYCLES SUB-TOTAL	CYCLES TOTAL	RAO-206-202 *HISTORY	STAMP OR INITIALS
9-4	0	30	30	30 Min	0	300	300	300	Teflon Seat Forming 4.2	
9-4	0	14	14	44 Min	0	0	0	300	Internal Leakage 4.3	
9-4	0	0	0	44 Min	0	3	3	303	Stroke Check 4.4	
9-4	0	0	0	44 Min	0	2	2	305	Drop Out Current 4.5	
9-4	0	0	0	44 Min	0	3	3	308	De-Energize Time 4.5	
9-4	0	0	0	44 Min	0	3	3	311	Pull In Current 4.6	
9-4	0	0	0	44 Min	0	2	2	313	Energize Time 4.6	
9-4	0	0	0	44 Min	0	1	1	314	Pressure Drop 4.7	
9-5	0	3	3	47 min	0	0	0	314	Proof Pressure 4.9	
9-5	0	0	0	47 min	0	100	100	414	Cycle Test 4.10	
9-5	0	0	0	47 min	0	2	2	416	Stroke Check 4.11	
9-5	0	0	0	47 min	0	2	2	418	Pull-in Current 4.12	
9-5	0	0	0	47 min	0	4	4	422	Energize Time 4.12	
9-5	0	3	3	50 min	0	0	0	422	Proof Pressure 4.14	
9/8	0	0	0	50 min	0	1	1	423	Pressure Drop 4.15	
9/8	0	14	14	64 min	0	0	0	423	Internal leakage 4.16	
9/9	0	12	12	76 min	0	1	1	424	Flushing 4.19.1	
9/9	0	15	15	91 min	0	0	0	424	Drying 4.19.2	

THIS ASSY INSTALLED ON P/N 20430, S/N 4064104 TCA

*ENTER INFORMATION SUCH AS, BUT NOT LIMITED TO: ENVIRONMENT WHEN OTHER THAN AMBIENT; TYPE OF TESTS REFORMED; MALFUNCTION HISTORY OF A PART, COMPONENT, SUB-SYSTEM OR SYSTEM, SERIAL NUMBERS OF ANY PARTS OR COMPONENTS REMOVED AND THEIR REPLACEMENTS, REMOVALS AND REASONS FOR SAME; INCONSISTENCIES OF A SYSTEM; AND THE SPACECRAFT NUMBER TO WHICH THIS ITEM HAS BEEN OR IS NOW ASSIGNED TO.

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CONFIDENTIAL

SCD52-52701-285

"CERTIFICATION IS HEREBY GIVEN THAT THE DELIVERABLE END ITEM COVERED BY THIS LOG BOOK WAS MANUFACTURED, INSPECTED AND TESTED IN ACCORDANCE WITH PRESCRIBED DRAWINGS, SPECIFICATION AND QUALITY ASSURANCE PROVISIONS. INSPECTION AND TEST RECORDS ARE ON FILE VERIFYING COMPLIANCE WITH APPLICABLE DRAWINGS AND SPECIFICATIONS, EXCEPT AS NOTED HEREIN"

LOG BOOK ACCEPTANCE DAT UNIT #047

SPACE ENGINES ENGINEERING	SPACE ENGINES QUALITY CONTROL	McDONNELL QUALITY REPRESENTATIVE	GOV'T INSPECTION AGENCY QUALITY REPRESENTATIVE
Vance W. Thomas	S. H. Cutrer	J. E. Euler	Nicholas J. Fabio
DATE 1/20/65	DATE 20 JAN. 1965	DATE 1-21-65	DATE 21 JAN 65

CONTENTS

SECTION I – DELIVERABLE END ITEM ASSEMBLY LOG

RECORDS CONTAINED IN THIS SECTION ARE PERTINENT TO THE DELIVERABLE END ITEM ACCEPTANCE AND ALSO INCLUDE MODEL CONFIGURATION, PERTINENT DETAILS OF SHORT SHIPMENTS, COMPONENT VARIATIONS, AGE SENSITIVE PARTS RECORD, WEIGHT AND SERIALIZATION RECORDS.

SECTION II – ACCEPTANCE TEST LOG

RECORDS OF ASSEMBLY ACCEPTANCE TESTS ARE PRESENTED IN THIS SECTION WITH PERFORMANCE DATA AND SUMMARY DATA ON INSPECTIONS AND ACCEPTANCE.

GENERAL INFORMATION

THIS LOG BOOK IS PROVIDED FOR SERVICE USE IN RECORDING PERTINENT HISTORICAL DATA AND ALL CHANGES FROM THE ORIGINAL CONFIGURATION. IT IS REQUESTED THIS LOG BOOK ACCOMPANY THE DELIVERABLE END ITEM WHEN TRANSFERRED BETWEEN ROCKETDYNE AND USING AGENCIES.

GROUP-4
Downgraded at 3 year intervals
declassified after 12 years

ROCKETDYNE – SPACE ENGINES
A DIVISION OF NORTH AMERICAN AVIATION, INC.

LOG BOOK SPECIFICS

McDONNELL	ITEM	ROCKETDYNE
THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18 U.S.C., SECTIONS 793 AND 794. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.		
	LOG BOOK DATE	20 JANUARY 1965
	DWG CHG LTR	DNA
Y20161R	CONTRACT NO.	
	GEN ORDER NO.	5252
SCD52-52701-285	SPEC NO.	
DNA	SERIAL NO.	4066382
52-52701-285	PART NO.	209301

SE-7 DELIVERABLE END ITEM – LOG BOOK IDENTIFICATION | PART NAME THRUST CHAMBER 100 LB., ASSY OF | 1.0

CONFIDENTIAL

DELIVERABLE END ITEM

THIS LOG BOOK CONTAINS INFORMATION PERTINENT TO THE DELIVERABLE END ITEM AS SPECIFIED HEREIN BY SERIAL NUMBER AND PART NUMBER. IT IS NECESSARY THAT ALL ENTRIES BE WRITTEN IN INK OR TYPED FOR PERMANENT RECORD. ENTRIES SUCH AS SERIALIZATION, WEIGHT, APPLICABLE MCR'S, ACCEPTANCE TEST DATA AND CALIBRATION DATA WILL BE ENTERED BY ROCKETDYNE AT THE TIME OF DELIVERY.

IT IS REQUESTED THAT THIS LOG BOOK ACCOMPANY THIS DELIVERABLE END ITEM IF THE ITEM IS RETURNED TO ROCKETDYNE FOR REPAIR, MODIFICATION OR RETEST. ROCKETDYNE WILL THEN ENTER REPAIR, MODIFICATION AND RETEST DATA IN THIS LOG BOOK.

THE FORMAT OF PAGES IN THIS LOG BOOK SHALL NOT BE REVISED WITHOUT OBTAINING APPROVAL OF ROCKETDYNE SPACE ENGINES PROGRAM OFFICE, QUALITY CONTROL, AND THE CUSTOMER REPRESENTATIVE.

DATE	PROGRAM OFFICE	QUALITY ASSURANCE	PURCHASER
4 NOV 64	W. E. McCravey	Wm E Ritz	J. E. Euler

52-52701-285 PART NO. 209301

PART NAME THRUST CHAMBER, 100 LB., ASSY OF 2.0

1.0 LOG BOOK IDENTIFICATION

2.0 FOREWORD

3.0 CONTENTS

4.0 MODULE/COMPONENT ASSEMBLY LOG--SECTION I

4.1 CONFIGURATION & SERIALIZATION LOG

4.2 MCR VERIFICATION

4.3 VARIATION LOG

4.4 REPLACEMENT LOG

5.0 COMPONENT ACCEPTANCE TEST LOG--SECTION II

5.1 COMPONENT ACCEPTANCE TEST

5.1.1 COMPONENT ACCEPTANCE TEST

5.1.2 COMPONENT ACCEPTANCE TEST

5.1.3 COMPONENT ACCEPTANCE TEST

5.1.4 COMPONENT ACCEPTANCE TEST

5.1.5 COMPONENT ACCEPTANCE TEST

5.2 CALIBRATED PERFORMANCE DATA

5.2.1 CALIBRATED PERFORMANCE DATA

5.2.2 CALIBRATED PERFORMANCE DATA

5.3 INFORMATION--CONTAMINATION

52-52701-285 PART NO. 209301

CONTENTS--SE-7 LOG BOOK

PART NAME THRUST CHAMBER 100 LB., ASSY OF

3.0

SECTION I

52-52701-285 PART NO. 209301

SE-7 MODULE / COMPONENT ASSEMBLY LOG

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

4.0

IND. NO.	PART NUMBER	REV. LTR.	PART NAME	SERIAL NO.	AGE CONTROL DATE OF MFG.	INSP.
1	209301	DNA	THRUST CHAMBER, 100 LB., ASSY OF	4066382	4 Q 64	ANR 208
2	209302	DNA	BODY, THRUST CHAMBER, ASSY OF	4064758	4 Q 64	ANR 208
2	209411	DNA	SHELL, THRUST CHAMBER, ASSY OF	8502297		ANR 208
3	209304	DNA	INJECTOR, THRUST CHAMBER, ASSY OF	4065092		ANR 208
2	409404	DNA	VALVE, OXIDIZER, T/C, ASSY OF	9371228		ANR 208
2	409405	DNA	VALVE, FUEL, T/C, ASSY OF	9362014		ANR 208

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DNA SERIAL NO. 4066382

52-52701-285 PART NO. 209301

SE-7 CONFIGURATION & SERIALIZATION LOG

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

4.1

MCR / ECP NO.	DATE	TITLE	DATE	INSP.
80 SE6-062	6 JAN 64	COMPONENT CLEANING; PROVISION FOR	20 JAN 65	AMR 721
SE6-064	30 JUL 63	TCA, ACCEPTANCE TESTS; REVISION OF	20 JAN 65	AMR 721
SE6-075	2 JUL 64	MAC REPORT 8518, INCORPORATION OF	20 JAN 65	AMR 721
SE6-133	22 APR 64	TCA PROPELLANT VALVES; ADDITIONAL REQUIREMENTS FOR	20 JAN 65	AMR 721
SE6-139	15 APR 64	PLACEMENT OF HAYNES STELLITE #3 SAND CAST ON APPROVED MATERIAL LIST	20 JAN 65	AMR 721
SE6-179	16 JUN 64	TUBE STUBS; MARKINGS OF	20 JAN 65	AMR 721
SE6-080	28 DEC 63	THRUST CHAMBER ASSEMBLIES, FABRICATION MATERIAL; APPROVAL OF	20 JAN 65	AMR 721
SE6-085	8 DEC 64	CUSTOMER TEST SURVEILLANCE; REQUIREMENT FOR	20 JAN 65	AMR 721
SE7-079	12 OCT 64	OAMS'S TCA'S; REDESIGN OF	20 JAN 65	AMR 721
SE6-237	12 OCT 64	FLIGHT CRITICAL COMPONENTS; CHIP AND BURR REMOVAL AND INSPECTION OF	20 JAN 65	AMR 721
SE7-041	15 APR 64	85# AND 100# THRUST CHAMBER ASSEMBLIES, PROPELLANT VALVES, INLET TUBES, MATERIAL; CHANGE TO 304L BAR PER QQ-S-763	20 JAN 65	AMR 721
SE7-071	11 DEC 64	OAMS TCA's 25#, 85# AND 100#; REDESIGN OF	20 JAN 65	AMR 721
SE7-089	8 AUG 64	100 LB. TCA MOUNTING POINTS; CHANGES TO	20 JAN 65	AMR 721

R-15019-2

DNA	SERIAL NO.	4066382	
52-52701-285	PART NO.	209301	
SE-7 DELIVERABLE END ITEM-MCR VERIFICATION	PART NAME	THRUST CHAMBER, 100 LB., ASSY OF	4.2

R-15019-2

MR NO.	PART OR COMP. INVOLVED	PART NUMBER	SERIAL NUMBER	BRIEF DESCRIPTION OF VARIATION AND MATERIAL REVIEW BOARD DISPOSITION	INSP.
MRR # 71558	THRUST CHAMBER ASSY, 100 LB.	209301	4066382	DISCREPANCY: CONDITION A: ELECTRICAL CONNECTORS WERE SWAB PASSIVATED WITH PHOSPHORIC ACID (20 TO 30% SOLUTION BY VOLUME) INSTEAD OF NITRIC ACID AS CALLED FOR IN THE ACCEPTANCE TEST PROCEDURE. CONDITION B: TCA AFTER HOT-FIRE WAS SUBJECTED TO AN EXTRA 5 MINUTES DECONTAMINATION FLUSH (FREON FOR NTO, ALCOHOL FOR MMH) BEFORE COMMENCING THE ATP DECONTAMINATION PROCEDURE. REF: 600N C41792 DISPOSITION: ACCEPTABLE TO USE	AMR 721
MRR # 71558 NOR #1	THRUST CHAMBER ASSY, 100 LB.	209301	4066382	DISCREPANCY: CONDITION B STATED: TCA AFTER HOT FIRE WAS SUBJECTED TO AN EXTRA FIVE (5) MINUTES DECONTAMINATION FLUSH (FREON FOR NTO, ALCOHOL FOR MMH) BEFORE COMMENCING THE ATP DECONTAMINATION PROCEDURE. THE EXTRA FIVE MINUTES WAS NEITHER REQUIRED NOR ACCOMPLISHED ON THIS TCA. THIS NOR IS WRITTEN TO AMEND THIS STATEMENT AND TO ADD CONDITION C TO THIS MRR AS FOLLOWS: REF: RA0220-408, PARA. 4.13; MAX. ALLOWABLE TIME FOR DECONTAMINATION AFTER HOT FIRE IS 12 HRS. ENGINE WAS DECONTAMINATED 37.8 HRS. AFTER HOT FIRE. SECOND DECONTAMINATION WAS RUN ON ENGINE. TOTAL HOT FIRE TIME IS 16.00 SECONDS. REF: 600N C41015 DISPOSITION: REWORKED PER MRR #71558 NOR #1	AMR 721

DNA SERIAL NO. 4066382
52-52701-285 PART NO. 209301

SE-7 DELIVERABLE END ITEM — VARIATION LOG

PART NAME THRUST CHAMBER 100 LB., ASSY OF

4.3

PART NO.	PART NAME	SERIAL NO.	REASON FOR REPLACEMENT	REPLACED BY		INSP.
				PART NO.	SERIAL NO.	
82			NONE THIS DATE - 20 JAN 65			ANR 721

R-150192

DNA SERIAL NO. 4066382

52-52701-285 PART NO. 209301

SE-7 DELIVERABLE END ITEM--REPLACEMENT LOG

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

4.4

M NASA ORE

R-15019-2

SECTION II

52-52701-285 PART NO. 209301

SE-7 COMPONENT ACCEPTANCE TEST LOG

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

5.0

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
ELECTRICAL RESISTANCE TESTS---TCA PROPELLANT VALVES	4.2				
BODY TEMPERATURE					
OXIDIZER	4.2.4	DEGREES F	70 ± 5	70	ANR 208
FUEL	4.2.11	DEGREES F	70 ± 5	70	ANR 208
COIL RESISTANCE					
OXIDIZER	4.2.5	OHMS	42 +2 -3	41.14	ANR 208
FUEL	4.2.11	OHMS	42 +2 -3	42.62	ANR 208
CONTINUITY RESISTANCE					
OXIDIZER	4.2.9	OHMS	1.0 MAX.	.008	ANR 208
FUEL	4.2.11	OHMS	1.0 MAX.	.004	ANR 208
DIELECTRIC STRENGTH TEST--PROPELLANT VALVES	4.3				
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICROAMPS	500 MAX.	43	ANR 208
FUEL	4.3.11	MICROAMPS	500 MAX.	55	ANR 208
PROOF PRESSURE TEST--TCA PROPELLANT VALVES	4.4				
VALVES PRESSURIZED FOR NOT LESS THAN 3 MINUTES					
OXIDIZER					
STEP I	4.4.3	PSIG	500 ± 10	VERIFIED	ANR 208
STEP II	4.4.5	PSIG	500 ± 10	VERIFIED	ANR 208

SPECIFICATION NUMBER	REVISION	AMENDMENT	DNA	SERIAL NO.	4066382
RA0220-408	N/C	#2	52-52701-285	PART NO.	209301

SE-7 COMPONENT ACCEPTANCE TEST

PART NAME THRUST CHAMBER, 100 LB. ASSY OF

5.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE TEST--TCA PROPELLANT VALVES (CONTINUED)	4.4				
FUEL					
STEP I	4.4.7	PSIG	500 ± 10	VERIFIED	ANH 208
STEP II	4.4.7	PSIG	500 ± 10	VERIFIED	ANH 208
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION					
OXIDIZER					
STEP I	4.4.4	DNA	NONE ALLOWED	NONE DETECTED	ANH 208
STEP II	4.4.5	DNA	NONE ALLOWED	NONE DETECTED	ANH 208
FUEL					
STEP I	4.4.7	DNA	NONE ALLOWED	NONE DETECTED	ANH 208
STEP II	4.4.7	DNA	NONE ALLOWED	NONE DETECTED	ANH 208
PROOF PRESSURE AND LEAKAGE TEST--THRUST CHAMBER	4.5				
PROOF PRESSURE TEST					
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES AT	4.5.7	PSIG	392 ± 10	VERIFIED	ANH 208
LEAKAGE TEST	4.5.7	DNA	NONE ALLOWED	NONE DETECTED	ANH 208
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	NONE ALLOWED	NONE DETECTED	ANH 208

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-408	N/C	#2	DNA	SERIAL NO.	4066382
			52-52701-285	PART NO.	209301

SE-7 COMPONENT ACCEPTANCE TEST

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
FUNCTIONAL TEST--TCA PROPELLANT VALVES	4.6				
OPENING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.021 MAX.	.0189	ANH 208
FUEL	4.6.8	SEC.	0.021 MAX.	.0167	ANH 208
CLOSING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.005 MAX.	.0032	ANH 208
FUEL	4.6.10	SEC.	0.005 MAX.	.0032	ANH 208
CLOSING DROP OUT VOLTAGE					
OXIDIZER	4.6.17	VOLT (DC)	1 MIN.	2.0	ANH 208
FUEL	4.6.13	VOLT (DC)	1 MIN.	2.5	ANH 208
LOAD ANALYSIS TEST	4.6				
FUEL VALVE STEADY STATE CURRENT AT	4.6.24				
20 ± .5 VOLTS	4.6.24	AMPS	DNA	.38	ANH 208
26 ± .5 VOLTS	4.6.25	AMPS	DNA	.51	ANH 208
33 ± .5 VOLTS	4.6.25	AMPS	DNA	.64	ANH 208
OXIDIZER VALVE STEADY STATE CURRENT AT	4.6.28				
20 ± .5 VOLTS	4.6.28	AMPS	DNA	.40	ANH 208
26 ± .5 VOLTS	4.6.28	AMPS	DNA	.51	ANH 208
33 ± .5 VOLTS	4.6.28	AMPS	DNA	.66	ANH 208

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-408	N/C	#2	DNA	SERIAL NO.	4066382
			52-52701-285	PART NO.	209301
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME	THRUST CHAMBER, 100 LB., ASSY OF	5.1.2

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAKAGE TEST -TCA PROPELLANT VALVES	4.7				
SEAT LEAKAGE RATE					
OXIDIZER	4.7.17	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 208
FUEL	4.7.22	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 208
PRE-TEST DATA					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.1.3	LB.	DNA	9.63	ANR 208
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	4.443	ANR 208
THROAT DIAMETER					
SECTION A-A		INCH	DNA	.708	ANR 208
B-B		INCH	DNA	.708	ANR 208
C-C		INCH	DNA	.709	ANR 208
D-D		INCH	DNA	.709	ANR 208
POST HOT-FIRE DATA					
PROOF PRESSURE TEST					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.14.1	LB.	DNA	9.32	ANR 208
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES					

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-408	N/C	#2	DNA	SERIAL NO.	4066382
			52-52701-285	PART NO.	209301

SE-7 COMPONENT ACCEPTANCE TEST

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
POST HOT-FIRE DATA (CONTINUED)					
PROOF PRESSURE TEST	4.14.5	PSIG	392 ± 10	392	ANR 208
LEAKAGE TEST THRUST CHAMBER	4.14.5	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.14.5	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
LEAKAGE TEST--TCA PROPELLANT VALVES					
SEAT LEAKAGE RATE					
OXIDIZER	4.14.5	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 208
FUEL	4.14.5	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 208
LEAK TEST--WELDED JOINTS					
LEAK TEST					
PRESSURIZED INLET TUBE WITH GASEOUS HELIUM					
OXIDIZER	4.14.6	PSIG	500 ± 10	VERIFIED	ANR 208
FUEL	4.14.9	PSIG	500 ± 10	VERIFIED	ANR 208
JOINT LEAKAGE RATE					
OXIDIZER	4.14.7	SCC/SEC	10^{-6} MAX.	LESS THAN 10^{-6}	ANR 208
FUEL	4.14.9	SCC/SEC	10^{-6} MAX.	LESS THAN 10^{-6}	ANR 208

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PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAK TEST--WELDED JOINTS (CONTINUED)					
INSPECTED VISUALLY FOR CLEANLINESS, CORROSION DETERIORATION, DAMAGE OR DEFORMATION	4.14.10	DNA	NONE ALLOWED	NONE DETECTED	ANH 208
THROAT DIAMETER (DELIVERED CONDITION)	4.15.1				
SECTION A-A		INCH	DNA	.708	ANH 208
B-B		INCH	DNA	.708	ANH 208
C-C		INCH	DNA	.708	ANH 208
D-D		INCH	DNA	.708	ANH 208
DRY WEIGHT (DELIVERABLE CONDITION)	4.15.2	LB.	DNA	9.27	ANH 208
(EXCLUDING PROTECTIVE COVERS & CLOSURES)					
INSPECTED VISUALLY FOR CLEANLINESS, CORROSION, DETERIORATION, DAMAGE OR DEFORMATION	4.15.3	DNA	NONE ALLOWED	NONE DETECTED	ANH 208

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-408	N/C	#2	DNA	SERIAL NO.	4066382
			52-52701-285	PART NO.	209301
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 100 LB., ASSY OF		5.1.5

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 369 TEST DATA	RUN 370 TEST DATA	RUN 382 TEST DATA	RUN 383 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	NFL	NFL	NFL	NFL	
CELL LOCATION	-	-	1-A	1-A	1-A	1-A	
CELL NUMBER	-	-	379	379	379	379	
TEST DATE	-	-	19 NOV 64	19 NOV 64	21 NOV 64	21 NOV 64	
TEST DURATION	SEC.	4 MIN.	4.0	4.0	4.0	4.0	
ENVIRONMENTAL Pc	PSIA	0.16 MAX	.06525	.06484	.06293	.06293	
AMBIENT PRESSURE	PSIA	DNA	12.21	12.21	12.21	12.21	
AMBIENT TEMPERATURE	°F	DNA	20.0	20.0	30.0	30.0	
TIME OF DATA SLICE-START	SEC.	DNA	3.8	3.8	3.8	3.8	
TIME OF DATA SLICE-END	SEC.	DNA	3.8	3.8	3.8	3.8	
OXIDIZER TEMPERATURE	°F	DNA	36.87	40.07	53.40	63.80	
FUEL TEMPERATURE	°F	DNA	36.44	39.00	52.80	62.20	
OXIDIZER DENSITY	LB/FT^3	DNA	92.47	92.22	92.69	91.88	
FUEL DENSITY	LB/FT^3	DNA	55.43	55.35	55.02	54.73	

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-408	N/C	#2	DNA	SERIAL NO.	4066382
			52-52701-285	PART NO.	209301
SE- 7 (REA) CALIBRATED PERFORMANCE DATA			PART NAME	THRUST CHAMBER 100 LB., ASSY OF	5.2

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CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 369 TEST DATA	RUN 370 TEST DATA	RUN 382 TEST DATA	RUN 383 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	NFL	NFL	NFL	NFL	
OXIDIZER INLET PRESSURE	PSIA	286 ± 10	285.4	285.4	285.9	285.9	
FUEL INLET PRESSURE	PSIA	280 ± 10	285.3	284.8	285.7	287.2	
OXIDIZER FLOWRATE	LB/SEC	DNA	.1918	.1911	.1843	.1838	
FUEL FLOWRATE	LB/SEC	DNA	.1542	.1544	.1557	.1570	
THRUST	LB.	DNA	98.5	98.2	95.7	95.4	
MIXTURE RATIO	O/F	DNA	1.24	1.24	1.18	1.17	
SPECIFIC IMPULSE	SEC	DNA	285.	284.	282.	280.	
INJECTOR END Pc	PSIA	DNA	140.3	140.5	136.1	136.3	
CHARACTERISTIC VELOCITY	FT/SEC	DNA	5143.	5160.	5070.	5067.	
THROAT DIAMETER	INCH	DNA	.7085	.7085	.7080	.7080	
FUEL ORIFICE DIAMETER	INCH	DNA	.09250	.09250	.08905	.08905	
OXIDIZER ORIFICE DIAMETER	INCH	DNA	.08421	.08421	.07965	.07965	
TCA FIRING TIME (TOTAL)	SEC	32 MAX.	4.0	8.0	12.0	16.0	
OXIDIZER SAMPLE NUMBER	-	-	363.	363.	365.	365.	
FUEL SAMPLE NUMBER	-	-	362.	362.	362.	362.	

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SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-408	N/C	#2	DNA	SERIAL NO.	4066382
			52-52701-285	PART NO.	209301

SE-7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER 100 LB., ASSY OF

5.2.1

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CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 369 TEST DATA	RUN 370 TEST DATA	RUN 382 TEST DATA	RUN 383 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	NFL	NFL	NFL	NFL	
ADJUST TO STANDARD CONDITIONS							
THRUST	LB.	94.5 ± 4.7	98.6	98.3	95.6	95.5	
MIXTURE RATIO	O/F	1.20 ± .05	1.26	1.25	1.19	1.19	
SPECIFIC IMPULSE	SEC	DNA	289.	288.	285.	284.	
INJECTOR END Pc	PSIA	DNA	138.8	139.2	134.5	135.0	
CHARACTERISTIC VELOCITY	FT/SEC	DNA	5156.	5172.	5078.	5082.	
ADJUST TO RATED CONDITIONS							
THRUST	LB.	94.5	94.5	94.5	94.5	94.5	
MIXTURE RATIO	O/F	1.20	1.20	1.20	1.20	1.20	
SPECIFIC IMPULSE	SEC	260 MIN.	285.	285.	285.	285.	

SPECIFICATION NUMBER	REVISION	AMENDMENT
RA0220-408	N/C	#2
RA0220-444	N/C	#1

DNA SERIAL NO. 4066382

52-52701-285 PART NO. 209301

SE-7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER 100 LB., ASSY OF

5.2.2

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THE FOLLOWING IS INFORMATION RELATIVE TO THE CLEANLINESS LEVEL OF THE PROPELLANT UTILIZED IN THE HOT-FIRE ACCEPTANCE TEST OF THE THRUST CHAMBER ASSEMBLY.

THE INFLUENT PARTICULATE COUNT OF THE PROPELLANT WAS:

		LIMITS	ACTUAL COUNT MMH - FUEL	ACTUAL COUNT NTO - OXID
	< 10	*	DNA	DNA
	10 - 25	100	21	26
	25 - 50	20	1	6
	50 - 100	5	0	1
	100 - 300	1	0	0
	300 - 1000	0	0	0
	> 1000	0	0	0
FIBERS	300 - 3000	0	0	0
FIBERS	> 3000	0	0	0

* NOTE: " NOT TO BE COUNTED BUT NO SLURRY OF FINE PARTICLES WHICH COVERS MORE THAN AN ESTIMATED 5 PERCENT OF THE TOTAL EFFECTIVE FILTER AREA SHALL BE ALLOWED." AT THE DISCRETION OF QUALITY ASSURANCE, A WEIGHT DETERMINATION OF TOTAL CONTAMINATION MAY BE MADE AS A REFEREE TEST IN BORDERLINE CASES. THE MAXIMUM ALLOWABLE WEIGHT OF CONTAMINANTS SHALL BE 0.001 GRAM (1 MG).

CLASS 4

INSP. _____

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0615-003	B	#2	DNA 52-52701-285	SERIAL NO. 4066382 PART NO. 209301	
SE-7 INFORMATION - CONTAMINATION			PART NAME THRUST CHAMBER 100 LB., ASSY OF		5.3

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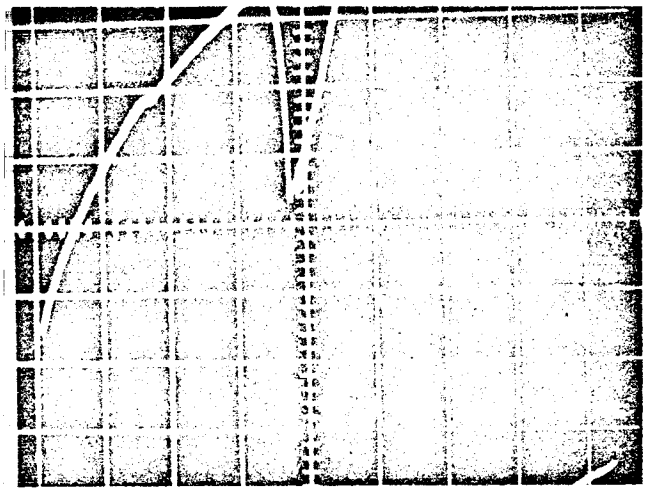
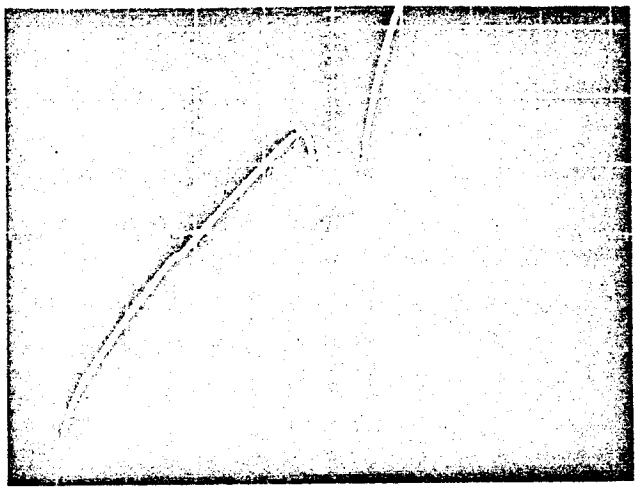
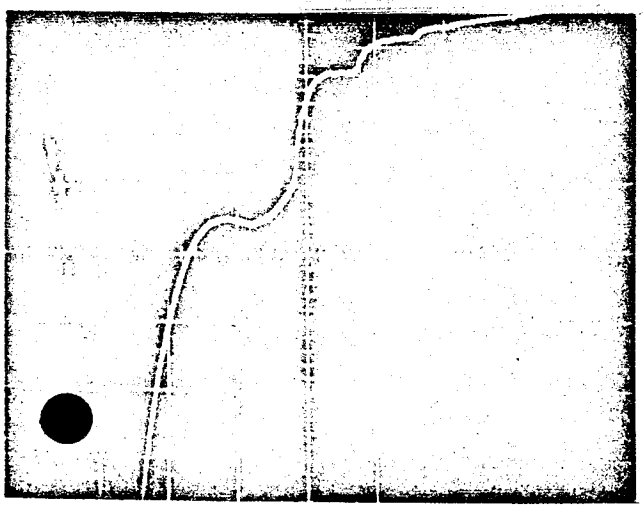


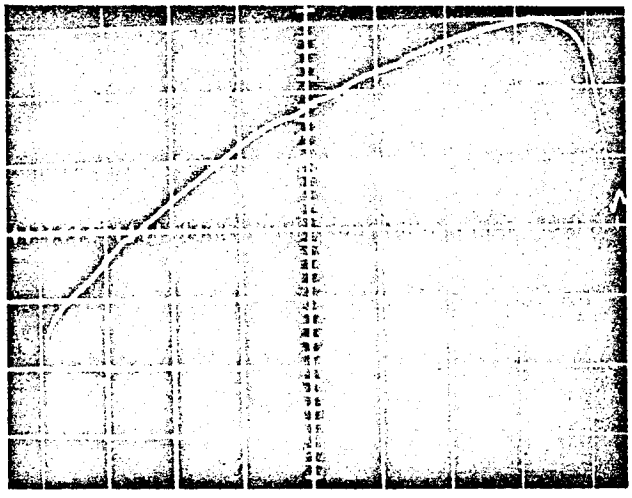
OXIDIZER VALVE OPENING
CURRENT TRACE AT 26 VDC
VERTICAL 10 M/VOLT/CM
HORIZONTAL 5M/SEC./CM
ENGINE P/N 209301
ENGINE S/N 4066382



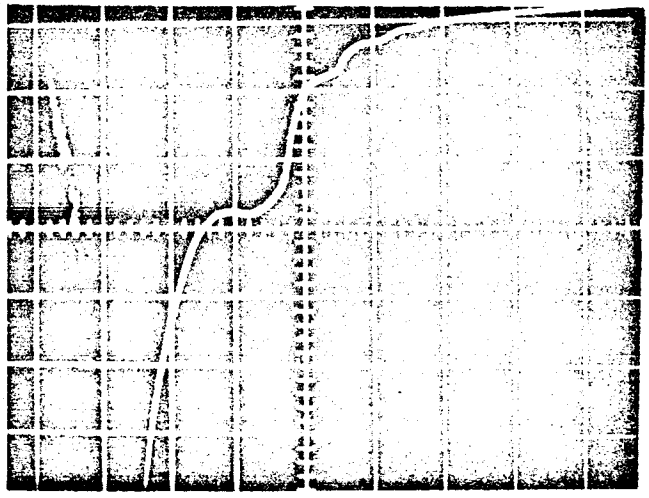
OXIDIZER VALVE OPENING
CURRENT TRACE AT 26 VDC
VERTICAL 20M/VOLT/CM
HORIZONTAL 5M/SEC./CM
ENGINE P/N 209301
ENGINE S/N 4066382



OXIDIZER VALVE CLOSING
CURRENT TRACE AT 26 VDC
VERTICAL 20 VOLT/CM
HORIZONTAL 1M/SEC./CM
ENGINE P/N 209301
ENGINE S/N 4066382



FUEL VALVE OPENING
CURRENT TRACE AT 26 VDC
VERTICAL 10M/VOLT/CM
HORIZONTAL 2M/SEC./CM
ENGINE P/N 209301
ENGINE S/N 4066382



FUEL VALVE CLOSING
CURRENT TRACE AT 26 VDC
VERTICAL 20 MVOLT/CM
HORIZONTAL 1M/SEC./CM
ENGINE P/N 209301
ENGINE S/N 4066382

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC.

