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GEMINI

DESIGN APPROVAL TEST PROGRAM

FINAL REPORT

THRUST CHAMBER ASSEMBLIES

VOLUME II

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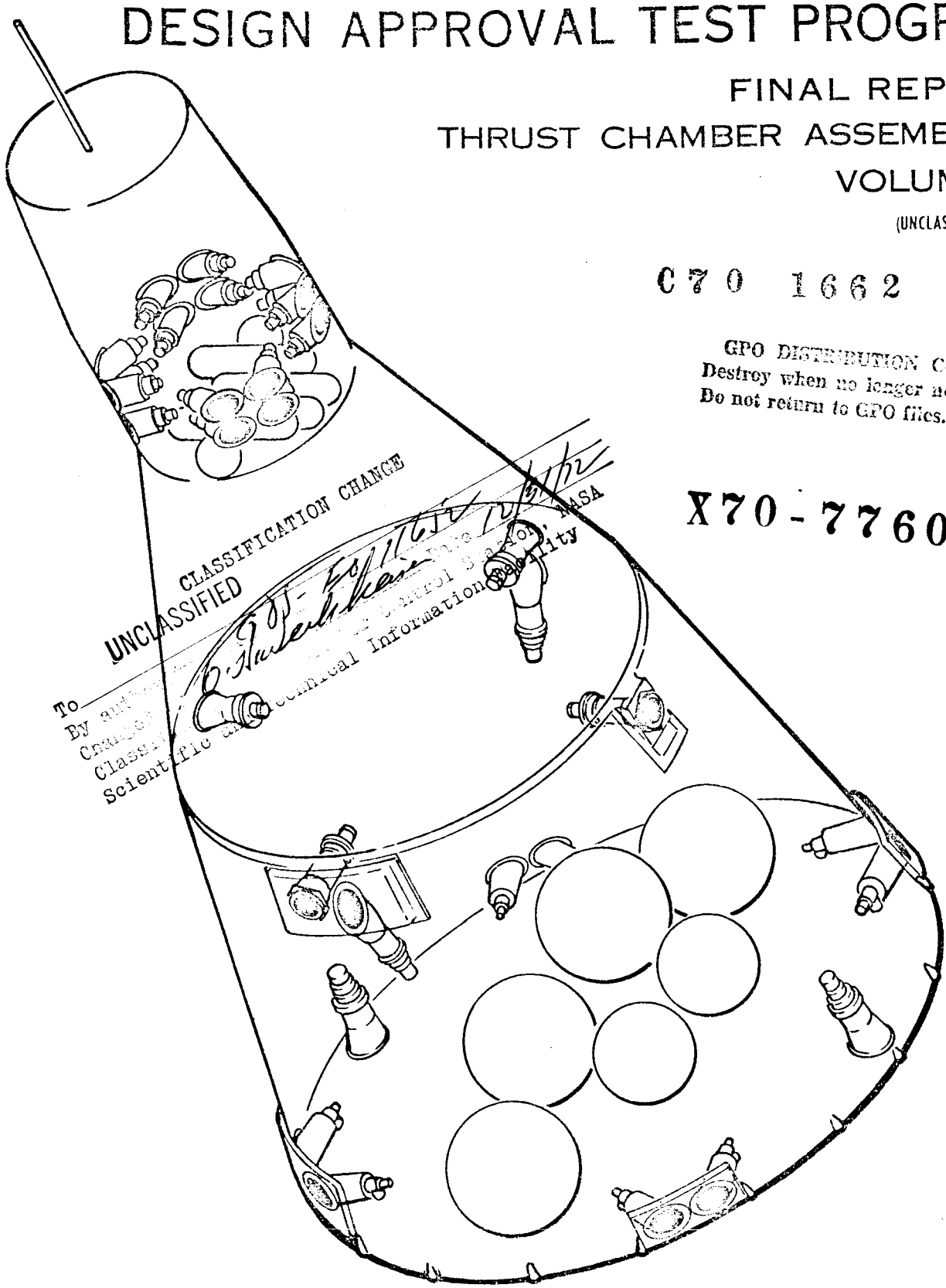

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GEMINI DESIGN APPROVAL TEST PROGRAM FINAL REPORT, THRUST CHAMBER ASSEMBLIES, VOLUME II, BOOK 1, 25-POUND-THRUST RCS TCA P/N 208130-61

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P.O. Y20161R
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133 p

52-52700 - 217, - 221, -225, -227, -239:

1/26/66

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exceeded the specification maximum of 550 F by 50 F after approximately 100 seconds of accumulated burn time. This failure was reported in OFR(FAR) 12918R of Appendix B. No performance degradation or incipient mechanical failure was observed during the test. The failure analysis concluded that the apparent failure was caused by a test facility inadequacy.

A thorough evaluation of the shutdown characteristics of the 25-pound-thrust RCS thrust chamber assembly was conducted prior to initiation of the Design Approval Test Program and continued as additional data were generated during the program. The results of this evaluation indicated that the performance of the TCA did not conform to the specification shutdown time requirement (7 milliseconds maximum from off signal to 2 percent of thrust).

As a result of this evaluation and at the request of the customer, an Engineering Change Notice (ECN-NA-SE6-289R1) was submitted by Rocketdyne recommending that the thrust chamber shutdown requirement be changed from a maximum shutdown time to a maximum shutdown impulse. Rocketdyne has proposed a maximum value inclusive of instrumentation error equal to 0.26 lb-sec. Tentative acceptance of this value has been indicated by the customer.

The recommendation relative to the incorporation of a maximum shutdown impulse instead of a maximum shutdown time and the proposed maximum shutdown impulse value are incorporated in Appendix D of this DAT report. All pages reflecting these changes are appropriately identified. Units 1A, 2A and 3A all exhibited shutdown performance within this requirement.

Compliance of the 25-pound-thrust-RCS Thrust Chamber Assembly with all specification requirements, with the above noted exception relating to maximum shutdown time, was adequately demonstrated.

TABLE 1

(Concluded)

Performance Data (continued)

Fuel Inlet Pressure, Rated, psia	291
Life, Specification Performance, MAC Mission Duty Cycle RC 103, seconds	100
Life Guaranteed, MAC Mission Duty Cycle RC 103, seconds	136
Propellant Valve Service Life, cycles	50,000
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	15
Shutdown Impulse (with spacecraft electrical circuit), Maximum, lb-sec	0.260
Environmental Temperature Range, Operating, F	15 to 200
Environmental Temperature Shock Range, Nonoperating, F	-40 to 185
Vibration Level Random, g rms	8.8
Shock Level (in shipping container), g	15 for 11 milliseconds
Proof Pressure	392 psig at room temperature

TABLE 1*
(Continued)

Performance Data (continued)

Specific Impulse,	Nominal, seconds	284
	Minimum, seconds	266

*Classified parameter

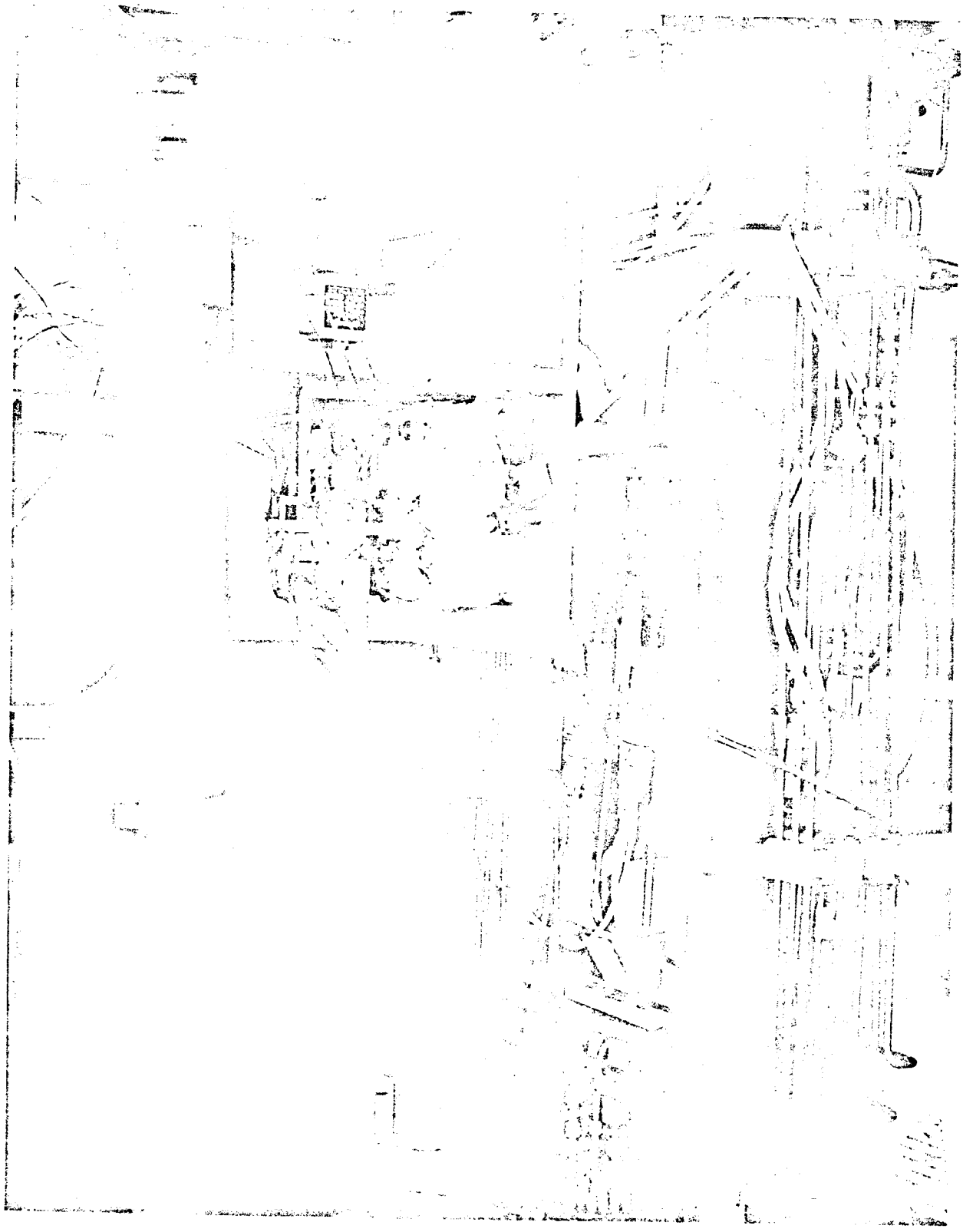

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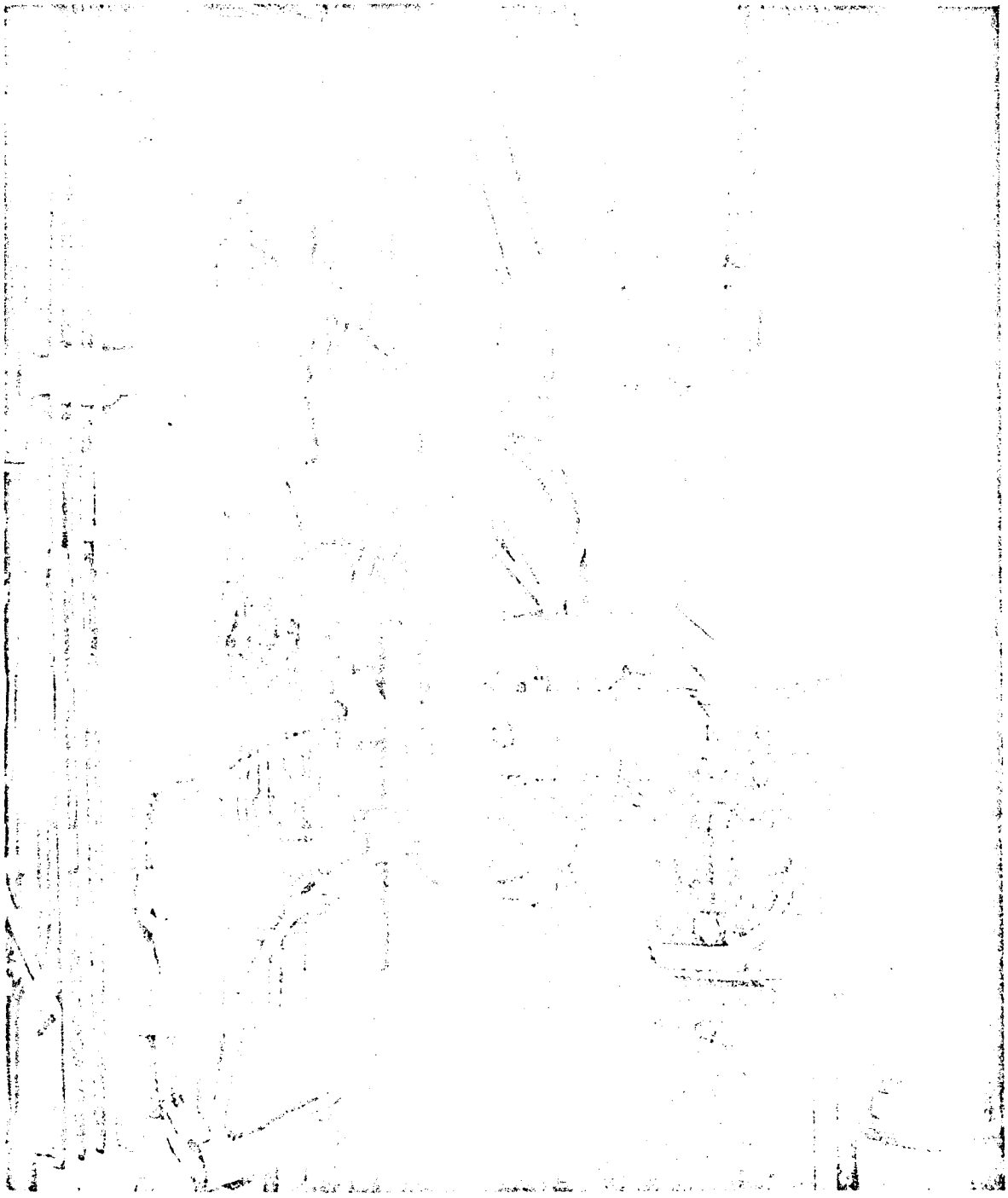
Figure 20. 25-Pound-Thrust RCS TCA DAT Unit 1A, Hot-Fire Test Installation, CTL-3, Cell 39J

FAR 12953R
Figure 4



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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME 25lb THRUST RCS TCA DAT UNIT 1A PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208130-101 SHEET ___ OF ___

DATE	APPROVED FOR NAA: DATE 11/15/65	APPROVED FOR MCDONNELL: DATE
	R H Eccle	

FORM 600-B-44 NEW 6-63

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GEMINI DESIGN APPROVAL TEST PROGRAM FINAL REPORT, THRUST CHAMBER ASSEMBLIES, VOLUME II, BOOK 1, 25-POUND-THRUST RCS TCA P/N 208130-61

Group 4
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Declassified After 12 Years

P.O. Y20161R
G.O. 8645

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Canoga Park, California

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DATE 31 August 1965

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FOREWORD

This report on the Design Approval Testing of the Gemini 25-pound-thrust RCS Thrust Chamber Assembly was prepared for the McDonnell Aircraft Corporation in accordance with the requirements of Purchase Order Y20161R.