MODULE & COMPONENT LOG

SUPPLIER NAME: ROCKETDYNE

P.O. NO.: Y20161R

DATE OF MFG.: 1-65 AND/OR CURE DATE: 4Q64

EXPECTED LIFE: 1. ELAPSED OPER. TIME: 3600 S 2. ELAPSED CYCLES: UNLIMITED 3. CALENDAR LIFE: 48 MONTHS

KEEP TIME IN MINUTES AND SECONDS. AND/OR CYCLES

PART NAME: TCA, 100# ROCKETDYNE PART NO.: 209301 SUPPLIER PART NO.: DNA SERIAL NUMBER: 406382 SYSTEM NAME: OAMS

SCP57-52701-285

YEAR 1964 MO-DAY	[X] TIME START	[ ] CYCLE STOP	[ ] MANUAL SUB-TOTAL	[ ] AUTO TOTAL	[ ] TIME START	[X] CYCLE STOP	[ ] MANUAL SUB-TOTAL	[ ] AUTO TOTAL	*HISTORY	STAMP
									FUEL VALVE	
									P/N 409405 S/N 9361017	
					ACCUMULATED HISTORY				ACCUM TIME 89 MIN.	
					FROM COMPONENT LOGS				ACCUM CYCLES 425	
									OXID VALVE	
									P/N 409404 S/N 9371228	
									ACCUM TIME 89 MIN.	
									ACCUM CYCLES 425	
					RAO 120-408 ASSY SECTION					
11-14	0	3	3	3M	0	—	—	0	LEAK TEST WELDS OPER 20	
			LEAK & FUNCTIONAL			RAO 120-408 Rev-N/C AMEND 2				
11-14	0	2	2	5M	0	—	—	0	RESIS. OXID 4.2.1	
11-14	0	2	2	7M	0	—	—	0	RESIS. FUEL 4.2.11	
11-14	0	1	1	8M	0	—	—	0	DIELECTRIC OXID 4.3.1	
11-14	0	1	1	9M	0	—	—	0	DIELECTRIC FUEL 4.3.11	
11-14	0	17	17	26M	0	5	5	5	PROOF PRES 4.5.1 – 4.5.12	
11-14	0	60	60	86M	0	40	40	45	FUNT. TEST 4.6.1 – 4.6.29	
11-14	0	10	10	96M	0	6	6	51	SEAT LEAK 4.7.1 – 4.7.23	

*ENTER INFORMATION SUCH AS, BUT NOT LIMITED TO: ENVIRONMENT WHEN OTHER THAN AMBIENT, TYPE OF TESTS PERFORMED, MALFUNCTION HISTORY OF PART, COMPONENT, SUB-SYSTEM OR SYSTEM, SERIAL NUMBERS OF ANY PARTS OR COMPONENTS REMOVED AND THEIR REPLACEMENTS, REMOVALS AND REASONS FOR SAME, INCONSISTENCIES OF A SYSTEM AND THE SPACECRAFT NUMBER TO WHICH THIS ITEM HAS BEEN OR IS NOW ASSIGNED.

FORM 800-S REV. 8/64

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ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

MODULE & COMPONENT LOG

SUPPLIER NAME: NAA LAD

P.O. NO.: 28-1281

DATE OF MFG.: 10-16-4 AND/OR CURE DATE: DNA

EXPECTED LIFE: 1. ELAPSED OPER. TIME: DNA 2. ELAPSED CYCLES: DNA 3. CALENDAR LIFE: DNA

KEEP TIME IN MINUTES AND SECONDS AND/OR CYCLES

PART NAME: Valve Asyoxid ROCKETDYNE PART NO.: 409404 SUPPLIER PART NO.: DNA SERIAL NUMBER: 8371228 SYSTEM NAME: OAMS

RH 0206-202

YEAR 64 MO-DAY	TIME START	TIME STOP	TIME SUB-TOTAL	TIME TOTAL	CYCLES START	CYCLES STOP	CYCLES SUB-TOTAL	CYCLES TOTAL	*HISTORY	STAMP OR INITIALS
10/11	0	30	30	30 min	0	300	300	300	Teflon Seat Forming 4.2	[illegible]
10/11	0	14	14	44 min	0	0	0	300	Internal Leakage 4.3	[illegible]
10/11	0	0	0	44 min	0	2	2	302	Stroke Check 4.4	[illegible]
10/11	0	0	0	44 min	0	2	2	304	Drop-out Current 4.5	[illegible]
10/11	0	0	0	44 min	0	4	4	308	De-Energize time 4.5	[illegible]
10/11	0	0	0	44 min	0	2	2	310	Pull-in Current 4.6	[illegible]
10/11	0	0	0	44 min	0	4	4	314	Energize time 4.6	[illegible]
10/11	0	0	0	44 min	0	1	1	315	Pressure Drop 4.7	[illegible]
10-11	0	3	3	47 min	0	0	0	415	Proof Pressure 4.9	[illegible]
10-11	0	0	0	47 min	0	100	100	415	Cycle Test 4.10	[illegible]
10-11	0	0	0	47 min	0	3	3	418	Stroke Check 4.11	[illegible]
10-11	0	0	0	47 min	0	2	2	420	Pull in Current 4.12	[illegible]
10-11	0	0	0	47 min	0	3	3	423	Energize Time 4.13	[illegible]
10-15	0	3	3	50 min	0	0	0	423	PROOF PRESSURE 4.14	[illegible]
10-15	0	0	0	50 min	0	1	1	424	PRESSURE DROP 4.15	[illegible]
10-15	0	14	14	64 min	0	0	0	424	INTERNAL LEAKAGE 4.16	[illegible]
10-15	0	10	10	74 min	0	1	1	425	Flushing 4.19.1	[illegible]
10-15	0	15	15	89 min	0	0	0	425	Drying 4.19.2	[illegible]

*ENTER INFORMATION SUCH AS, BUT NOT LIMITED TO: ENVIRONMENT WHEN OTHER THAN AMBIENT; TYPE OF TESTS PERFORMED; MALFUNCTION HISTORY OF A PART, COMPONENT, SUB-SYSTEM OR SYSTEM; SERIAL NUMBERS OF ANY PARTS OR COMPONENTS REMOVED AND THEIR REPLACEMENTS; REMOVALS AND REASONS FOR SAME, INCONSISTENCIES OF A SYSTEM, AND THE SPACECRAFT NUMBER TO WHICH THIS ITEM HAS BEEN OR IS NOW ASSIGNED TO.

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC.

MODULE & COMPONENT LOG

SUPPLIER NAME: NAA LAD

P.O. NO. 28-1281

DATE OF MFG. 10-17-4 AND/OR CURE DATE DNA

EXPECTED LIFE: 1. ELAPSED OPER TIME DNA; 2. ELAPSED CYCLES DNA; 3. CALENDAR LIFE DNA

KEEP TIME IN MINUTES AND SECONDS AND/OR CYCLES

PART NAME: Valve Asy FUEL ROCKETDYNE PART NO. 409405 SUPPLIER PART NO. DNA SERIAL NUMBER 2362014 SYSTEM NAME OAMS

RH 0206-202

YEAR 1964 MO-DAY	TIME START	TIME STOP	TIME SUB-TOTAL	TIME TOTAL	CYCLES START	CYCLES STOP	CYCLES SUB-TOTAL	CYCLES TOTAL	*HISTORY	STAMP OR INITIALS
10/14	0	30	30	30 min	0	300	300	300	Teflon Seat Forming 4.2	
10/14	0	14	14	44 min	0	0	0	300	Internal leakage 4.3	
10/14	0	0	0	44 min	0	2	2	302	Stroke Check 4.4	
10/14	0	0	0	44 min	0	2	2	304	Drop-out Current 4.5	
10/14	0	0	0	44 min	0	4	4	308	De-Energize time 4.5	
10/14	0	0	0	44 min	0	2	2	310	Pull-in Current 4.6	
10/14	0	0	0	44 min	0	4	4	314	Energize time 4.6	
10/14	0	0	0	44 min	0	1	1	315	Pressure Drop 4.7	
10-14	0	3	3	47 min	0	0	0	315	Proof Pressure 4.9	
10-14	0	0	0	47 min	0	100	100	415	Cycle Test 4.10	
10-14	0	0	0	47 min	0	2	2	417	Stroke Check 4.11	
10-14	0	0	0	47 min	0	4	4	421	Pull-in Current 4.12	
10-14	0	0	0	47 min	0	2	2	423	Energize Time 4.12	
10-15	0	3	3	50 min	0	0	0	423	Proof Pressure 4.14	
10/15	0	0	0	50 min	0	1	1	424	Pressure Drop 4.15	
10/15	0	14	14	64 min	0	0	0	424	Internal leakage 4.16	
10/15	0	10	10	74 min	0	1	1	425	Flushing 4.18.1	
10/15	0	15	15	89 min	0	0	0	425	Drying 4.18.2	

*ENTER INFORMATION SUCH AS, BUT NOT LIMITED TO: ENVIRONMENT WHEN OTHER THAN AMBIENT; TYPE OF TESTS PEFORMED; MALFUNCTION HISTORY OF A PART, COMPONENT, SUB-SYSTEM OR SYSTEM, SERIAL NUMBERS OF ANY PARTS OR COMPONENTS REMOVED AND THEIR REPLACEMENTS; REMOVALS AND REASONS FOR SAME, INCONSISTENCIES OF A SYSTEM, AND THE SPACECRAFT NUMBER TO WHICH THIS ITEM HAS BEEN OR IS NOW ASSIGNED TO.

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ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

MODULE & COMPONENT LOG

SUPPLIER NAME: ROCKET DYNE

P.O. NO. Y20161R

DATE OF MFG. 1-65 AND/OR CURE DATE 4964

EXPECTED LIFE: 1. ELAPSED OPER. TIME 400 S 2. ELAPSED CYCLES 1 WDEF 1 3. CALENDAR LIFE 48 MONTHS

KEEP TIME IN MINUTES AND SECONDS. AND/OR CYCLES 5C052-52701-295

PART NAME TCA 100# ROCKETDYNE PART NO. 209 301 SUPPLIER PART NO. ONA SERIAL NUMBER 406638Z SYSTEM NAME OAMS

15019-2

YEAR 1964 MO-DAY	[X] TIME START	[ ] CYCLE STOP	[ ] MANUAL SUB-TOTAL	[ ] AUTO TOTAL	[ ] TIME START	[X] CYCLE STOP	[ ] MANUAL SUB-TOTAL	[ ] AUTO TOTAL	*HISTORY	STAMP
				POST	HOT-FIRE		RAO 220-408 R.N/C A 2			
11-25	0	17	17	523:66	0	6	6	311	PROOF TCA 4.14.5-4.5.1	
11-25	0	6	6	529:66	0	3	3	314	INTERNAL OXID 4.7.1-4.14.5	
11-25	0	7	7	536:66	0	3	3	317	INTERNAL FUEL 4.7.21	
11-25	0	5	5	541:66	0	—	—	317	MASS SPEC OXID 4.14.8	
11-25	0	5	5	546:66	0	—	—	317	MASS SPEC FUEL 4.14.8	
1-15-65	0	60	60	606:66	0	25	25	342	FUNT. MAC NOR #1 4.6.1-4.6.4	
			TOTAL HOT	FIRE	16.0	SEC				
			600N-C41	792	MAC	MRR 71558				
			600N-C41	15	NOR	#1			RAO-220-408 N.C. #4	
1-19	0	22	22 MIN	622:66	0	48	48	390	RE-CHECK OXID OPEN. TIME PER MAC 4.6.1	
				EOR	F161531					

*ENTER INFORMATION SUCH AS, BUT NOT LIMITED TO: ENVIRONMENT WHEN OTHER THAN AMBIENT, TYPE OF TESTS PERFORMED, MALFUNCTION HISTORY OF PART, COMPONENT, SUB-SYSTEM OR SYSTEM, SERIAL NUMBERS OF ANY PARTS OR COMPONENTS REMOVED AND THEIR REPLACEMENTS, REMOVALS AND REASONS FOR SAME, INCONSISTENCIES OF A SYSTEM AND THE SPACECRAFT NUMBER TO WHICH THIS ITEM HAS BEEN OR IS NOW ASSIGNED.

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YEAR 1964 MO - DAY	☒ TIME START	☐ CYCLES STOP	☐ MANUAL SUB-TOTAL	☐ AUTO TOTAL	☐ TIME START	☒ CYCLES STOP	☐ MANUAL SUB-TOTAL	☐ AUTO TOTAL	*HISTORY	STAMP
			LIQUID CALIB.		RAO 220-416			AMEND 1		
11-14	0	45	45	141M	0	6	6	57	OXID SIDE 4.2-4.2.13	[illegible]
11-14	0	45	45	186M	0	6	6	63	FUEL SIDE 4.3-4.3.13	[illegible]
11-14	0	10	10	196M	0	2	2	65	PURGE 4.4-4.4.11	[illegible]
			D1094 HOT FIRE CALIB.		RAO 220-408 NK Amend 2					
11-19	0	3	3	199M	0	1	1	66	EM & LEAK CHECK 4.9.6.1	[illegible]
11-19	0	75	75	274M	0	—	—	66	ALTITUDE 4.9.6.7	[illegible]
11-19	0	4 sec	4 sec.	274:04	0	1	1	67	H/F 4.9.6.9	[illegible]
11-19	0	4 sec	4 sec.	274:08	0	1	1	68	H/F 4.9.6.9	[illegible]
11-19	0	2	2	276:08	0	4	4	72	PURGE 4.9.6.10	[illegible]
11-20	0	46	46	322:08	0	72	72	144	DECONT 4.13	[illegible]
11-21	0	50 sec	50 sec	322:58	0	10	10	154	HOT GN2 PURGE 4.13	[illegible]
11-21	0	15	15	337:58	0	1	1	155	EM/LEAK 4.9.6.1-4.9.6.6	[illegible]
11-21	0	75	75	412:58	0	—	—	155	ALTITUDE 4.9.6.7	[illegible]
11-21	0	4 sec	4 sec	412.62	0	1	1	156	H/F 4.9.6.9	[illegible]
11-21	0	4 sec	4 sec	412.66	0	1	1	157	H/F 4.9.6.9	[illegible]
11-21	0	2	2	414:66	0	4	4	161	PURGE 4.9.6.10	[illegible]
11-21	0	46	46	460:66	0	72	72	233	DECONT. DCP #1 (MAC MRR 71057 NOR)	[illegible]
11-22	0	46	46	506:66	0	72	72	305	DECONT. 2ND TIME REF DCP 4 @ MAC MRR 71558	[illegible]
			INSP. COMPLETE		D1094		11/22/64			

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FORM 620-5 REV. 8/64 (BACK)

APPENDIX D

APPENDIX D

DESIGN APPROVAL TEST SPECIFICATION AND DATA

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DESIGN APPROVAL TEST OF COMPONENTS

FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

(SE-7)

THRUST CHAMBER ASSEMBLY - 100#

McDonnell Part Number 52-52701 -285
Rocketdyne Part Number 209301
Test Number 209301-401

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.
6633 CANOGA AVENUE
CANOGA PARK, CALIFORNIA

PREPARED BY

E. Adams

APPROVED BY

R. W. Helsel
Sr. Project Engineer
Gemini

NO. OF PAGES 105

REVISIONS

DATE 2 January 1965

DATE	REV. BY	PAGES AFFECTED	REMARKS

FORM R 18-B

DESIGN APPROVAL TEST OF COMPONENTS

FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

(SE-7)

THRUST CHAMBER ASSEMBLY - 100#

McDonnell Part Number 52-52701 -285
Rocketdyne Part Number 209301
Test Number 209301-401

~~NOTE:~~

~~THIS DOCUMENT MAY BE HANDLED AS~~

~~UNCLASSIFIED~~

~~WHEN SHEET NUMBERS 87,88,89~~

~~ARE REMOVED~~

[illegible] FINAL APPROVAL

This drawing is [illegible] approved [illegible] without changes. Such approval does not [illegible] Seller warranty as provided in M. A. [illegible] conditions

EFF. 133P | CONT. [illegible] 52-52701

[illegible] D. [illegible] 3-3-65

[illegible]

APPROVAL IS GRANT TO ALL PAGES IN THIS SPECIFICATION CARRYING A MCDONNELL SIGNATURE. J.D.M.

FORM R 18-0-4

THRUST CHAMBER ASSEMBLY -100#	
McDonnell Part Number	52-52701-285
Rocketdyne Part Number	209301-[illegible]
Test Number	209301-401

DESCRIPTION OF COMPONENT

The OAMS Thrust Chamber Assembly consists of an ablation cooled thrust chamber with a silicon carbide throat insert and expansion nozzle, an injector, two fast acting solenoid valves for propellant flow control, orifices for fixing the component pressure drop, associated interconnecting plumbing and mounting provisions for attaching the assembly to the spacecraft structure.

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ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. MAC 52-52701-285 / NAA 209301

TEST NO. 209301-401 SHEET 1 OF 105

Reference: MAC SCD 52-52701, Rev. H

1.0 SCOPE

This specification establishes the method of test and the test equipment required to conduct the Design Approval Tests of one Thrust Chamber Assembly for the McDonnell Aircraft Corporation Model 133P Orbit Attitude and Maneuver System as specified in McDonnell Aircraft Corporation Specification Control Drawing 52-52701, Rev. H, paragraph 6.3.1.3.2.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
E. Adams	10-20-64	[illegible]	1-6-65	[illegible]	3/3/64
CHECKED BY:	DATE				
[illegible]	12-31-64				

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301

TEST NO. 209301-401 SHEET 2 OF 105

Reference: a) MAC SCD 52-52701, Revision #

2.0 APPLICABLE DOCUMENTS

The documents listed in this specification are for reference only except those marked with an asterisk (*). If the requirements of this specification differ from those listed below, the requirements of this specification shall govern, except in the case of SCD 52-52701 which is the contractual controlling document.

2.1 McDonnell Aircraft Specifications

SCD 52-52701	Specification Control Drawing, MAC Model 133P, Orbit Attitude and Maneuver System Rev. H, dated 21 Jan. 1965, (CONFIDENTIAL), and as revised per NCI RD-571 dated 18 December 1964.
*Report #8392	Standard Engineering Responsibilities Technical Data Requirements and Product Support Recommendations, Model 133P SCD Equipment, dated 8 October 1962.
Report #8518	General Electrical Design Requirements for Electrical Equipment and Equipment Utilizing Electrical Power for MAC Model 133P, dated 1 May 1962.

2.2 McDonnell Aircraft Drawings

Drawing 506612	Elbow
Drawing 506737	Union

2.3 Military Specifications

MIL-E-5272C-1	Environmental Testing, Aero and Associated

PREPARED BY: DATE	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL DATE
E. Adams 10-20-64	[signature] 1-6-65	James D. Marrozenis 3/4/65
CHECKED BY: DATE		
[signature] 12-31-64		

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301-

TEST NO. 209301-401 SHEET 3 OF 105

2.3 (Continued)		Equipment, General Specification for, dated 20 January 1960.
	MIL-L-25567	Leak Test Compound, Oxygen System, dated 7 January 1959.
	*MIL-P-26539A	Propellant, Nitrogen Tetroxide, dated 31 July 1961.
	MIL-P-27401A	Propellant, Nitrogen Pressurizing, dated 7 November 1960.
	*MIL-P-27404	Propellant, Monomethyl Hydrazine, dated 3 April 1962.
	MIL-A-6091B	Alcohol; Ethyl, Specially denatured, dated 12 January 1962.
	Federal Stock No. 6830-263-9842	Helium
2.4	Rocketdyne Specifications	
	*RA0220-444	SE7 209301 Assembly Data Reduction and Adjustments, dated 13 July 1963. (CONFIDENTIAL)
	*RA0220-408	SE7 Thrust Chamber Assembly Acceptance Testing, dated 13 July 1964.
	*RA0112-002	Lubricants, Anti-Seize Compounds and Gasketing Type Seal Compounds for Rocket Engines, dated 29 July 1963.
	*RA0220-290	SE7 Weight Determination, dated Oct 2, 1963.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
E. Adams	10-20-64	[illegible]	1-6-65	James D. [illegible]	3/3/65
CHECKED BY:	DATE				
[illegible]	12-31-64				

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301

TEST NO. 209301-401 SHEET 4 OF 105

2.4 (Continued)	*RA0201-050	Acceptance Test Instrumentation Requirements, dated 9 August 1961
	*RA0607-009	In Place Brazing of Tubes and Fittings for Space Engines, dated 30 December 1963
	*RA0610-002	Ultrasonic Cleaning of Space Engines Hardware, dated 20 June 1963
	*RA0610-003	Cleaning Space Engine Hardware by Liquid Flushing, dated 24 October 1963
	*RA0610-009	Chemical Cleaning of Filter Elements for Space Engines
	*RA0616-005	SE7 Propulsion System Inter and Intra Plant Handling, dated 20 March 1963
	*RA0616-008	SE7 Propulsion System; Preparation for Customer Delivery, dated 4 September 1963
	*PEM 25.C1 G	Environmentally Controlled Areas, Definitions and Specification for, dated 2 December 1963
2.5	Rocketdyne Drawings	
	Drawing 209301	Thrust Chamber, 100 lbs, 9 Min., Assy. of, dated 10 July 1963
	Drawing 99-106126	Adapter - Fitting, Assy. of, dated 22 October 1963
	Drawing 9017844	Seal Assembly, Thrust Chamber Drain, 100 lb TC, dated 11 September 1962

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
E. Adams		[illegible]	1-5-65	[illegible]	3/3/65
CHECKED BY: [illegible]	DATE 12-31-64				

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R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301

TEST NO. 209301-401 SHEET 5 OF 105

2.5 (Continued)	Drawing RK 398-10035	Shipping Container, SE7 TCA (100#) with Extended Inlet Adapters, dated 30 September 1964
	Drawing 99-106715	Tube-Assy of (Fuel) dated
	Drawing 99-106716	Tube-Assy of (Oxidizer) dated

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
E. Adams		[illegible]	1-6-65	[illegible]	2/5/65
CHECKED BY: [illegible]	DATE 12-31-64				

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301

TEST NO. 209301-401 SHEET 6 OF 105

Reference: (a) MAC SCD 52-52701, Revision H

3.0 GENERAL REQUIREMENTS

3.1 Safety

All safety precautions necessary to comply with this procedure shall be in accordance with Rocketdyne Safety Department Directives.

3.2 Handling

All inter and intra plant handling and packaging shall be accomplished per the requirements of Rocketdyne Specification RA0616-005 when the TCA is being transported, or stored between test, except that components with extended inlet tube adapters be packaged in Container RK 398-10035 . Adequate measures shall be taken to prevent accidental damage to the TCA at all times.

3.3 Photographic Coverage

Photographs shall be taken of each different test setup and shall be included in the final test report. Three preliminary copies of these pictures shall be forwarded to the Rocketdyne Gemini Project Office within 14 days from the exposure date.

Photographs shall be taken of each different test setup and shall be taken of the component after any malfunction. Sufficient views shall be taken to provide complete visual coverage of the failure, including photomicrographs when applicable.

3.4 Instrumentation (paragraph 6.2.1.2 of reference a)

All test parameters shall be assigned a tolerance of ±2% of the specified value unless otherwise specified herein.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
E. Adams		[illegible]	1-6-65	James D. Gargano	3/3/65
CHECKED BY:	DATE				
[illegible]	12-31-64				

FORM 608-B-40 NEW 6-63
R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301-

TEST NO. 209301-401 SHEET 7 OF 105

3.4 (cont'd) All instrumentation employed for monitoring the required test parameters shall be calibrated to insure attainment of minimum steady-state accuracy of ±2% of the full scale range of the instrumentation being used - except where instrumentation accuracy is otherwise specified.

Calibration records shall be maintained and made available to authorized personnel upon request. Hot fire instrumentation shall be in accordance with specification RA0201-050 and Table I of this specification.

3.5 Maintenance (paragraph 6.2.3 of reference a)

Servicing, adjustment, or replacement of parts shall not be permitted unless specifically stated in this specification. Lubrication of fittings is permitted per RA0112-002.

3.6 Failures (paragraph 2.5.2 of McDonnell Report 8392)

In the event that the component fails to pass any part of the Design Approval Test, immediately discontinue all testing of that component and notify the Rocketdyne Gemini Project Office, and the responsible McDonnell representative.

McDonnell Aircraft Corporation and Rocketdyne shall jointly review the failure and determine the corrective action to be taken and the point in the test procedure where retesting is to begin.

3.7 Test Witnessing (paragraph 6.2.1.3 of reference a)

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
E. Adams		[illegible]	1-6-65	[illegible]	3/4/65
CHECKED BY: [illegible]	DATE 12-31-64				

FORM 608-B-40 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301-

TEST NO. 209301-401 SHEET 8 OF 105

3.7 (cont'd) Each Design Approval Test shall be witnessed and the test data certified by Rocketdyne inspection, and certified by the Government Inspection Agency having cognizance at the testing facility. McDonnell and Government inspectors shall be notified 4 hours in advance of all tests.

MAC Engineering shall be notified 3 days in advance of the schedule date of any Design Approval Test. If MAC Engineering indicates a desire to witness any test, notification shall again be performed 4 hours prior to the beginning of the test. Actual testing shall not commence prior to the arrival of all witnesses unless prior waiver is obtained. Notification of the MAC Resident Engineering Office shall constitute notification of MAC Engineering.

3.8 Cleanliness Requirements

Hot Fire Test and Decontamination Facilities: During the time that the TCA is being installed in or removed from a hot fire test facility or a decontamination facility, the TCA propellant valve inlets, when open, shall be protected by a plastic enclosure. A low volume nitrogen purge, filtered through two, 10 micron absolute, stainless steel wire mesh filters, installed in series, shall be used to prevent entrance of foreign material into the closure, when in a Non-Class IV area as specified in Rocketdyne Plant Engineering Manual PEM 25.01G.

Other Test Facilities: The propellant valve inlets shall not be directly exposed to an environmental atmosphere which does not meet the requirements of a Class IV area as specified in Rocketdyne Plant Engineering Manual PEM 25.01G. It shall be a requirement that a ten (10) micron absolute wire mesh stainless steel filter be installed on the propellant valve inlets in a Class IV area when the test setup is to be in a Non-Class IV area. The entire test setup shall be assembled and disassembled in a Class IV area.

PREPARED BY: E. Adams	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
CHECKED BY:	DATE 12-31-64		1-6-65		3/4/65

FORM 608-B-40 NEW 6-63
R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301-

TEST NO. 209301-401 SHEET 2 OF 105

3.8 (cont'd) Cleaning of Test Setup Hardware: The ten micron absolute stainless steel wire mesh filters shall be cleaned per Rocketdyne Specification RA0616-009 and stored in polyethylene bags until ready for use. Millipore filter housings shall be cleaned per Rocketdyne Specification RA0615-003 prior to installation of the new Millipore filter elements into the housings. The Millipore filter assemblies shall be stored in polyethylene bags until ready for use. The lines which are to be used between the test setup filters and the TCA shall be cleaned per Rocketdyne Specification RA0610-002 each time the filters are installed into test setup. Test setup hardware, which is too large for polyethylene bags, shall be protected by appropriate closures, which have also been cleaned so as not to lower the level of cleanliness of the hardware.

3.9 Report

Data: Data shall be recorded directly on the applicable data sheets inserted after each test of this specification. All raw data shall be identified relative to the test to which it pertains. That raw data specifically requested by MAC Engineering shall be further identified relative to parameter measured, calibration factors, etc. and shipped to MAC, St. Louis. Reduced data shall include graphical presentations and time histories of all pertinent performance parameters.

Discussion of Data: In the final report all pertinent data obtained in the LAT series shall be analyzed and discussed. Any significant trends leading to pertinent conclusions or recommendation for further testing shall be covered. (Reference: McDonnell Aircraft Specification Report #8392.)
Acceptance Test Data: Acceptance test data shall be retained and be included as part of the final report for this component.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301

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3.10 Component Test Modification

The propellant valve inlets of each TCA shall be modified following Pre-Test Inspection by the addition of an inlet tube adapter, see Figure 10. Attachment of the adapter shall be by brazing in accordance with RA0607-009. Failure at the inlet adapter or the braze joint during subsequent testing shall not constitute a failure of the TCA.

3.11 Sampling and Analysis of Propellants

Samples of propellants shall be obtained for analysis whenever propellants are introduced into the test facility tanks and at least once daily, during the time that DAT hot fire tests are conducted, for the purpose of specific gravity determination.

Samples of propellants shall be obtained for analysis whenever propellants are introduced into the test facility tanks and at least once weekly, during the time that DAT hot fire tests are conducted, for the purpose of propellant composition determination. The current propellant composition analysis of the Nitrogen Tetroxide must be known prior to any Hot Fire Test on Gemini DAT hardware.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301

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3.12 Abbreviations

Abs	-	Absolute
AC	-	Alternating Current
b	-	Bracket
cps	-	Cycles per Second
DAT	-	Design Approval Test
DC	*	Direct Current
F	-	Fahrenheit
Freq	-	Frequency
g	-	Acceleration of Gravity
GN_2	-	Gaseous Nitrogen
He	-	Helium
Hr	-	Hour
L	-	Lower
MAC	-	McDonnell Aircraft Corporation
Min	-	Minimum
NOM	-	Nominal
OAMS	-	Orbit Attitude and Maneuver System
Prop	-	Propellant
psia	-	Pounds per Square Inch Absolute
psig	-	Pounds per Square Inch Gauge
RMS	-	Root - Mean - Square
SCC	-	Standard Cubic Centimeters
SCD	-	Specification Control Drawing
sec	-	seconds
TCA	-	Thrust Chamber Assembly
U	-	Upper
V	-	Volts or Valve
P_m	-	Maximum Pressure

3.13 Post Test Hardware Routing

Upon successful completion of all Design Approval Test, the component shall be placed in the appropriate hold area pending further disposition.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301-

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3.14 Definitions

*Duration - Total time from "first indication" in starting sequence to 2%-of-maximum thrust point in the shutdown sequence.

Impulse, Shutdown- Area under the thrust-time curve between the "off signal" and 2-percent-of-maximum thrust point in the shutdown sequence.

Impulse, Mean Specific - Total impulse divided by total weight of propellants consumed.

Impulse, Specific - The thrust in pounds divided by the propellant consumption rate in pounds per second.

Impulse, Total - Area under the thrust-time curve.

*Pulse - A pulse includes all events from the "on signal" to 2-percent-of-maximum thrust point in the shutdown sequence.

*Signal, ON - The signal to open the propellant valves. This is the start of the starting sequence.

*Signal, OFF - The signal to close the propellant valves. This is the start of the shutdown sequence.

*Signal Width - Time from "on signal" to "off signal".

*Time, Cutoff - Time from the "off signal" to 10-percent-of-maximum thrust point in the shutdown sequence.

*Time, Decay - Time from the 90-percent-of-maximum thrust point to the 10-percent-of-maximum thrust point in the shutdown sequence.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301

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3.14 (cont'd)

*Time to First Indication - Time from the "on signal" to the first indication on the thrust record.

*Time, Ignition - Time from the "on signal" to the time of first indication in the starting sequence.

*Time, Rise - Time from first indication to 90-percent-of-maximum thrust point in the starting sequence.

*Time, Start - Time from "on signal" to the 90-percent-of-maximum thrust point in the starting sequence.

*Time, Shutdown - Time from "off signal" to 2-percent-of-maximum thrust point in the shutdown sequence.

*Time, Effective Firing - Time from 90-percent-of-maximum thrust point in the start sequence to the 90-percent-of-maximum thrust point in the shutdown sequence.

Lockup Pressure - Pressure immediately upstream of the propellant valve prior to TCA operation.

Soakout Period - Time required for all TCA skin temperatures to stabilize and drop 5° F to verify that peak temperature has been reached.

Burn Time - That time which both propellant valves are open simultaneously.

* See Figure 11.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301

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Reference: MAC SCD 52-52701, Revision μ, Figure 12

4.0 Test Program

One Thrust Chamber Assembly (P/N 209301), having passed the acceptance tests of RA0220-408, shall be subjected to Design Approval Tests in accordance with the requirements herein specified.

4.1 Test Sequence

The following paragraphs list the applicable environmental and service life tests for the TCA and the operational tests and procedures which will be used to demonstrate SCD compliance. The tests for the TCA shall be performed in the order listed.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. {MAC 52-52701-285 / NAA 209301}

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4.1.1 Thrust Chamber Assembly Number One

	Para.	Page	SCD Reference
Pre-Test Inspection	7.1.1		6.2.2.1
Weight Determination	6.6		6.3.1.4.1
Vibration	7.1.2		6.2.3.17.1
Propellant Valve Proof Pressure & Leakage	6.1		6.2.3.1
Thrust Chamber Proof Pressure & Leakage	6.2		6.2.3.1
Propellant Valve Electrical Resistance	6.3		6.2.3.2
Propellant Valve Dielectric Strength	6.4		6.2.3.3
Propellant Valve Functional	6.5		6.3.1.3.1
Mechanical Shock	7.1.3		6.2.3.16
Propellant Valve Proof Pressure & Leakage	6.1		6.2.3.1
Thrust Chamber Proof Pressure & Leakage	6.2		6.2.3.1
Propellant Valve Electrical Resistance	6.3		6.2.3.2
Propellant Valve Dielectric Strength	6.4		6.2.3.3
Propellant Valve Functional	6.5		6.3.1.3.1
DAT Duty Cycle to 757 Seconds	7.1.4		6.3.1.3.2.2
Weight Determination	6.6		6.3.1.4.1

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301

TEST NO. 209301-401 SHEET 16 OF 105

Reference: MAC SCD 52-52701, Revision G

5.0 EQUIPMENT AND MATERIAL (Equivalent Items May be Used)

5.1 Material

5.1.1 Nitrogen tetroxide - MIL-P-26539A (Oxidizer)

5.1.2 Monomethyl Hydrazine - MIL-P-27404A (Fuel)

5.1.3 Nitrogen Gas - MIL-P-27401A

5.1.4 Freon MF - Commercial Grade

5.1.5 Helium - Federal Stock Number 6830-263-9842

5.1.6 Alcohol - MIL-A-6091B (Reagent grade isopropyl alcohol, AM CHEM SOC standard is considered equivalent)

5.1.7 Leak Test Compound - MIL-L-25567

5.2 Special Equipment

5.2.1 Hot Fire Facility

A facility capable of static firing the TCA's at both ambient conditions and at a simulated pressure altitude of 100,000 feet or greater. This facility shall be capable of maintaining a conditioned thermal environment without significant convective heating or cooling.

Suitable equipment to provide and utilize hot GN_2 purge, Anhydrous Isopropyl Alcohol and Freon MF fluids for decontamination, flushing and cleaning the TCA after firing.

The facility shall be equipped to meet the instrumentation requirements of Table 1.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301-

TEST NO. 209301-401 SHEET 17 OF 105

5.2.1 (Cont'd) The facility shall be equipped with a high natural frequency thrust mount for axial thrust determination during DAT duty cycle operation.

The facility shall be equipped with a TCA firing control system consisting of a regulated DC power supply, the TCA installation wiring as shown in the MAC SCD 52-52701, Revision H, Figure 18 and an automatic programmer capable of controlling the pulse sequence and duration per Table II.

The facility shall be equipped with a propellant feed system per Figure 6.

5.2.2 Vibration Testing Facility

The facility shall be capable of vibrating the TCA at frequencies of 5 to 2000 cps and at the random vibration power spectral density per Figure 8.

The facility shall be equipped with a servo control unit for varying the vibration frequency logarithmically.

The facility shall be equipped with a Ling ASDE 80 equalization console and a Ling power amplifier to control the random vibration input.

The facility shall be equipped with a test fixture to which the TCA can be attached by employing simulated spacecraft brackets and use of its attach points shown in Figure 7. The test fixture shall be capable of being mounted on the vibration machine such that the TCA can be vibrated along each of the three mutually perpendicular axes shown in Figure 7. Provision shall be made for attaching the extended propellant valve inlet lines to the test fixture.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301-

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5.2.2 (cont'd) The facility shall be equipped with accelerometers with an accuracy of ±5% from 5 to 2000 cps, and a natural frequency over 30,000 cps.

The facility shall be equipped with a multichannel oscillograph for recording the accelerometer output during the vibration sweeps.

The facility shall be equipped with a multichannel FM magnetic tape recorder for recording the accelerometer output during the random vibration.

The facility shall be equipped with a Ballantine True RMS Meter to measure the RMS G acceleration.

The facility shall be equipped with a Technical Products Company analyzer to analyze the accelerometer output power spectral density shape.

5.2.3 Shock Testing Facility

The facility shall be capable of imparting half sine wave shocks of 15 ±1.5 g magnitude and 11 ±1.0 millisecond duration to the TCA.

The facility shall be equipped with a rigid jig test fixture to which the TCA shipping container, as specified in RA0616-008, can be rigidly attached. The rigid jig test fixture shall be capable of being mounted on the shock machine such that the TCA, in its shipping container, can be shocked along the plus and minus direction of each of the three mutually perpendicular axes shown in Figure 7.

The facility shall be equipped with an accelerometer (Statham, Model A5TCA-50-350) which shall be mounted on the rigid jig test fixture.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52701-285 NAA 209301-

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5.2.3 (cont'd) The facility shall be equipped with an oscilloscope (Tektronix, Model 535 or 564) for monitoring the accelerometer output and recorded on a Polaroid camera.

5.2.4 Electrical Harness

A moisture proof jumper assembly incorporating at one end two Bendix MG06-8-4S plugs potted in accordance with RA0106-006. Each lead shall be identified according to valve (oxidizer or fuel) and pin (A, B, C or D). See Figure 1. This electrical harness shall be used whenever electrical power is supplied to the TCA.

5.3 Standard Pneumatic and Hydraulic Equipment

5.3.1 Pressure Gauges

G_1, G_2 - 0 to 600 psig, $\pm$ 1% accuracy, full scale

G_3 - 0 to 1000 psig, $\pm$1% accuracy, full scale

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER - 100# PART NO. MAC 52-52701-285 NAA 209301-

TEST NO. 209301-401 SHEET 20 OF 105

5.3.2 Valves

V_1, V_2 - 1/4" hand valve, 0 to 1000 psig

5.3.3 Regulators

R_1 - 1/4" pressure regulator, 0 to 1000 psig

5.3.4 Filters

F_1 - 2 micron nominal, 10 micron absolute stainless steel wire mesh

F_2 - Millipore filter, CA12 440 00; Housing, MS 28720-12

5.4 Standard Electrical Equipment

(Equivalent items may be used)

5.4.1 DC Power Supply - 0 to 36 VDC

5.4.2 AC Power Supply - 110 VAC nominal, 60 cps

5.4.3 Oscilloscope - Hewlett Packard, Model 122 AR, dual trace (for Propellant Valve Functional)

5.4.4 Milliammeter - Weston Model 1951, 0-200 MA Range

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100 # PART NO. MAC 52-52701-285 / NAA 209301-

TEST NO. 209301-401 SHEET 21 OF 105

5.4.5	Switch - 40 watt minimum power rating
5.4.6	High Voltage Leak Detector - Associated Research, Model 411
5.4.7	Impedance Bridge - 0 to 50 ohms, ± 1/10% accuracy
5.4.8	Voltmeter - Hewlett Packard, Model 412A, 0 to 30 VDC and 0 to 100 VDC, ±1 % full scale accuracy
5.4.9	Temperature Recorder - Leeds and Northrop, ±3 % accuracy
5.4.10	Thermocouple - Bare wire junction, accuracy class D per RA0201-050
5.4.11	Mercury Switch - 20 watt minimum power rating
5.5	Standard Leakage Testing Equipment
5.5.1	Burette - 25 ml, 0.1 ml graduations
5.5.2	Beaker - 400 ml
5.6	Miscellaneous Equipment
5.6.1	Camera-Polaroid (with oscilloscope adapter)
5.6.2	Propellant Valve Inlet Adapter
	Adapter - P/N 99-106126-31
	Elbow - MAC P/N 506612 -5 -5
	Union - MAC P/N 506737 -5 -5

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A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301

TEST NO. 209301-401 SHEET 22 OF 105

5.6.3 Scale - 0 to 25 pounds, 0.01 pound subdivisions

5.6.4 Stop Watch - One second subdivisions

5.6.5 Seal Assembly - 9017844

5.6.6 Diode-Motorola SR417

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DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301-401

NAME OF TEST OPERATIONAL TESTS AND PROCEDURES TEST NO. 209301 SHEET 23 OF 105

Reference: MAC SCD 52-52701, Revision G

6.0 Operational Tests and Procedures

This section contains those procedures which shall be used in conjunction with the Environmental and Service Life Tests to demonstrate SCD compliance.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301-401

NAME OF TEST PROPELLANT VALVE PROOF PRESSURE AND LEAKAGE TEST NO. 209301-401 SHEET 24 OF 105

Reference: MAC SCD 52-52701, Revision H, Paragraph 6.2.3.1

6.1 Propellant Valve Proof Pressure and Leakage

6.1.1 Install the TCA in a test setup similar to Figure 2. If the propellant valves have been removed from the TCA, they shall be equipped with propellant valve outlet adapters. Do not attach the leakage sensing line at this time.

6.1.2 Slowly adjust the regulated helium supply pressure at the propellant valve inlet to 500 $^{+10}_{-0}$ psig as indicated by the pressure gage.

6.1.3 Maintain this pressure for a period of not less than three minutes.

6.1.4 De-pressurize the propellant valve.

6.1.5 Adjust the regulated helium supply pressure to 150 ±10 psig.

6.1.6 Adjust the DC power supply to 26 ±0.5 VDC.

6.1.7 Cycle the propellant valve three times and leave in the closed position.

6.1.8 Attach the leakage sensing line and arrange the leakage testing equipment similar to Figure 2.

6.1.9 Adjust the regulated helium supply pressure to 500 $^{+10}_{-0}$ psig.

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FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301-401

NAME OF TEST PROPELLANT VALVE PROOF PRESSURE AND LEAKAGE TEST NO. 209301- SHEET 25 OF 105

6.1.10 At first indication of leakage, wait at least two minutes to insure a steady leakage rate and then measure the leakage over a period of at least five minutes with a stopwatch. If no leakage is apparent after five minutes or if the measured leakage is less than 0.5 ml, record the leakage rate as "less than 0.1 scc He/MIN". The maximum allowable leakage is 2.23 scc He/MIN.

6.1.11 De-pressurize the propellant valve. Disconnect the helium supply line, the DC power supply and the leakage sensing line. Cap the propellant valve inlet port and electrical receptacle.

6.1.12 Failure to pass the above tests shall constitute a failure of the propellant valve. See paragraph 3.6.1.

6.1.13 Remove the TCA from the test setup. Replace all protective covers.

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FORM 608-3-38 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100#
PART NO.: MAC 52-52701-285; NAA 209301
NAME OF TEST: THRUST CHAMBER PROOF PRESSURE AND LEAKAGE
TEST NO. 209301-401 SHEET 26 OF 105

Reference: MAC SCD 52-52701 Revision H, paragraph 6.2.3.1

6.2 Thrust chamber Proof Pressure and Leakage

6.2.1 Install the TCA in a test setup similar to Figure 3.

NOTE: It shall be necessary to perform this test in a hazardous test cell. See paragraph 3.8.

6.2.2 Close V_1.

6.2.3 Apply leak test compound to all accessible welds on the TCA.

6.2.4 Energize the fuel propellant valve with 12 ±2 VDC.

6.2.5 Slowly increase the regulated Helium supply pressure to 392 ±10 psig. Maintain this pressure for a period of $3^{+.25}_{-0}$ minutes. Evidence of leakage in the areas specified in paragraph 6.2.3 shall constitute a failure of the TCA.

6.2.6 Reduce the regulated Helium pressure to zero and de-energize the fuel valve.

6.2.7 Repeat paragraphs 6.2.3 through 6.2.6.

6.2.8 Failure to pass the above test shall constitute a failure of the TCA. (Reference paragraph 3.6)

6.2.9 Wash residual leak test compound from the TCA with deionized water and blow dry with GN_2.

6.2.10 Remove the TCA from the test setup and re-install all protective closures.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301-401

NAME OF TEST PROPELLANT VALVE ELECTRICAL RESISTANCE TEST NO. 209301- SHEET 27 OF 105

Reference: MAC SCD 52-52701 Revision H, paragraph 6.2.3.2

6.3 Propellant Valve Electrical Resistance

6.3.1 Install the electrical harness on the propellant valves. Obtain a valve body temperature of 70 ±10 F.

6.3.2 Adjust the impedance bridge to measure resistance.

6.3.3 Measure and record the resistance between leads A and B of the propellant valve. The acceptable resistance is as shown on Figure 9.

6.3.4 Measure and record the resistance between leads C and D of the propellant valve. The maximum acceptable resistance is 1.0 ohm.

6.3.5 Failure to pass the above test shall constitute a failure of the propellant valve. See paragraph 3.6.

6.3.6 Remove the electrical harness from the propellant valve and reinstall the protective covers on the propellant valve electrical connector .

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FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PROPELLANT VALVE DIELECTRIC STRENGTH

PART NO. MAC 52-52701-285 / NAA 209301-401

NAME OF TEST

TEST NO. 209301-401 SHEET 28 OF 105

Reference: MAC SCD 52-52701 Revision H, paragraph 6.2.3.3

6.4 Propellant Valve Dielectric Strength

6.4.1 Install the electrical harness on the propellant valve. Attach ground leads to the propellant valve electrical connector body by means of alligator clips.

6.4.2 Adjust the 60 cps AC voltage output of the leakage tester to zero.

6.4.3 Set the capacity compensation selector switch on the leakage tester to "NONE".

6.4.4 Connect one of the leakage tester leads to lead A of the propellant valve and the other lead to the propellant valve ground lead.

6.4.5 Depress power switch on the leakage tester, and adjust the voltage control until 500 $^{+10}_{-0}$ VRMS is indicated on the voltmeter. If the leakage tester ammeter reads off-scale, reduce the voltage until approximately 800 micro-amps is indicated on the ammeter.

6.4.6 Rotate the capacity compensation selector switch until a minimum current flow is indicated on the ammeter.

6.4.7 Adjust the voltage control until 500 $^{+10}_{-0}$ VRMS is indicated on the voltmeter.

6.4.8 Observe the ammeter for a period of one minute. Maximum allowable current leakage is 500 micro-amps.

6.4.9 Release the leakage tester power switch and disconnect the leakage tester leads.

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E. Adams		[signature]	1-6-65	James D. Marrogesis	3/4/65
CHECKED BY: [signature]	DATE 12-31-64				

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PROPELLANT VALVE DIELECTRIC STRENGTH

PART NO. { MAC 52-52701-285 / NAA 209301-401

NAME OF TEST: TEST NO. 209301- SHEET 29 OF 105

6.4.10 Repeat paragraphs 6.4.2 and 6.4.3.

6.4.11 Connect one of the leakage tester leads to lead C of the propellant valve and the other lead to the propellant valve ground lead.

6.4.12 Repeat paragraphs 6.4.5 through 6.4.9.

6.4.13 Repeat paragraphs 6.4.2 and 6.4.3.

6.4.14 Connect one of the leakage tester leads to lead A of the propellant valve and the other to lead C of the propellant valve.

6.4.15 Repeat paragraphs 6.4.5 through 6.4.9.

6.4.16 Failure to pass the above test shall constitute a failure of the propellant valve. See paragraph 3.6.

6.4.17 Remove the electrical harness and the ground leads from the propellant valve and replace the propellant valve protective covers.

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E. Adams		[illegible]	1-6-65	[illegible]	3/4/65
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[illegible]	12-31-64				

FORM 608-3-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301-401

NAME OF TEST PROPELLANT VALVE FUNCTIONAL TEST NO. 209301- SHEET 30 OF 105

Reference: MAC SCD 52-52701, Revision H, paragraph 6.3.1.3.1

6.5 Propellant Valve Functional

6.5.1 Install the TCA in a test setup as shown in Figure 4. Provide a temperature environment of 70 ±5 °F until temperature stabilization is obtained. Stabilization is defined as a temperature variation of not more than ±3 F for a 30 minute time period. Connect the current trace lead to the propellant valve. Do not connect the voltage trace lead.

6.5.2 Adjust the pressure regulator to obtain 300 ±10 psig on the pressure gage.

6.5.3 Adjust the DC power supply so that 26 ±0.5 VDC is read on the voltmeter.

6.5.4 Close the mercury switch and record the oscilloscope current trace with the Polaroid camera. A sample current trace is shown in Figure 5. The maximum valve opening response time is 0.021 seconds from electrical signal to poppet open. See Figure 5 for typical valve opening response characteristics. Open the mercury switch.

6.5.5 Reduce the helium supply pressure to zero.

6.5.6 Disconnect the current trace lead and connect the voltage trace lead.

6.5.7 Close the mercury switch to verify that the propellant valve has opened. Then open the mercury switch and record the oscilloscope voltage trace with the Polaroid camera. A sample voltage trace is shown in Figure 5. The maximum valve closing response time is 0.075 seconds from electrical signal to poppet closed.

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[illegible]	12-31-64				

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301-401

NAME OF TEST PROPELLANT VALVE FUNCTIONAL TEST NO. 209301-401 SHEET 31 OF 105

6.5.8 Adjust the helium supply pressure to 300 ±10 psig.

6.5.9 Adjust the DC power supply voltage to zero.

6.5.10 Close the mercury switch.

6.5.11 Increase the DC power supply voltage until the propellant valve opens as indicated by a pressure drop. The maximum acceptable pull in voltage is 16 VDC as indicated on the output voltmeter.

6.5.12 Reduce the helium supply pressure to zero.

6.5.13 Reduce the DC power supply voltage until the propellant valve closes. Note deflection on milliammeter which indicates valve closing. Record valve closing voltage. The minimum acceptable drop out voltage is 1.0 volts.

6.5.14 Open the mercury switch.

6.5.15 Failure to pass the above test shall constitute a failure of the propellant valve. See paragraph 3.6.

6.5.16 Remove electrical leads and the helium supply.

6.5.17 Replace all protective closures.

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CHECKED BY: [illegible]	DATE 12-31-64				

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301-401

NAME OF TEST WEIGHT DETERMINATION TEST NO 209301 SHEET 32 OF 105

Reference: MAC SCD 52-52701, Revision H, Paragraph 6.3.1.4.1

6.6 Weight Determination

6.6.1 Weigh the TCA to the nearest one-hundredth (0.01) pound in accordance with RA0220-290 and record.

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FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301

NAME OF TEST THRUST CHAMBER ASSEMBLY FIRING PROCEDURE TEST NO. 209301-401 SHEET 33 OF 105

Reference: MAC SCD 52-52701, Revision H, paragraph 6.3.1.3.2.2

6.7 Thrust Chamber Assembly Firing Procedures

6.7.1 Inspect TCA braze and weld joints for leakage using Seal Assembly 9017844 and leak test compound at 100 ±25 psig.

6.7.2 Install the TCA in the applicable thrust mount located in a hot fire test installation equipped with instrumentation per Table I. The required propellant feed system is shown schematically in Figure 6. Leak check all connections downstream of the flowmeter.

6.7.2.1 The Cape Cycle Firing Test shall be controlled automatically and conducted as follows:

6.7.2.1.1 Make a one second firing followed by another one second firing five minutes later.

6.7.2.1.2 Wait ten minutes and make a one second firing followed by another one second firing five minutes later.

6.7.2.1.3 Repeat paragraph 6.7.2.1.2.

6.7.2.2 For DAT duty cycle firings the firing control shall be automatic. The pulse sequence and duration shall be according to the schedule of Table II.

6.7.3 Prime the facility feed system with the propellants.

6.7.4 Activate altitude chamber to achieve and maintain a simulated pressure altitude of 100,000 feet or greater. If the firing is to be cape cycle the pressure altitude shall be local ground level.

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CHECKED BY: [signature]	DATE 7-23	[signature]	2-23-65	James D. Mavrogenis	3/16/65

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301

NAME OF TEST THRUST CHAMBER ASSEMBLY FIRING PROCEDURE TEST NO. 209301-401 SHEET 34 OF 105

6.7.5 Establish a valve voltage of 26 ±1 VDC i.e., as measured at the valve in the energized position.

6.7.6 Condition the propellants and the TCA hardware and environment to the required temperatures.

6.7.7 Make final propellant tank pressure adjustments to obtain the required TCA inlet pressures during steady state operation as follows:

Oxidizer Inlet Pressure	286 ±10 psia
Fuel Inlet Pressure	280 ±10 psia

6.7.8 Turn on instrumentation. The parameters tabulated in Table I shall be monitored and recorded during the hot fire test.

6.7.9 Fire TCA as required to accomplish Hot-Fire Test objectives per paragraph 7, while maintaining the propellants and TCA environmental temperatures.

6.7.10 Reduce the pressure altitude to local ground level conditions upon completion of test objectives.

6.7.11 Remove propellants from the propellant feed lines employing the Facility Evacuation System.

6.7.12 Purge through the TCA using GN_2.

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CHECKED BY: [signature]	DATE 2-23				

FORM 608-B-38 NEW 6-63
R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100#
PART NO.: MAC 52-52701-285; NAA 209301
NAME OF TEST: THRUST CHAMBER ASSEMBLY FIRING PROCEDURE
TEST NO. 209301-401
SHEET 35 OF 105

6.7.12.1 Adjust GN_2 purge pressurant to 120 ±20 psig.

6.7.12.2 Cycle the TCA oxidizer and fuel valves two times simultaneously and leave in the open position.

6.7.12.3 Continue to purge for thirty seconds.

6.7.12.4 Close the TCA oxidizer and fuel valves.

6.7.13 Remove the TCA from the Hot Fire Test installation.

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R. Cole		
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FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. { MAC 52-52701-285 / NAA 209301 }

NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 209301 401 SHEET 36 OF 105

6.8 Decontamination Procedure

6.8.1 The TCA shall be decontaminated as follows, using a hot GN_2 purge and anhydrous isoprophl alcohol, reagent grade, ACS, for the fuel side flush and freon MF for the oxidizer side flush.

NOTE: The hot GN_2 purge may be accomplished at the hot fire test facility.

6.8.2 Attach 26 VDC (nominal) electrical power supply leads to the TCA electrical connectors.

6.8.3 Connect GN_2 purge line to the oxidizer valve inlet. See paragraph 3.8.

6.8.4 Open the GN_2 supply valve and purge the oxidizer side as follows for five (5) cycles, using 26 $\pm$1 VDC.

(a) 60 seconds on (minimum)
(b) 15 seconds off (maximum)

NOTE: The GN_2 pressure and temperature, at the valve inlet, shall be 120 $\pm$20 psig and 160 $\pm$20°F.

6.8.5 Close the GN_2 supply valve and vent the GN_2 downstream of the supply valve.

6.8.6 Disconnect the supply line from the oxidizer valve.

6.8.7 Cap the valve adapter.

6.8.8 Repeat paragraph 6.8.2 through 6.8.7 on the fuel valve.

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FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301

NAME OF TEST: DECONTAMINATION PROCEDURE TEST NO. 209301-401 SHEET 37 OF 105

6.8.9 Install the TCA in the decontamination facility.

6.8.10 Attach the facility alcohol supply line to the TCA fuel valve inlet. See paragraph 3.8.

6.8.11 Cap the TCA oxidizer inlet line.

6.8.12 Install the electrical harness on the propellant valves and connect the harness to the DC power supply.

6.8.13 Energize the TCA fuel valve to the open position with 26 ±1 VDC.

6.8.14 Flow alcohol through the TCA for 5 minutes minimum. The alcohol shall be flowed at a TCA inlet pressure of 50 ±5 psig. Continue to flow alcohol through the TCA as follows for twenty-five cycles:

(a) 10 seconds on (minimum)
(b) 2 seconds off (maximum)

6.8.15 De-energize the TCA fuel valve to closed position and vent the alcohol supply system.

6.8.16 Remove the facility alcohol line and attach the GN_2 supply line to the TCA fuel valve.

6.8.17 Energize the TCA fuel valve to the open position with 26 ±1 VDC.

6.8.18 Purge the TCA with GN_2 at pressure of 120 ±10 psig for 3 minutes minimum.

6.8.19 De-energize the TCA fuel valve to the closed position.

6.8.20 Disconnect GN_2 line from TCA fuel valve and cap the fuel valve inlet.

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FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301

NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 209301-401 SHEET 38 OF 105

6.8.21 Remove cap from TCA oxidizer valve inlet.

6.8.22 Attach Freon MF supply line to TCA oxidizer valve inlet.

6.8.23 Energize TCA oxidizer valve to open position with 26 ±1 VDC.

6.8.24 Flow Freon MF through the TCA for 5 minutes minimum. The Freon shall be flowed at a TCA inlet pressure of 50 ±5 psig. Continue to flow Freon MF through the TCA as follows for twenty-five cycles:

(a) 10 seconds on (minimum)
(b) 2 seconds off (maximum)

6.8.25 De-energize TCA oxidizer valve to closed position and vent the Freon supply system.

6.8.26 Disconnect Freon Supply line and attach GN_2 supply to TCA oxidizer inlet.

6.8.27 Energize the TCA oxidizer valve to open position with 26 ±1 VDC.

6.8.28 Purge the TCA with GN_2 at a pressure of 120 ±10 psig for 3 minutes minimum.

6.8.29 De-energize the TCA oxidizer valve to closed position and remove the electrical harness.

6.8.30 Remove the GN_2 supply line from the TCA oxidizer valve and remove the cap from the fuel valve inlet.

6.8.31 Install throat plug and connect vacuum equipment to the throat plug port and the propellant valve inlets.

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R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-281 NAA 209301

NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 209301-401 SHEET 39 OF 105

6.8.32 Place TCA in environment of 1.0 psia or less for a period of not less than fifteen minutes. The propellant valves and injector shall be heated and maintained at a temperature of 160 ±10 F for the entire fifteen minute period.

6.8.33 Remove the throat plug and the vacuum lines from the TCA.

6.8.34 Replace all protective closures.

PREPARED BY: R.Cole	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: [signature]	DATE 1-5-65	[signature]	1-6-65	James D. [signature]	3/16/65

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301

NAME OF TEST ENVIRONMENTAL AND SERVICE LIFE TESTS TEST NO. 209301-401 SHEET 40 OF 105

Reference: MAC SCD 52-52701, Revision G, Figure 12

7.0 Environment and Service Life Tests

In this section the required environment and service life tests are specified for the TCA. Sheets are provided for the recording of environmental and service life data and the data of the operational tests required to demonstrate specification compliance.

PREPARED BY: DATE	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
E. Adams	[illegible] 1-6-65	James D. Mangonis 3/4/65
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[illegible] 12-31-64		

FORM 608-B-38 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301-401

NAME OF TEST: ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 209301 SHEET 41 OF 105

Reference: MAC SCD 52-52701, Revision H, Figure 12

7.1 Thrust Chamber Assembly Number One

This sub-section specifies those tests which are to be performed on Thrust Chamber Assembly Number One.

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E. Adams 10-20-64	1-6-65	3/4/65
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FORM 608-B-38 NEW 6-63

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301

NAME OF TEST PRE-TEST INSPECTION TEST NO. 209301-401 SHEET 42 OF 105

Reference: MAC SCD 52-52701, Revision A, paragraph 6.2.2.1

7.1.1 Pre-Test Inspection - TCA #1

7.1.1.1 Test Procedure

7.1.1.1.1 Verify that the TCA is of the proper configuration, that it has been properly packaged and that it contains no defects such as broken parts, corrosion, damage or deterioration. Also verify that the TCA has passed the acceptance tests of RA0220-408. Only those TCA's meeting the above requirements shall be accepted for DAT. An exception to the above configuration requirement is the TCA modified by MAC for the vibration test. Reference MAC Drawing 52-52067.

7.1.1.1.2 Braze the extended propellant valve inlet tube adapters (P/N 99-106716 and 99-106715) to the oxidizer and fuel propellant valves per RA0607-009. Remove after vibration test. Braze basic inlet tube adapters (P/N 99-106126-31) to TCA after mechanical shock test.

7.1.1.1.3 Perform Weight Determination on TCA with basic inlet tube adapters per paragraph 6.6.

PREPARED BY: R.Cole	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: [signature]	DATE 2-23	[signature]	2-23-65	James D. Mavrogenis	3/4/65

FORM 608-B-38 NEW 6-63

R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301-401

NAME OF TEST PRE-TEST INSPECTION TEST NO. 209301 SHEET 43 OF 105

7.1.1.2 Test Data - TCA #1

7.1.1.2.1 Component Identification

Component Name	TCA	Oxidizer Valve	Fuel Valve
McDonnell Part No.	[illegible]		
Rocketdyne Part No.	[illegible]	[illegible]	[illegible]
Component Serial No.	[illegible]	[illegible]	[illegible]

7.1.1.2.2 Inspection (Reference paragraph 7.1.1.1)

7.1.1.2.2.1 The TCA was inspected to insure that it was of the proper configuration (with the exception of the vibration test TCA), that it had been properly packaged and that it contained no defects such as broken parts, corrosion, damage or deterioration. Also the TCA records were inspected and it was verified that the TCA had passed the acceptance tests of RA0220-408 [illegible] (yes or no).

7.1.1.2.2.2 The extended inlet tube adapters were installed on the propellant valves per paragraph 7.1.1.1.2 for vibration tests only. [illegible] (yes or no)

7.1.1.2.2.3 The extended inlet tube adapters were removed from the propellant valves following the vibration tests and the basic inlet tube adapters installed on the TCA. [illegible] (yes or no)

7.1.1.2.2.4 Inspection Remarks

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams						[illegible]	
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301-401

NAME OF TEST PRE-TEST INSPECTION TEST NO. 209301-401 SHEET 44 OF 105

7.1.1.2.3 Weight Determination Test (reference paragraph 6.6)

All protective closures were removed from the TCA.
_____(Yes or No)

The TCA dry weight was _____pounds.
(Record to the nearest one-hundredth pound)

Inspection Remarks THIS OPERATION WAS INADVERTENTLY OMITTED DURING THE CONDUCT OF THE TEST PROGRAM ON THIS TEST UNIT. THE ERROR WAS NOT NOTED UNTIL AFTER THE MDC OF PARAGRAPH 7.1.4 HAD BEEN CONDUCTED. IT WAS NO LONGER POSSIBLE TO SATISFY THE REQUIREMENTS OF THIS OPERATION AT THAT TIME.

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E. Adams						VERIFIED BY USAF	DATE

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301 401

NAME OF TEST: VIBRATION TEST NO. 209301- SHEET 45 OF 105

Reference: MAC SCD 52-52701, Revision H, Paragraph 6.2.3.17.3

7.1.2 Vibration - TCA #1

7.1.2.1 Test Procedure

7.1.2.1.1 Install the TCA into the vibration test facility. The direction of the vibration input shall be along the X axis of the TCA (see Figure 7).

NOTE: Remove nameplate and mount accelerometer. Replace nameplate at new location on TCA.

7.1.2.1.2 Perform a sine wave survey on the thrust chamber.

7.1.2.1.2.1 The survey shall be a one (1) G maximum peak logarithmic sweep from 5 to 2000 cps in 5 ±1 minutes.

7.1.2.1.2.2 Record the input and output accelerations on an oscillograph recorder.

7.1.2.1.3 The random vibration input shall be per Figure 8.

7.1.2.1.3.1 Perform a ten (10) second vibration table equalization run at the test level to verify spectrum shape and tolerance.

7.1.2.1.3.2 Record and analyze the data.

7.1.2.1.3.3 The power spectral density is to be the specified value with a plus forty (40) percent and minus thirty (30) percent tolerance when analyzed with 1/3 - octave or narrower filters.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
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FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301 }

NAME OF TEST VIBRATION TEST NO. 209301-401 SHEET 66 OF 105

7.1.2.1.3.4	The overall RMS acceleration level is to be 9.6 G's plus fifteen (15) percent, minus zero (0) percent.
7.1.2.1.3.5	No smaller than three (3) sigma clippers shall be used to limit the input level.
7.1.2.1.4	Readjust the controls and repeat paragraphs 7.1.2.1.3 and 7.1.2.1.3.1 as required to conform to paragraphs 7.1.2.1.3.2 through 7.1.2.1.3.4.
7.1.2.1.4.1	Full level equalization time for the purpose of varifying the spectrum shape shall not exceed twenty (20) percent of total test duration for each individual axis.
7.1.2.1.5	Vibrate the TCA with the random vibration input established in paragraph 7.1.2.1.4 for a duration of eight (8) ±0.1 minutes less the time accumulated, for each respective axis, in paragraphs 7.1.2.1.3 and 7.1.2.1.4.
7.1.2.1.5.1	Record and analyze the input and output accelerations at selected intervals.
7.1.2.1.6	Remove the TCA from the test setup.
7.1.2.1.7	Perform paragraph 6.1 through 6.1.4 of the Propellant Valve Proof Pressure and Leakage Test on both valves. Apply leak test compound on the inlet tubes during paragraph 6.1.3.
7.1.2.1.8	Repeat paragraphs 7.1.2.1.1 through 7.1.2.1.7 except that the direction of vibration input shall be along the Y axis (see Figure 7).
7.1.2.1.9	Repeat paragraphs 7.1.2.1.1 through 7.1.2.1.6 except that the direction of vibration input shall be along the Z axis (see Figure 7).