ABSTRACT

The Design Approval Test program conducted on the Gemini 25-pound-thrust RCS 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 25-pound-thrust Re-entry Control System (RCS) 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 25-pound-thrust RCS TCA with the requirements of McDonnell Aircraft Corporation Specification Control Drawing 52-52700 by conducting a planned series of environmental and operating tests on three TCAs.

A total of six TCAs was required to conduct the program because of failures that were encountered. These six TCAs were designated Units 1, 1A, 2, 2A, 3, and 3A for purposes of identification during the program.

During the sinusoidal vibration test on Unit 1 a structural failure occurred adjacent to the weld joint at the fuel valve inlet tube orifice housing as reported in Operation and Failure Report (OFR) and Failure Analysis Report (FAR) 20413R of Appendix B. The TCA was removed from the program for failure analysis and replaced by Unit 1A. Analysis revealed that the failure was caused by metal fatigue resulting from the excessive dynamic loads imposed by the sinusoidal vibration test, as related to the inlet tube configuration and the manner in which the inlet tube was supported. The inlet tube was configured to simulate the spacecraft installation and was supported per customer instructions. Prior to the resumption of testing, the vibration requirement was changed from sinusoidal sweep with resonant dwell to a more representative random spectrum. The vibration test was then successfully completed on Unit 1A.

During the pre-explosive atmosphere functio[illegible]sts, the oxidizer valve on Unit 1A failed to actuate. This failure [illegible]eported in OFR(FAR) 12952R of Appendix B. Both of the Unit 1A propell[illegible]lves were removed from the TCA, and the oxidizer valve was sub[illegible] for failure analysis. The failure was found to be caused by extru[illegible]of the Teflon valve seat which resulted from heat soakback to the va[illegible]llowing the mission duty cycle test (MDC) to failure. The valve ope[illegible] normally during the MDC and showed zero leakage during failure anal[illegible]

The tests remaining to be conducted in the [illegible]A test series, i.e., the propellant valve explosive atmosphere test [illegible]e propellant resistance test, were rescheduled to be conducted on t[illegible]pellant valves from the 25-pound-thrust OAMS TCA DAT Unit 1 per Roc[illegible]e Internal Letter 4388-5152, page 346 of Appendix D. The[illegible]ts were subsequently successfully completed on the substitute te[illegible]ts. The results of these tests are reported in Rocketdyne Report R-1[illegible], Volume II, Book 2, "Gemini Design Approval Test Program, Final [illegible]t, Thrust Chamber Assemblies."

During the posttemperature shock functional [illegible] conducted on TCA Unit 2, the oxidizer valve failed the closing respo[illegible]me requirement. This failure was reported in OFR(FAR) 06856R of A[illegible]ix B. The TCA was removed from the program for failure analysis [illegible]eplaced by Unit 2A. The failure was found to be caused by a surge su[illegible]sion diode in the propellant valve electrical control circuit that h[illegible]en installed at the request of the customer. The use of this con[illegible]circuit increased the valve closing time by approximately 1 millisecond. [illegible] DAT specification closing time requirement was subsequently changed to [illegible]e into account the effect of the surge suppression diode.

During the failure analysis of the oxidizer valve, the fuel valve was also tested and failed the closing time requirement. This failure was reported in OFR(FAR) 06875F of Appendix B. The cause of this failure was galling between the valve armature and bobbin bore. The temperature shock test was subsequently successfully completed on TCA Unit 2A.

During the mission duty cycle test to "in specification life" (100 seconds burn time) conducted on TCA Unit 2A, the throat station shell temperature exceeded the specification maximum of 550 F by 115 F after approximately 100 seconds of accumulated burn time. This failure was reported in OFR(FAR) 12953R of Appendix B. No performance degradation or incident mechanical failure was observed during the test. Testing was continued with the hot-fire burst pressure test since it was believed that the shell temperature failure would not compromise the burst pressure test and that the burst pressure test would not detract from the subsequent shell temperature failure analysis. This judgement was verified by the test results. The failure analysis concluded that the apparent failure was caused by a test facility inadequacy.

During the posthumidity functional tests on TCA Unit 3, the fuel valve failed the closing time requirement. This failure was reported in OFR(FAR) 12909R of Appendix B. The TCA was removed from the program for failure analysis and replaced by Unit 3A. The failure was caused by internal corrosion of the valve which resulted from improper capping of the valve ports during the humidity test or the preceding salt spray test. The humidity test was subsequently successfully completed on TCA Unit 3A.

During the mission duty cycle test to "guaranteed life" (136 seconds burn time) conducted on TCA Unit 3A, the throat station shell temperature

exceeded the specification maximum of 550 F by 50 F after approximately 100 seconds of accumulated burn time. This failure was reported in OFR(FAR) 12918R of Appendix B. No performance degradation or incipient mechanical failure was observed during the test. The failure analysis concluded that the apparent failure was caused by a test facility inadequacy.

A thorough evaluation of the shutdown characteristics of the 25-pound-thrust RCS thrust chamber assembly was conducted prior to initiation of the Design Approval Test Program and continued as additional data were generated during the program. The results of this evaluation indicated that the performance of the TCA did not conform to the specification shutdown time requirement (7 milliseconds maximum from off signal to 2 percent of thrust).

As a result of this evaluation, an Engineering Change Notice (ECN-NA-SE6-289R1) was submitted to the customer by Rocketdyne recommending that the thrust chamber assembly shutdown requirement be changed from a maximum shutdown time to a maximum shutdown impulse and proposing a maximum impulse value (0.260 lb-sec).

The recommendation relative to the incorporation of a maximum shutdown impulse instead of a maximum shutdown time and the proposed maximum shutdown impulse value are incorporated in Appendix D of this DAT report. All pages reflecting these changes are appropriately identified. Units 1A, 2A and 3A all exhibited shutdown performance within this requirement.

Compliance of the 25-pound-thrust RCS Thrust Chamber Assembly with all specification requirements was adequately demonstrated by the Design Approval Test Program.

DESCRIPTION OF 25-POUND-THRUST RCS THRUST CHAMBER ASSEMBLY P/N 208130-61

The 25-pound-thrust Re-entry Control System (RCS) Thrust Chamber Assembly (TCA) is a storable liquid, bipropellant, pressure fed, ablation cooled assembly. It is used in the Re-entry Control System for pitch, yaw, and roll control during re-entry of the Gemini spacecraft. 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 90-degree oriented (perpendicular to the TCA centerline) high-silica resin impregnated ablative material. The nozzle segment is fabricated from 0-degree oriented (parallel to the TCA centerline) high-silica resin impregnated ablative material. In addition, the thrust chamber body is wrapped with a layer of phenolic impregnated asbestos fiber to provide additional sealing capabilities. The bond line between the combustion chamber segment and 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 attach 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 seven-piece segmented JTA graphite liner backed up by a 0-degree ablative sleeve. A throat insert of solid

silicon carbide is used to resist the erosive effects of the combustion gases. The thrust chamber injector is fabricated from stainless steel. It consists of four pairs of unlike doublets which impinge on a splash plate providing propellant mixing for high combustion efficiency.

TCA operation is controlled by two fast-acting, electrically operated, solenoid propellant valves (Fig. 1) 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 armature stroke. Closing is accomplished through the use of a spring, and sealing force is obtained from the spring and the pressure of the propellant acting on the ball.

The 25-pound-thrust RCS TCA is shown in Fig. 1, and schematics are presented in Fig. 2 and 3. The physical and performance data for this TCA are presented in Table 1.

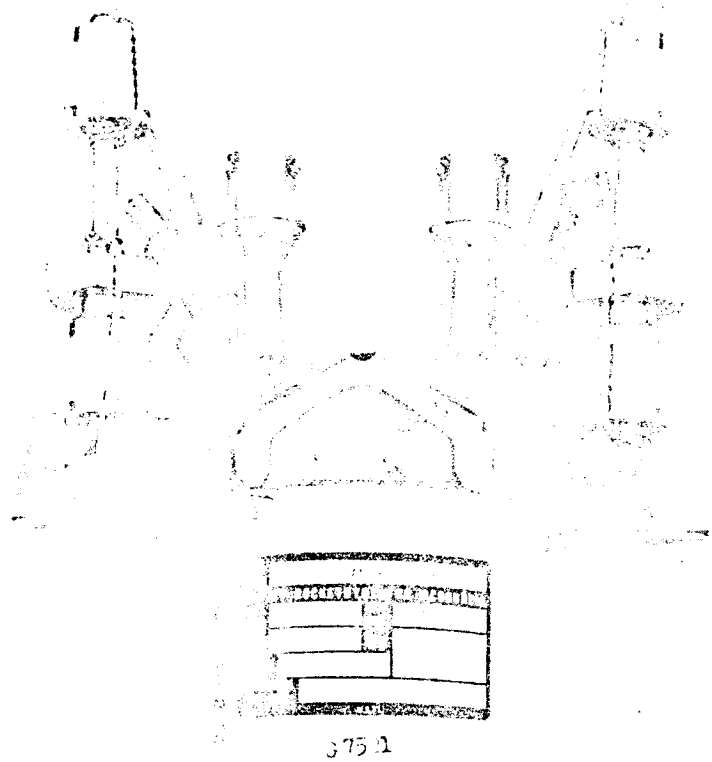

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Figure 1 . Gemini 25-Pound-Thrust RCS TCA P/N 208130-61