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R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301

NAME OF TEST: VIBRATION TEST NO. 209301-401 SHEET 47 OF 105

7.1.2.1.10	Record post condition of TCA using a borescope.
7.1.2.1.11	Perform Propellant Valve Proof Pressure and Leakage Test per paragraph 6.1 on the oxidizer valve.
7.1.2.1.12	Perform Propellant Valve Electrical Resistance Test per paragraph 6.3 on the oxidizer valve.
7.1.2.1.13	Perform Propellant Valve Dielectric Strength Test per paragraph 6.4 on the oxidizer valve.
7.1.2.1.14	Perform Propellant Valve Functional Test per paragraph 6.5 on the oxidizer valve.
7.1.2.1.15	Repeat paragraph 7.1.2.1.11 through 7.1.2.1.14 on the fuel propellant valve.
7.1.2.1.16	Perform Thrust Chamber Proof Pressure and Leakage Test per paragraph 6.2.
7.1.2.1.17	Remove extended inlet tube adapters.
7.1.2.1.18	Testing may be continued per sections 7.1.3 and 7.1.4 while awaiting the data reduction of the vibration testing (section 7.1.2).

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole					
CHECKED BY:	DATE				
	3-16-65		3-16-65	James D. Morgenis	3/16/65

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME Thrust Chamber Assembly 100# PART NO. { MAC 52-52701-285 / NAA 209301

NAME OF TEST Vibration TEST NO 209301-107 SHEET ___ OF ___

IL 5388-6210

Deviation Request:

Subject: Additional Accelerometers and Strain Gages for the 100# TCA #1 OAMS cap 6, S/N 4064104 DAT Gemini

In addition to the accelerometer blocks Nos. 1, 2 & 3 shown on Fig. 7, p 100 of cap 6 - DAT Specif., locate accel blocks 4 & 5 on TCA and three strain gages on valve inlet tubes as per Engrg. instructions from D896/388. This is for information purposes only.

Recopied from original request dated 9 March 1965.

F.B.Klein
Gemini DAT Unit
D896-397, 3-9-65

James D Mavrogenis
MAC Engineering

FORM 608-8-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME Thrust Chamber Assembly 100# PART NO. { MAC 52-52701-285 / NAA 209301 }

NAME OF TEST Vibration TEST NO. 209301-401 SHEET ___ OF ___

IL 5388-6211

Deviation Request:

Subject: Loose connection of lug @ exit end of 100# TCA DAT Gemini Vibration, S/N 4064104

The lug & integral bracket ass'y is furnished & installed with bolts to the intermediate exit flange by MAC-St.Louis. The lug is bolted by one 1/4" bolt (single shear) to a tee-lug which is bolted by two bolts to the main fixture. This tee-lug is furnished by MAC. During the random vibration test, the single shear 1/4" bolt became partially loose. This condition shall be accepted by inspection in order to proceed with proof & leak test as per paragraphs 6.1 to 6.4 & 7.1.2.1.7 of DAT Gemini Spec. for 100# TCA S/N 4064104.

Recopied from original request dated 15 March 1965.

F.S.Klein
Gemini DAT Unit
D896/388
3-15-65

James D. Mavrogenis
MAC Engineering

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME Thrust Chamber Assembly 100# PART NO. { MAC 52-52701-285 / NAA 209301

NAME OF TEST Vibration TEST NO 209301-401 SHEET ___ OF ___

IL 5388-6212

Deviation Request:

Subject: DAT-Gemini Vibration Test of 100# TCA-OAMS, cap 6

The bolted connection @ exit end lug of 100# TCA which became loose during the random vibration test on 3-12-65 shall be noted "for information only" and the vibration tests & subsequent tests shall continue as per DAT Gemini Specif.

Recopied from original request dated 17 March 1965.

F.B.Klein
Gemini DAT Unit
D396/388 3-17-65

James D. Mavrogenis
MAC Engineering

FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC.

IL 5388-6147

INTERNAL LETTER
North American Aviation, Inc.

DATE 25 March 1965

TO Those Concerned
Address

SUBJECT Deviation to DAT Specification 209301-401 for TCA Unit #1 P/N 208301, S/N 4064104

After the completion of vibration testing, both the oxidizer propellant valve, P/N 409404, S/N 9371280, and the fuel propellant valve, P/N 409405, S/N 9362063, on the subject TCA exceeded the closing time requirement of .075 sec as specified in 209301-401. In addition, closing response times were taken of both propellant valves with an electrical setup similar to that used during acceptance testing. With this setup, the propellant valves met the acceptance criteria of .005 sec maximum closing time.

Since the propellant valves still meet the acceptance criteria, it is concurred between Rocketdyne and McDonnell that the exceeding of the DAT closing requirement is not to be considered a failure of the valves.

The discrepancy shall be noted on the data sheet and testing of the TCA continued.

R. A. Cole
R. A. Cole
Gemini DAT Unit

Approved: R. G. Eide
R. G. Eide
Supervisor
Gemini DAT Unit

J. D. Mavrogenis
J. Mavrogenis
MAC Engineering
3/25/65

R-15019-2

FORM R 18-D-4

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4064104.
Dwg. No. 209301
Model SE/7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
#1	ANR 941 12/MAY/65	PART NO. 209301 THE #10 BOLT AT EXIT END ATTACH LUG LOOSENED DURING RANDOM DWELL @ 4:31 OF 7:08 OF VIBRATION RUN			
ACTION TAKEN		THE THREE FIBRE-GLASS WASHERS & THREE STEEL WASHERS WERE REPLACED BY SIX AN960C10 & TWO AN960C10L WASHERS AND TORQUED TO 25# LBS J.P. McClain D896-388	1621 3/17/65	1621	ANR 94
#2	3/24/65	PART NO. 209301 - .075 MAX. VALVE CLOSING RESPONSE TIME WAS .079. (REF. SHEET 60 - 6.5.7)			
ACTION TAKEN		REF. I.L. 5388-6147 3/25/65		ANR 922 3/24/65	ANR 922 3/24/65
#3	3/24/65	PART NO. 209301 - .075 MAX. VALVE CLOSING RESPONSE TIME WAS .079 (REF. SHEET 64 - 6.5.7)			
ACTION TAKEN		REF. I.L. 5388-6147		ANR 922 3/25/65	ANR 922 3/25/65
4	4/5/65	PART NO. General During the M.D.C. The Temp on the TC located 9" down on the long side was 810°F max allowed 500°F Ref Para 7.1.4.1.2.1			
ACTION TAKEN					
5	4/5/65	PART NO. General During The MDC. The Temp on The TC located in the throat on the long side was 559°F. max allowed 500°F Ref Para 7.1.4.1.2.1			
ACTION TAKEN					

R-15019-2

Form R 25-U Rev. 12-57

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4064104

Dwg. No. 209301

Model SE 7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
		CTL III SSFL			
6	4/5/65	PART NO. General During The MDC The Temp on the TC located in the throat 120° ckw was 554°F max allowed 500°F Ref Para 7.1.4.1.2.1			
ACTION TAKEN					
7	4/15/65	PART NO. General During the MDC The Temp on the TC located on the throat 120° ckw was 550°F max allowed 500°E Ref Para 7.1.4.1.2.1			
ACTION TAKEN					
8.	4/6/65	PART NO. General: Subsequent to Cape Cycle & Duty Cycle tests at CTL III, SSFL, weight determination was not accomplished. Ref para 7.1.4.2.6			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					

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Form R 25-U Rev. 12-57

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No.

Dwg. No.

Model

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
1	5/31/65	PART NO. 209301, S/N 4066382, 100 LB. TCA, REF. PARA. 7.1. 3.2.6. THE OXIDIZER VALVE DROP-OUT TIME WAS 0.130 SECONDS. MAX. ALLOWABLE IS 0.075 SECONDS.			
		ACTION TAKEN: OXIDIZER PROPELLANT VALVE BROUGHT WITHIN ACCEPT. LIMITS PER TL 5288-6189-OFR-FAR # 12851B		5-7-65	5-7-65
		PART NO.			
		ACTION TAKEN			
		PART NO.			
		ACTION TAKEN			
		PART NO.			
		ACTION TAKEN			
		PART NO.			
		ACTION TAKEN			

R-15019-2

Form R 25-U Rev. 12-57

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301-401

NAME OF TEST VIBRATION TEST NO. 209301-401 SHEET 48 OF 105

7.1.2.2 Test Data - TCA #1

7.1.2.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52701-285

Rocketdyne Part No. 209301

Component Serial No. 4064104

7.1.2.2.2 Accelerometer Identification (Reference Figure 7)

Location	Sensitive Axis	Identification No.
TCA Input	X	S/N 102
TCA Input	Y	S/N 102
TCA Input	Z	S/N 102
TCA Shell at Comb. Zone	X	S/N 1086
TCA Shell at Comb. Zone	Y	S/N 1009
TCA Shell at Comb. Zone	Z	S/N 1019
TCA Shell at Exit	X	S/N 1161
TCA Shell at Exit	Y	S/N 1161
TCA Shell at Exit	Z	S/N 1161

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		J. Murchison	3-10-65	[signature]	3-18-65	WAIVED BY R.J. [illegible]	[illegible]
						VERIFIED BY USAF	DATE
						[signature]	3-[illegible]

FORM 608-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100#
PART NO. { MAC 52-52701-285 / NAA 209301-401
NAME OF TEST: VIBRATION
TEST NO. 209301 SHEET 49 OF 105

7.1.2.2.3 Vibration Test (Reference paragraph 7.1.2.1)

7.1.2.2.3.1 Resonant Survey - X Axis

Freq. cps	Input g's	Output g's	Identification (no)
135	1.0	6.0	8
210	1.0	14.0	7
336	1.0	11.0	3
372	1.0	9.0	3
500	1.0	9.0	3
1400	1.0	17.0	11

7.1.2.2.3.2 Vibration Table Equalization Test - X Axis

Test No	Satisfactory Spectrum Shape	Satisfactory RMS G Level	Test Duration	Accumulated Duration
1	YES	YES	0:52	0:52

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		[illegible]	3-12-63	[illegible]		[illegible]	
						VERIFIED BY USAF	DATE
						[illegible] Wood	

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301-101

NAME OF TEST VIBRATION TEST NO. 209301 SHEET 50 OF 105

7.1.2.2.3.3 Random Vibration Test - X Axis

Accelerometer outputs were recorded for analysis at the following elapsed times:

SAMPLE #1 (1 ±0.5 Minute) 1:00
SAMPLE #2 (3 ±0.5 Minutes)
SAMPLE #3 (6 ±0.5 Minutes)

The elapsed time at test cutoff was 8.0 minutes.

Results of the Analysis:

SAMPLE #1 Satisfactory see SM20-5-15
X shaped 60-65 seconds

SAMPLE #2 Satisfactory see SM20-5-15
X shaped 180-185 seconds

SAMPLE #3 Satisfactory see SM20-5-15
X shaped 360-365 seconds

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. L. Adams			5-3-65			VERIFIED BY USAF	5-19-65

FORM 608-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100#
PART NO. { MAC 52-52701-285 / NAA 209301-401
NAME OF TEST: VIBRATION
TEST NO. 209301 SHEET 51 OF 102

7.1.2.2.3.4 Propellant Valve Proof Pressure (Reference Paragraph 6.1)

Proof Pressure	Oxidizer Valve	Fuel Valve
Pressure (500 $^{+10}_{-0}$)	500 psig	500 psig
Time Duration (3 minimum)	4 minutes	4 minutes

Inspection Remarks: OXIDIZER & FUEL VALVES AND TUBES WERE LEAK TESTED @ 300 PSIG - H_2O WITH LEAK DETECTOR SOLUTION. THERE WAS NO VISIBLE LEAKAGE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		T. T. Pope	3-15-65			[illegible]	3/15/65
						VERIFIED BY USAF	DATE
						[illegible]	3/15/65

FORM 608-B-39 NEW 6-63
R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301-101

NAME OF TEST VIBRATION TEST NO. 209301 SHEET 52 OF 105

7.1.2.2.3.5 Resonant Survey - Y Axis

Freq. cps	Input g's	Output g's	Identification (no)
139	1	7	906 & 1079
374	1	9	906
337	1	9	906
223	1	14	1087
468	1	4	1087
1050	1	8	906
826	1	3	1193
486	1	20	906

7.1.2.2.3.6 Vibration Table Equalization Test - Y Axis

Test No	Satisfactory Spectrum Shape	Satisfactory RMS G Level	Test Duration	Accumulated Duration
1	NO	YES	33 SEC	33 SEC
2	NO	YES	2 SEC	35 SEC
3	YES	YES	11 SEC	46 SEC

3/17/65
3/10/65
3/17/65

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		3/12/65			3/24/65		
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301-401

NAME OF TEST VIBRATION TEST NO. 209301 SHEET 53 OF 105

7.1.2.2.3.7 Random Vibration Test - Y Axis

Accelerometer outputs were recorded for analysis at the following elapsed times:

SAMPLE #1 (1 ±0.5 Minute) 1.0
SAMPLE #2 (3 ±0.5 Minutes) 3.0
SAMPLE #3 (6 ±0.5 Minutes) 6.0

The elapsed time at test cutoff was 8.0 minutes.

Results of the Analysis:

SAMPLE #1 Satisfactory
see SM20-5-15 y shaped
60-65 seconds

SAMPLE #2 Satisfactory
see SM20-5-15 Y shaped
120-125 seconds

SAMPLE #3 Satisfactory
see ~~SM20-15~~ - SM20-5-15
360-365 seconds y shaped

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		[illegible]	5-4-65	[illegible]		VERIFIED BY USAF [illegible]	5-19-65

FORM 608-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301-401

NAME OF TEST VIBRATION TEST NO. 209301 SHEET 54 OF 105

7.1.2.2.3.8 Propellant Valve Proof Pressure (Reference Paragraph 6.1)

Proof Pressure	Oxidizer Valve	Fuel Valve
Pressure (500 +10 -0)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes

Inspection Remarks: VISUALLY INSPECTED PROP VALVE AND CONNECTING TUBING WITH LEAK DETECTOR SOLUTION WHILE PART WAS PRESSURIZED WITH 300 PSIG HELIUM. NO LEAKAGE WAS NOTED ON EITHER FUEL OR OXIDIZER SYSTEMS

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams			3-17-65		3-17-65		3-17-65
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301-401

NAME OF TEST: VIBRATION TEST NO. 209301-401 SHEET 55 OF 105

7.1.2.2.3.9 Resonant Survey - Z Axis

Freq. cps	Input g's	Output g's	Identification (no.)
123	1	26	1099
210	1	11	1193
420	1	5	1099 & 1161
560	1	3	1193
1030	1	2.5	906
1305	1	2	1087

7.1.2.2.3.10 Vibration Table Equalization Test - Z Axis

Test No	Satisfactory Spectrum Shape	Satisfactory RMS G Level	Test Duration	Accumulated Duration
1	NO	yes	42 sec	42 sec
2	NO	yes	9 sec	51 sec
3	NO	yes	8 sec	59 sec
4	NO	YES	1.5 sec	1.5 sec
5	NO	[illegible]	[illegible]	[illegible]
6	NO	YES	[illegible]	[illegible]
7	NO	YES	5 sec	[illegible]
8	YES	YES	5 sec	[illegible]

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		[illegible]	3/12/65	[illegible]	3/12/65	[illegible]	
						VERIFIED BY USAF	DATE
						[illegible]	

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA. 209301-401

NAME OF TEST VIBRATION TEST NO. 209301 SHEET 56 OF 105.

7.1.2.2.3.11 Random Vibration Test-Z Axis

Acceleration outputs were recorded for analysis at the following elapsed times:

SAMPLE #1 (1 ±0.5 Minute) 1.0
SAMPLE #2 (3 ±0.5 Minutes) 3.0
SAMPLE #3 (6 ±0.5 Minutes) 6.0

The elapsed time at test cutoff was 5.0 minutes.

Results of the Analysis:

SAMPLE #1 Satisfactory
see 5M30-5-15 Z shaped
60-65 seconds

SAMPLE #2 Satisfactory
see 5M30-5-15 Z shaped
180-185 seconds

SAMPLE #3 Satisfactory
see 5M30-5-15 Z shaped
300-305 seconds

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		P. Foley	5-5-65	5-19-65			
						VERIFIED BY USAF	5-19-65 DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301

NAME OF TEST VIBRATION TEST NO. 209301-401 SHEET 56.1 OF 105

7.1.2.2.3.11.1 Post Hardware Condition

Injector No damage noted after visual insp.

Combustion Zone No damage noted after visual insp.

Throat Insert No damage noted after visual insp.

Nozzle No damage noted after visual insp.

Stainless Steel Shell No damage noted after visual insp.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R. Cole		[illegible]	3-22-65	[illegible]	3-22-65	VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301-401

NAME OF TEST VIBRATION TEST NO. 209301- SHEET 57 OF 105

7.1.2.2.3.12 Propellant Valve Proof Pressure and Leakage test (reference paragraph 6.1)

Oxidizer Valve

Proof Pressure

Pressure (500 $^{+10}_{-0}$)	500 psig	Leakage Voltage (26 ±0.5)	26.0 VDC
Time Duration (3 minimum)	3 minutes	Inlet Pressure (500 $^{+10}_{-0}$)	500 psig
Inlet Pressure (150 ±10)	150 psig	Time Duration (5 minimum)	5 minutes
Number of Cycles (3)	3 #	Leakage Rate (2.23 maximum)	<0.1 scc He/min

Inspection Remarks:

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		Frank Volpe	3/23/65	[illegible]	3-23-65	[illegible]	
						VERIFIED BY USAF	DATE
						[illegible]	

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301-401

NAME OF TEST VIBRATION TEST NO 209301-401 SHEET 58 OF 105

7.1.2.2.3.13 Propellant Valve Electrical Resistance Test (reference paragraph 6.3)

Environmental Temperature 75°F (70 ±10 F)

Resistance A - B

Oxidizer Valve 41.5 ohms (Acceptable per Figure 9, yes or no yes)

Resistance C - D (1.0 maximum)

Oxidizer Valve 0.12 ohms

Inspection Remarks * SUSPECTED TEST LEAD TARE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		3/23/65				VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. MAC 52-52701-285 NAA 209301-

NAME OF TEST VIBRATION TEST NO. 209301-401 SHEET 59 OF 105

7.1.2.2.3.14 Propellant Valve Dielectric Strength test (reference paragraph 6.4.).

	Oxidizer Valve	
	Voltage Volts 500 +10 -0	Current Microamps 500 max.
A to Ground	500	67
C to Ground	500	22
A to C	500	17

Inspection Remarks

NON

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams			3/23/65		3-23-65		
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301-401

NAME OF TEST VIBRATION TEST NO. 209301- SHEET 60 OF 105

7.1.2.2.3.15 Propellant Valve Functional test (reference paragraph 6.5)

Oxidizer Valve

Response Time

Ambient Temperature (70 ±10)	75°	F
Energizing Voltage (26 ±0.5)	26	VDC
Inlet Pressure (300 ±10 for "pull-in")	300	psig
Opening Time (0.021 maximum)	0.018	seconds
Inlet Pressure (zero for "drop-out")	0	psig
Closing Time (0.075 maximum)	.079	seconds DCN #2

Low Voltage Operation

Ambient Temperature (70 ±10)	71°	F
Inlet Pressure (300 ±10 for "pull-in")	300	psig
Opening Voltage (16 maximum)	11	VDC
Inlet Pressure (zero for "drop-out")	0	psig
Closing Voltage (1.0 minimum)	1.4	VDC

Inspection Remarks NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		[illegible]	3/24/65	[illegible]	3-24-65	[illegible]	
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F. Pope	735814	ENV.LAB.	2061	3-24-65

PART	PART NO.	TYPE OF TEST
100# OAMS TCA UNIT #1	209301 406410 4	POST VIBRATION

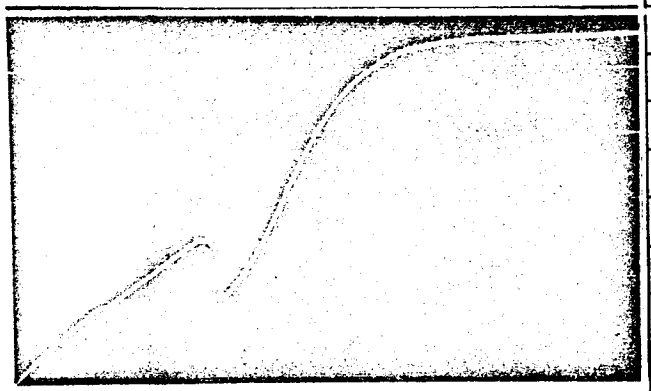
OXIDIZER VALVE

P/N 409404 S/N 9371280

CURRENT TRACE
(OPENING TIME)

Horizontal = 5ms/cm
Vertical = 10 mv/cm

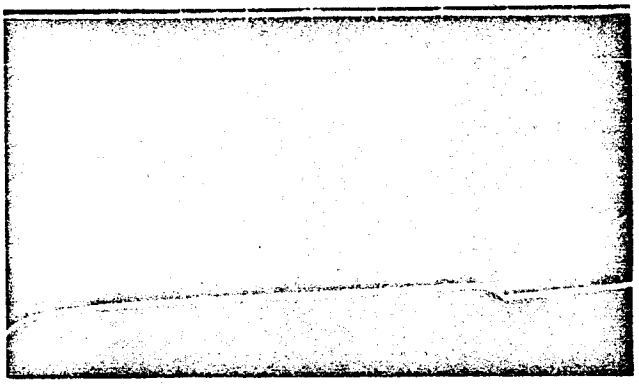
Requirement = .021 sec/max
Actual = .018 seconds



VOLTAGE TRACE (WITH DIODE)
(CLOSING TIME)

Horizontal = 10 ms/cm
Vertical = 200 mv/cm

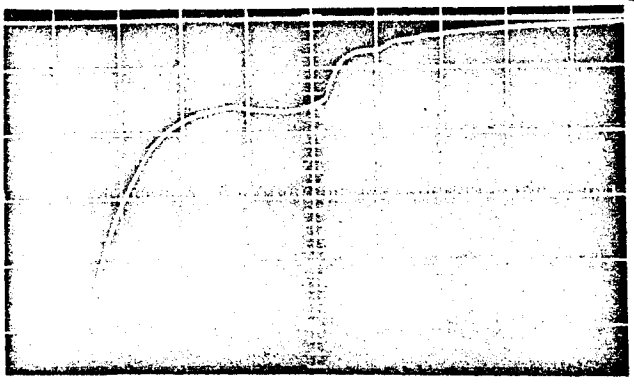
Requirement = .075 sec/max
* Actual = .079 sec



VOLTAGE TRACE (WITHOUT DIODE)
(CLOSING TIME)

Horizontal = 1 ms/cm
Vertical = 20 mv/cm

Requirement = .005 sec/max
* Actual = .0048 sec.



* Reference: IL 5388-6147

R-15019-2

Form 600-V-67 New 10-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301-401

NAME OF TEST VIBRATION TEST NO. 209301- SHEET 61 OF 105

7.1.2.2.3.16 Propellant Valve Proof Pressure and Leakage test (reference paragraph 6.1)

Fuel Valve

Proof Pressure

Pressure (500 $^{+10}_{-0}$)	500 psig	Leakage Voltage (26 ±0.5	26 VDC
Time Duration (3 minimum)	3 minutes	Inlet Pressure (500 $^{+10}_{-0}$)	500 psig
Inlet Pressure (150 ±10)	150 psig	Time Duration (5 minimum)	5 minutes
Number of Cycles (3)	3 #	Leakage Rate (2.23 maximum)	<0.1 scc He/min

Inspection Remarks:

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		[illegible]	3/24/65	[illegible]	3-24-65	[illegible]	
						VERIFIED BY USAF	DATE
						[illegible]	

FORM 608-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301-401

NAME OF TEST VIBRATION TEST NO. 209301-401 SHEET 62 OF 105

7.1.2.2.3.17 Propellant Valve Electrical Resistance Test (Reference paragraph 6.3)

Environmental Temperature 72° (70 ±10 F)

Resistance A -B

Fuel Valve 41.5 ohms (Acceptable per Figure 9, yes or no yes).

Resistance C - D (1.0 maximum)

Fuel Valve .06 ohms

Inspection Remarks NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		[illegible]	3/29/65	[illegible]	3-24-65	[illegible]	
						VERIFIED BY USAF	DATE
						[illegible]	3/25/65

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301-401

NAME OF TEST VIBRATION TEST NO 209301- SHEET 63 OF 105

7.1.2.2.3.18 Propellant Valve Dielectric Strength test (reference paragraph 6.4.)

	Fuel Valve	
	Voltage Volts 500 $^{+10}_{-0}$	Current Microamps 500 max.
A to Ground	500	63
C to Ground	500	21
A to C	500	17

Inspection Remarks

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		[signature]	3/24/65	[signature]	3-24-65	[signature]	
						VERIFIED BY USAF	DATE
						[signature]	3/24/65

FORM 608-B-39 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301-401

NAME OF TEST VIBRATION TEST NO. 209301- SHEET 64 OF 105

7.1.2.2.3 19 Propellant Valve Functional test (reference paragraph 6.5)

Fuel Valve

Response Time

Ambient Temperature (70 ±10)	74°	F
Energizing Voltage (26 ±0.5)	26	VDC
Inlet Pressure (300 ±10 for "pull-in")	300	psig
Opening Time (0.021 maximum)	.017	seconds
Inlet Pressure (zero for "drop-out")	0	psig
Closing Time (0.075 maximum)	.079	seconds PCP#3

Low Voltage Operation

Ambient Temperature (70 ±10)	73°	F
Inlet Pressure (300 ±10 for "pull-in")	300	psig
Opening Voltage (16 maximum)	10.5	VDC
Inlet Pressure (zero for drop-out")	0	psig
Closing Voltage (1.0 minimum)	1.4	VDC

Inspection Remarks NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR MCDONNELL	DATE
E. Adams		[illegible]	3/24/65	F. A. Hayden	3-24-65		
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

DEVELOPMENT LABORATORY TEST REPORT

PAGE ____ OF ____

LAB TEST NO. ____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F. POPE	735814	ENV. LAB.	2061	3-24-65

PART	PART NO.	TYPE OF TEST
100# OAMS TCA UNIT #1	209301 4064104	POST VIBRATION

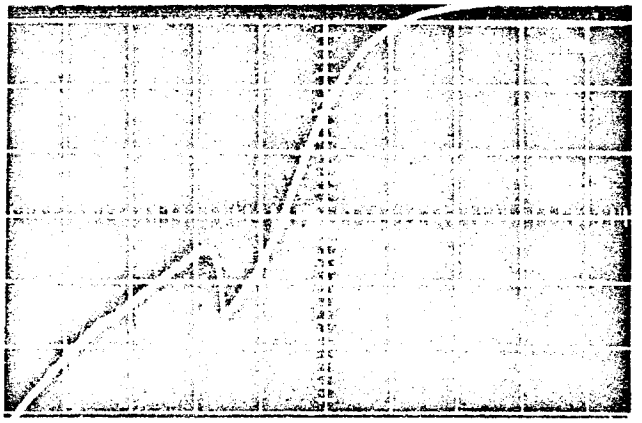
FUEL

P/N 409405 S/N 9362063

CURRENT TRACE
(OPENING TIME)

Horizontal = 5 ms/cm
Vertical = 10 mv/cm

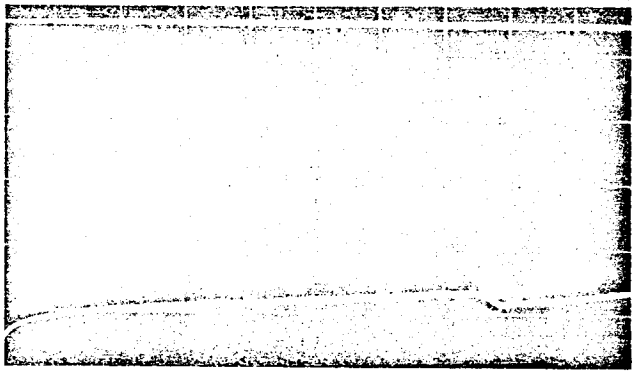
Requirement = .021 sec/max
Actual = .017



VOLTAGE TRACE (WITH DIODE)
(CLOSING TIME)

Horizontal = 10 ms/cm
Vertical = 200 mv/cm

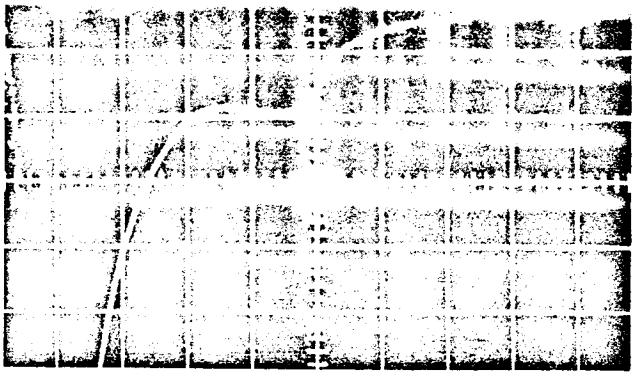
Requirement = .075 sec/max
* Actual = .079 sec



VOLTAGE TRACE (WITHOUT DIODE)
(CLOSING TIME)

Horizontal = 1 ms/cm
Vertical = 20 mv/cm

Requirement = .005 sec/max
* Actual = .0045 sec



* Reference: IL 5388-6147

R-15019-2

Form 600-W-67 New 10-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301-

NAME OF TEST VIBRATION TEST NO. 209301-401 SHEET 65 OF 105

7.1.2.2.3.20 Thrust Chamber Proof Pressure and Leakage test (reference paragraph 6.2)

Proof Pressure

	1st Application	2nd Application
Pressure (392+10)	395 psig	325 psig
Time Duration (3±.25)	3 minutes	3 minutes
Voltage (12.±2)	12 VDC	12 VDC

Inspection Remarks: NONE.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		[illegible]	3/25/65	[illegible]		[illegible]	
						VERIFIED BY USAF	DATE
						[illegible]	3/25

FORM 608-B-39 NEW 6-63

IL 5388-6135

INTERNAL LETTER
North American Aviation, Inc.

DATE 19 March 1965

TO Those Concerned
Address

FROM Gemini DAT Unit
Address D/896-388

SUBJECT Plan of Action - Deviation to Gemini DAT TCA Specification 209301-401

The mechanical shock test was originally scheduled for 100 lb TCA Unit #1 (P/N 209301, S/N 4064104). However TCA Unit #1 is not representative of the production configuration. This unit was modified at McDonnell, St. Louis, with a MAC nozzle extension.

The objective of the mechanical shock test is to verify that the customer shipping container for the Gemini 100 lb thrust chamber assemblies is structurally adeqaute to protect the production hardware from damage during transportation from Rocketdyne to McDonnell, St. Louis.

Therefore, it is proposed that 100 lb TCA, P/N 209301, S/N 4066382, be substituted to complete the mechanical shock test requirement. The TCA shall be designated as Unit #1A. (Spare DAT TCA hardware.)

Post shock functional tests will be performed with propropellant valve inlet adapters supplied by manufacturing.

R. Cole
R. Cole
Gemini DAT Unit

Approved: R G Eide
R. G. Eide
Supervisor
Gemini DAT Unit

For James D. Mavrogenis
S. Scott
MAC Engineering

FORM R 18-0-4

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301-401

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301-SHEET 66 OF 105

Reference: MAC SCD 52-52701, Revision H, Paragraph 6.2.3.16

7.1.3 Shock - TCA #1A

7.1.3.1 Test Procedure

7.1.3.1.1 Place the TCA into its shipping container per RA0616-008. Then install the container into the shock test facility. The direction of shock input shall be along the + X Axis of the TCA (see Figure 7). A

7.1.3.1.2 Apply a half sine wave shock of 15 $^{+1.5}_{-0}$ g magnitude and 11 $\pm$1.0 milliseconds duration to the TCA. The shock magnitude and duration shall be monitored by an oscilloscope and the trace recorded with a Polaroid camera.

7.1.3.1.3 Repeat paragraph 7.1.3.1.2 two times for a total of three shocks.

7.1.3.1.4 Repeat paragraphs 7.1.3.1.1 through 7.1.3.1.3 for the -X Axis of the TCA. Inspect the TCA for visible evidence of damage following the completion of shock applications.

7.1.3.1.5 Repeat paragraphs 7.1.3.1.1 through 7.1.3.1.4 for the Y Axis of the TCA.

7.1.3.1.6 Repeat paragraphs 7.1.3.1.1 through 7.1.3.1.4 for the Z Axis of the TCA.

7.1.3.1.7 Perform Propellant Valve Proof Pressure and Leakage per paragraph 6.1 on the oxidizer valve.

PREPARED BY: DATE	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
E. Adams	R. Heide 1-6-65	James D. Mavrogenis 3/4/65
CHECKED BY: DATE		
[illegible] 12-31-64		

FORM 608-B-38 NEW 6-63

Rev. J. D. Mavrogenis Date 3/25/65

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301-[illegible]

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301-401 SHEET 67 OF 105

7.1.3.1.8	Perform Propellant Valve Electrical Resistance per paragraph 6.3 on the oxidizer valve.
7.1.3.1.9	Perform Propellant Valve Dielectric Strength per paragraph 6.4 on the oxidizer valve.
7.1.3.1.10	Perform Propellant Valve Functional per paragraph 6.5 on the oxidizer valve.
7.1.3.1.11	Repeat paragraphs 7.1.3.1.7 through 7.1.2.1.10 on the fuel propellant valve.
7.1.3.1.12	Perform Thrust Chamber Proof Pressure and Leakage Test per paragraph 6.2.
7.1.3.1.13	Perform Visual Inspection.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
E. Adams		B. Heide	1-6-65	James D. Mavrogenis	3/4/65
CHECKED BY:	DATE				
[illegible]	12-31-64				

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301-401

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301 SHEET 68 OF 105

7.1.3.2 Test Data - TCA #1A

7.1.3.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52701-285

Rocketdyne Part No. 209301

Component Serial No. 0061265

7.1.3.2.2 Shock Test (Reference Paragraph 7.1.3.1)

Magnitude 15 $^{+1.5}_{-0}$ g's	Duration 11 ±1.0 milliseconds
+X Axis	
16G	11.4 m sec
15.5G	11.4 m sec
15.3G	11.4 m sec
-X Axis	
15.1 G	11.5 m sec
15.0 G	11.5 m sec
15.0 G	11.5 m sec

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams							
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301-

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301-401 SHEET 69 OF 105

7.1.3.2.2 (cont'd) Shock Test (Reference Paragraph 7.1.3.1)

Magnitude $15^{+1.5}_{-0}$ g's	Duration 11 ±1.0 milliseconds	Magnitude $15^{+1.5}_{-0}$ g's	Duration 11 ±1.0 milliseconds
+Y Axis		+ Z Axis	
15.0 G	11.2 M SEC (ANR 585)	15.0 G	11.1 M SEC (ANR 585)
15.2 G	11.2 M SEC (ANR 585)	15.1 G	11.1 M SEC (ANR 585)
16.0 G	11.2 M SEC (ANR 585)	15.9 G	11.1 M SEC (ANR 585)
- Y Axis		-Z Axis	
15.2 G	11.3 M SEC (ANR 585)	15.0 G	11.2 M SEC (ANR 585)
15.0 G	11.3 M SEC (ANR 585)	15.1 G	11.2 M SEC (ANR 585)
15.0 G	11.3 M SEC (ANR 585)	15.2 G	11.2 M SEC (ANR 585)

Inspection Remarks: (ANR 585) NO VISIBLE DAMAGED NOTED

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		V. Davis		(ANR 585) [signature]		WAIVED BY T. A. MARGENIS (ANR 585)	
						VERIFIED BY USAF	DATE
						C. F. Wack	

FORM 608-B-39 NEW 6-63
R-15019-2

ROCKETDYNE DEVELOPMENT LABORATORY .
SHOCK TEST DATA SHEET

Page 1 of 2
Lab Test No. SK20-11-13

Prepared by	EWR No.	Facility	Date
V. DAVIS.	735814	CANO	4-2-65

Part	Part No.	Serial No.
T.G.A. 100LB.	209301	4066382

Metering Pin Data

Hyge Unit 6401
Acceleration 15G+-10%
Acc. Waveshape HALF-SINE
Acc. Time 11MSEC.+-1MSEC.

Accelerated Mass

a. Specimen and fixture 45.0 lbs.
b. Carriage 30.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 125.0 lbs.

Hydraulic Fluid Level

a. 150 cc ~~inches~~ as measured down from top of top cylinder.
b.

Operational Data

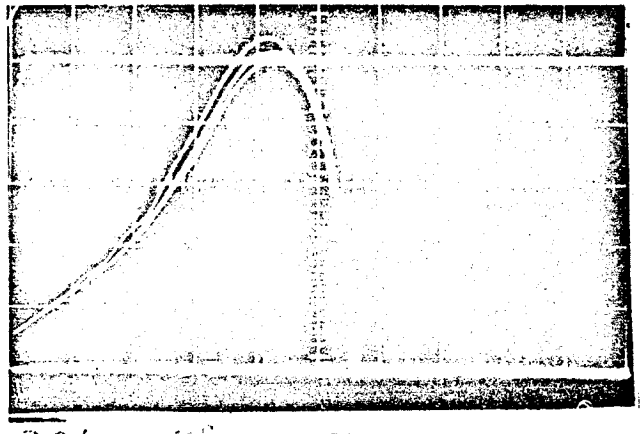
Set Pressure 15.5 psig
Firing Pressure 375.0 psig
Brake Pressure 50 psig
Accumulator Pressure psig

Deceleration Orifice Position

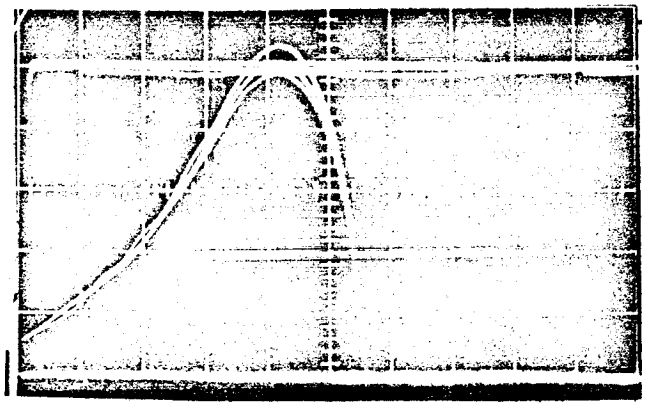
a. Contour side up
b. ✓ Contour side down

Calibration

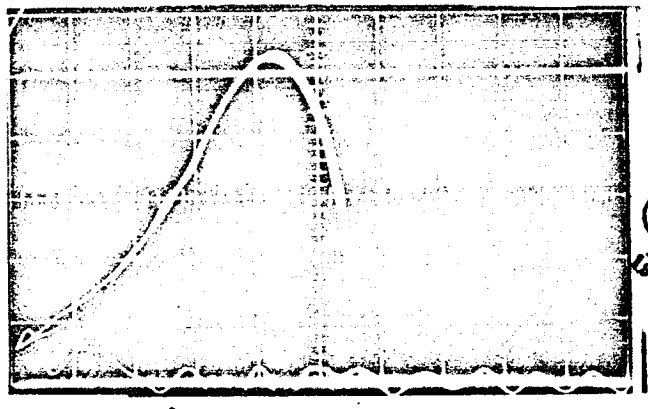
Vertical (G's/square) 3
Horizontal (MS/square) 2
Accelerometer
STATHAMASTE-50-350



3 Shocks +X AXIS



3 Shocks +Y AXIS



3 Shocks +Z AXIS

Remarks: NO VISIBLE DAMAGE

R-15019-2

Form 600-V-69 New 3-64

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Page 2 of 2
Lab Test No. 5K20-12-13

Prepared by	EWR No.	Facility	Date
V. DAVIS	730-814	CANO	4-2-65

Part	Part No.	Serial No.
T.C.A. 1001B.	209301	4066382

Metering Pin Data

Hyge Unit 6401
Acceleration 15G +- 10%
Acc. Waveshape HALF-SINE
Acc. Time 11 M.SEC +- 1 M.SEC.

Accelerated Mass

a. Specimen and fixture 45.9 lbs.
b. Carriage 80.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 175.9 lbs.

Hydraulic Fluid Level

a. 150 ~~inches~~ CC as measured down from top of top cylinder.
b.

Operational Data

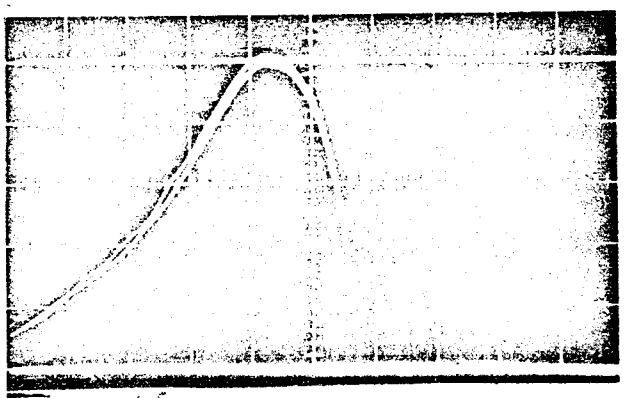
Set Pressure 155 psig
Firing Pressure 275 psig
Brake Pressure 50 psig
Accumulator Pressure psig
(Alternate Firing)

Deceleration Orifice Position

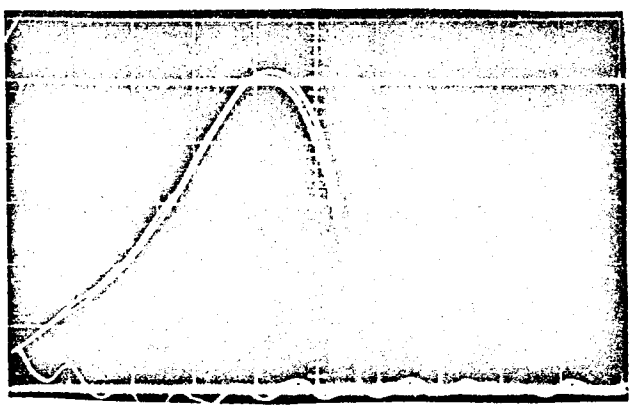
a. Contour side up
b. ✓ Contour side down

Calibration

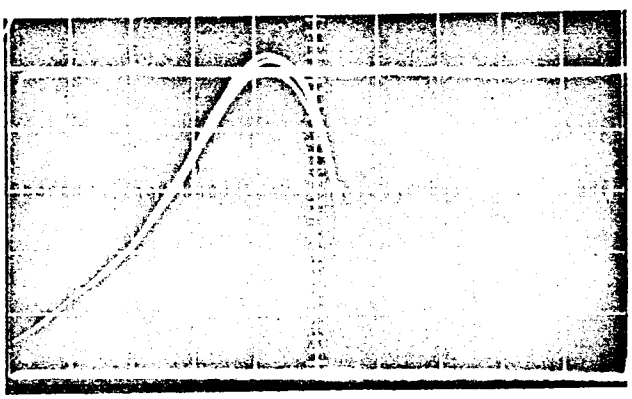
Vertical (G's/square) 3
Horizontal (MS/square) 2
Accelerometer
STATHAM ASTC-50-350



3 Shocks — X AXIS



3 Shocks — Y AXIS



3 Shocks — Z AXIS

Remarks: NO VISIBLE DAMAGE

Form 600-V-69 New 3-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301-

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301-401 SHEET 70 OF 105

7.1.3.2.3. Propellant Valve Proof Pressure and Leakage test (reference paragraph 6.1)

Oxidizer Valve

Proof Pressure

Pressure (500 $^{+10}_{-0}$)	500 psig	Leakage Voltage (26 ±0.5)	26 VDC
Time Duration (3 minimum)	5 minutes	Inlet Pressure (500 $^{+10}_{-0}$)	500 psig
Inlet Pressure (150 ±10)	150 psig	Time Duration (5 minimum)	5 minutes
Number of Cycles (3)	3 #	Leakage Rate (2.23 maximum)	< 0.1 scc He/min

Inspection Remarks:

NONE.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		Frank Volpe	3/31/65	D. Mansum	3-31-65	J. D. MAVROGENIS	3-31-65
						VERIFIED BY USAF	DATE
						C. F. Ward	3/31/65

FORM 608-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. MAC 52-52701-285 / NAA 209301-401

NAME OF TEST MECHANICAL SHOCK TEST NO. 209201- SHEET 71 OF 105

7.1.3.2.4 Propellant Valve Electrical Resistance Test (reference paragraph 6.3)

Environmental Temperature 70 (70 ±10 F)

Resistance A - B

Oxidizer Valve 42 ohms (Acceptable per Figure 9, yes or no YES)

Resistance C - D

(1.0 maximum)

Oxidizer Valve * 0.01 ohms

Inspection Remarks * SUBTRACTED TEST LEAD TARE.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams			3/31/65		3-31-65		
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. MAC 52-52701-285 / NAA 209301-401

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301- SHEET 72 OF 105

7.1.3.2.5 Propellant Valve Dielectric Strength test (reference paragraph 6.4.).

	Oxidizer Valve	
	Voltage Volts 500 +10 -0	Current Microamps 500 max.
A to Ground	500	144
C to Ground	500	8
A to C	500	4

Inspection Remarks

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		Frank Kupa	3/31/65	[illegible]	3-31-65	[illegible]	
						VERIFIED BY USAF	DATE
						C. F. Wood	3/31/65

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301-101

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301-101 SHEET 73 OF 105

7.1.3.2.6 Propellant Valve Functional test (reference paragraph 6.5)

Oxidizer Valve

Response Time

Ambient Temperature (70 ±10)	70°	F
Energizing Voltage (26 ±0.5)	26	VDC
Inlet Pressure (300 ±10 for "pull-in")	300	psig
Opening Time (0.021 maximum)	0.018	seconds
Inlet Pressure (zero for "drop-out")	ZERO	psig
Closing Time (0.075 maximum)	* 0.130 ~~0.044~~	seconds DCP#1

Low Voltage Operation

Ambient Temperature (70 ±10)	70°	F
Inlet Pressure (300 ±10 for "pull-in")	300	psig
Opening Voltage (16 maximum)	11.5	VDC
Inlet Pressure (zero for "drop-out")	ZERO	psig
Closing Voltage (1.0 minimum)	1.2	VDC

Inspection Remarks DONE * REPLACED FAULTY TEST
DONE. SEE DCP#1

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		Frank Volpe	3/31/65	[illegible]	3-31-65	WAIVED J. D. MAVROGENES	3-31-65
						VERIFIED BY USAF [illegible]	DATE

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

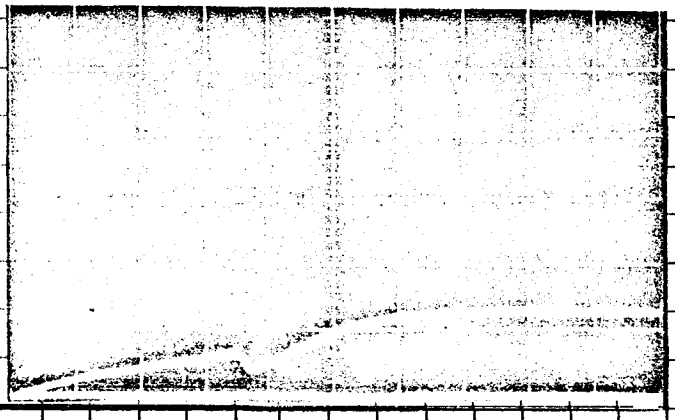
PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	735814	DEV.LAB.	2061	3-31-65

PART	PART NO.	TYPE OF TEST
100 OAMS TCA (Unit 1A)	209301 S/N 4066382	POST MECHANICAL SHOCK

OXIDIZER VALVE

P/N 409404 S/N 9371228

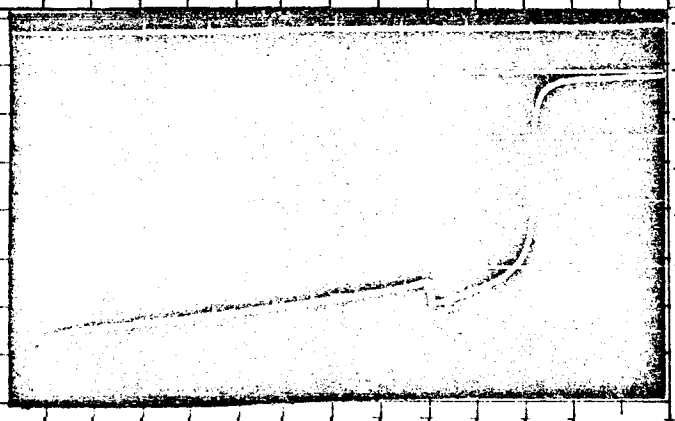
CURRENT TRACE
(Opening Time)



Horizontal = 5 ms/cm
Vertical = 50 mv/cm

Requirement = .021 sec/max
Actual = .018 sec

VOLTAGE TRACE
(Closing Time)



Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = .075 sec/max
* Actual = .130 sec.

* Reference OFR 12851R

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701- 285 / NAA 209301-401

NAME OF TEST MECHANICAL SHOCK TEST NO 209301- SHEET 74 OF 105

7.1.3.2.7 Propellant Valve Proof Pressure and Leakage test (reference paragraph 6.1)

Fuel Valve

Proof Pressure

Pressure (500 $^{+10}_{-0}$)	500 psig	Leakage Voltage (26 ±0.5	26 VDC
Time Duration (3 minimum)	5 minutes	Inlet Pressure (500 $^{+10}_{-0}$)	500 psig
Inlet Pressure (150 ±10)	150 psig	Time Duration (5 minimum)	5 minutes
Number of Cycles (3)	3 #	Leakage Rate (2.23 maximum)	< 0.1 scc He/min

Inspection Remarks:

None

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		Frank Vespa	3/31/65	[illegible]	3-31-65	[illegible]	3-31-65
						VERIFIED BY USAF	DATE
						C. T. Ward	[illegible]

FORM 608-B-39 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. MAC 52-52701-285 NAA 209301-

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301-401 SHEET 75 OF 105

7.1.3.2.8 Propellant Valve Electrical Resistance Test (Reference paragraph 6.3)

Environmental Temperature 70° (70 ±10 F)

Resistance A -B

Fuel Valve 43 ohms (Acceptable per Figure 9, yes or no YES).

Resistance C - D (1.0 maximum)

Fuel Valve * 0.01 ohms

Inspection Remarks *SUBTRACTED TEST LEAD TARE.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		[signature]	3/31/65	[signature]	3-31-65	[signature] T.D. [illegible]	3-31-65
						VERIFIED BY USAF	DATE
						[signature]	

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. MAC 52-52701-285 / NAA 209301-401

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301- SHEET 76 OF 105

7.1.3.2.9 Propellant Valve Dielectric Strength test (reference paragraph 6.4.)

	Fuel Valve	
	Voltage Volts 500 $^{+10}_{-0}$	Current Microamps 500 max.
A to Ground	500	54
C to Ground	500	6
A to C	500	3

Inspection Remarks

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		[signature]	3/31/65	[signature]	3-31-65	WAIVED J.D. MAVROMENIS	3-31-65
						VERIFIED BY USAF	DATE
						C. F. Wood	4/1/65

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. MAC 52-52701-285 / NAA 209301-401

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301-401 SHEET 77 OF 105

7.1.3.2.10 Propellant Valve Functional test (reference paragraph 6.5)

Fuel Valve

Response Time

Ambient Temperature (70 ±10)	70 F	
Energizing Voltage (26 ±0.5)	26 VDC	
Inlet Pressure (300 ±10 for "pull-in")	300 psig	
Opening Time (0.021 maximum)	.016.5 seconds	
Inlet Pressure (zero for "drop-out")	ZERO psig	
Closing Time (0.075 maximum)	0.075 seconds	3-31-65

Low Voltage Operation

Ambient Temperature (70 ±10)	68° F	4-1-65
Inlet Pressure (300 ±10 for "pull-in")	300 psig	
Opening Voltage (16 maximum)	10.5 VDC	
Inlet Pressure (zero for drop-out")	ZERO psig	
Closing Voltage (1.0 minimum)	1.5 VDC	

Inspection Remarks NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		[signature]	4/1/65	[signature]	4-1-65	WAIVED J.D. MAVROGENIS	4/1/65
						VERIFIED BY USAF [signature]	DATE

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE ____ OF ____

LAB TEST NO. ____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	735814	DEV.LAB.	2061	3-31-65

PART	PART NO.	TYPE OF TEST
100 OAMS TCA (Unit 1A) S/N 4066382	209301	POST MECHANICAL SHOCK

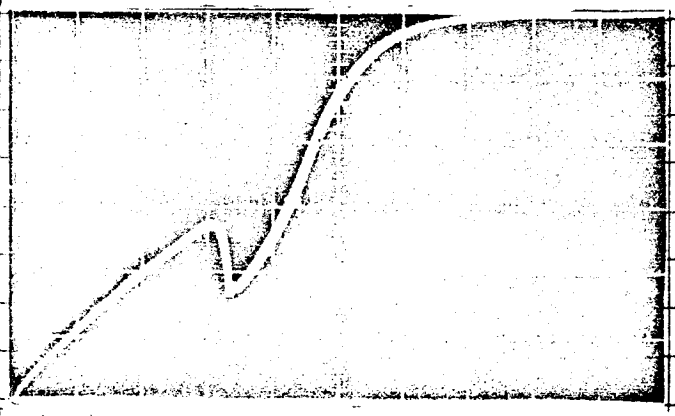
FUEL VALVE

P/N 409405 S/N 9362014

CURRENT TRACE
(Opening Time)

Horizontal = 5 ms/cm
Vertical = 10 mv/cm

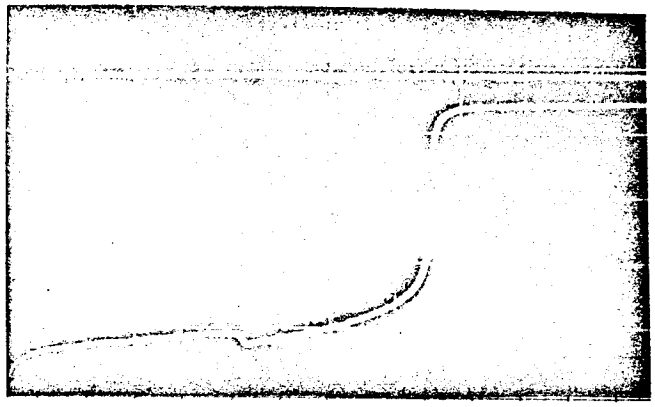
Requirement = .021 sec/max
Actual = .0165 sec.



VOLTAGE TRACE
(Closing Time)

Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = .075 sec/max
Actual = .075 sec



R-15019-2

Form 600-V-67 New 10-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301-

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301-401 SHEET 78 OF 105

7.1.3.2.11 Thrust Chamber Proof Pressure and Leakage Test
(Reference Paragraph 6.2)

	1st Application	2nd Application
Proof Pressure	395 psig	395 psig
Pressure (392 +10)		
Time Duration (3 +.25 -0)	3 minutes	3 minutes
Voltage (12 ±2)	12 VDC	12 VDC

Inspection Remarks: NO LEAKAGE.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		Frank Vo[illegible]	9/1/65	[illegible] Mangum	4-1-65	WAIVED J. D. MAVROGENIS	4/1/65
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

IL 538F-6189

INTERNAL LETTER
North American Aviation, Inc.

DATE 5 May 1965

TO Those Concerned
Address

FROM Gemini DAT Unit
Address D/896-388

SUBJECT Rerun of Mechanical Shock Test for 100 lb Gemini TCA, P/N 209301, S/N 4066382, per DAT Specification 209301-401

REFERENCE OFR and FAR 12851R

It is mutually agreed between McDonnell and Rocketdyne to rerun the mechanical shock test on subject TCA. The OFR action on the oxidizer propellant valve has brought it within acceptable limits.

Prior to the mechanical shock test, the propellant valve functional test (reference paragraph 6.5) will be run on both propellant valves to insure that the valves are within DAT specification limits. If the closing response times exceed the limit of .075 seconds with the diode (SR 417) in the electrical setup it will be considered a failure only if the closing response exceeds .005 seconds without the diode.

R. A. Cole
R. A. Cole
Gemini DAT Unit

Approved: R. G. Eide
R. G. Eide
Supervisor
Gemini DAT Unit

S. Scott
S. Scott
MAC Engineering

FORM R 113-G-4

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301-401

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301- SHEET ___ OF 105

7.1.3.2.6 Propellant Valve Functional test (reference paragraph 6.5)

Oxidizer Valve

Response Time

Ambient Temperature (70 ±10)	78° F
Energizing Voltage (26 ±0.5)	26.0 VDC
Inlet Pressure (300 ±10 for "pull-in")	308 psig
Opening Time (0.021 maximum)	0.018 seconds
Inlet Pressure (zero for "drop-out")	ZERO psig
Closing Time (0.075 maximum)	0.073 seconds

Low Voltage Operation

Ambient Temperature (70 ±10)	78° F
Inlet Pressure (300 ±10 for "pull-in")	308 psig
Opening Voltage (16 maximum)	12.0 VDC
Inlet Pressure (zero for "drop-out")	ZERO psig
Closing Voltage (1.0 minimum)	1.55 VDC

Inspection Remarks NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams			5-7-65			VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

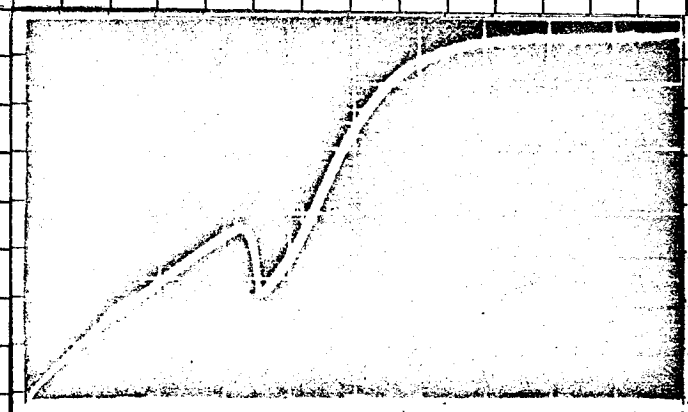
PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	735814	DEV.LAB	2061	5-7-65

PART	PART NO.	TYPE OF TEST
100# OAMS TCA(Unit 1A)	209301 S/N 4066382	PRE-MECHANICAL SHOCK(RERUN)

OXIDIZER VALVE

P/N 409404 S/N 9371228

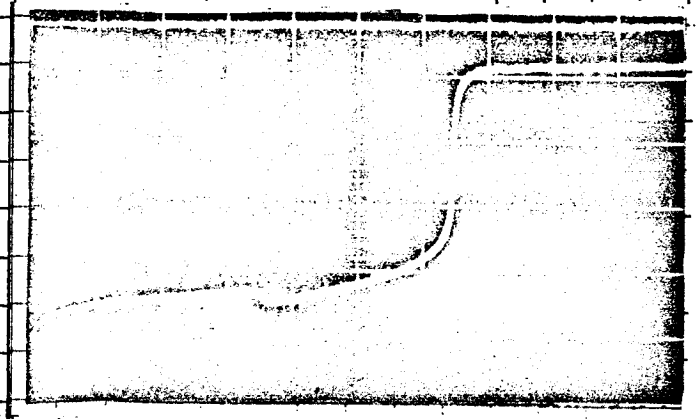
CURRENT TRACE
(OPENING TIME)



Horizontal = .5 ms/cm
Vertical = 10 mv/cm

Requirement = .021 sec/max
Actual = .018

VOLTAGE TRACE
(CLOSING TIME)



Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = .075 sec/max
Actual = .073 sec

R-15019-2

Form 600-V-67 New 10-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. MAC 52-52701-285 NAA 209301-401

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301- SHEET ___ OF 105

7.1.3.2.10 Propellant Valve Functional test (reference paragraph 6.5)

Fuel Valve

Response Time

Ambient Temperature (70 ±10)	77° F
Energizing Voltage (26 ±0.5)	26.0 VDC
Inlet Pressure (300 ±10 for "pull-in")	305 psig
Opening Time (0.021 maximum)	0.016 seconds
Inlet Pressure (zero for "drop-out")	ZERO psig
Closing Time (0.075 maximum)	0.080 seconds WITHOUT DIODE = 0.0042 SECONDS *

Low Voltage Operation

Ambient Temperature (70 ±10)	78° F
Inlet Pressure (300 ±10 for "pull-in")	302 psig
Opening Voltage (16 maximum)	10.4 VDC
Inlet Pressure (zero for drop-out")	ZERO psig
Closing Voltage (1.0 minimum)	1.4 VDC

Inspection Remarks * NOTE: CLOSING "DROP-OUT" TIME WITHIN LIMITS PER IL 5388-6189 "WITHOUT DIODE."

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		[signature]	[illegible]	[signature]		[signature]	
						VERIFIED BY USAF [signature]	DATE 1/7/65

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE ____ OF ____

LAB TEST NO. ____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F. Pope	735814	DEV. Lab	2061	5-7-65

PART	PART NO.	TYPE OF TEST
100# OAMS TCA(Unit 1A)	209301 S/N 4066382	PRE-MECHANICAL SHOCK (RERUN)

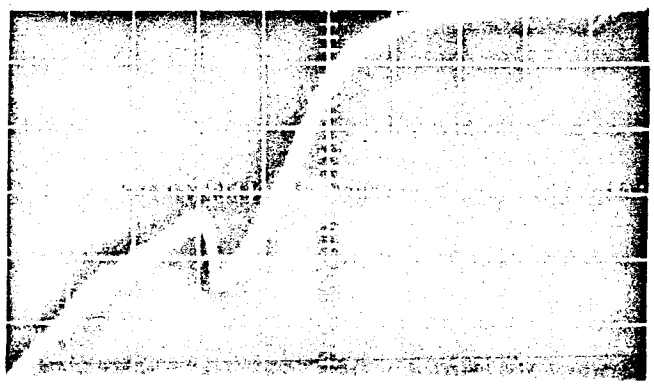
FUEL VALVE

P/N 409405 S/N 9362014

CURRENT TRACE
(OPENING TIME)

Horizontal = 5 ms/cm
Vertical = 10 mv/cm

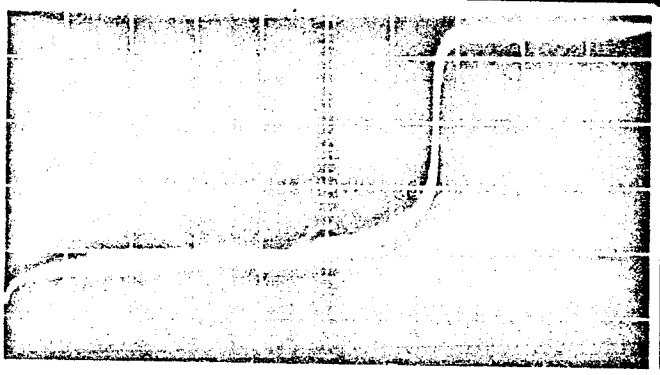
Requirement = .021 sec/max
Actual = .016 sec



VOLTAGE TRACE (With Diode)
(CLOSING TIME)

Horizontal = 20 ms/cm
Vertical = 200 mv/cm

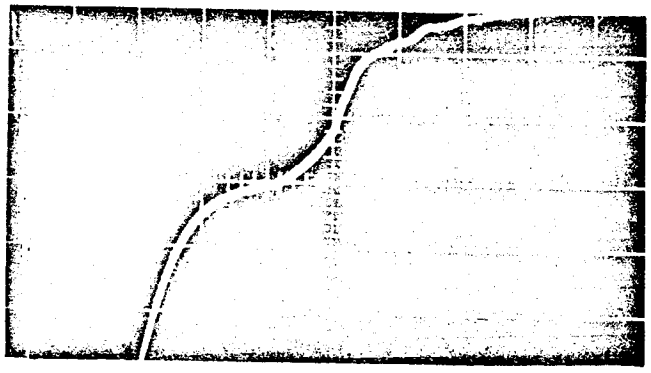
Requirement = .075
* Actual = .080



VOLTAGE TRACE (Without Diode)
(CLOSING TIME)

Horizontal = 1 ms/cm
Vertical = 20 mv/cm

Requirement = .005 sec/max
*Actual = .0042



* Reference IL 5388-6189

R-15019-2

Form 600-V-67 New 10-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301-401

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301 SHEET 68 OF 105

7.1.3.2 Test Data - TCA #1 A

7.1.3.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52701-285

Rocketdyne Part No. 209301

Component Serial No. 4066382

7.1.3.2.2 Shock Test (Reference Paragraph 7.1.3.1)

Magnitude 15 $^{+1.5}_{-0}$ g's	Duration 11 ±1.0 milliseconds
+X Axis	
15	10.9
15	10.9
15	10.9
-X Axis	
15.5	10.5
15	10.5
14.5	10.5

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		E. Adams	5-11-65	J. Kaye	5-11-65	WAIVED BY S. SCOTT	5-11-65
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301-401

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301 SHEET 69 OF 105

7.1.3.2.2 (cont'd) Shock Test (Reference Paragraph 7.1.3.1)

Magnitude $15^{+1.5}_{-0}$ g's	Duration 11 ±1.0 milliseconds	Magnitude $15^{+1.5}_{-0}$ g's	Duration 11 ±1.0 milliseconds
+Y Axis		+ Z Axis	
14.8	11	15	11.2
14.5	11	15	10.2
14.5	11	15	11.2
- Y Axis		-Z Axis	
15	10.9	15	10.5
14.5	10.9	14.7	11
14	10.9	14.7	11

Inspection Remarks: NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		E. Adams	5-11-65	E. Kaye	5-11-65	WAIVED BY S. Scott	5-11-65
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

R-15019-2

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Page 1 of 2
Lab Test No. [illegible]

Prepared by	EWR No.	Facility	Date
Y DAVIS	735814	CANC	5-11-65

Part	Part No.	Serial No.
TCA #1C	209301	4066382

Metering Pin Data

Hyge Unit 6401
Acceleration 15G+-10%
Acc. Waveshape HALF-SINE
Acc. Time 11MSEC+-1MSEC.