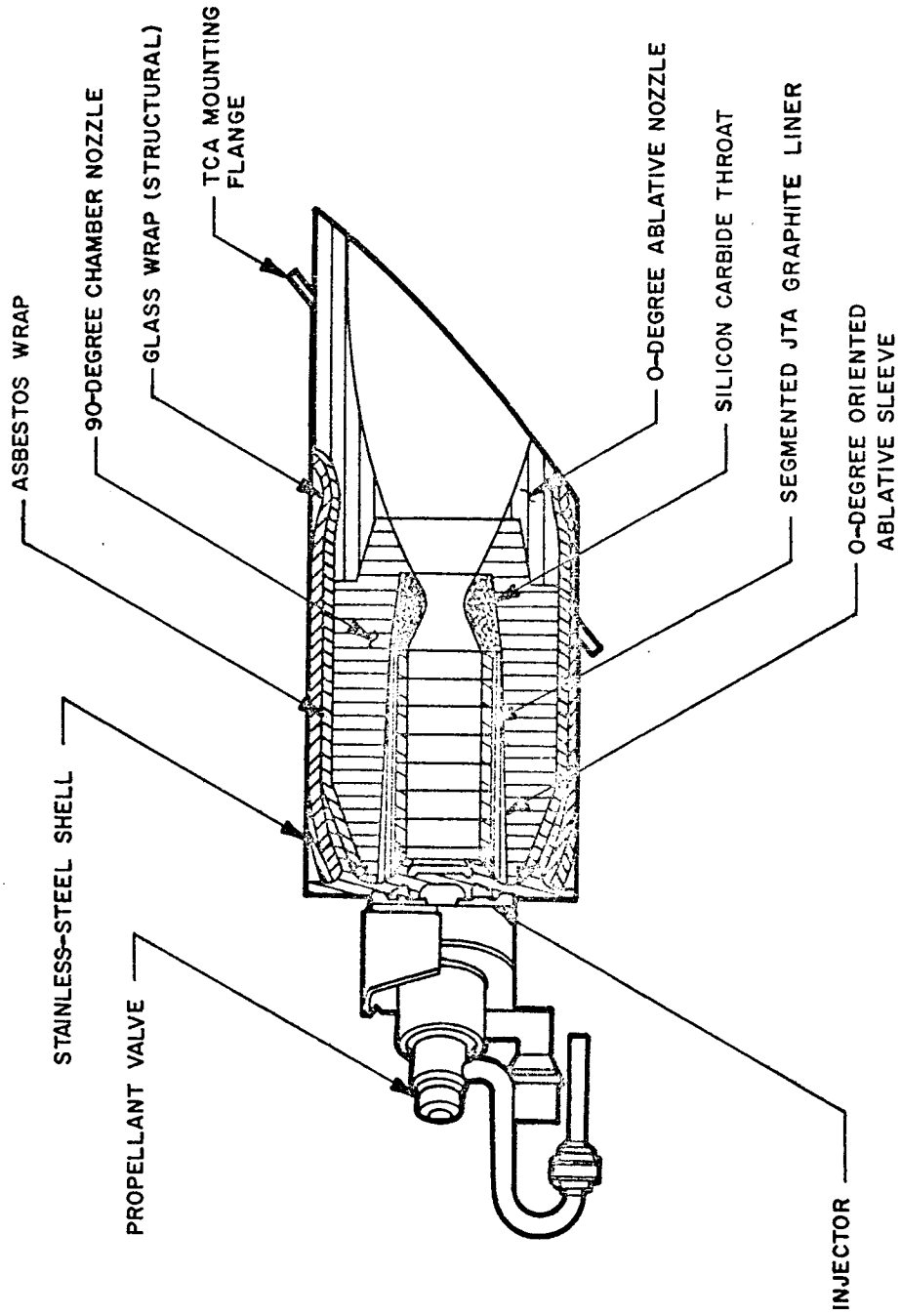

Figure 2. Gemini 25-Pound-Thrust RCS Thrust Chamber Assembly Schematic

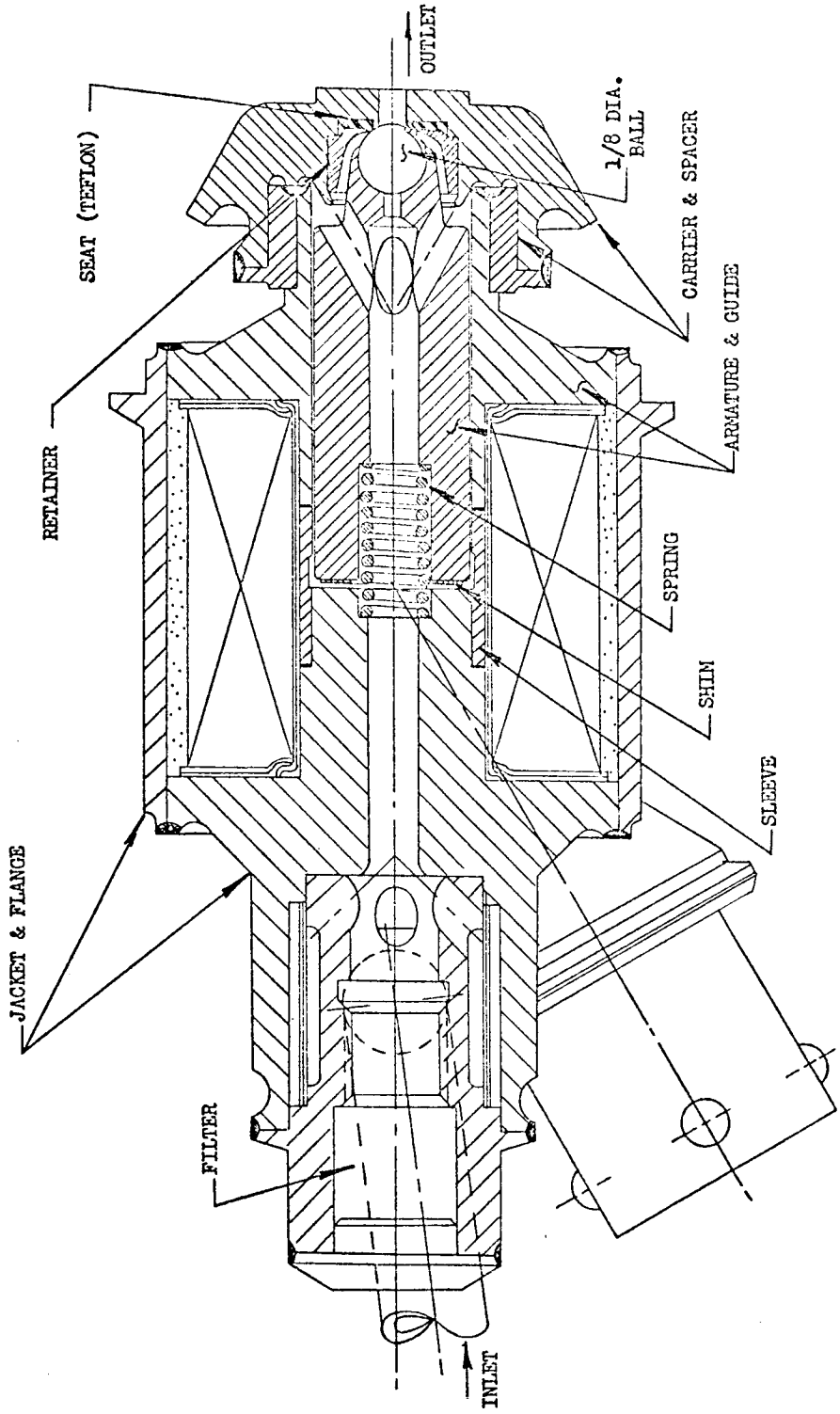

Figure 3. Schematic of Gemini RCS TCA Propellant Valve

TABLE 1

25-POUND-THRUST RCS TCA P/N 208130-61
PHYSICAL AND PERFORMANCE DATA

Compliance of the Gemini 25-pound-thrust RCS TCA P/N 208130-61 with the following physical and performance requirements has been verified by design approval tests.

Physical Data	
Envelope, inches	Overall dimensions: length 9.7 inches; diameter 2.5 inches
Weight, pounds (nominal)	2.24
Compatibility	Nitrogen tetroxide and monomethylhydrazine
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 tetorixide (oxidizer) and monomethylhydrazine (fuel)
Thrust, Vacuum, Rated, pounds	23.0
Chamber Pressure, Nominal, psia	130.0
Mixture Ratio, Rated o/f	1.3
Specific Impulse	Classified (see page 13)
Oxidizer Inlet Pressure, Rated, psia	287

TABLE 1

(Concluded)

Performance Data (continued)

Fuel Inlet Pressure, Rated, psia	291
Life, Specification Performance, MAC Mission Duty Cycle RC 103, seconds	100
Life Guaranteed, MAC Mission Duty Cycle RC 103, seconds	136
Propellant Valve Service Life, cycles	50,000
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	15
Shutdown Impulse (with spacecraft electrical circuit), Maximum, lb-sec	0.260
Environmental Temperature Range, Operating, F	15 to 200
Environmental Temperature Shock Range, Nonoperating, F	-40 to 185
Vibration Level Random, g rms	8.8
Shock Level (in shipping container), g	15 for 11 milliseconds
Proof Pressure	480 psig at 68 F

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TABLE 1*

(Continued)

Performance Data (continued)

Specific Impulse, Nominal, seconds	284

*Classified parameter

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TEST PROGRAM

TEST OUTLINE

Three RCS 25-pound-thrust TCA's were originally scheduled to be tested during the program. As a result of failures encountered, however, it was necessary to use a total of six test units. These six TCA's, designated Units 1, 1A, 2, 2A, 3, and 3A were subjected to the tests outlined in Table 2 in the order listed.

TEST UNIT IDENTIFICATION, P/N 208130-61

Unit 1	S/N 4056174
Unit 1A	S/N 4060448
Unit 2	S/N 4059276
Unit 2A	S/N 4054995
Unit 3	S/N 4055298
Unit 3A	S/N 4060450

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 RA0220-350.

TABLE 2

TEST SEQUENCE

Tests	Units					
	1	1A	2	2A	3	3A
Visual Inspection	X	X	X	X	X	X
Component Modification	X	X	X	X	X	X
Vibration Test	X	X				
Propellant Valve Proof Pressure and Leakage	X	X				
Thrust Chamber Proof Pressure and Leakage		X				
Propellant Valve Electrical Resistance		X				
Propellant Valve Dielectric Strength		X				
Propellant Valve Functional		X				
Mechanical Shock Test		X				
Propellant Valve Proof Pressure and Leakage		X				
Thrust Chamber Proof Pressure and Leakage		X				
Propellant Valve Electrical Resistance		X				
Propellant Valve Dielectric Strength		X				
Propellant Valve Functional		X				
Propellant Valve Continuous Duty		X				
Propellant Valve Proof Pressure and Leakage		X				
Propellant Valve Electrical Resistance		X				
Propellant Valve Dielectric Strength		X				
Propellant Valve Functional		X				
Mission Duty Cycle to Failure		X				
Propellant Valve Electrical Resistance		X				
Propellant Valve Dielectric Strength		X				
Propellant Valve Functional		X				
Explosive Atmosphere Test		X				
Temperature Shock Test			X	X		
Propellant Valve Proof Pressure and Leakage			X	X		
Thrust Chamber Proof Pressure and Leakage			X	X		
Propellant Valve Electrical Resistance			X	X		
Propellant Valve Dielectric Strength			X	X		
Propellant Valve Functional			X	X		

TABLE 2

(Concluded)

Tests	Units					
	1	1A	2	2A	3	3A
Mission Duty Cycle to 100 Seconds and Hot-Fire Burst Pressure Test				X		
Salt-Spray Test					X	
Propellant Valve Proof Pressure and Leakage					X	
Propellant Valve Electrical Resistance					X	
Propellant Valve Dielectric Strength					X	
Propellant Valve Functional					X	
Humidity Test					X	X
Propellant Valve Proof Pressure and Leakage					X	X
Propellant Valve Electrical Resistance					X	X
Propellant Valve Dielectric Strength					X	X
Propellant Valve Functional					X	X
Mission Duty Cycle to 136 Seconds						X
Propellant Valve Service Life Test						X
Propellant Valve Proof Pressure and Leakage						X
Propellant Valve Electrical Resistance						X
Propellant Valve Dielectric Strength						X
Propellant Valve Functional						X
Disassembly and Inspection		X		X		X

Following the visual inspection, Unit 1 was modified by the addition of simulated spacecraft system tube extensions (P/N 99-106691 and 99-106692) to the existing oxidizer and fuel inlet tube stubs. Installation of the simulated spacecraft system tube extensions was accomplished per Rocketdyne Specification RA0607-009, "In-Place Brazing of Tubes and Fittings for Space Engines."

Results

Visual inspection was successfully completed.

VIBRATION TEST

Description

Unit 1 was installed in a rigid fixture and subjected to sinusoidal vibration along each of the three mutually perpendicular axes. The testing in each axis started with a 1-g logarithmic sinusoidal sweep to calibrate the accelerometers. The test in each axis then proceeded as follows:

1. From 5 to 14 cps at 0.30 inch double amplitude
2. From 14 to 100 cps at ±3 g
3. From 100 to 500 cps at ±5 g
4. From 500 to 2000 cps at ±8 g

The vibration frequency was varied logarithmically from 5 to 2000 cps and back to 5 cps in 15 minutes, twice along each axis for a total of 30

minutes per axis. All resonant frequencies were noted. Resonance was defined as an output equal to 1.5 times the input. The unit was then vibrated for 7 minutes at each of the resonant frequencies. The order of testing was X-axis, Y-axis, and Z-axis. Leakage and functional tests were to be performed following the vibration testing.

Results

A dye penetrant test following the Z-axis vibration revealed a crack at the weld joint between the fuel inlet tube and the fuel valve body. This failure was reported in OFR(FAR) 20413R. The TCA was removed from the program and replaced by Unit 1A. The failure was the result of a combination of marginal weld quality, inadequate support for the simulated spacecraft system tube extensions, and unrealistically high loads imposed by the resonant dwell method of vibration testing. The vibration test requirement was subsequently changed to a less severe random vibration test.

TEST DESCRIPTION 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 RA0220-350.

Following visual inspection, Unit 1A was modified by the addition of simulated spacecraft system tube extensions (P/N 99-106691 and 99-106692) to the existing oxidizer and fuel inlet tube stubs. Installation of the simulated spacecraft system tube extensions was accomplished per Rocketdyne Specification RA0607-009, "In-Place Brazing of Tubes and Fittings for Space Engines."

Results

Visual inspection was successfully completed.

VIBRATION TEST

Description

Unit 1A was subjected to random vibration testing along each of three mutually perpendicular axes. The random vibration time for each axis was 10 minutes less the equalization time required to verify 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 8.8 g rms. The vibration frequency was varied from 20 to 2000 cps. The vibration spectrum was as follows:

1. 0.02 to 0.09 g^2/cps from 20 to 400 cps
2. 0.09 g^2/cps from 400 to 800 cps
3. 0.09 to 0.01 g^2/cps from 800 to 1000 cps
4. 0.01 g^2/cps from 1000 to 2000 cps

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

Results

The vibration test was successfully completed.

MECHANICAL SHOCK TEST

Description

Unit 1A was installed in a mechanical shock test fixture and was subjected to three shocks in each direction along each of the three mutually perpendicular axes. The shocks were of 15-g magnitude and 11-millisecond duration. Functional and leakage tests were conducted after completion of the mechanical shock test.

Results

The mechanical shock test was successfully completed.

PROPELLANT VALVE CONTINUOUS DUTY

The propellant valve continuous duty test was originally scheduled to be conducted last in the Unit 1A test series. It was rescheduled to be conducted before the mission duty cycle test to expedite testing by avoiding facility interference. This was authorized by Rocketdyne Internal Letter 4388-5341 page 329 of Appendix D.