Hydraulic Fluid Level

a. 100 ~~inches~~ CC as measured down from top of top cylinder.
b.

Deceleration Orifice Position

a. ____ Contour side up
b. ✓ Contour side down

Calibration

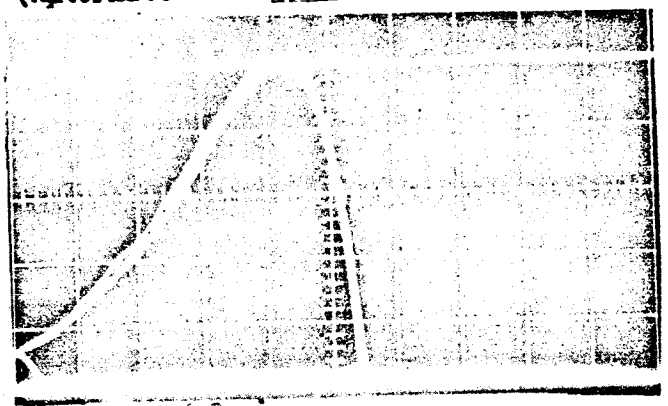
Vertical (G's/square) 3
Horizontal (MS/square) 2
Accelerometer SIN 7030
[illegible] ASTC-50-35C

Accelerated Mass

a. Specimen and fixture 105.0 lbs.
b. Carriage 30.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 185.0 lbs.

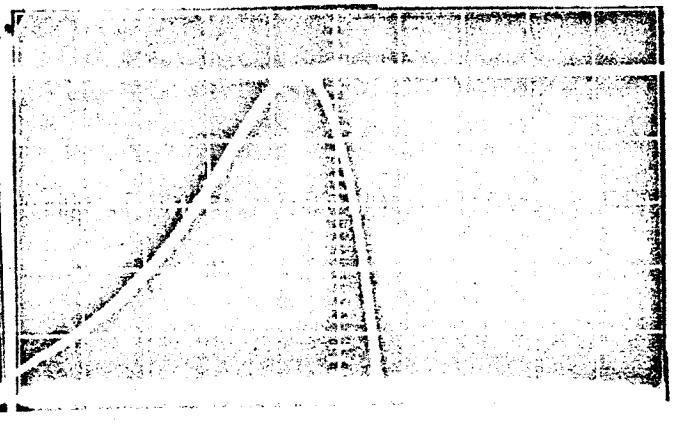
Operational Data

Set Pressure 20 psig
Firing Pressure 475 psig
Brake Pressure 75 psig
Accumulator Pressure ____ psig
(Alternate Firing)



3 SHOCKS +X AXIS

3 SHOCKS +Y AXIS



3 SHOCKS +Z AXIS

Remarks: NO VISIBLE DAMAGE

R-15019-2

Form 600-V-69 New 3-64

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Page 1 of 1
Lab Test No. [illegible]

Prepared by	EWR No.	Facility	Date
V. DAVIS	735814	CANO	5-11-65

Part	Part No.	Serial No.
TCA 100 #	209301	4066382

Metering Pin Data

Hyge Unit 401
Acceleration 15 G+-10%
Acc. Waveshape HALF-SINE
Acc. Time 11 MSEC+-1 MSEC.

Hydraulic Fluid Level

a. 11 1/2 inches as measured down from top of top cylinder.
b. _____

Deceleration Orifice Position

a. _____ Contour side up
b. ✓ Contour side down

Calibration

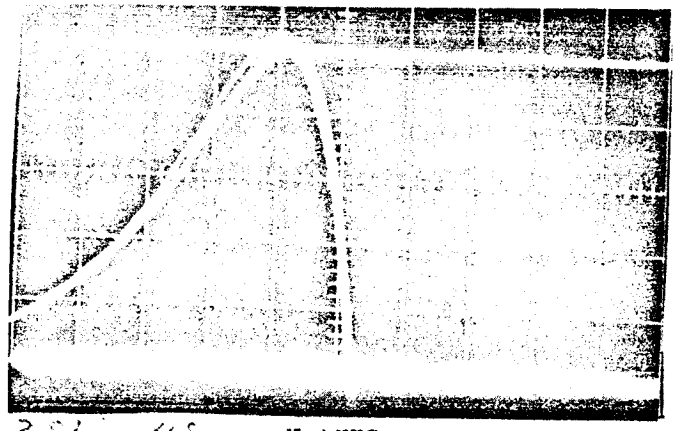
Vertical (G's/square) 3
Horizontal (MS/square) 2
Accelerometer [illegible]
STATHAM ASTC-50-350

Accelerated Mass

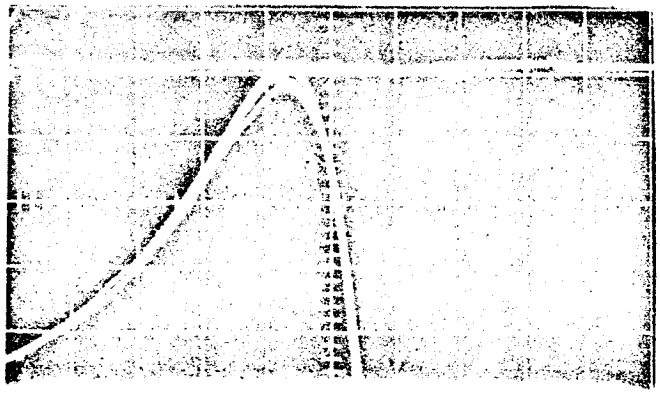
a. Specimen and fixture 105.0 lbs.
b. Carriage 30.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 185 lbs.

Operational Data

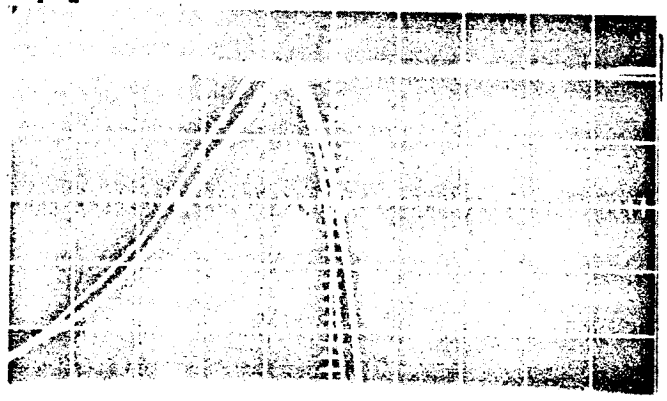
Set Pressure 20 psig
Firing Pressure 425 psig
Brake Pressure 25 psig
Accumulator Pressure _____ psig



3 SHOCKS —X AXIS



3 SHOCKS —Y AXIS



3 SHOCKS — Z AXIS

Remarks: NO VISIBLE DAMAGE

R-15019-2

Form 600-V-69 New 3-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301-

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301-401 SHEET 70 OF 105

7.1.3.2.3 Propellant Valve Proof Pressure and Leakage test (reference paragraph 6.1)

Oxidizer Valve

Proof Pressure

Pressure (500^{+10}_{-0})	500 psig	Leakage Voltage (26 ±0.5)	26 VDC
Time Duration (3 minimum)	3 minutes	Inlet Pressure (500^{+10}_{-0})	500 psig
Inlet Pressure (150 ±10)	150 psig	Time Duration (5 minimum)	5 minutes
Number of Cycles (3)	3 #	Leakage Rate (2.23 maximum)	< 0.1 scc He/min

Inspection Remarks:

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		[signature]	5/13/65	[signature]	5-13-65	WAIVED BY S. SCOTT 5-13-65	
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. MAC 52-52701-285 NAA 209301-401

NAME OF TEST MECHANICAL SHOCK TEST NO. 209201- SHEET 71 OF 105

7.1.3.2.4 Propellant Valve Electrical Resistance Test (reference paragraph 6.3)

Environmental Temperature 70 (70 ±10 F)

Resistance A - B

Oxidizer Valve 41.31 ohms (Acceptable per Figure 9, yes or no YES)

Resistance C - D (1.0 maximum)

Oxidizer Valve 0.01 ohms

Inspection Remarks NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		[illegible]	5/13/65	[illegible]	5-13-65	WAIVED BY G. SCOTT	5-13-65
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. MAC 52-52701-285 NAA 209301-401

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301- SHEET 72 OF 105

7.1.3.2.5 Propellant Valve Dielectric Strength test (reference paragraph 6.4.).

	Oxidizer Valve	
	Voltage Volts 500 $^{+10}_{-0}$	Current Microamps 500 max.
A to Ground	500	52
C to Ground	500	57
A to C	500	20

Inspection Remarks

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		Fred Moeller	5/13/65	D. Kaye	5-13-65	WAIVED BY S SCOTT	5-13-65
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301-401

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301- SHEET 73 OF 105

7.1.3.2.6 Propellant Valve Functional test (reference paragraph 6.5)

Oxidizer Valve

Response Time

Ambient Temperature (70 ±10)	70° F	
Energizing Voltage (26 ±0.5)	26 VDC	
Inlet Pressure (300 ±10 for "pull-in")	300 psig	
Opening Time (0.021 maximum)	0.018 seconds	
Inlet Pressure (zero for "drop-out")	ZERO psig	
Closing Time (0.075 maximum)	0.075 seconds	

Low Voltage Operation

Ambient Temperature (70 ±10)	70° F	
Inlet Pressure (300 ±10 for "pull-in")	300 psig	
Opening Voltage (16 maximum)	11.7 VDC	
Inlet Pressure (zero for "drop-out")	ZERO psig	
Closing Voltage (1.0 minimum)	1.65 VDC	

Inspection Remarks NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		[signature]	5-13-65	[signature]	5-13-65	WAIVED BY S. SCOTT	5-13-65
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F. Pope	735814	DEV. LAB.	2061	5-13-65

PART	PART NO.	TYPE OF TEST
100# OAMS TCA (Unit 1A) S/N 4066382	209301	POST MECHANICAL SHOCK

OXIDIZER VALVE

P/N 409404 S/N 9371228

CURRENT TRACE
(OPENING TIME)

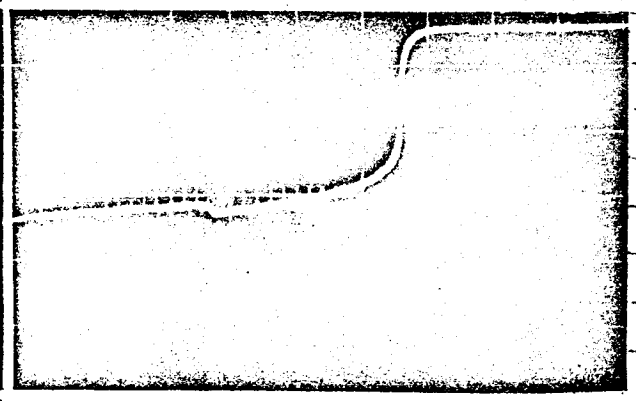
Horizontal = 5 ms/cm
Vertical = 10 mv/cm

Requirement = .021 sec/max
Actual = .018

VOLTAGE TRACE
(CLOSING TIME)

Horizontal = 20 ms/cm
Vertical = 200 mv/sm

Requirement = .075 sec/max
Actual = .075 sec



R-15019-2

Form 600-V-67 New 10-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701- 285 / NAA 209301-401

NAME OF TEST MECHANICAL SHOCK TEST NO 209301- SHEET 74 OF 105

7.1.3.2.7 Propellant Valve Proof Pressure and Leakage test (reference paragraph 6.1)

Fuel Valve

Proof Pressure

Pressure (500 $^{+10}_{-0}$)	500 psig	Leakage Voltage (26 ±0.5	26 VDC
Time Duration (3 minimum)	3 minutes	Inlet Pressure (500 $^{+10}_{-0}$)	500 psig
Inlet Pressure (150 ±10)	150 psig	Time Duration (5 minimum)	5 minutes
Number of Cycles (3)	3 #	Leakage Rate (2.23 maximum)	< 0.1 scc He/min

Inspection Remarks:

None

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E. Adams		[illegible]	5/13/65	[illegible]	5-13-65	WAIVED BY S. SCOTT	5-13-65
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. MAC 52-52701- 285 / NAA 209301-

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301-401 SHEET 75 OF 105

7.1.3.2.8 Propellant Valve Electrical Resistance Test (Reference paragraph 6.3)

Environmental Temperature 70 (70 ±10 F)

Resistance A -B

Fuel Valve 42.81 ohms (Acceptable per Figure 9, yes or no YES).

Resistance C - D
(1.0 maximum)

Fuel Valve 0.01 ohms

Inspection Remarks None

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		[illegible] Mueller	5/13/65	[illegible]	5-13-65	WAIVED BY G. SCOTT	5-13-65
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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. MAC 52-52701-285 NAA 209301-

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301-401 SHEET 76 OF 105

7.1.3.2.9 Propellant Valve Dielectric Strength test (reference paragraph 6.4.)

	Fuel Valve	
	Voltage Volts 500 $^{+10}_{-0}$	Current Microamps 500 max.
A to Ground	500	43
C to Ground	500	58
A to C	500	24

Inspection Remarks

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		Fred Moeller 5/13/65		J. Kaye 5-13-65		WAIVED BY S. SCOTT 5-13-65	
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. MAC 52-52701-285 / NAA 209301-[illegible]

NAME OF TEST MECHANICAL SHOCK TEST NO. 209301-401 SHEET 77 OF 105

7.1.3.2.10 Propellant Valve Functional test (reference paragraph 6.5)

	Fuel Valve
Response Time	
Ambient Temperature (70 ±10)	70° F
Energizing Voltage (26 ±0.5)	26 VDC
Inlet Pressure (300 ±10 for "pull-in")	300 psig
Opening Time (0.021 maximum)	0.017 seconds
Inlet Pressure (zero for "drop-out")	ZERO psig
Closing Time (0.075 maximum)	* 0.078 seconds * WITHOUT DIODE 0.0038 SECONDS
Low Voltage Operation	
Ambient Temperature (70 ±10)	70° F
Inlet Pressure (300 ±10 for "pull-in")	300 psig
Opening Voltage (16 maximum)	10.5 VDC
Inlet Pressure (zero for drop-out")	ZERO psig
Closing Voltage (1.0 minimum)	1.6 VDC

Inspection Remarks * CLOSING "DROP-OUT" TIME WITHIN LIMITS PER IL 5389-6189 WITHOUT DIODE.

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E. Adams		[signature]	5-13-65	[signature]	5-13-65	WAIVED BY S. SCOTT	5-13-65
						VERIFIED BY USAF [signature]	DATE

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ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301-401

NAME OF TEST: MECHANICAL SHOCK TEST NO. 209301 SHEET 78 OF 105

7.1.3.2.11 Thrust Chamber Proof Pressure and Leakage Test
(Reference Paragraph 6.2)

Proof Pressure

	1st Application	2nd Application
Pressure (392 +10)	392 psig	392 psig
Time Duration (3 +.25 -0)	3 minutes	3 minutes
Voltage (12 ±2)	12 VDC	12 VDC

Inspection Remarks: No LEAKAGE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		[illegible]	5/13/65	[illegible]	5-13-65	S. Scott	5-13-65
						VERIFIED BY USAF	DATE

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301 }

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 209301-401 SHEET 79 OF 105

Reference:	MAC SCD 52-52701, Revision H, paragraph 6.3.1.3.2.2
7.1.4	DAT Duty Cycle to Guaranteed Life - TCA #1
7.1.4.1	Test Procedure
7.1.4.1.1	Perform Cape Cycle Firing Test per paragraph 6.7.
7.1.4.1.2	Perform the DAT Duty Cycle Firing Test per paragraph 6.7, and Table II with propellant temperature of 160 $\pm 10^{\circ}$ F and a TCA environmental temperature of 200 $\pm 10^{\circ}$ F.
	NOTE: Prior to the start of the MDC the throat skin temperatures will be held at 200 $\pm 10^{\circ}$ F for at least sixty minutes.
7.1.4.1.2.1	The TCA shall demonstrate specification performance to 557 seconds and operate to 757 seconds without catastrophic failure. Catastrophic failure is defined in Table II, Note 4.
7.1.4.1.2.2	Following the termination at the firing, the TCA shall be maintained at altitude conditions during the soakout period. Monitor and record temperature every two minutes during soakout period.
7.1.4.1.3	Perform decontamination per paragraph 6.8.
7.1.4.1.4	Record post condition of TCA using a borescope.
7.1.4.1.5	Perform Weight Determination per paragraph 6.6.
7.1.4.1.6	Reduce data per RA0220-444.

PREPARED BY: DATE	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
R. Cole	[illegible] 3-16-65	James D. Morgan 3/16/65
CHECKED BY: DATE		
[illegible]		

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 209301-401 SHEET 80 OF 105

7.1.4.1.6.1	The results of significant data shall include but not be limited to the following:
7.1.4.1.6.1.1	Graphical presentation of temperature versus time for all TCA thermocouple locations.
7.1.4.1.6.1.1.1	The average temperature shall be used only when 500 F is not exceeded by the TCA.
7.1.4.1.6.1.1.2	Each individual temperature shall be plotted starting at the elapsed time when 500 F is first exceeded.
7.1.4.1.6.1.1.3	In addition to the average temperature each individual temperature shall be presented at the end of the minimum duration time period.
7.1.4.1.6.1.1.4	Dotted lines shall be used after TCA cutoff.
7.1.4.2.6.1.2	Graphical presentation of thrust versus time.
7.1.4.1.6.1.3	Graphical presentation of oxidizer flowrate versus time.
7.1.4.1.6.1.4	Graphical presentation of fuel flowrate versus time.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R.Cole		[signature]	3-16-65	James D. Mavrogenis	3/16/65
CHECKED BY: [signature]	DATE				

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 209301-401 SHEET 81 OF 105

7.1.4.2 Test Data - TCA #1

7.1.4.2.1 Component Identification

Component Name THRUST CHAMBER ASSEMBLY

McDonnell Part No. [illegible] 4/5/65

Rocketdyne Part No. [illegible]

Component Serial No. [illegible]

Accumulated Acceptance Test Firing Time, seconds 16 SEC.

	Pretest		Posttest	
Throat Diameter, inches (four measurements) 4/5/65	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
Nozzle Exit Diameter, inches	[illegible]		[illegible]	

7.1.4.2.2 Propellant Samples

4/5/65	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	4/5/65	4/5/65
Sample Batch Number	[illegible]	[illegible]
Sample Temperature, F	[illegible]	[illegible]
Sample Specific Gravity	[illegible]	[illegible]
Met Mil Spec. Requirements (Yes or No)	YES	YES
Water Content	[illegible]	[illegible]

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[illegible]						VERIFIED BY USAF	DATE

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 209301-401 SHEET 82 OF 105

7.1.4.2.3 Cape Cycle Test (Reference paragraph 7.1.4.1)

Test Cell Location CTL III, SSFL

Test Cell Number 39-K

Test Number 958-199

Test Date 4/5/65

7.1.4.2.4 Duty Cycle Test (Reference paragraph 7.1.4.1)

Test Cell Location CTL III, SSFL

Test Cell Number 39-K

Test Number 958-200

Test Date 4-5-65

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R.Cole		[illegible]		[illegible]		[illegible]	
						VERIFIED BY USAF	DATE
						[illegible]	

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 209301- SHEET 401 83 OF 105

7.1.4.2.5 Post Hardware Condition

Injector [illegible]

Combustion Zone [illegible]

Throat Insert [illegible]

Nozzle [illegible]

Stainless Steel Shell [illegible]

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R.Cole		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
						VERIFIED BY USAF	DATE

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A DIVISION OF NORTH AMERICAN AVIATION, INC.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301-...

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 209301- SHEET 401 84 OF 105

7.1.42.6 Weight Determination Test (Reference Paragraph 6.6)

All protective closures were removed from the TCA YES (yes or no)

The TCA dry weight was 11.31 pounds (record to nearest one-hundred pound)

Inspection Remarks: NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams		F. B. Pope	4-9-65	B. J. Gerold	4-9-65	WAIVED BY R. L. FREE	4-9-65
						VERIFIED BY USAF	DATE
						C. F. Ward	4/9/65

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 209301-401 SHEET 85 OF 105

7.1.4.2.7 Hot Fire Test Data Reduction

7.1.4.2.7.1 Cape Cycle

	Pulse Duration (sec) (1.000 sec)	Time between Pulses, (minutes)
1st Pulse	1.030	5 (5)
2nd Pulse	1.028	10 (10)
3rd Pulse	1.031	5 (5)
4th Pulse	1.023	10 (10)
5th Pulse	1.025	5 (5)
6th Pulse	1.020	
Accumulated Cape Cycle Firing Time, seconds 6.157		

Remarks: NONE

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R.Cole						VERIFIED BY USAF	DATE

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701 -285 NAA 209301

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 209301-401 SHEET 86 OF 105

7.1.4.2.7.2 Mission Duty Cycle

TCA skin temperature at the conclusion of "in spec" duration (557 sec) met the specification requirements. No (Yes or No)

TCA skin temperature at the conclusion of "guaranteed life" duration (757 sec) met the specification requirements. No (Yes or No)

TCA oxidizer inlet temperature was within specification limits. Yes (Yes or No)

TCA fuel inlet temperature was within specification limits. Yes (Yes or No)

TCA environmental temperature was within specification limits. Yes (Yes or No)

Accumulated MIC Firing Time, seconds 748.4.

Remarks: REFERENCE OFR 32690R

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R.Cole						VERIFIED BY USAF	DATE

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301 }

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 209301-101 SHEET ___ OF ___

Pulse Number 2	Site Data	Standard Vacuum
Firing Duration, sec	2.96	
Accumulated Firing Time, sec	35.8	
Data Slice Number	2	
Time of Data Slice	.5	
Environmental Pressure, psia	.031	0
Environmental Temperature, °F	186 (Rad. shield)	
Oxidizer Temperature, °F	158	160
Fuel Temperature, °F	179	160
Oxidizer Inlet Pressure, psia	281.2	286
Fuel Inlet Pressure, psia	279.4	280
Oxidizer Flowrate, lbs/sec	.1554	.1863
Fuel Flowrate, lbs/sec	.1462	.1519
Mixture Ratio, o/f (1.2±.07) *	1.26	1.23
Thrust, lbs (94.5±5.6) *	94.3	96.0
Specific Impulse, sec (260 min) *	274	274
Start Time, msec (50 max)*	53	
Shutdown Time, msec (125 max) *	89	
Oxidizer Valve Voltage, volts	25.0	
Fuel Valve Voltage, volts	26.0	
Oxidizer Valve Current, amps	.546	
Fuel Valve Current, amps	.542	
Electrical Power, watts	27.9	

* For reference only; applicable only under standard conditions of propellant and environmental temperature and pressure.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301 }

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 209301-401 SHEET ___ OF ___

Pulse Number 7	Site Data	Standard Vacuum
Firing Duration, sec	14.8	
Accumulated Firing Time, sec	97.9	
Data Slice Number	3	
Time of Data Slice	.5	
Environmental Pressure, psia	.031	0
Environmental Temperature, °F	206 (RHd. shield)	
Oxidizer Temperature, °F	177	160
Fuel Temperature, °F	180	160
Oxidizer Inlet Pressure, psia	282.7	286
Fuel Inlet Pressure, psia	277.9	280
Oxidizer Flowrate, lbs/sec	.1668	.1684
Fuel Flowrate, lbs/sec	.1435	.1490
Mixture Ratio, o/f (1.2±.07) *	1.16	1.13
Thrust, lbs (94.5±5.6)*	92.4	94.5
Specific Impulse, sec (260 min)*	298	299
Start Time, msec (50 max)*	52	
Shutdown Time, msec (125 max) *	85	
Oxidizer Valve Voltage, volts	24.5	
Fuel Valve Voltage, volts	26.0	
Oxidizer Valve Current, amps	.527	
Fuel Valve Current, amps	.532	
Electrical Power, watts	26.7	

* For reference only; applicable only under standard conditions of propellant and environmental temperature and pressure.

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[illegible] 8/25/65	[illegible]	[illegible]	VERIFIED BY USAF DATE

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 1004 PART NO. { MAC 52-52701-285 / NAA 209301

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 209301-101 SHEET ___ OF ___

Pulse Number 11	Site Data	Standard Vacuum
Firing Duration, sec	95.9	
Accumulated Firing Time, sec	480.8	
Data Slice Number	4	
Time of Data Slice	.5	
Environmental Pressure, psia	.031	0
Environmental Temperature, °F	203 (Rad. shield)	
Oxidizer Temperature, °F	165	160
Fuel Temperature, °F	151	160
Oxidizer Inlet Pressure, psia	281.7	286
Fuel Inlet Pressure, psia	278.4	280
Oxidizer Flowrate, lbs/sec	.1736	.1748
Fuel Flowrate, lbs/sec	.1488	.1528
Mixture Ratio, o/f (1.2±.07)*	1.17	1.15
Thrust, lbs (94.5±5.6)*	92.8	94.4
Specific Impulse, sec (260 min) *	289	292
Start Time, msec (50 max) *	NOT RECORDED INSTR. PROBLEM	
Shutdown Time, msec (125 max) *	91	
Oxidizer Valve Voltage, volts	25.0	
Fuel Valve Voltage, volts	25.5	
Oxidizer Valve Current, amps	.513	
Fuel Valve Current, amps	.527	
Electrical Power, watts	26.2	

* For reference only; applicable only under standard conditions of propellant and environmental temperature and pressure.

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[illegible] 8/27/65	[illegible]	[illegible]	VERIFIED BY USAF DATE

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 209301-401 SHEET ___ OF ___

Pulse Number 18	Site Data	Standard Vacuum
Firing Duration, sec	2.95	
Accumulated Firing Time, sec	550.4	
Data Slice Number	5	
Time of Data Slice	.5	
Environmental Pressure, psia	.031	0
Environmental Temperature, °F	235 (Rad. shield)	
Oxidizer Temperature, °F	165	160
Fuel Temperature, °F	168	160
Oxidizer Inlet Pressure, psia	282.2	286
Fuel Inlet Pressure, psia	276.9	280
Oxidizer Flowrate, lbs/sec	.1763	.1723
Fuel Flowrate, lbs/sec	.1174	.1531
Mixture Ratio, o/f (1.2±.07) *	1.20	1.16
Thrust, lbs (94.5±5.6) *	91.8	93.5
Specific Impulse, sec (260 min)*	284	283
Start Time, msec (50 max)*	55	
Shutdown Time, msec (125 max)*	90	
Oxidizer Valve Voltage, volts	24.5	
Fuel Valve Voltage, volts	26.0	
Oxidizer Valve Current, amps	.537	
Fuel Valve Current, amps	.548	
Electrical Power, watts	27.4	

* For reference only; applicable only under standard conditions of propellant and environmental temperature and pressure.

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[illegible]	[illegible]	[illegible]		[illegible]		VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 209301-401 SHEET ___ OF ___

Pulse Number Separation	Site Data	Standard Vacuum
Firing Duration, sec	14.7	
Accumulated Firing Time, sec	29.7	
Data Slice Number	1	
Time of Data Slice	.5	
Environmental Pressure, psia	.031	0
Environmental Temperature, °F	163 (Rad. shield)	
Oxidizer Temperature, °F	163	160
Fuel Temperature, °F	176	160
Oxidizer Inlet Pressure, psia	283.7	286
Fuel Inlet Pressure, psia	276.9	280
Oxidizer Flowrate, lbs/sec	.1786	.1786
Fuel Flowrate, lbs/sec	.1446	.1508
Mixture Ratio, o/f (1.2±.07) *	1.24	1.18
Thrust, lbs (94.5±5.6) *	95.3	96.8
Specific Impulse, sec (260 min) *	295	294
Start Time, msec (50 max) *	NOT RECORDED - INSTRUMENTATION PROB.	
Shutdown Time, msec (125 max) *	90	
Oxidizer Valve Voltage, volts	24.5	
Fuel Valve Voltage, volts	26.0	
Oxidizer Valve Current, amps	.542	
Fuel Valve Current, amps	.548	
Electrical Power, watts	27.5	

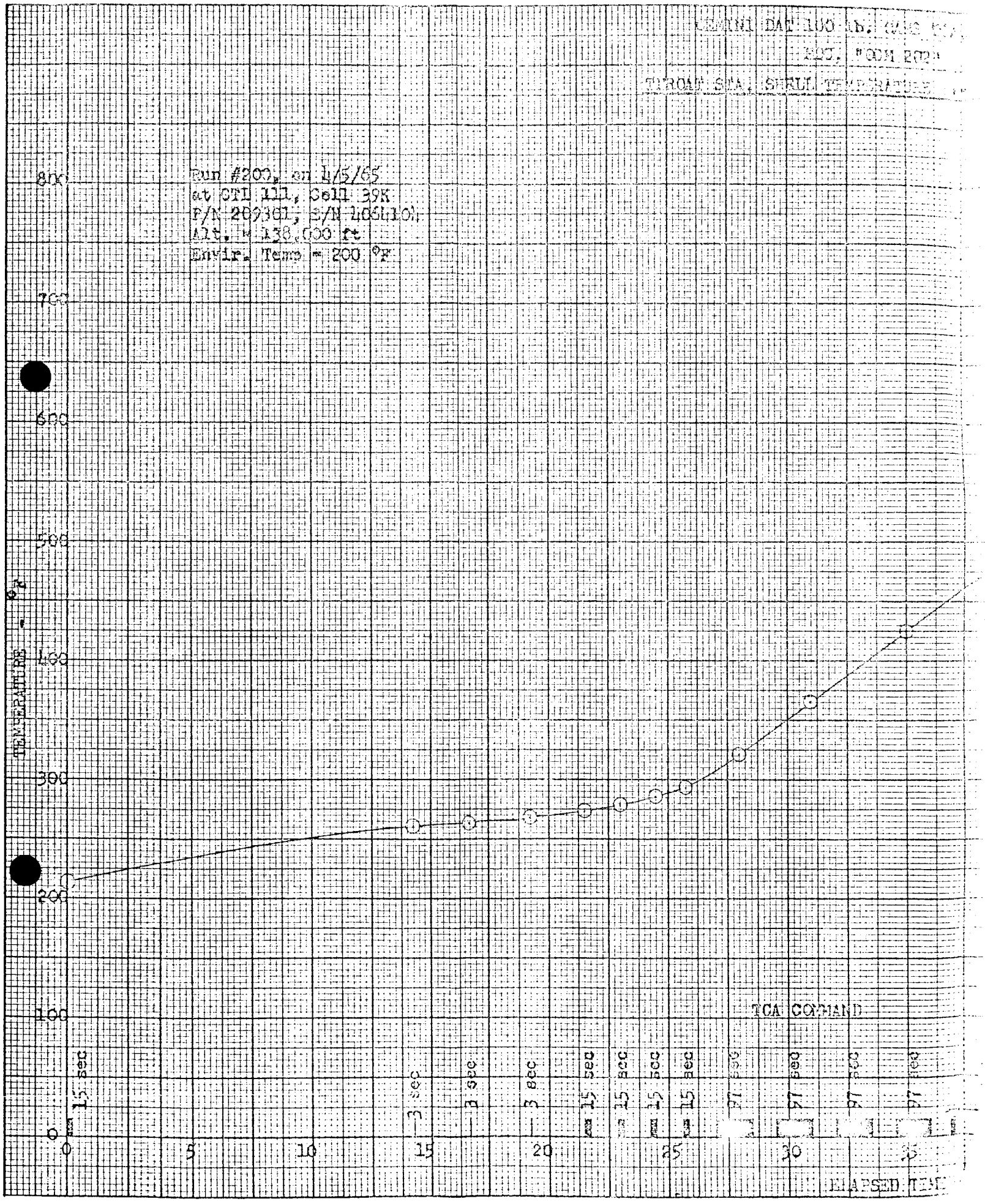
* For reference only; applicable only under standard conditions of propellant and environmental temperature and pressure.

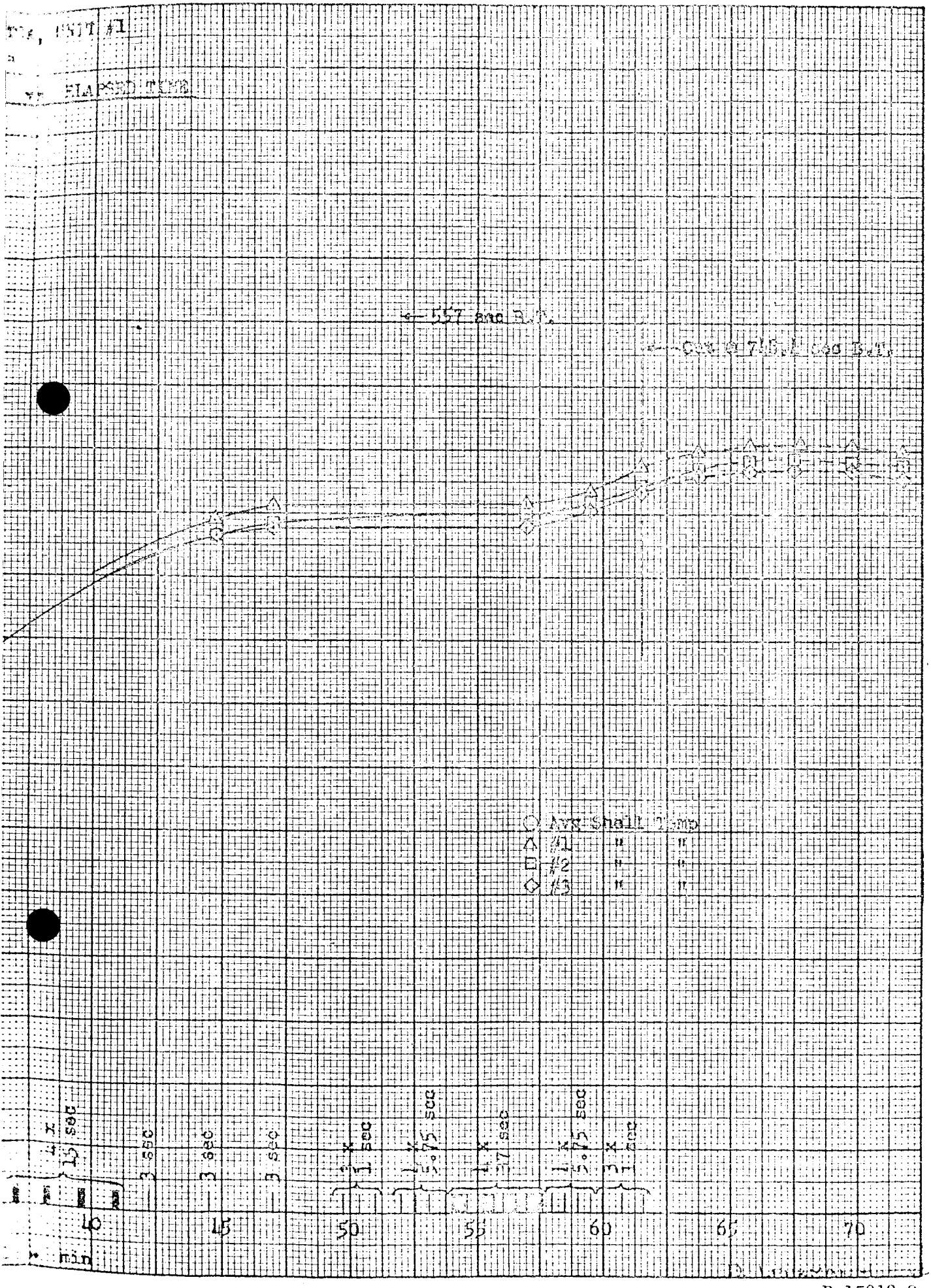
PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
						VERIFIED BY USAF	DATE

R-15019-2

~~CONFIDENTIAL~~

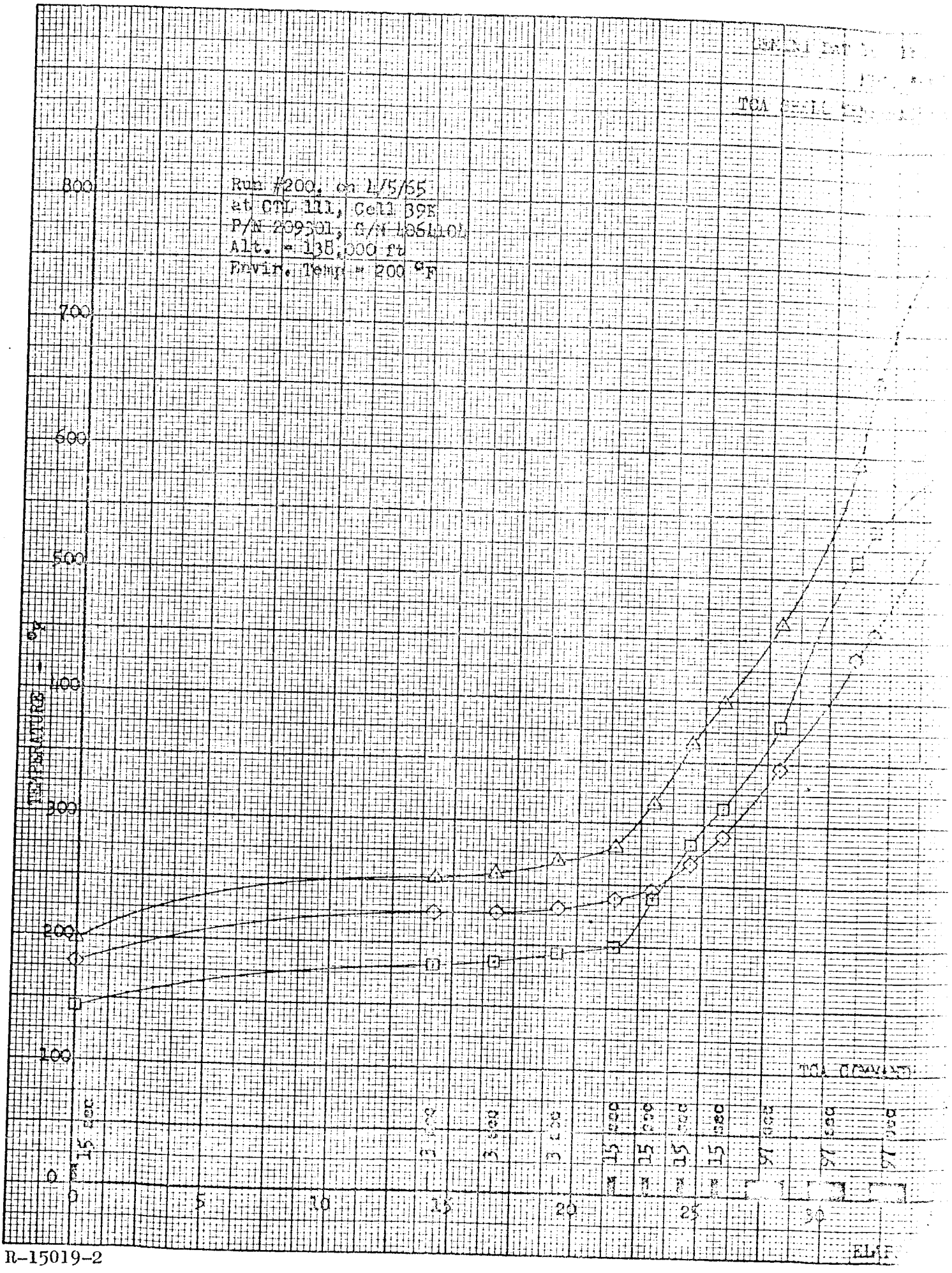
FORM 608-B-39 NEW 6-63

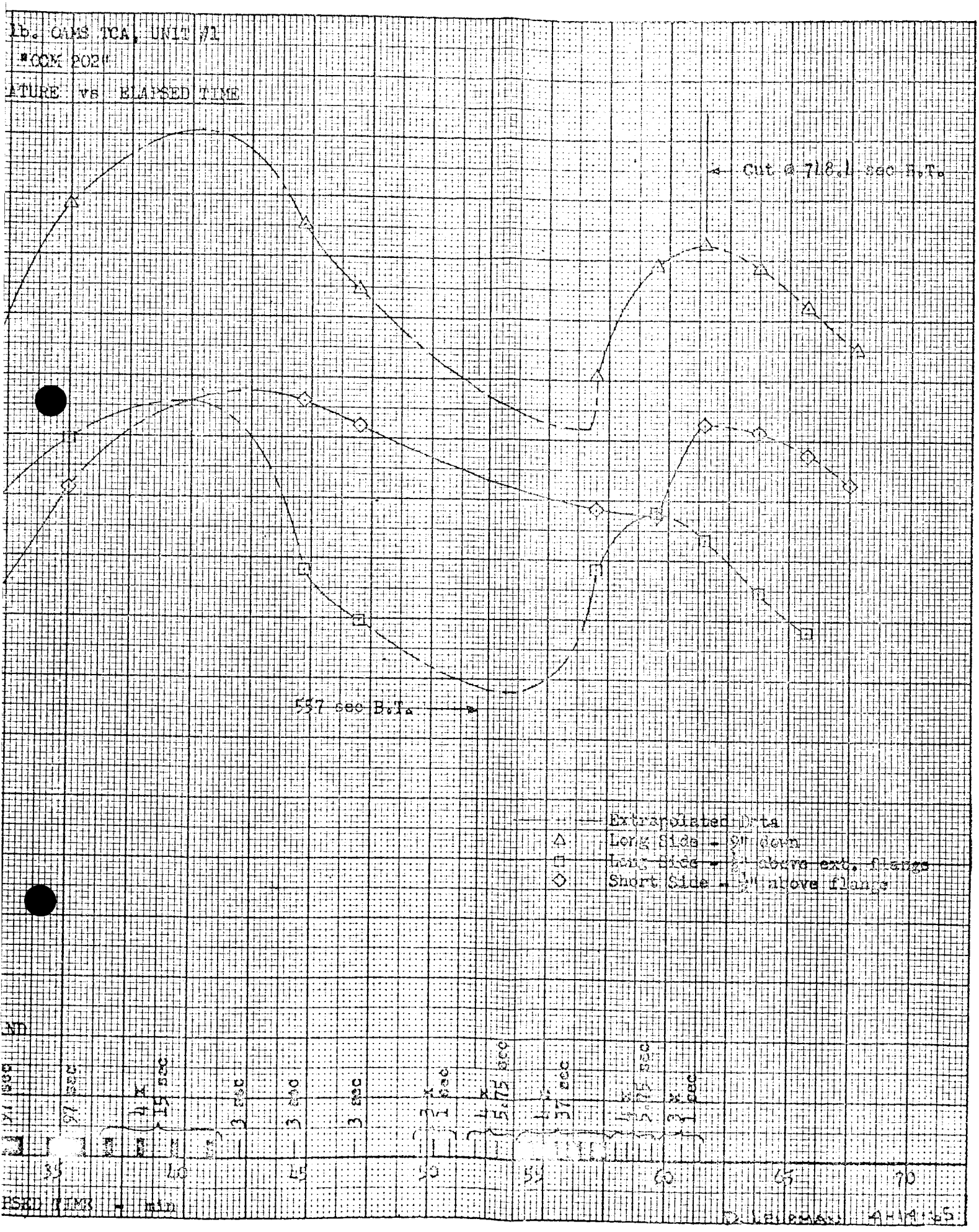

Run #200, on 1/5/65
at CTI 111, Cell 39K
P/N 289361, S/N 406410
Alt. ≈ 138,000 ft
Envir. Temp = 200 °F
TEMPERATURES - °F
800
700
600
500
400
300
200
100
0
TCA COMMAND
15 sec
3 sec
0
5
10
15
20
25
30
35
ELAPSED TIME



UNIT #1
ELAPSED TIME
557 sec B.T.
Avg Shell Temp
#1 " "
#2 " "
#3 " "
4 x 15 sec
3 sec
3 sec
3 sec
3 x 1 sec
1 x 5.75 sec
1 x 37 sec
1 x 5.75 sec
3 x 1 sec
40
45
50
55
60
65
70
min

R-15019-2


Run #200, on 1/5/65
at CTL 111, Cell B9E
P/N 209301, S/N 1061101
Alt. = 138,000 ft
Envir. Temp = 200 °F
TEMPERATURE °F
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30


lb. OAMS TCA, UNIT #1
"OCM 202"
ATURE vs ELAPSED TIME
Cut @ 718.1 sec B.T.
557 sec B.T.
Extrapolated Data
Long Side - 9" down
Long Side - ½" above ext. flange
Short Side - ½" above flange
ND
97 sec
4 x 15 sec
3 sec
3 sec
3 sec
3 x 1 sec
4 x 5.75 sec
4 x 37 sec
4 x 5.75 sec
3 x 1 sec
35
40
45
50
55
60
65
70
PSED TIME - min

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301

NAME OF TEST MINIMUM INSTRUMENTATION REQUIREMENTS - HOT FIRE TESTS TEST NO. 209301-401 SHEET 90 OF 105

TABLE I

MEASUREMENT	RANGE	(2) PRECISION	(1) RESPONSE (SEC)	RECORDER
Main Thrust	0-120 lb	B(±0.5%)	1.25 max	Null Balance
Main Thrust	0-120 lb	Y*	0.001	Oscillograph
Oxidizer Inlet Pressure	0-500 psig	C(±1.0%)	1.25 max	Null Balance
Oxidizer Inlet Pressure	0-500 psig	Y**	0.001	Oscillograph
Fuel Inlet Pressure	0-500 psig	C(±1.0%)	1.25 max	Null Balance
Fuel Inlet Pressure	0-500 psig	Y**	0.001	Oscillograph
Oxidizer Flowmeter Temperature	0-300 F	D(±5.0F)		Null Balance
Fuel Flowmeter Temperature	0-300 F	D(±5.0F)		Null Balance
Oxidizer Inlet Temperature	0-300 F	D(±5.0F)		Null Balance
Fuel Inlet Temperature	0-300 F	D(±5.0F)		Null Balance
Oxidizer Flowrate	0.50-1.5 gpm	C(±1.0%)	1.25 max	Null Balance
Oxidizer Flowrate	0.50-1.5 gpm	B(±0.5%)	0.001	Oscillograph
Fuel Flowrate	0.50-2.0 gpm	C(±1.0%)	1.25 max	Null Balance
Fuel Flowrate	0.50-2.0 gpm	B(±0.5%)	0.001	Oscillograph
Oxidizer Valve Current	0-1.0 amp	Y	0.001	Oscillograph
Fuel Valve Current	0-1.0 amp	Y	0.001	Oscillograph
Oxidizer Valve Voltage	0-40 volts	Y***	0.001	Oscillograph
Fuel Valve Voltage	0-40 volts	Y***	0.001	Oscillograph
Local Ambient Pressure	21-40 in. Hg	Y		Barometer
Environmental Pressure (Fine)	0.0-0.20 psia	C(±1.0%)	1.25 max	Null Balance
Environmental Pressure (Coarse)	0.0-15.0 psia	D(±2.0%)	1.25 max	Null Balance
Environmental Temperature	0-300 F	D(±5.0F)		Null Balance
TCA Wall Temperature (3 Places)	0-1000 F	D(±20F)		Null Balance

NOTE: Additional TCA thermocouples may be added by mutual agreement between MAC and Rocketdyne as indicated in the Test Request. Of these, a minimum of three (3) must be certified with a "D" precision per RA0201-050 at a range of 0-1000 F.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole		[signature]	3-16-65	James D. Harrigan	3/16/65
CHECKED BY: [signature]	DATE				

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301

NAME OF TEST MINIMUM INSTRUMENTATION REQUIREMENTS - HOT FIRE TESTS TEST NO. 209301-401 SHEET 91 OF 105

TABLE I
(cont'd)

MEASUREMENT	(1) RESPONSE (SEC)	RECORDER
Start and Cutoff, Pip	0.001	Oscillograph and
	1.0	Max. Time Sequence
Oscillograph Drive, Pip	1.0	Max. Time Sequence
DIGR Drive, Pip	1.0	Max. Time Sequence
Camera Drive, Pip	1.0	Max. Time Sequence
Facility Shutoff Valve Position, Pip	1.0	Max. Time Sequence
Event Marker, Pip	1.0	Max. Time Sequence

NOTES:

(1) Response is defined as the time required for the measurement recording system to travel from zero to full scale.

(2) Letters designate instrumentation precision category per RA0201-050.

(3) Delete for Cape Cycle Test.

PREPARED BY: R.Cole	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 3-11		3-11-65		3/16/65

FORM 608-B-38 NEW 6-63
R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# MINIMUM INSTRUMENTATION PART NO. MAC 52-52701-285 NAA 209301

NAME OF TEST requirements - HOT FIRE TESTS TEST NO. 209301-401 SHEET 92 OF 105

TABLE I
(Cont'd)

NOTES: (cont'd)

* Perform a pre test multi-step calibration and record on the oscillograph at the following simulated thrusts; 0, 6, 12, 24, 60, 72, 84, 96, 108, 120, 108, 96, 84, 72, 60, 24, 12, 6 and 0. This shall be followed by a pre and post test standardization and a two-step calibration (verification).

** Perform a multi-step transfer calibration and record on the oscillograph and DIGR at the following inlet pressures ±25 psi; 150 and 250 psig, and test lock-up inlet pressure. A post test one-step transfer calibration shall be recorded at the test lock-up inlet pressure. Record pre and post test standardizations.

*** Perform a multi-step calibration and record on the oscillograph at the following voltages ±1 volt; 22, 30 and 26. A post test one-step calibration shall be recorded at 26 ±1 volt.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole	RC 12/19/64	[signature]	1-6-65	James D. Morrigan	3/16/65
CHECKED BY:	DATE				
[signature]	12-31-64				

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 / NAA 209301

NAME OF TEST DESIGN APPROVAL TEST DUTY CYCLE TEST NO. 209301-401 SHEET 93 OF 105

TABLE II

PULSE NO.	ON TIME (SEC.)	OFF TIME (SEC.)	(1) TOTAL ON (SEC.)	ELAPSED TIME-MIN.
Separation	15	885	31	15
1	3	147	34	17.5
2	3	147	37	20.0
3	3	147	40	22.5
4	15	66	55	23.85
5	15	66	70	25.20
6	15	66	85	26.55
7	15	66	100	27.90
8	97	53	197	30.40
9	97	53	294	32.90
10	97	53	391	35.40
11	97	53	488	37.90
12	15	66	503	39.25
13	15	66	518	40.60
14	15	66	533	41.95
15	15	66	548	43.30
16	3	147	551	45.80
17	3	147	554	48.30
18	3	147	557	50.80 (2)

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 3-16	3-16-65			3/16

FORM-608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY 100# PART NO. MAC 52-52701-285 / NAA 209301

NAME OF TEST DESIGN APPROVAL TEST DUTY CYCLE TEST NO. 209301-401 93.1 SHEET OF 105

TABLE II (Cont'd)

PULSE NO.	ON TIME (SEC.)	OFF TIME (SEC.)	(1) TOTAL ON (SEC.)	ELAPSED TIME-MIN.
19	1	49	558	51.63
20	1	49	559	52.47
21	1	49	560	53.30
22	5.75	25.75	565.75	53.83
23	5.75	25.75	571.5	54.35
24	5.75	25.75	577.25	54.88
25	5.75	25.75	583	55.40
26	37	20	620	56.35
27	37	20	657	57.30
28	37	20	694	58.25
29	37	20	731	59.20
30	5.75	25.75	736.75	59.73
31	5.75	25.75	742.5	60.25
32	5.75	25.75	748.25	60.78
33	5.75	25.75	754	61.30
34	1	49	755	62.13
35	1	49	756	62.97
36	1	49	757	63.80 (3)

PREPARED BY: DATE	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
R. Cole	3-16-65	3/16/65
CHECKED BY: DATE 3-16		

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMLY - 100# PART NO. MAC 52-52701-285 / NAA 209301

NAME OF TEST DESIGN APPROVAL TEST DUTY CYCLE TEST NO. 209301-401 SHEET 93.2 OF 105

(1) Includes 10 seconds of calibration firing time and 6 seconds of simulated Cape Canaveral firing time.

(2) The TCA shall demonstrate specification performance for an accumulative firing time, including calibration and simulated Cape Canaveral firing time of 557 seconds minimum. (Maximum temperature 500° F.)

(3) The TCA shall demonstrate operation without catastrophic chamber failure for an accumulative firing time of 757 seconds minimum.

(4) Catastrophic chamber failure is defined as a condition in which further operation would endanger the spacecraft or crew. Specifically it shall include:

(a) Lack of the capability to stop propellant flow,

(b) Any flow or leakage of propellants or products of combustion from locations other than the TCA exit,

(c) Temperature in excess of 500 F at any point on TCA exterior wall.

NOTE: Three temperature sensors shall be mounted on the exterior wall as shown in Figure 6.

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 3-16		3-16-65		3/16/65

FORM 608-B-38 NEW 6-63
R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-100# PART NO. { MAC 52-52701-285 / NAA 209301-101

NAME OF TEST PROPELLANT VALVE ELECTRICAL SCHEMATIC TEST NO 209301- SHEET 94 OF 105

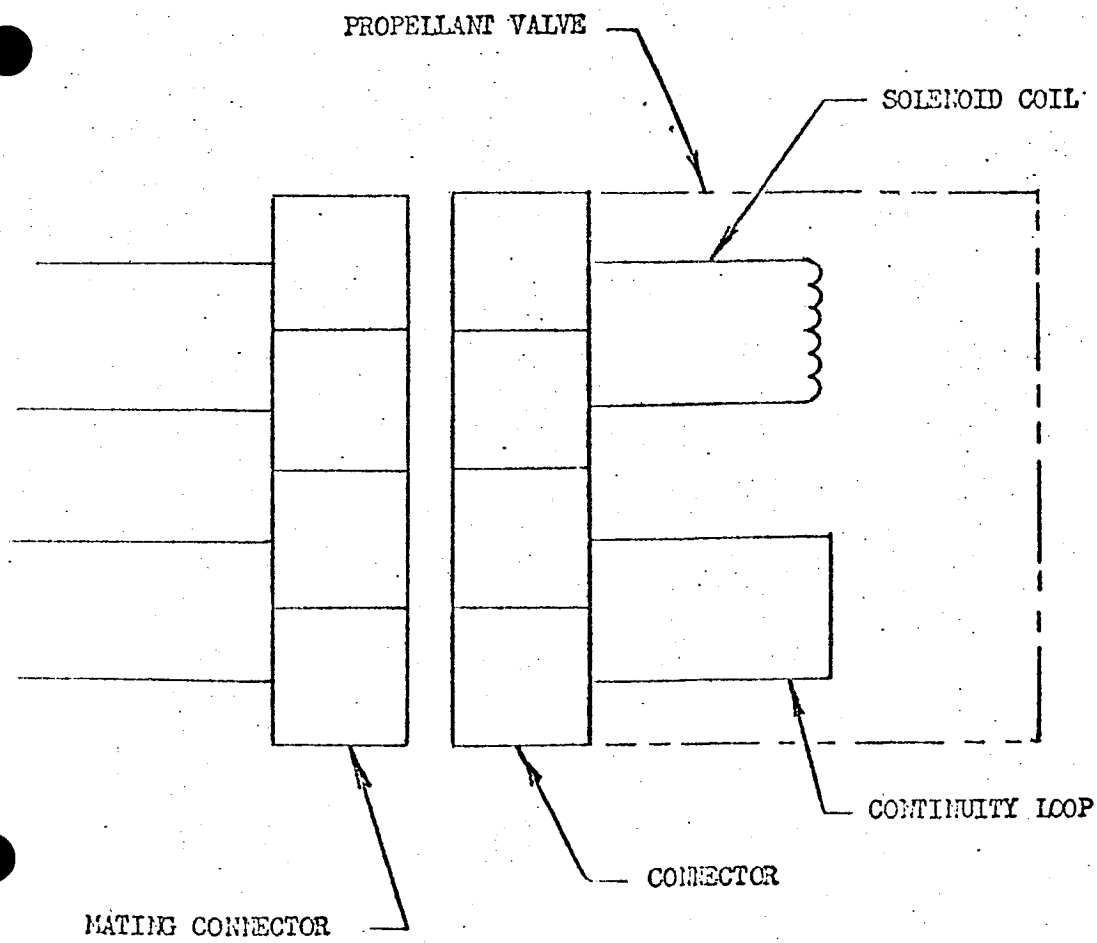


FIGURE 1

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-100# PROPELLANT VALVE PROOF — PART NO. MAC 52-52701-285 / NAA 209301-101

NAME OF TEST PRESSURE AND LEAKAGE — TEST NO 209301-REE 95 OF 105

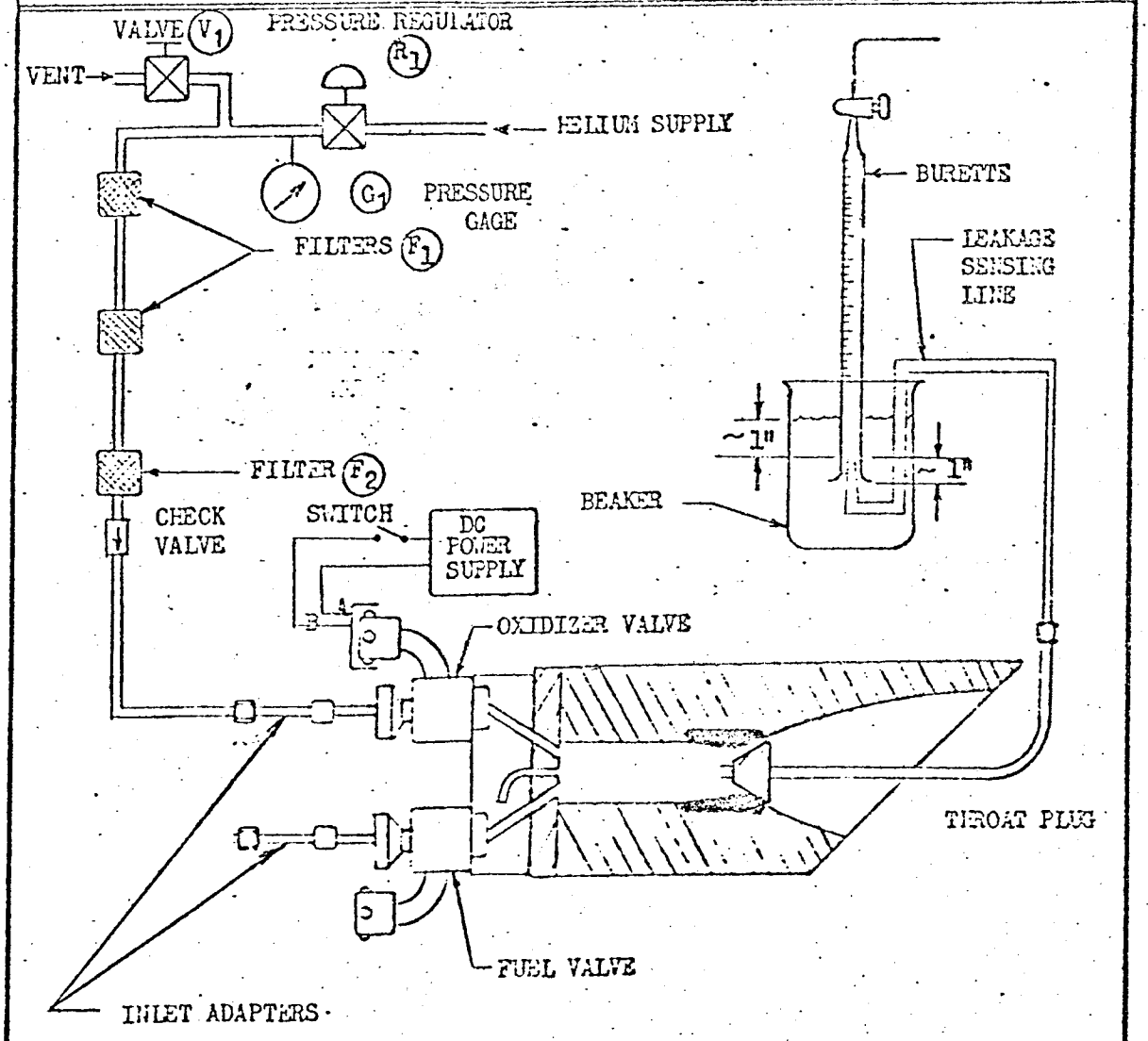


FIGURE 2

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-100# PART NO. MAC 52-52701-285 / NAA 209301-
NAME OF TEST THRUST CHAMBER PROOF PRESSURE AND LEAKAGE TEST NO 209301-SHEET 96 OF 105

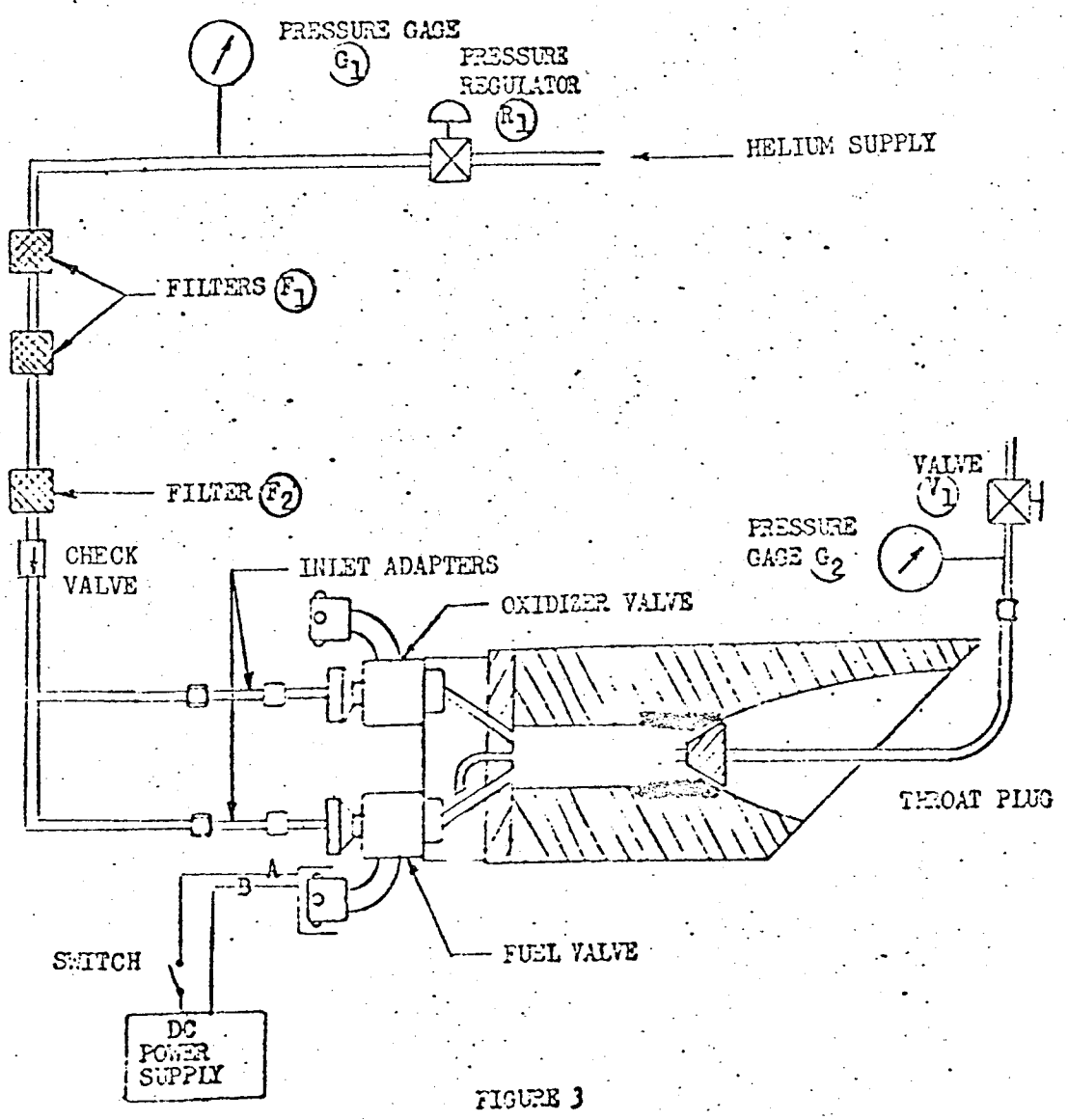


FIGURE 3

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. { MAC 52-52701-285 / NAA 209301-401