Description

Unit 1A was installed in the propellant valve continuous duty test setup. The oxidizer valve was then energized continuously for a period of 24 hours. The valve was initially energized with 26 vdc. Following pull-in, the voltage was reduced to 10 vdc for the remainder of the test. The oxidizer valve was then subjected to functional and leakage tests.

Results

The propellant valve continuous duty test was successfully completed.

MISSION DUTY CYCLE TO FAILURE

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

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

Description

Unit 1A was installed in the hot-fire test facility and was subjected to a mission duty cycle to failure. The first portion of the MDC was a "cape firing cycle" conducted at local ambient conditions, after which the temperature of the TCA was allowed to return to local ambient temperature. The second portion of the MDC was to consist of the pulses described for MDC to failure in Table II, page 542 of Appendix D. This portion of the MDC was conducted at a simulated altitude in excess of 100,000 feet and local ambient temperature.

Results

The MDC to failure was successfully completed. The test was terminated after 2415 seconds of elapsed time because of excessive (775 F) throat station shell temperature. This elapsed time is approximately 88 seconds short of the nominal elapsed time for a guaranteed-life MDC; however, the test data showed all the TCA pulses to be excessively long because of slow dropout of a switching relay in the test control system. Based on actual burn time, the throat station skin temperatures were only 10 F above the specification maximum of 650 F at guaranteed life (136 seconds burn time). This resulted from the increase in percent burn of the MDC caused by the long pulses.

EXPLOSIVE ATMOSPHERE TEST

During the pre-explosive atmosphere functional tests, the oxidizer valve of Unit 1A failed to open. On later attempts the valve opened slightly, allowing a small flow of gas through the valve. This failure was reported in OFR(FAR) 12952R of Appendix B. The mode of failure was extrusion of the Teflon valve seat which resulted in a greatly shortened armature stroke. The seat extrusion was caused by heat soakback from the thrust chamber following the preceding MDC test. The valves are not normally required to operate following an MDC beyond guaranteed life. The oxidizer valve operated properly during the MDC and showed zero leakage during failure analysis.

The explosive atmosphere and propellant resistance tests were rescheduled to be conducted on the valves from 25-pound-thrust OAMS TCA DAT Unit 1 per Rocketdyne Internal Letter 4388-5152, page 346 of Appendix D. The results of these tests are reported in Rocketdyne Report R-15019-2, Volume II, Book 2, "Gemini Design Approval Test Program, Final Report, Thrust Chamber Assemblies."

DISASSEMBLY AND INSPECTION

The oxidizer valve from Unit 1A was sectioned by FAR action. Information concerning the posttest condition may be found in OFR(FAR) 12952R of Appendix B.

Description

Unit 1A was visually inspected for any defects, damage, or abnormal wear. A record was made of the pertinent items visible prior to disassembly. The

disassembly consisted of (1) sectioning of the fuel valve at the fabrication welds, (2) disassembly of the fuel valve internal parts, and (3) sectioning of the thrust chamber body. The valve parts and chamber sections were visually inspected to determine internal condition. A record was made of the pertinent observations.

Results

The predisassembly inspection of Unit 1A revealed the following: (1) slight delaminations in the nozzle ablative material, and (2) heat discoloration of the stainless-steel shell.

The postdisassembly inspection revealed the following: (1) the ablative was charred to the OD over approximately 90 percent the length, (2) the asbestos was charred and slightly separated in the throat area, (3) the glass wrap was charred slightly in the throat area, and (4) there were delaminations in the 90-degree ablative material.

TEST DESCRIPTION AND RESULTS, UNIT 2

VISUAL INSPECTION

Description

Unit 2 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 RA0220-350.

Following the visual inspection, Unit 2 was modified by the addition of inlet tube adapters (P/N 99-106126) to the existing oxidizer and fuel inlet tubes. Installation of the adapters was accomplished per Rocketdyne specification RA0607-009, "In-Place Brazing of Tubes and Fittings for Space Engines."

Results

Visual inspection was successfully completed.

TEMPERATURE SHOCK TEST

Description

Unit 2 was placed in a temperature chamber and exposed to a temperature of 185 F for a period of 4 hours. It was then transferred within 5 minutes to a second temperature chamber where it was exposed to a temperature of -40 F for 4 hours. This was repeated until a total of three heating and three cooling cycles was accumulated. The TCA was then allowed to return to room temperature, and within 1 hour thereafter was subjected to leakage and functional tests.

Results

During the temperature shock functional tests, the oxidizer valve of Unit 2 failed to meet the specification closing response time of 0.002 second; the actual time was 0.003 second. This failure was reported in

OFR(FAR) 06856R of Appendix B. The TCA was removed from the program for failure analysis and replaced by Unit 2A. The failure was found to be caused by a surge suppression diode in the propellant valve electrical control circuit which had been installed at the request of the customer. The use of this control circuit increased the valve closing time by approximately 1 millisecond. The valve was found to meet the closing time requirement with the diode out of the circuit. The DAT specification closing time requirement was subsequently changed to take into account the effect of the surge suppression diode.

During failure analysis of the oxidizer valve noted above, the fuel valve of Unit 2 was also tested and failed to meet the specification closing response time. This failure was reported in OFR(FAR) 06875R of Appendix B. Later checks during failure analysis yielded closing times ranging from within specification to no indication of armature movement. Disassembly of the valve revealed particles of contamination imbedded in the Teflon seat and galled areas on the armature and bobbin bore. The failure of the valve to close resulted from the galling of the armature and bobbin. The galling was probably initiated by contamination and was aggravated by the stresses resulting from valve bracket welding and by shrinkage of the bobbin ID during seat weld cooling.

TEST DESCRIPTION AND RESULTS, UNIT 2A

VISUAL INSPECTION

Description

Unit 2A 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 RA0220-350.

Following the visual inspection, Unit 2A was modified by the addition of inlet tube adapters (P/N 99-106126) to the existing oxidizer and fuel inlet tube stubs. Installation of the adapters was accomplished per Rocketdyne Specification RA0607-009, "In-Place Brazing of Tubes and Fittings for Space Engines."

Results

Visual inspection was successfully completed.

TEMPERATURE SHOCK TEST

Description

Unit 2A was placed in a temperature chamber and exposed to a temperature of 185 F for a period of 4 hours. It was then transferred within 5 minutes to a second temperature chamber where it was exposed to a temperature of -40 F for 4 hours. This was repeated until a total of three heating and three cooling cycles was accumulated. The TCA was then allowed to return to room temperature, and within 1 hour thereafter was subjected to leakage and functional test.

Results

The temperature shock test was successfully completed.

MISSION DUTY CYCLE TO "IN SPEC" LIFE (100 SECONDS)
AND HOT-FIRE BURST PRESSURE TEST

Description

In preparation for the MDC and hot-fire burst test, Unit 2A was reworked by removing the propellant metering orifices. The orifices were installed in special orifice adapters (P/N 99-106167) and the unit was then installed in the hot-fire test facility. The special adapters were installed in the test facility propellant feed system so that the propellant would be allowed to flow through the orifices during the MDC and later bypass the orifices during the hot-fire burst pressure test.

The first portion of the MDC was "cape firing cycle" conducted at local ambient pressure and temperature conditions, after which the TCA was allowed to return to ambient temperature. The second portion of the MDC consisted of the pulses, described in Table 2 page 542 of Appendix D, up to 100 seconds of accumulated burn time.

During the temperature soakout period following the MDC, the test facility propellant tank pressures were raised to 750 psig and the orifice adapter bypass valves were opened. After all TCA shell throat station temperatures had peaked and subsequently dropped 5 F, a 3-second steady-state burst pressure firing was conducted at a chamber pressure of 269 psia. The MDC, temperature soakout, and hot-fire burst pressure tests were conducted at a simulated pressure altitude in excess of 100,000 feet and local ambient temperature.

Results

The MDC to 100 seconds was successfully completed; however, during the MDC the TCA throat station shell temperature exceeded the specification limit of 550 F by 115 F, and during the soakout period the shell temperature exceeded the specification limit of 650 F. This failure was reported in OFR(FAR) 12953R of Appendix B. The high skin temperatures did not result in degradation of the TCA performance or structural integrity.

Testing was continued with the hot-fire burst pressure test because it was believed that the shell temperature failure would not compromise the burst pressure test and that the burst pressure test would not detract from the subsequent shell temperature failure analysis.

The hot-fire burst pressure test was successfully completed with no apparent degradation of the TCA.

DISASSEMBLY AND INSPECTION

Description

Unit 2A was visually inspected for any defects, damage, or abnormal wear. A record was made of the pertinent items visible prior to disassembly. The disassembly consisted of (1) removal of the propellant valves, (2) sectioning of the propellant valves at the fabrication welds, (3) disassembly of the propellant valve internal parts, and (4) sectioning of the thrust chamber body. The propellant valve parts and thrust chamber sections were visually inspected to determine internal conditions. A record was made of the pertinent items.

Results

The predisassembly inspection of Unit 2A revealed the following: (1) two longitudinal cracks in the throat insert, (2) slight erosion in the first liner upstream of the throat, and (3) slight delaminations of the nozzle ablative material.

The postdisassembly inspection revealed the following: (1) the ablative was charred to the OD over approximately 95 percent of the length, (2) there were slight delaminations in the 90-degree ablative material, (3) the asbestos layer was charred and slightly separated in the throat area, and (4) the glass wrap was slightly charred in the throat area.

TEST DESCRIPTION AND RESULTS, UNIT 3

VISUAL INSPECTION

Description

Unit 3 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 RA0220-350.

Following the visual inspection, Unit 3 was modified by the addition of inlet tube adapters (P/N 99-106126) to the existing oxidizer and fuel inlet tube stubs. Installation of the adapters was accomplished per Rocketdyne Specification RA0607-009, "In-Place Brazing of Tubes and Fittings for Space Engines."

Results

Visual inspection was successfully completed.

SALT SPRAY TEST

Description

Unit 3 was installed in a salt spray test chamber. It was then subjected to a 5-percent salt concentration spray solution for a period of 50 hours. Within 1 hour after the completion of the salt spray exposure, and again after 48 hours had elapsed, the TCA was subjected to leakage and functional tests.

Results

The salt spray test was successfully completed.

HUMIDITY

Description

Unit 3 was placed in a humidity test chamber where it was exposed to a relative humidity between 95 and 100 percent. During the humidity exposure, the temperature conditioning was as follows: (1) 1 hour at room ambient, (2) 2 hours of gradual increase to 160 F, (3) 6 hours at 160 F, (4) 16 hours of gradual decrease to room ambient, and (5) repeat 2 through 4 for a total of 10 cycles. The total exposure time was 240

hours. The TCA was then allowed to return to ambient conditions of temperature and humidity, and within 1 hour was subjected to leakage and functional tests.

Results

During the posthumidity functional test the fuel valve of Unit 3 was found to be stuck in the open position. This failure was reported in OFR(FAR) 12909R of Appendix B. The TCA was removed from the program for failure analysis and replaced by Unit 3A. Disassembly of the Unit 3 fuel valve revealed that it was contaminated with a red residue that was determined to be rust. The investigation also revealed severe corrosion of the caps used on the valve inlet tubes during the salt spray and humidity tests, including corrosion of the sealing surfaces of the caps. This latter point verified that the corrosion resulted from the caps being improperly installed during the humidity test and/or the preceding salt spray test.

TEST DESCRIPTION AND RESULTS, UNIT 3A

VISUAL INSPECTION

Description

Unit 3A 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 RA0220-350.

Following the visual inspection, Unit 3A was modified by the addition of inlet tube adapters (P/N 99-106126) to the existing oxidizer and fuel inlet

tube stubs. Installation of the adapters was accomplished per Rocketdyne Specification RA0607-009, "In-Place Brazing of Tubes and Fittings for Space Engines."

Results

Visual inspection was successfully completed.

HUMIDITY

Description

Unit 3A was placed in a humidity test chamber where it was exposed to a relative humidity between 95 and 100 percent. During the humidity exposure the temperature conditioning was as follows: (1) 1 hour at room ambient, (2) 2 hours of gradual increase to 160 F, (3) 6 hours at 160 F, (4) 16 hours of gradual decrease to room ambient, and (5) repeat 2 through 4 for a total of 10 cycles. The total exposure time was 240 hours. The TCA was then allowed to return to ambient conditions of temperature and humidity and within 1 hour was subjected to leakage and functional tests.

Results

The humidity test was successfully completed.

MISSION DUTY CYCLE TO GUARANTEED LIFE (136 SECONDS)

Description

Unit 3A was installed in the hot-fire test facility and was subjected to a mission duty cycle to guaranteed life (136 seconds). The first portion of the MDC was a "cape firing cycle" conducted at local ambient conditions, after which the TCA was allowed to return to local ambient temperature. The second portion of the MDC consisted of the pulses described in Table II, page 542 of Appendix D, up to 136 seconds of burn time. This portion of the MDC was conducted at a simulated altitude in excess of 100,000 feet and local ambient temperature.

Results

The MDC to guaranteed life was successfully completed; however, the throat station shell temperature exceeded the specification limit of 550 F at 100 seconds burn time by 50 F. In addition, the shell temperature exceeded the specification limit of 650 F by 80 F at 136 seconds burn time. This failure was reported in OFR(FAR) 12918R of Appendix B. The high shell temperatures did not result in any apparent degradation of TCA performance or structural integrity.

PROPELLANT VALVE SERVICE LIFE TEST

Action on OFR 12918R was delayed to permit completion of the propellant valve service life test as authorized by Rocketdyne Internal Letter 4388-5155, page 493 of Appendix D.

Description

Unit 3A was installed in the propellant valve service life test setup. The valves were then cycled as follows: 3300 cycles with room temperature GN_2 at 200 psig and a room temperature environment, 5000 cycles with 200 F water at 200 psig and a 250 F environment, 20,000 cycles with 160 F water at 200 psig and a 160 F environment, and 20,000 cycles with a 15 F water-alcohol solution at 200 psig and a 15 F environment. The first group of 3300 cycles consisted of 660 cycles each at rates of 1, 2, 3, 4, and 5 cps. Each succeeding group of 5000 cycles consisted of 1000 cycles each at rates of 1, 2, 3, 4, and 5 cps. In each case, the valves were actuated simultaneously with 26 vdc. Complete valve checkout tests were conducted before and after the service life tests with proof pressure, leakage, and functional tests being conducted following the room temperature, the 200 F, and the 160 F tests.

Results

The propellant valve service life test was successfully completed. Deviations to the sequence of valve checkout tests to expedite testing were authorized by Rocketdyne Internal Letters 4388-5348 and 4388-5349, pages 497 and 498 of Appendix D. Rocketdyne Internal Letter 4388-5350, page 499 of Appendix D, authorized the use of a sealing compound on the nozzle of the TCA to prevent leakage of the test fluids through the charred ablative.

DISASSEMBLY AND INSPECTION

Description

Unit 3A was visually inspected for any defects, damage, or abnormal wear. A record was made of the pertinent items visible prior to disassembly. The disassembly consisted of (1) removal of the propellant valves, (2) sectioning of the propellant valves at the fabrication welds, (3) disassembly of the propellant valve internal parts, and (4) sectioning of the thrust chamber body. The propellant valve parts and thrust chamber sections were visually inspected to determine internal condition. A record was made of the pertinent items.

Results

The predisassembly inspection of Unit 3A revealed heat discoloration of the stainless-steel shell.

The postdisassembly inspection revealed the following: (1) the ablative was charred to the OD over approximately 90 percent of the combustion and throat area, (2) minor delaminations in the 90-degree ablative material, and (3) the asbestos was charred in the throat area.

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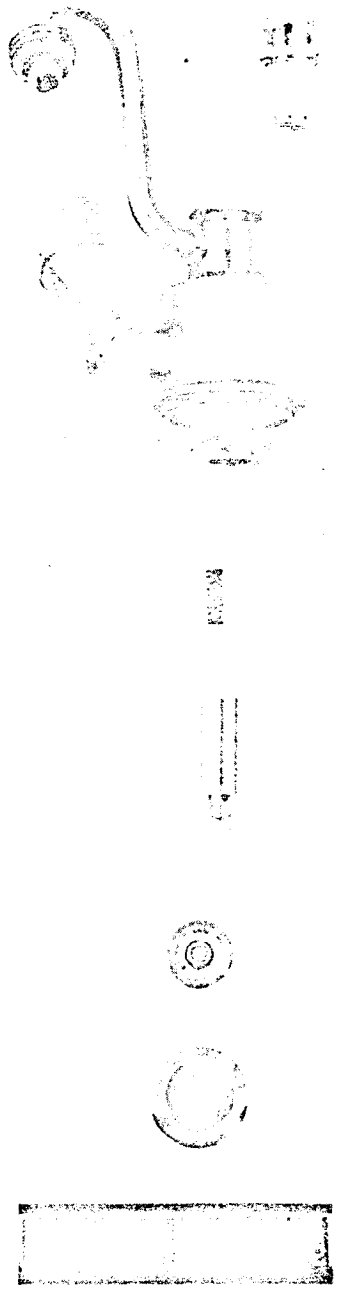
APPENDIX A

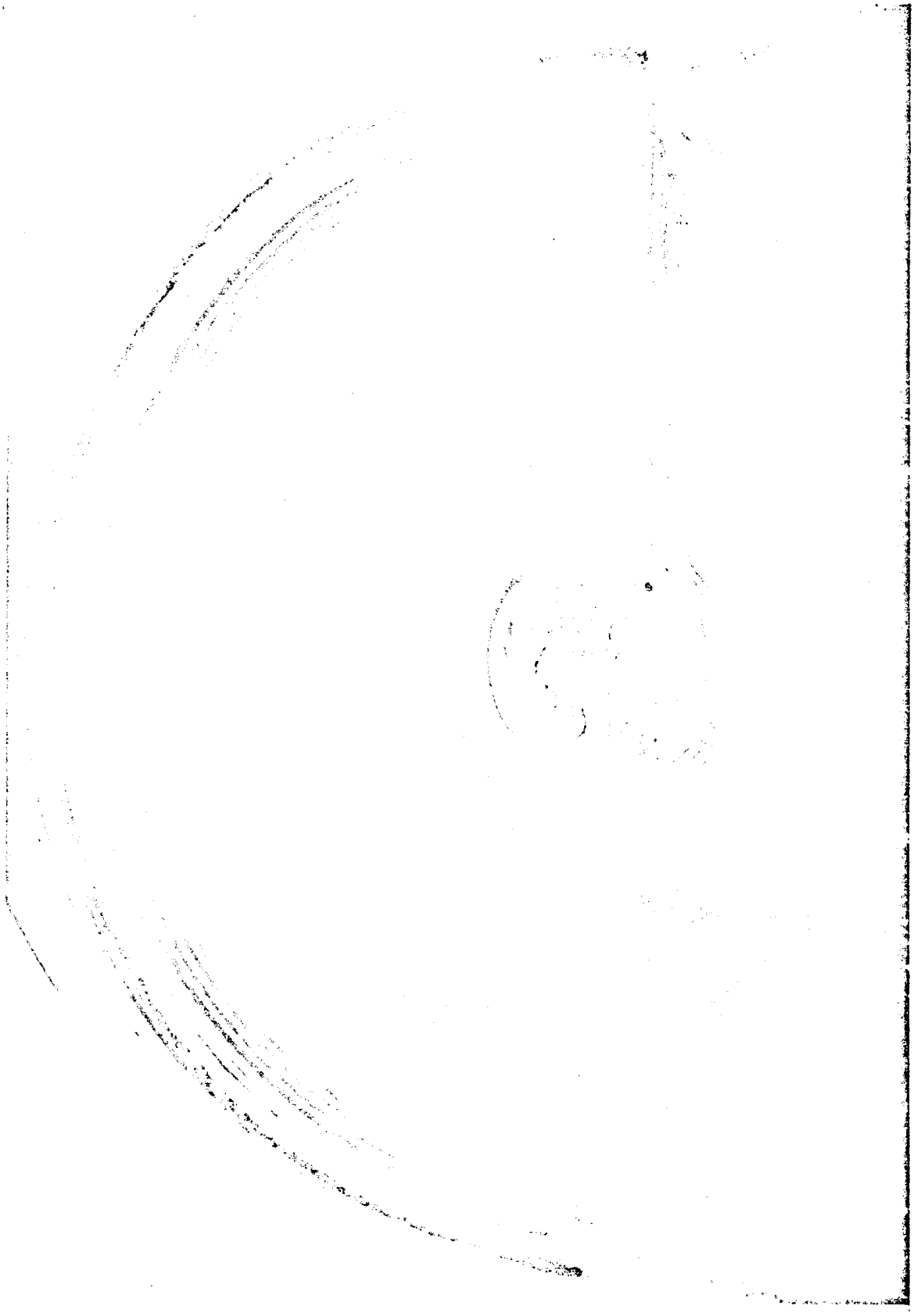
APPENDIX A

PHOTOGRAPHS OF TESTS AND TEST EQUIPMENT



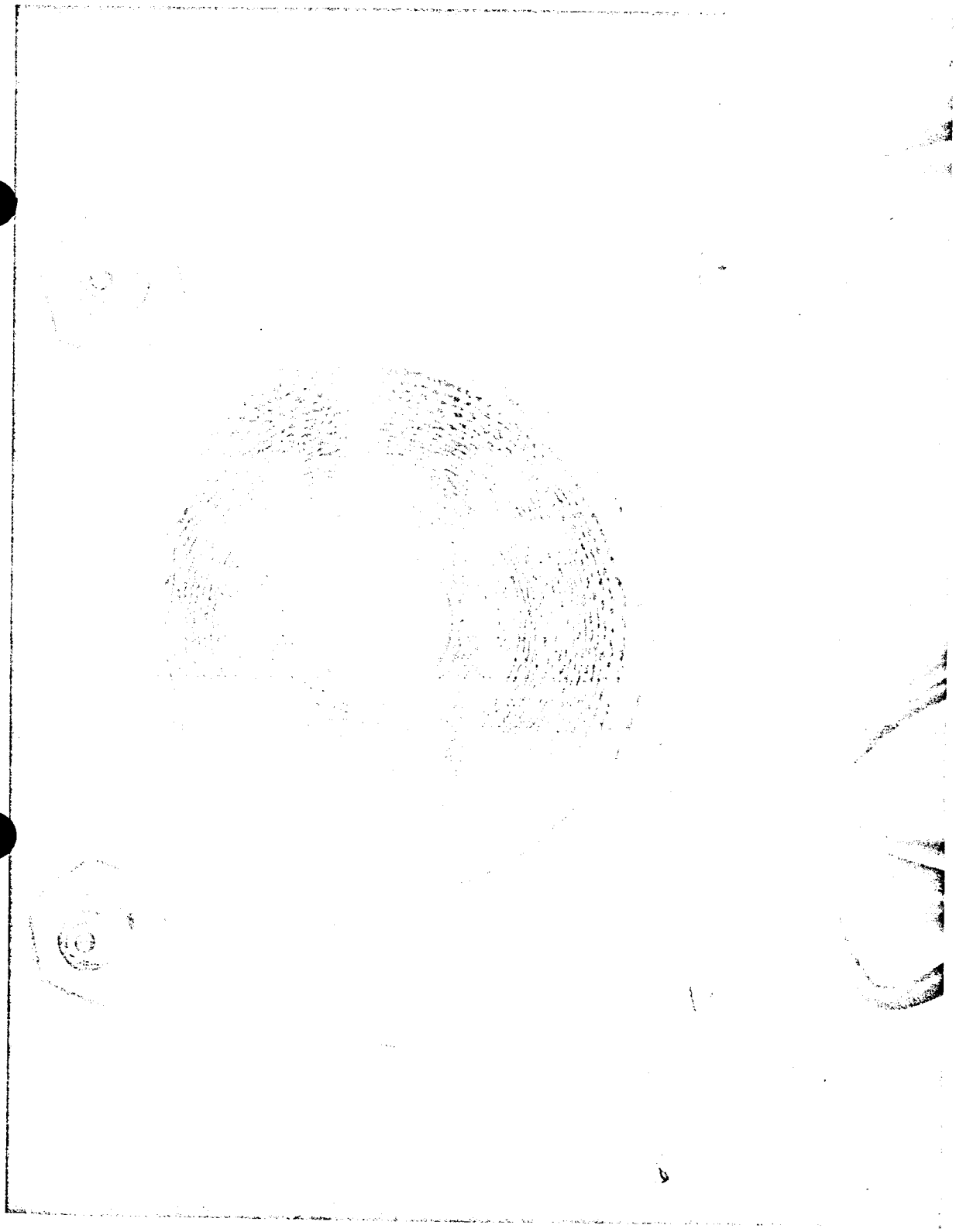
S/N 9202637
LHE35-8/12/65-C1A

Figure 4. 25-Pound-Thrust RCS TCA DAT Unit 1A, Fuel Valve Disassembly and Inspection



1HD35-6/28/65-C1A

Figure 5. 25-Pound-Thrust RCS TCA DAT Unit 1A, Disassembly and Inspection, Post-MDC to Failure Test