NAME OF TEST PROPELLANT VALVE FUNCTIONAL TEST NO. 209301 SHEET 97 OF 105

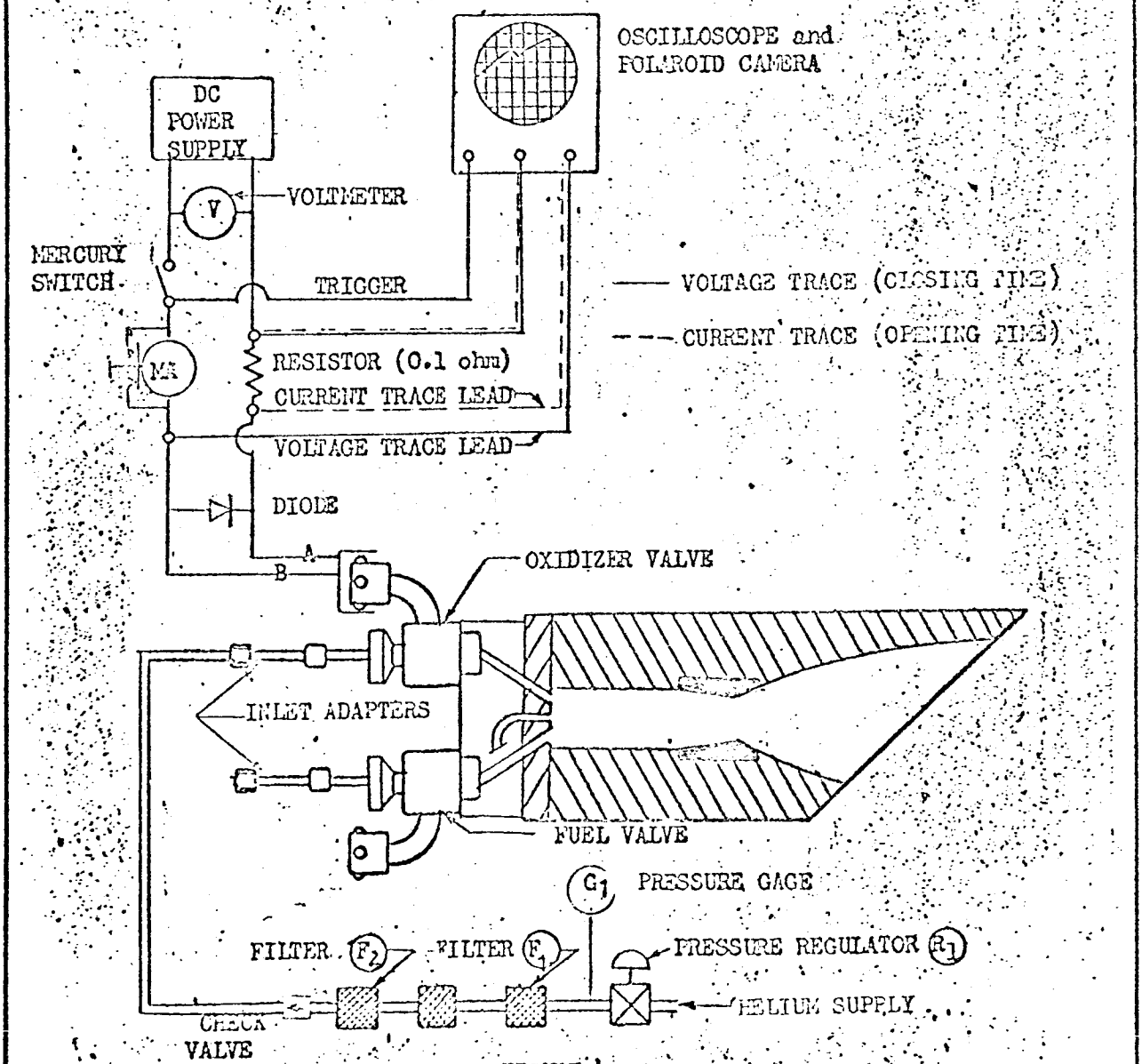


FIGURE 4

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. { MAC 52-52701-285 / NAA 209301-

NAME OF TEST PROPELLANT VALVE VOLTAGE AND CURRENT TRACES TEST NO 209301- LOT 98 SHEET 105 OF

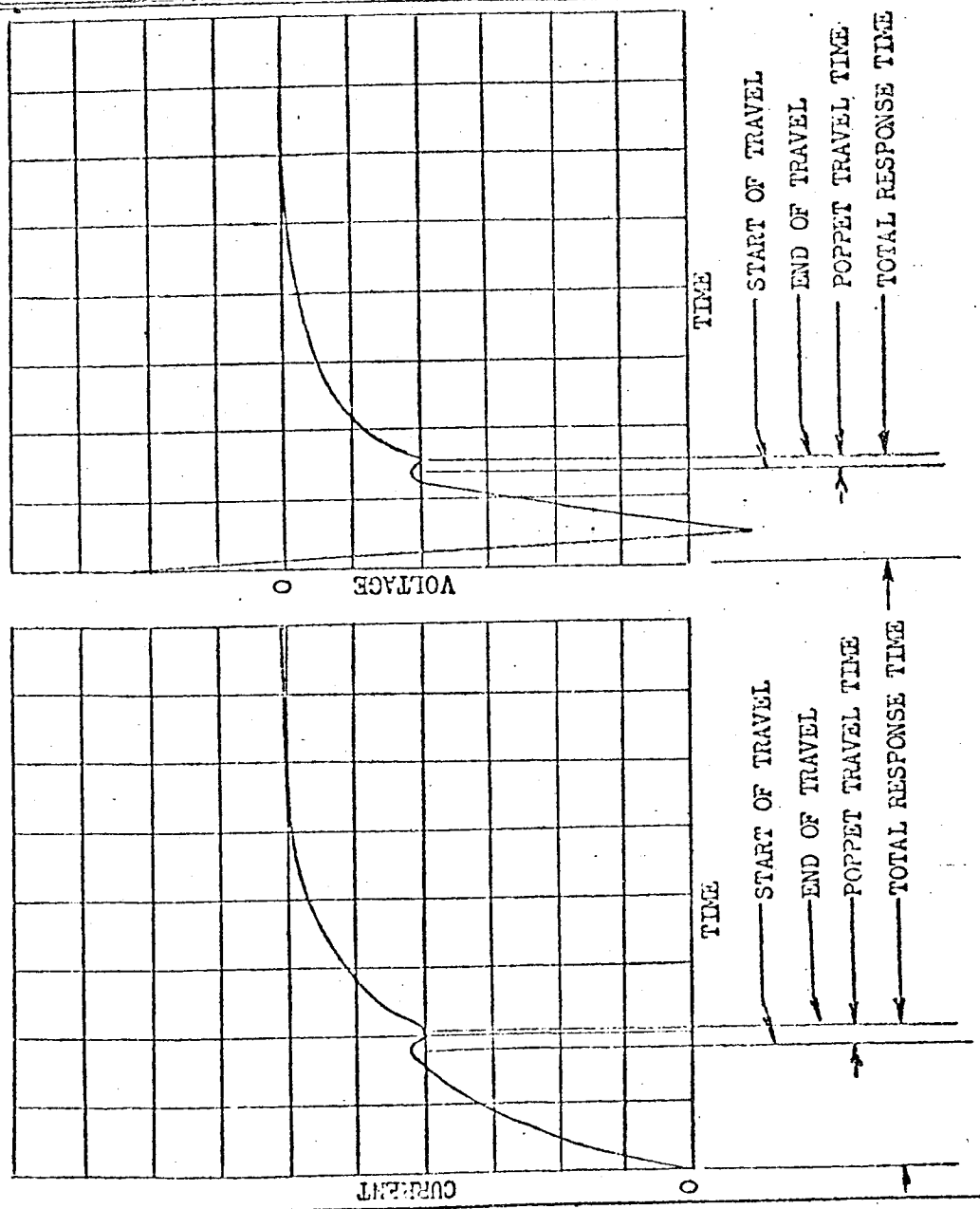


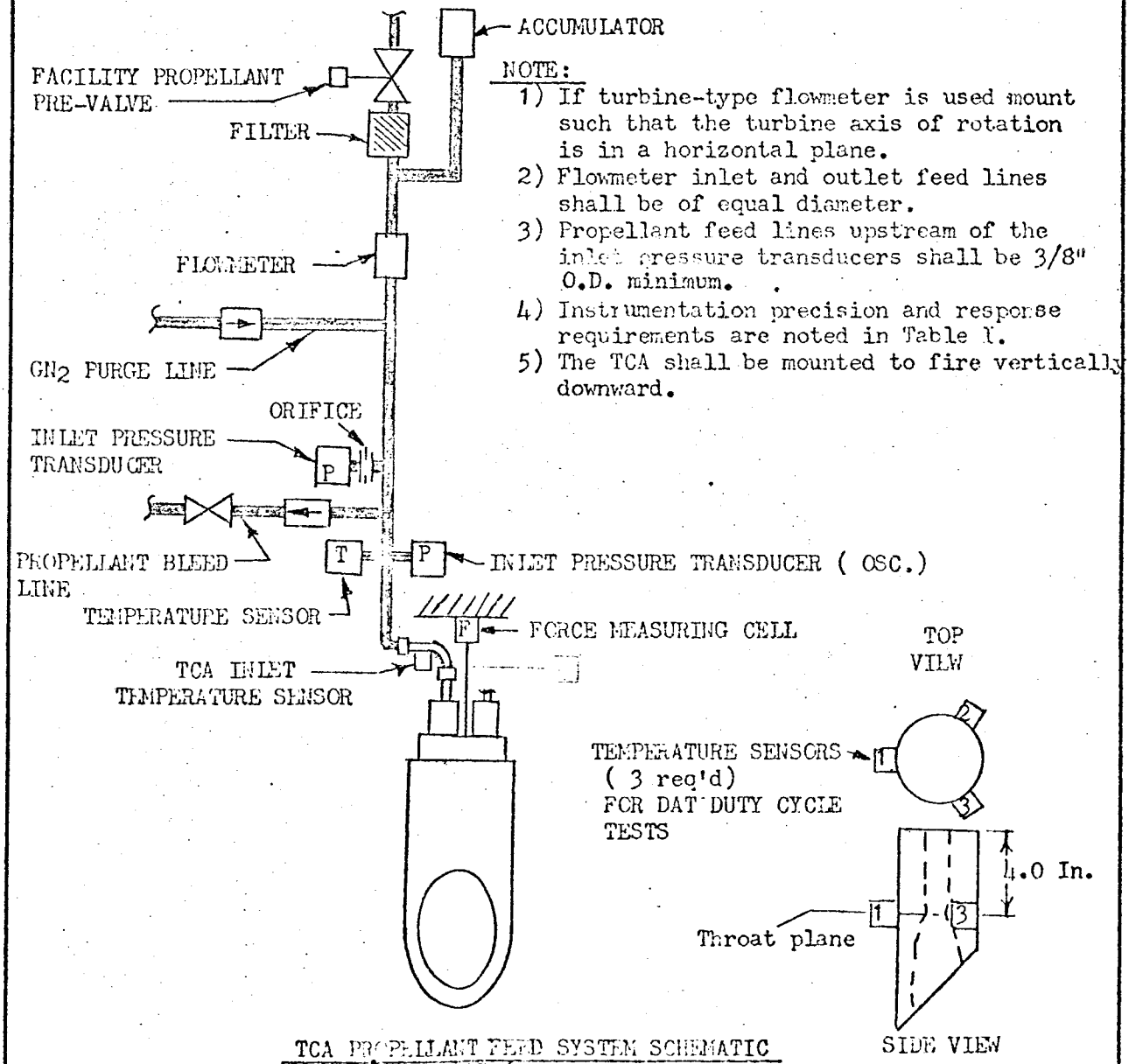
FIGURE 5

FORM 608-8-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-285 NAA 209301

NAME OF TEST PROPPELLANT FEED SYSTEM TEST NO. 209301-401 SHEET 99 OF 105



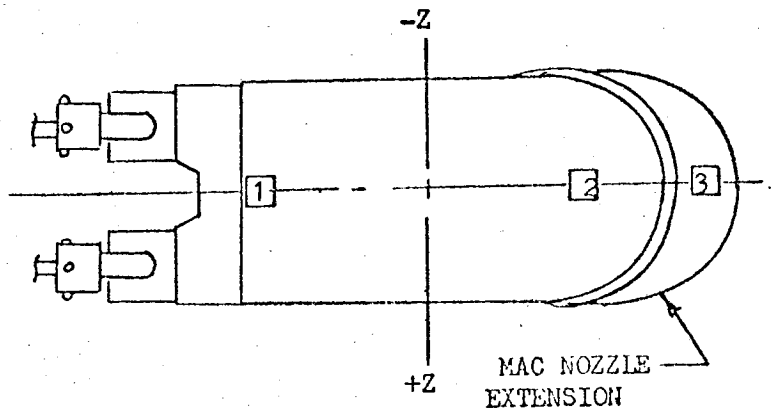
NOTE:
1) If turbine-type flowmeter is used mount such that the turbine axis of rotation is in a horizontal plane.
2) Flowmeter inlet and outlet feed lines shall be of equal diameter.
3) Propellant feed lines upstream of the inlet pressure transducers shall be 3/8" O.D. minimum.
4) Instrumentation precision and response requirements are noted in Table V.
5) The TCA shall be mounted to fire vertically downward.

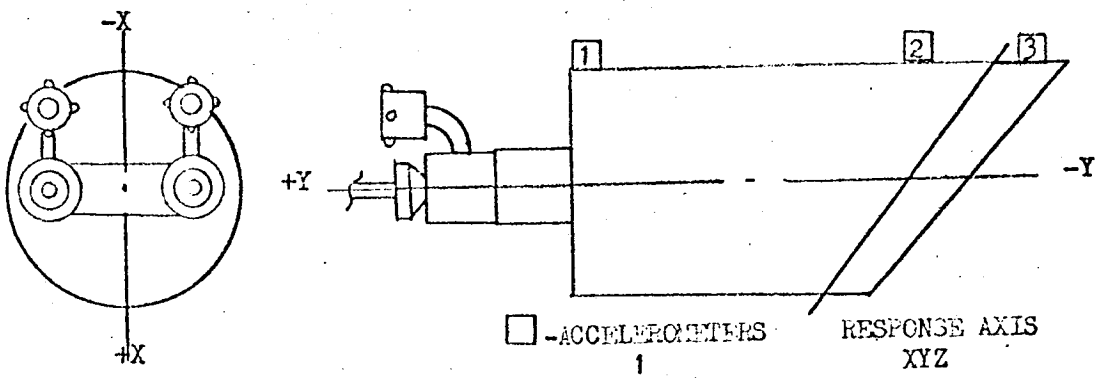
TCA PROPELLANT FEED SYSTEM SCHEMATIC
FIGURE 6

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301-401

NAME OF TEST VIBRATION TEST NO. 209301- SHEET 100 OF 105





□ -ACCELEROMETERS	RESPONSE AXIS
1	XYZ
2	XYZ
3	XYZ

NOTE: The MAC TCA Propellant Valve Support Bracket, simulated Spacecraft Tubing and Mounting Brackets not shown.

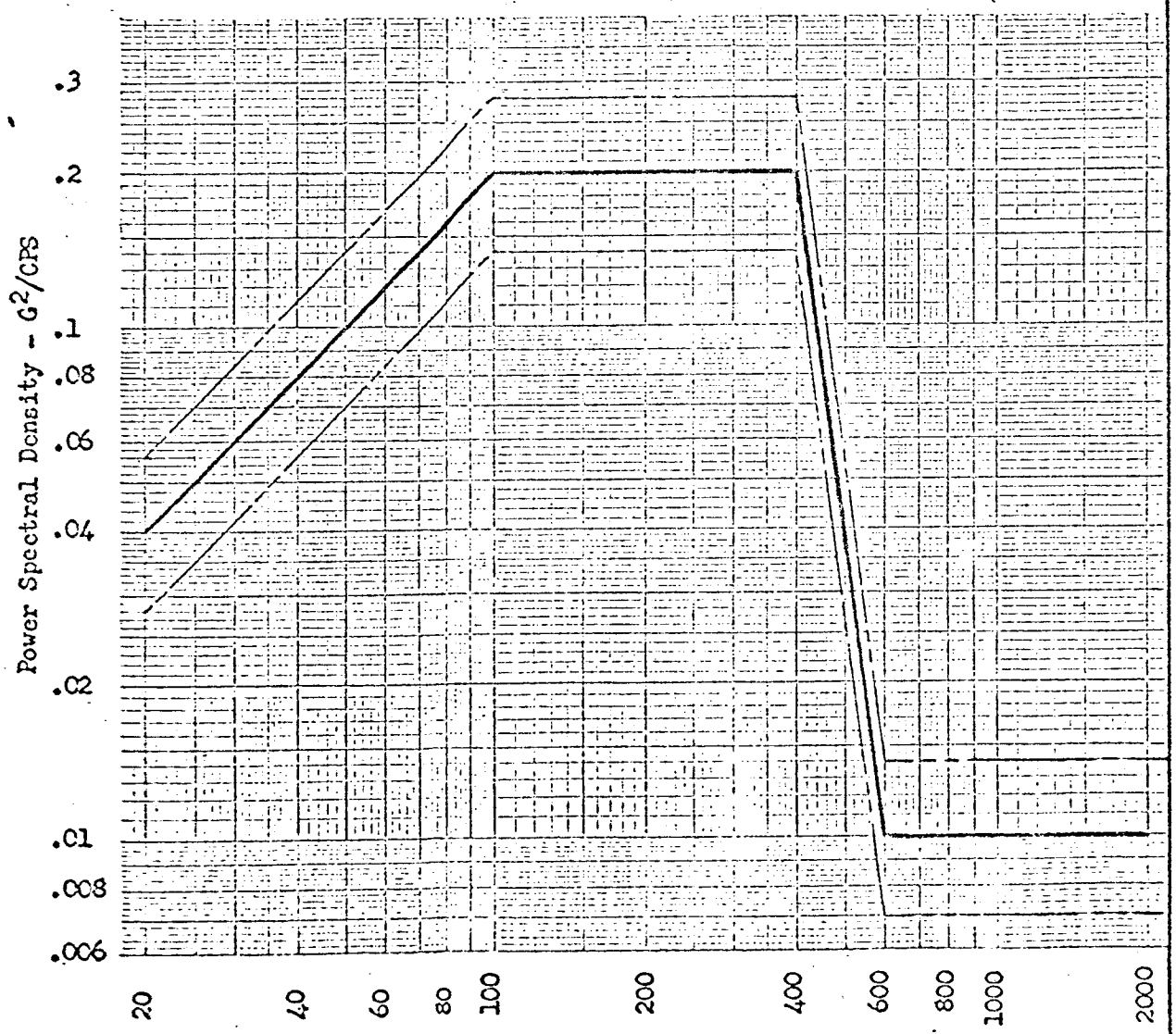
FIGURE 7

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301-101 }

NAME OF TEST RANDOM VIBRATION TEST NO. 209301-101 SHEET 101 OF 105



FREQUENCY - CPS

FIGURE 8

3

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-100# PART NO. { MAC 52-52701-285 / NAA 209301- }

NAME OF TEST PROPELLANT VALVE ELECTRICAL RESISTANCE TEST NO 209301-101 SHEET 102 OF 105

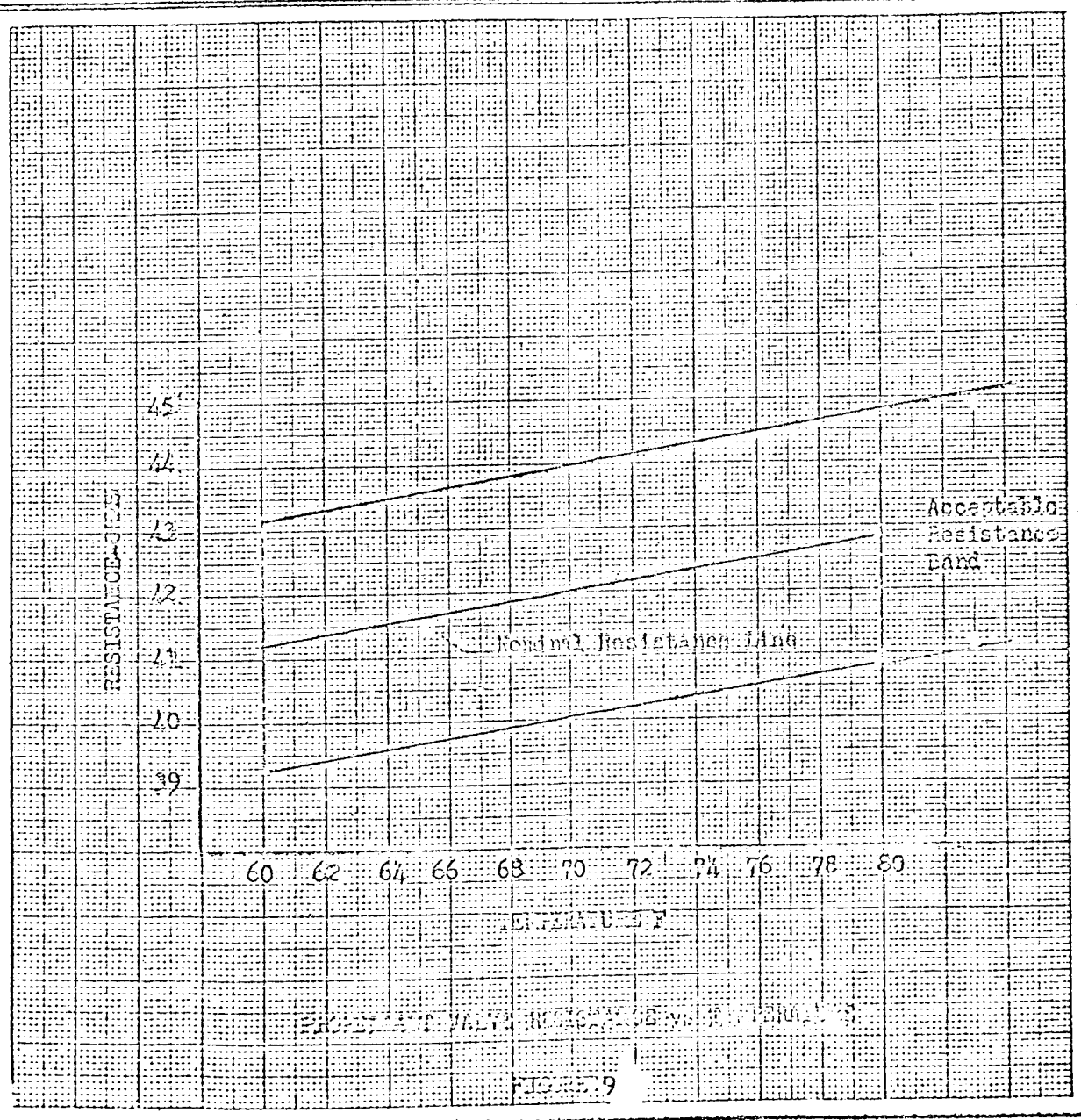
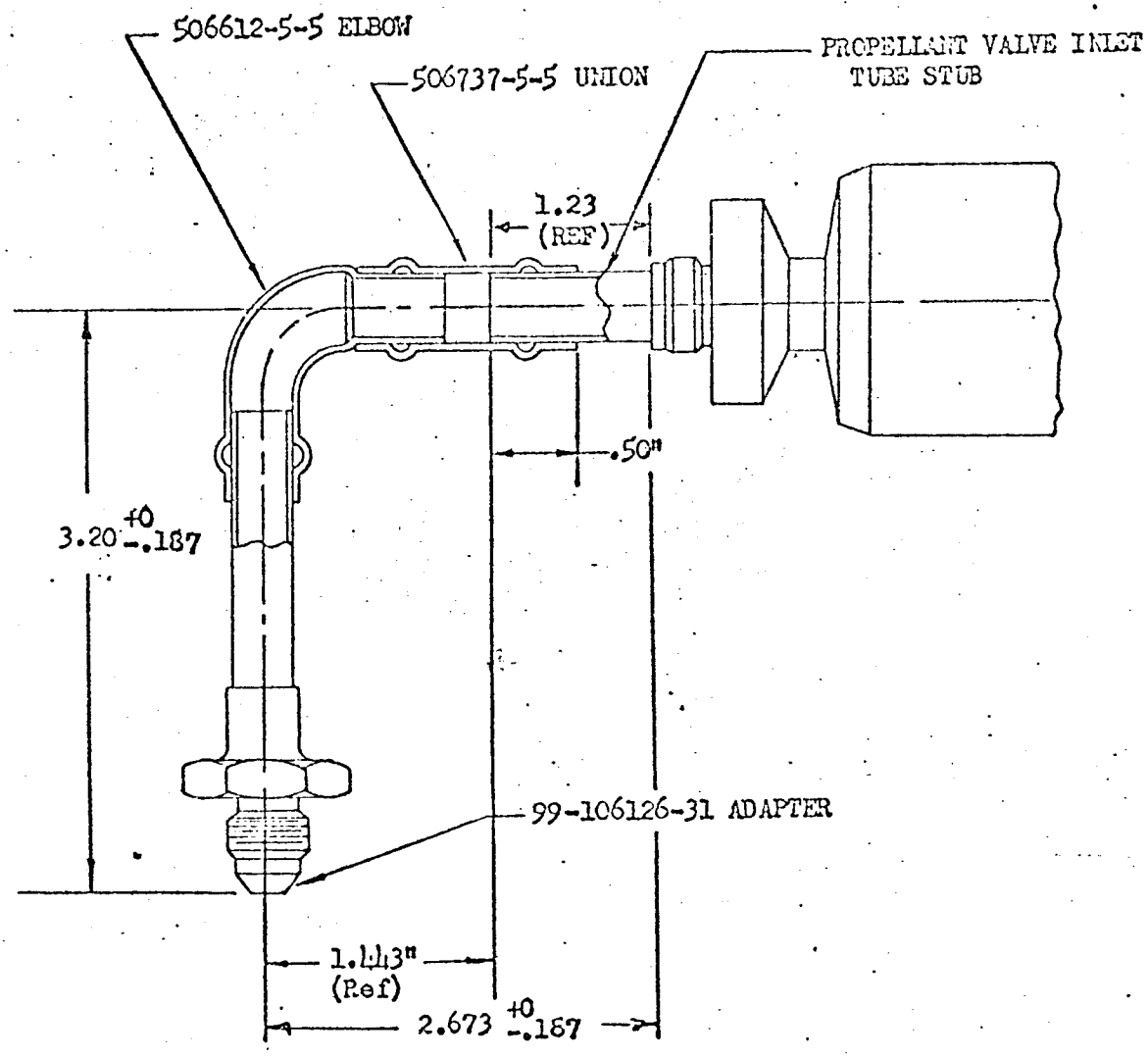


FIGURE 9

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. { MAC 52-52701-285 / NAA 209301

NAME OF TEST COMPONENT TEST MODIFICATION TEST NO. 209301-401 SHEET 103 OF 105



PROPELLANT VALVE INLET ADAPTER

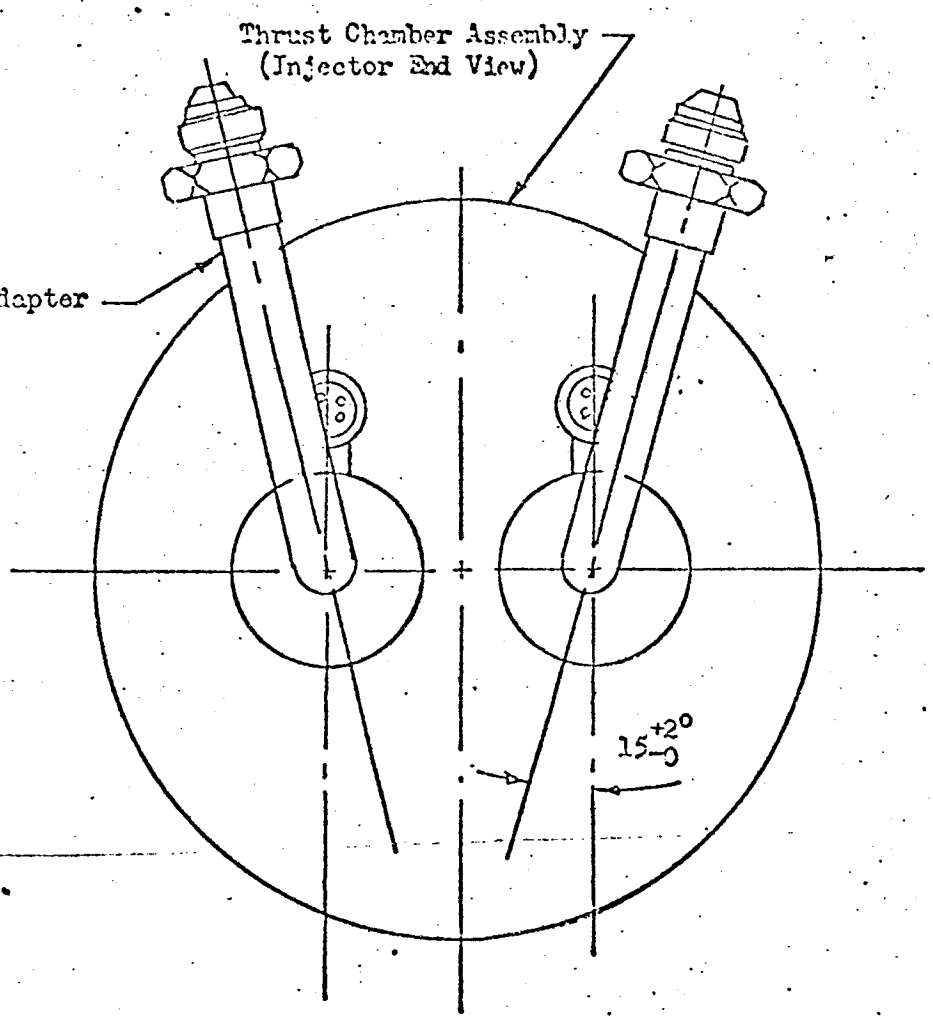
FIGURE 10

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. { MAC 52-52701-285 / NAA 209301-401

NAME OF TEST COMPONENT TEST MODIFICATION TEST NO. 209301- SHEET 104 OF 105



PROPELLANT VALVE INLET ADAPTER ORIENTATION

FIGURE 10A

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-285 / NAA 209301-401

NAME OF TEST THRUST PULSE PARAMETERS TEST NO. 209301 SHEET 105 OF 105

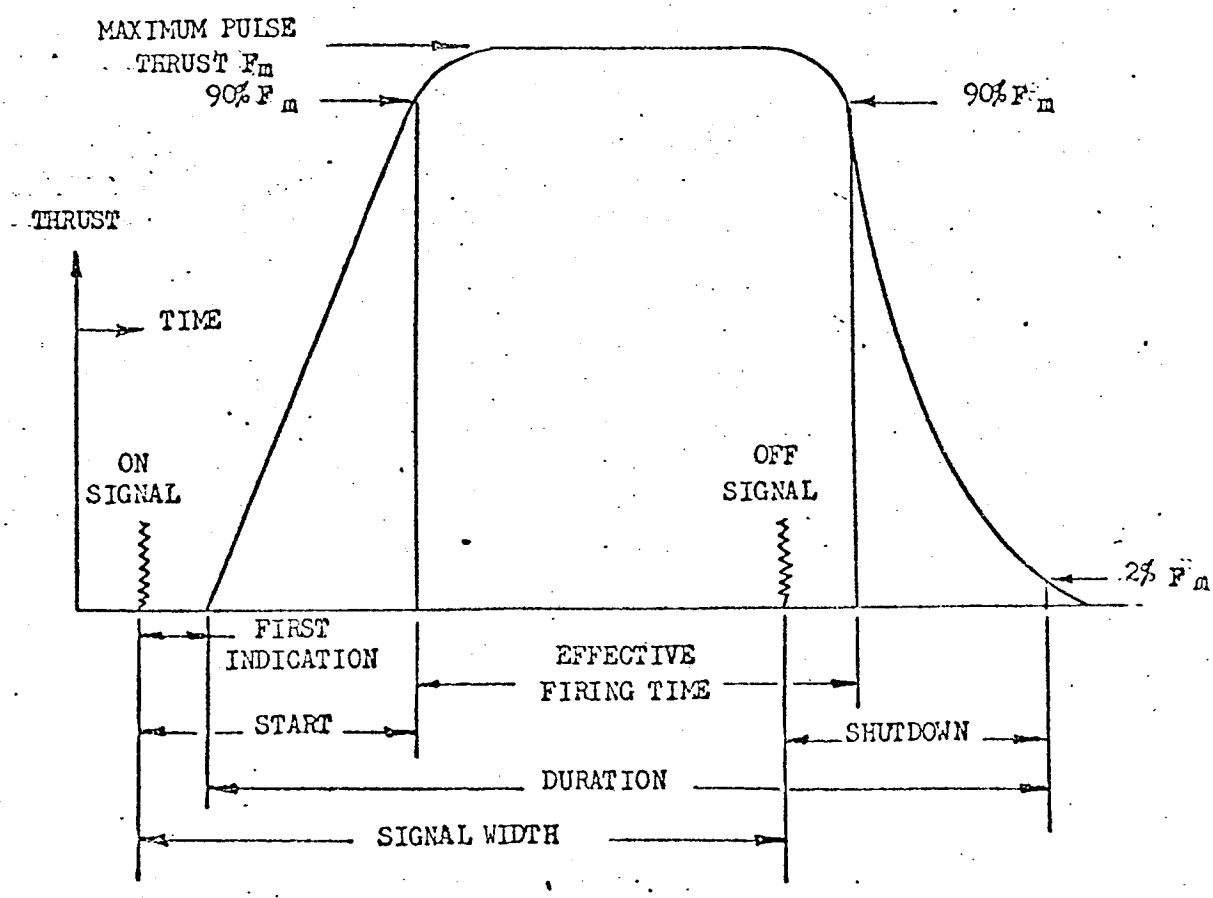


FIGURE 11

FORM 608-B-37 NEW 6-63

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