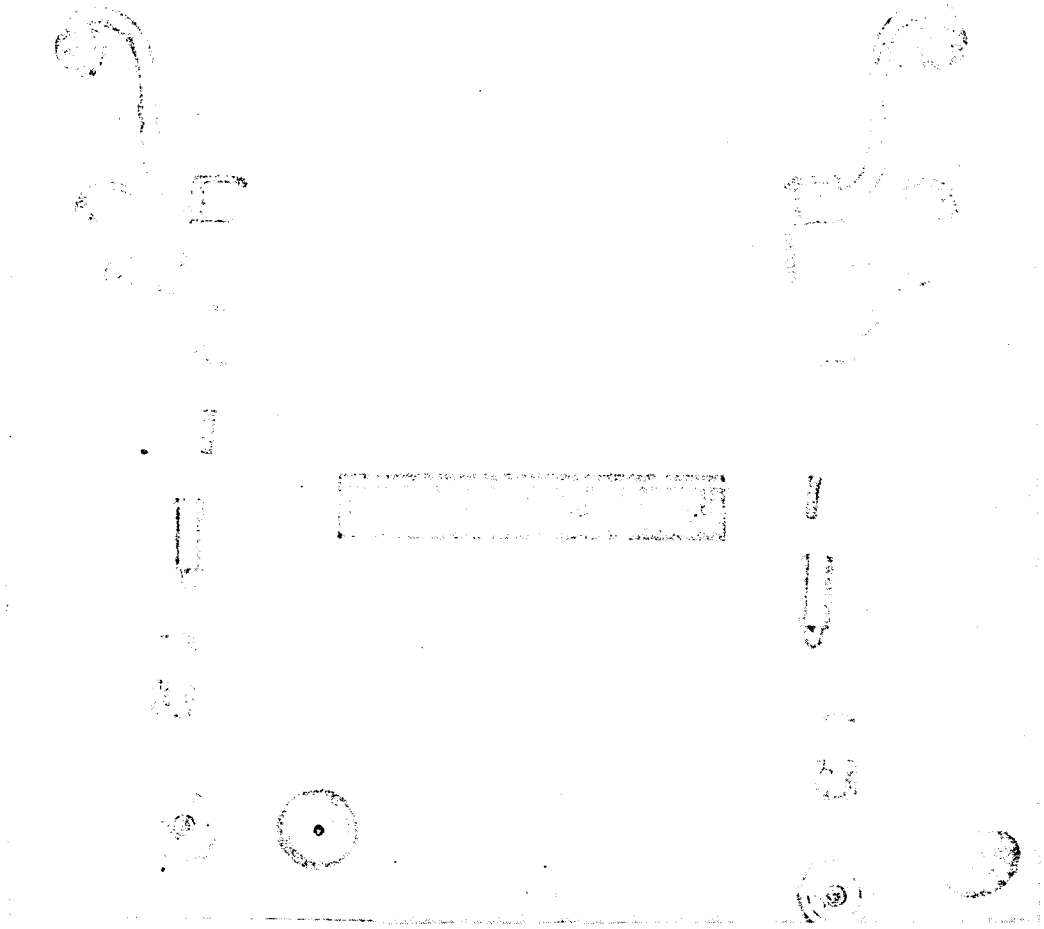


1HD35-9/23/64-S1A

Figure 6. 25-Pound-Thrust RCS TCA DAT Unit 1A, Post-MDC to Failure Test

1HD35-9/23/64-S1B

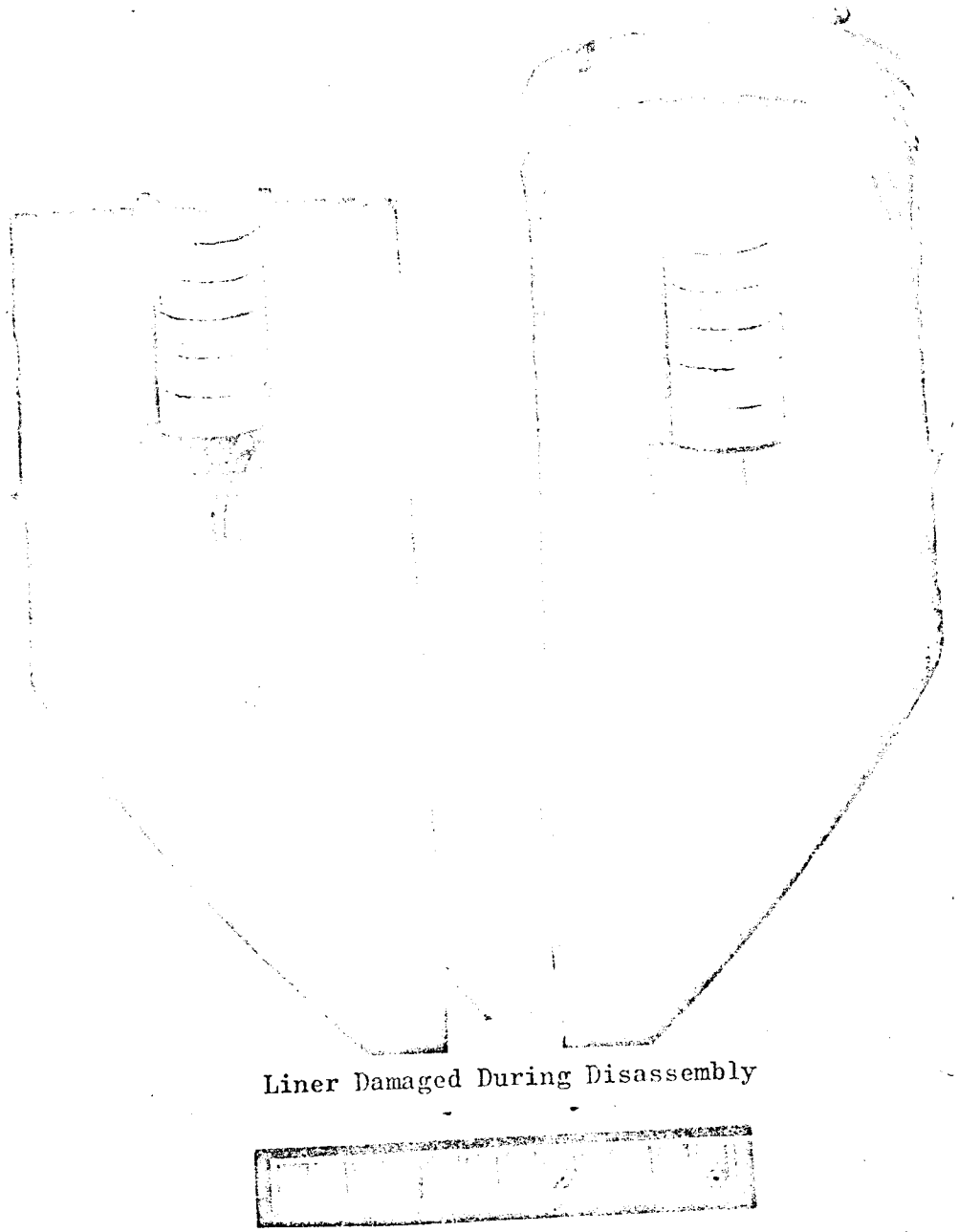
Figure 7. 25-Pound-Thrust RCS TCA DAT Unit 1A, Post-MDC to Failure Test



Fuel Valve Oxidizer Valve

1HD65-6/9/65-C3

Figure 8. 25-Pound-Thrust RCS TCA DAT Unit 2A Propellant Valves, Disassembly and Inspection, Post-MDC to 100 Seconds and Hot-Fire Burst Pressure Test



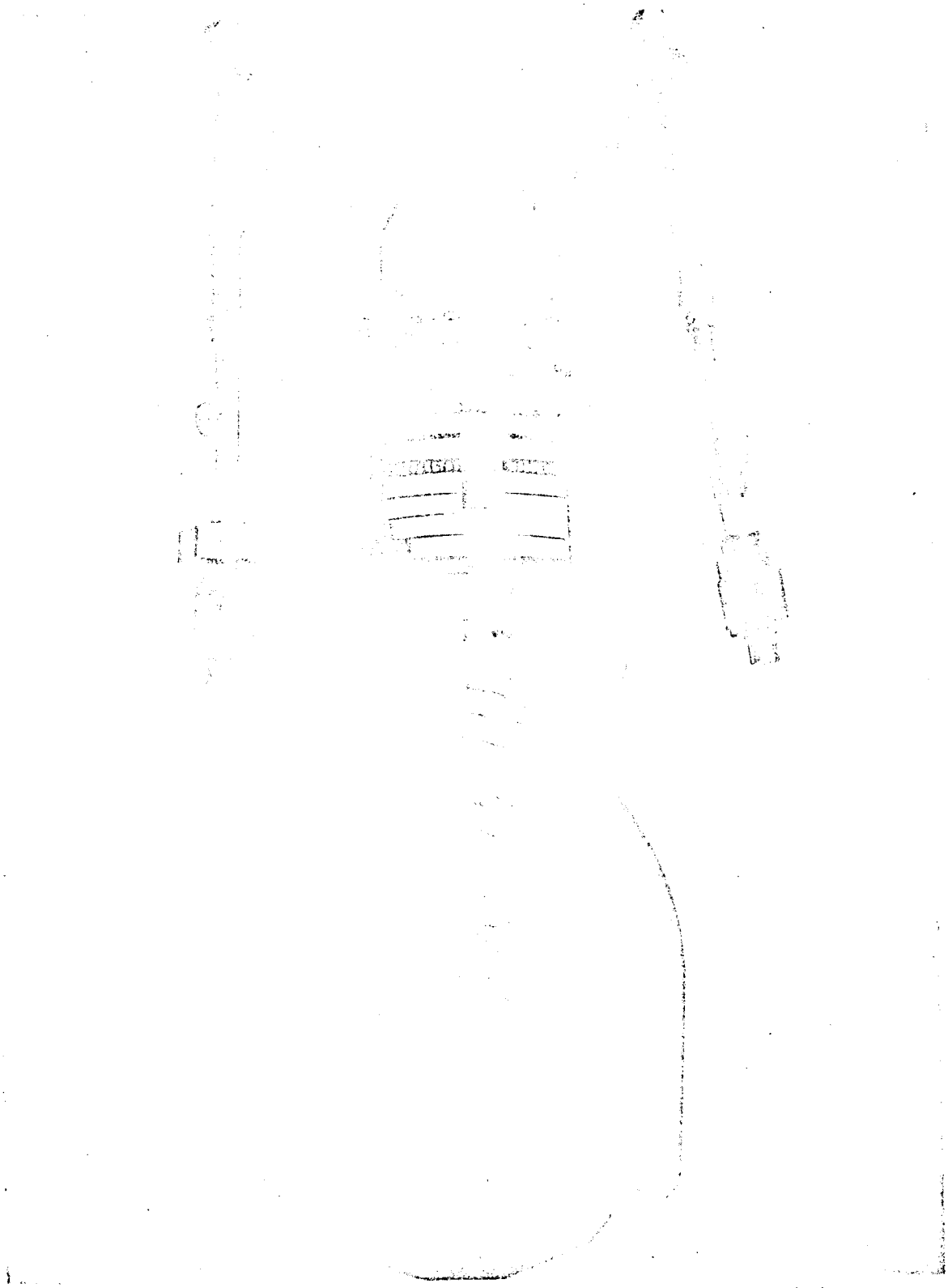
Liner Damaged During Disassembly

1HD35-6/16/65-C1A

Figure 9. 25-Pound-Thrust RCS TCA DAT Unit 2A, Disassembly and Inspection, Post-MDC to 100 Seconds and Hot-Fire Burst Pressure Test

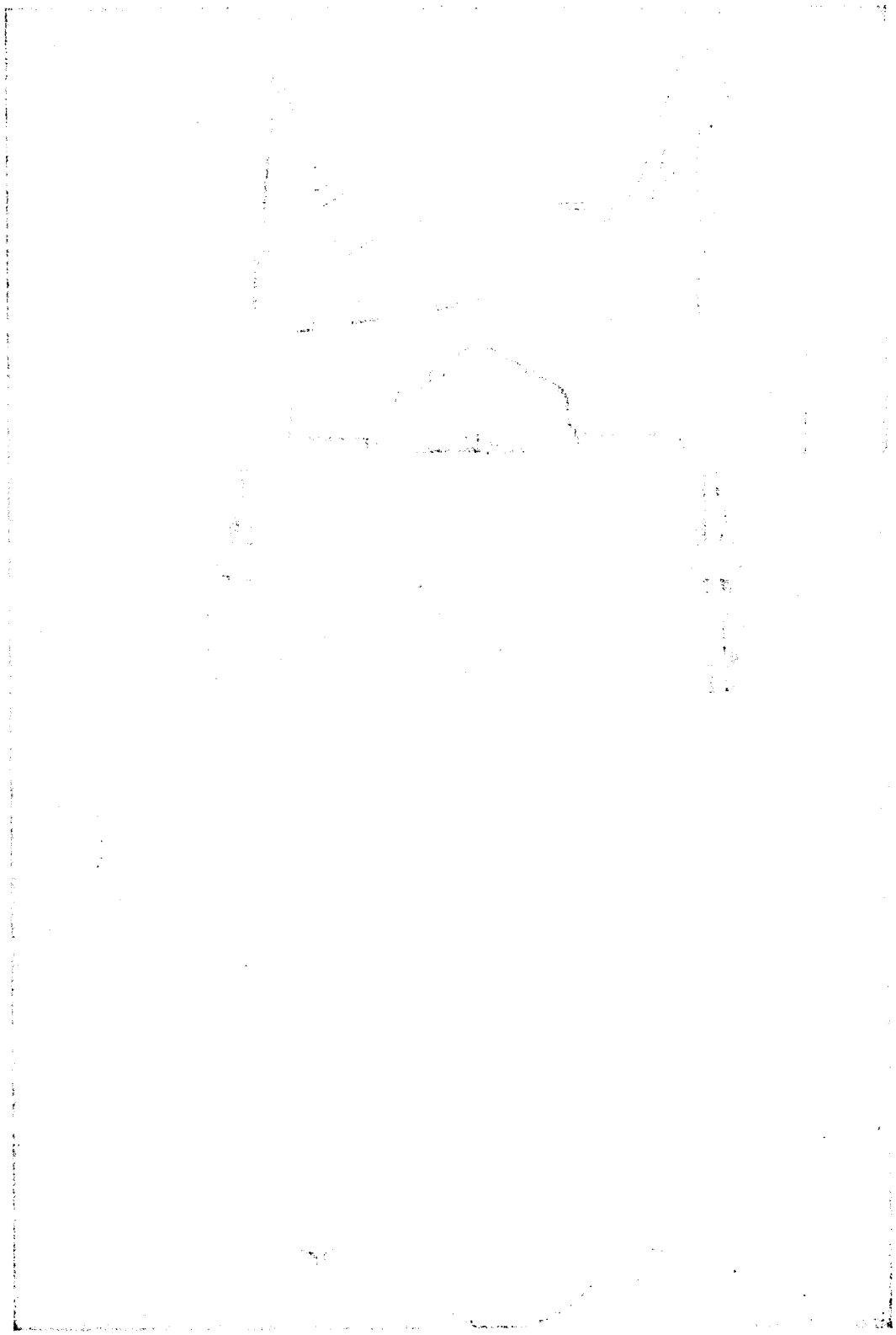
1HE25-11/4/64-S2A

Figure 10. 25-Pound-Thrust RCS TCA DAT Unit 2A, Post-MDC to 100 Seconds and Hot-Fire Burst Pressure Test



1HE25-11/4/64-S2B

Figure 11. 25-Pound-Thrust RCS TCA DAT Unit 2A, Post-MDC to 100 Seconds and Hot-Fire Burst Pressure Test



1HE25-11/4/64-S2C

Figure 12. 25-Pound-Thrust RCS TCA DAT Unit 2A, Post-MDC to 100 Seconds and Hot-Fire Burst Pressure Test

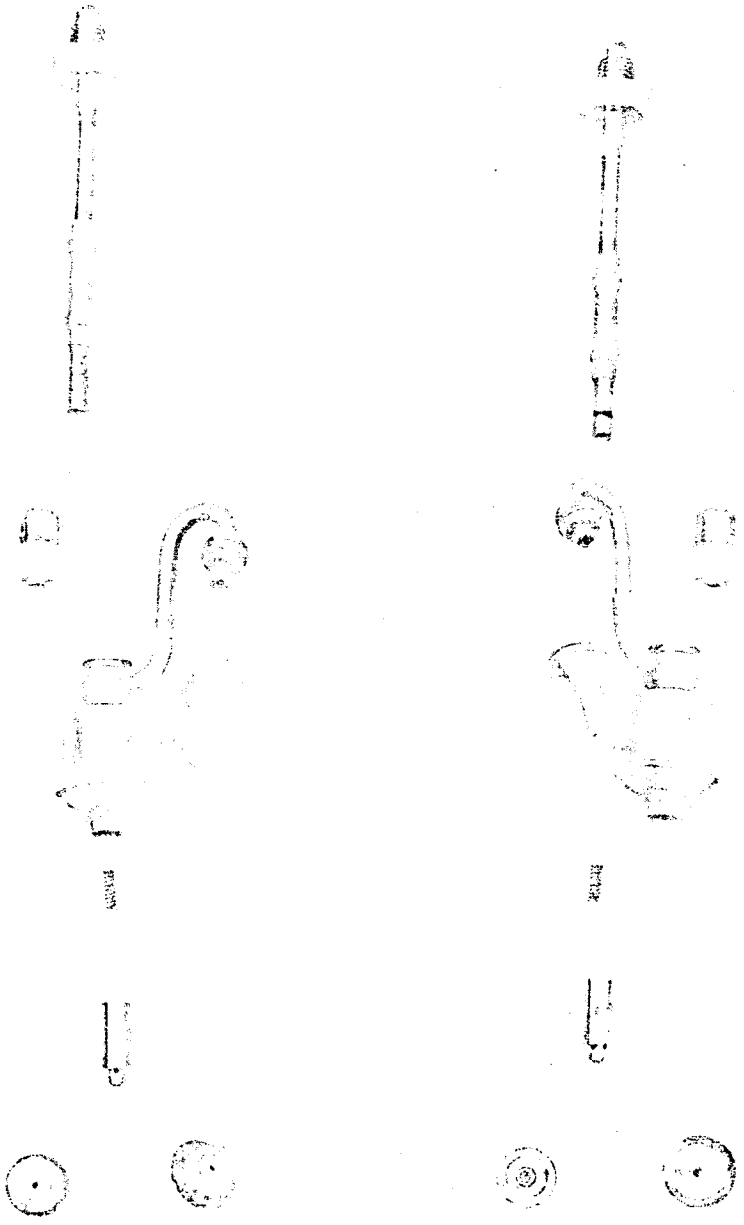
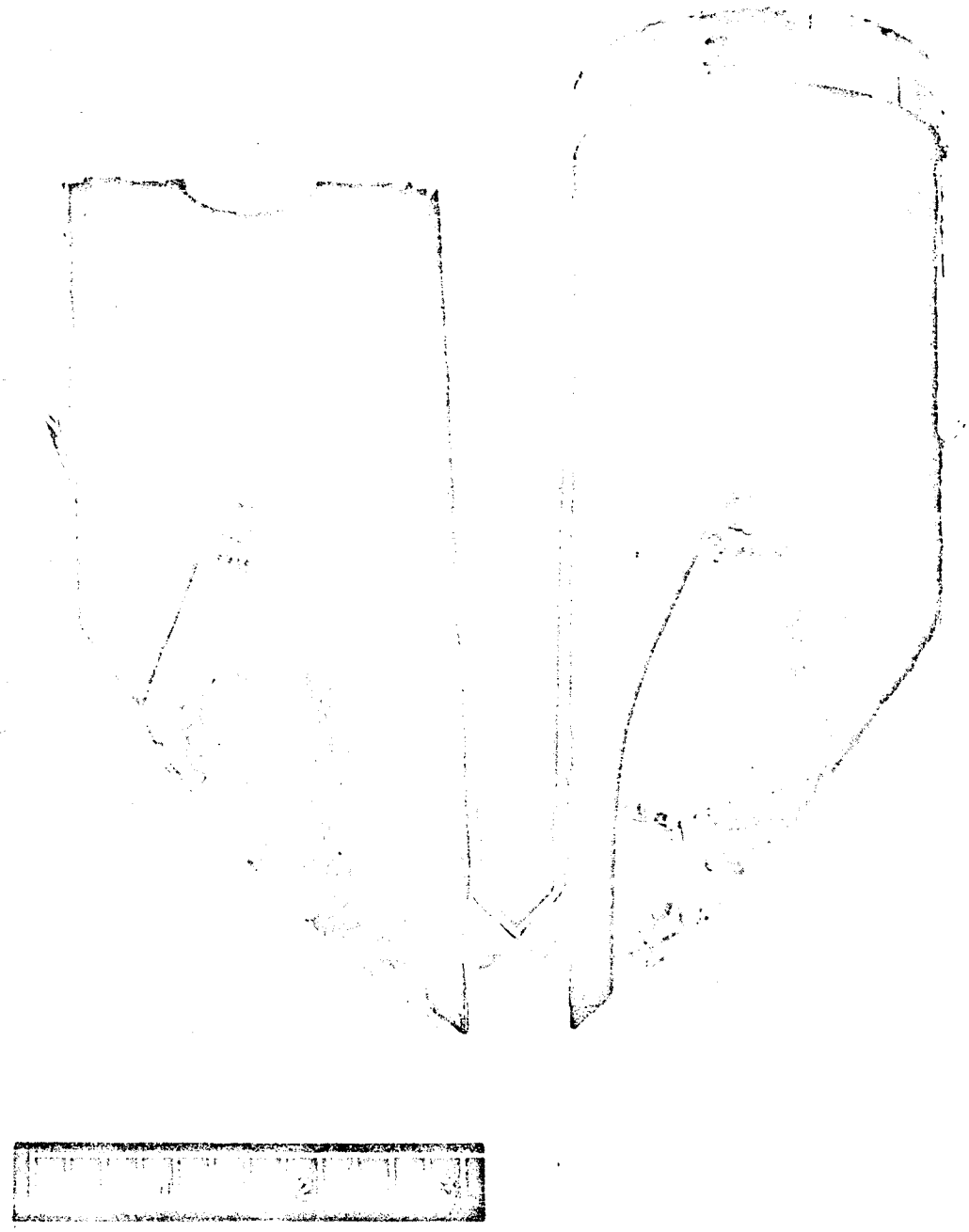
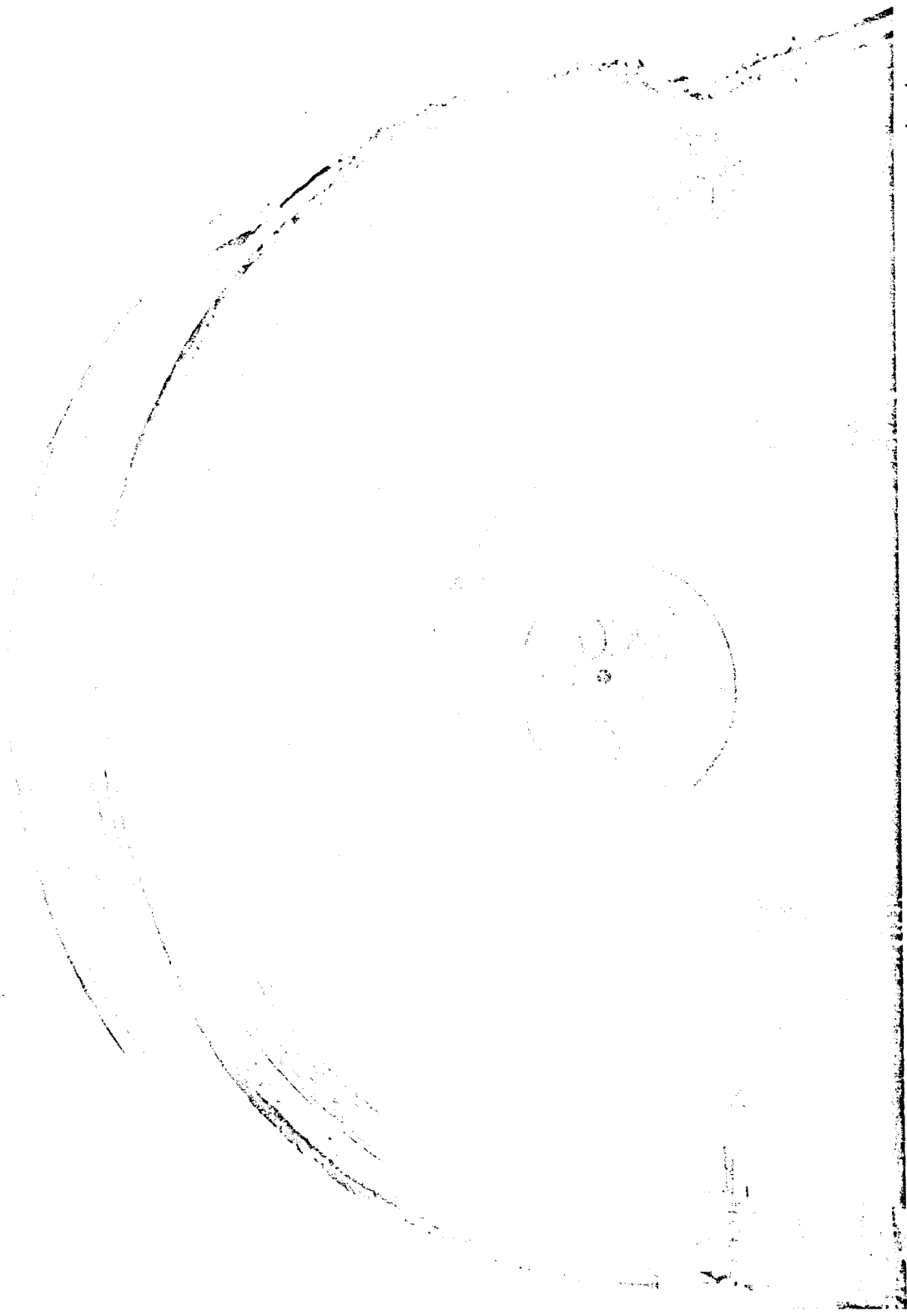


Figure 13. 25-Pound-Thrust RCS TCA DAT Unit 3A, Propellant Valves Disassembly and Inspection



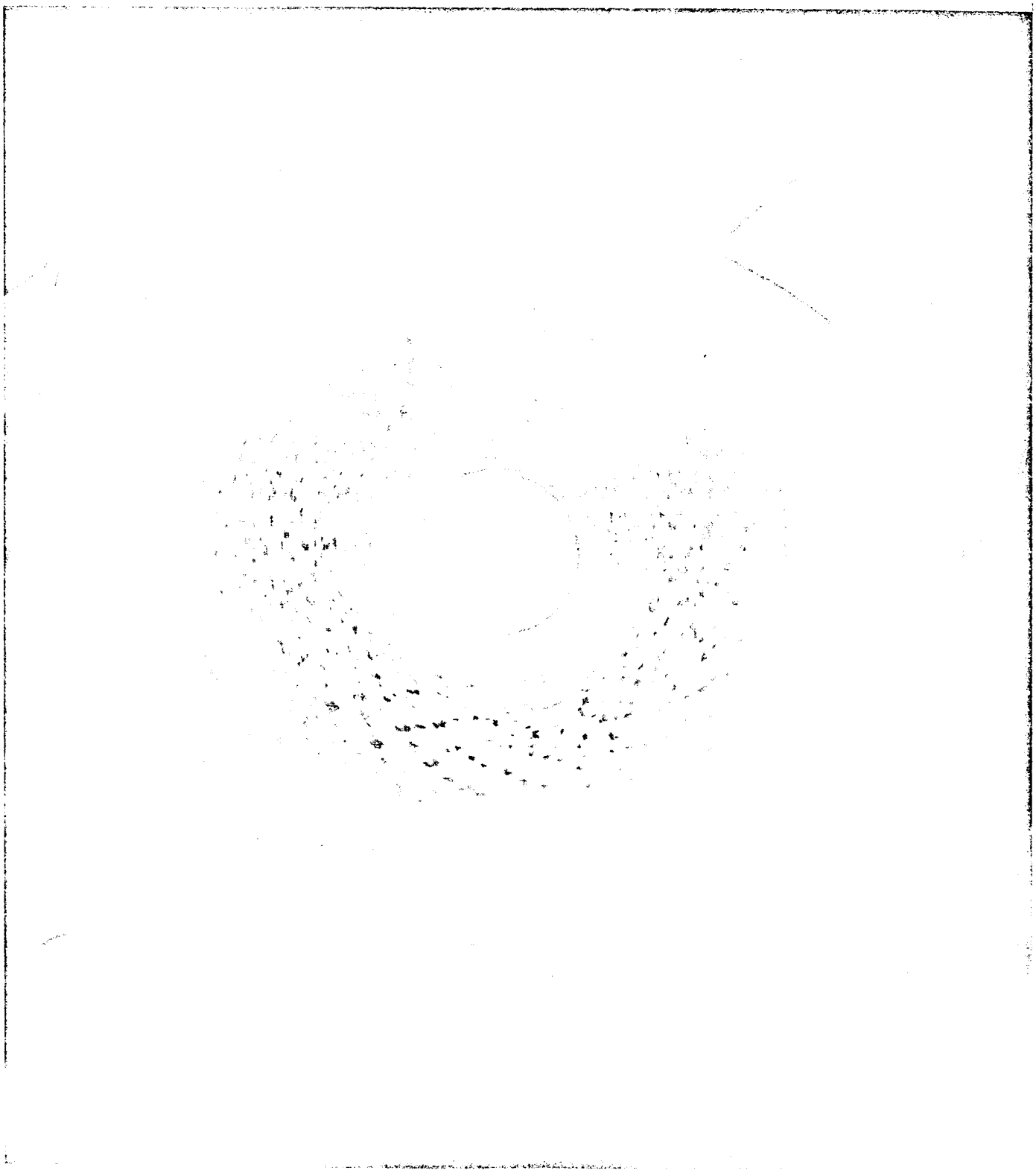
1HD35-6/16/65-C1B

Figure 14. 25-Pound-Thrust RCS TCA DAT Unit 3A, Disassembly and Inspection (Showing Epoxy Resin Coated Nozzle ID), Post-MDC to 136 Seconds



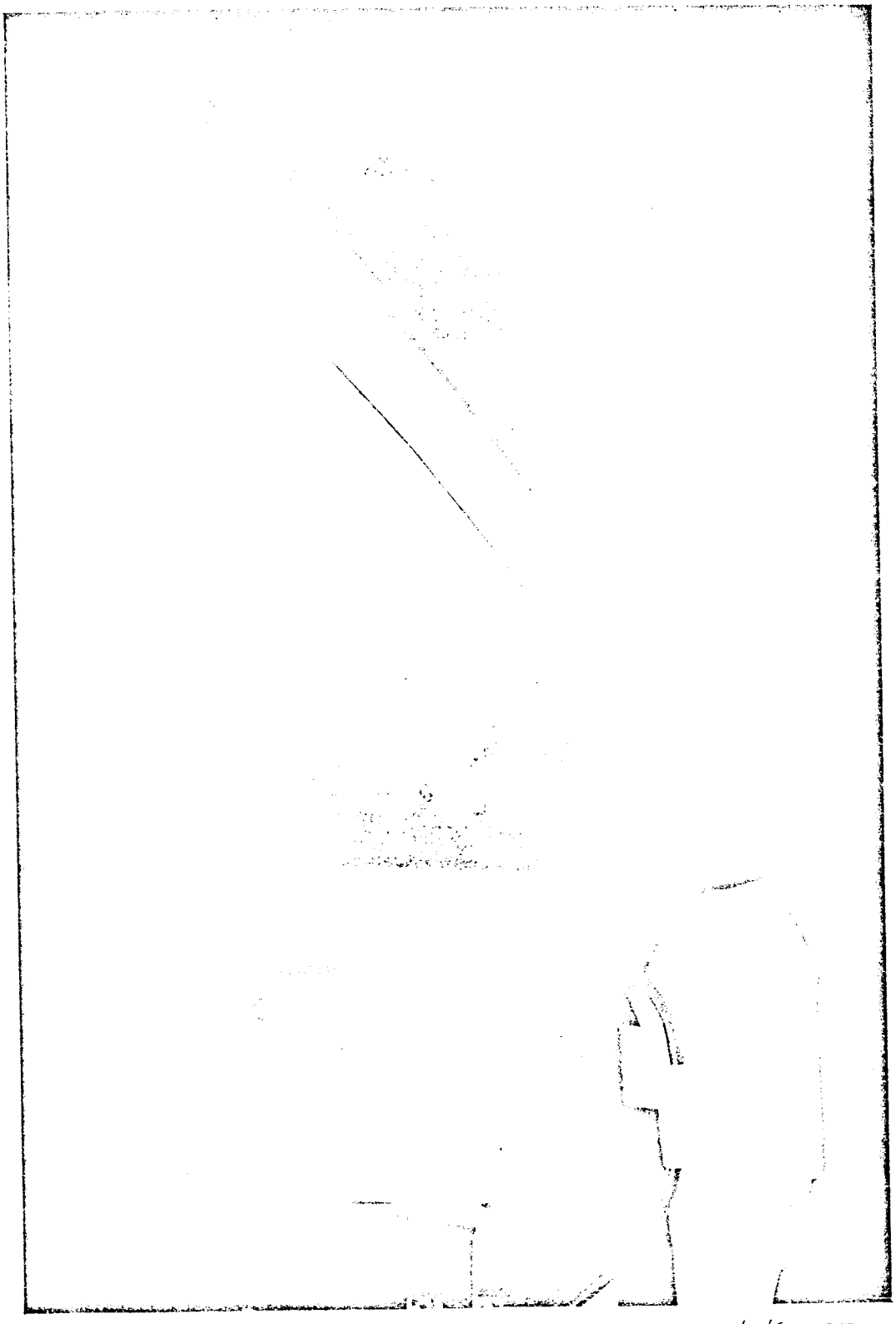
1HD35-6/16/65-C1D

Figure 15. 25-Pound-Thrust RCS TCA DAT Unit 3A, Disassembly and Inspection, Post-MDC to 136 Seconds



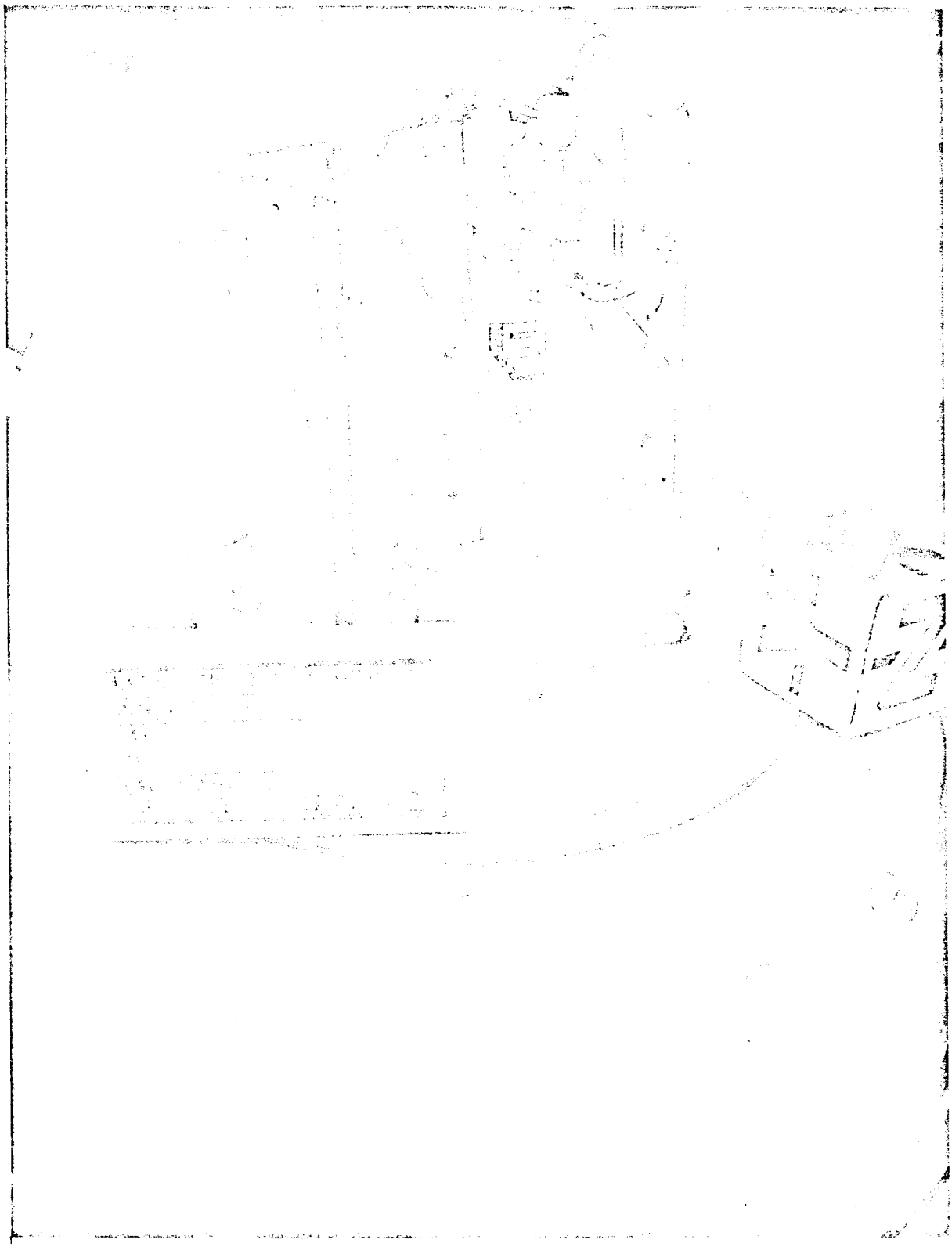
1HE25-10/7/64-S1D

Figure 16. 25-Pound-Thrust RCS TCA DAT Unit 3A, Post-MDC to 136 Seconds



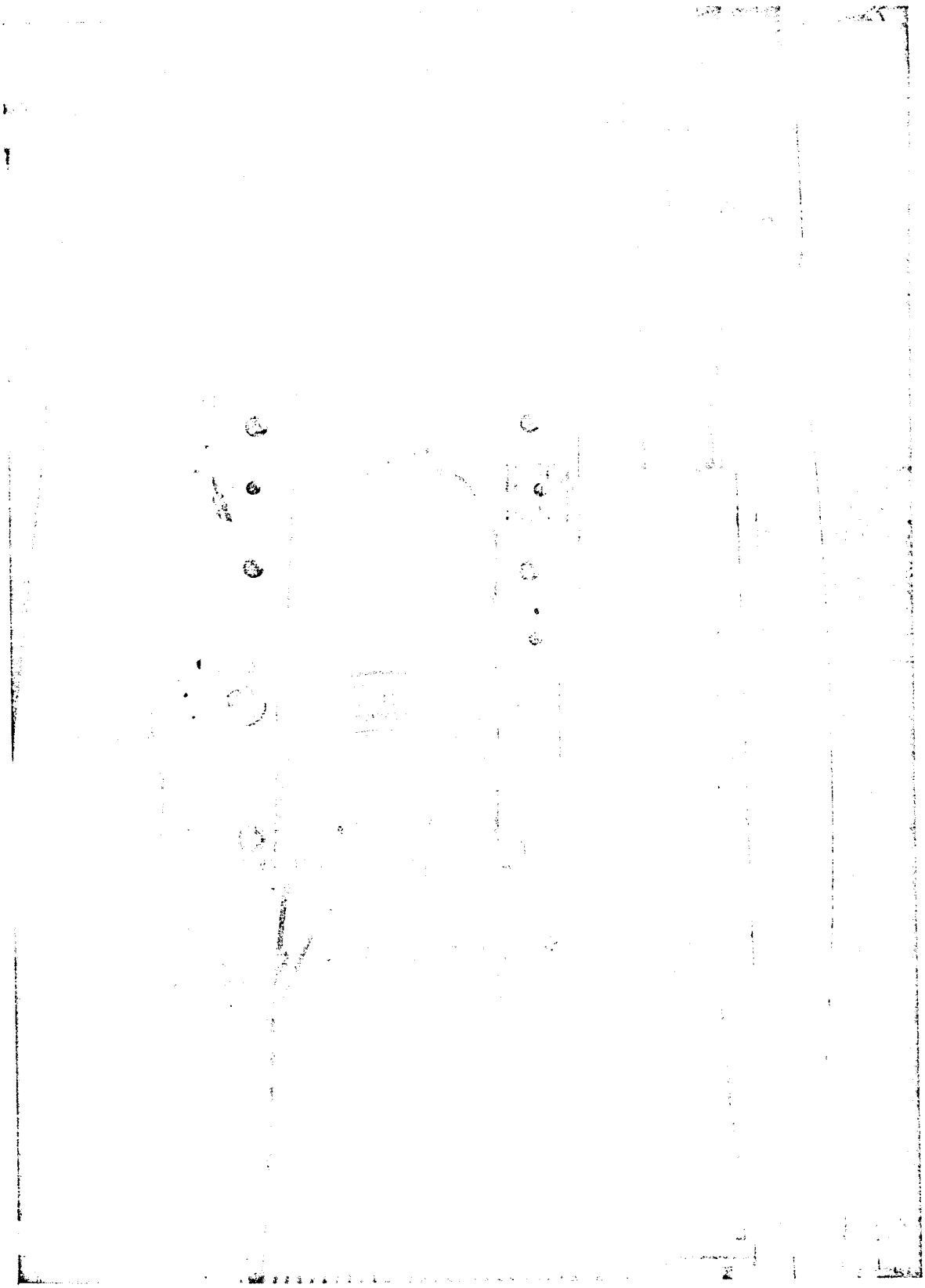
1HE25-10/7/64-S1F

Figure 17. 25-Pound-Thrust RCS TCA DAT Unit 3A, Post-MDC to 136 Seconds



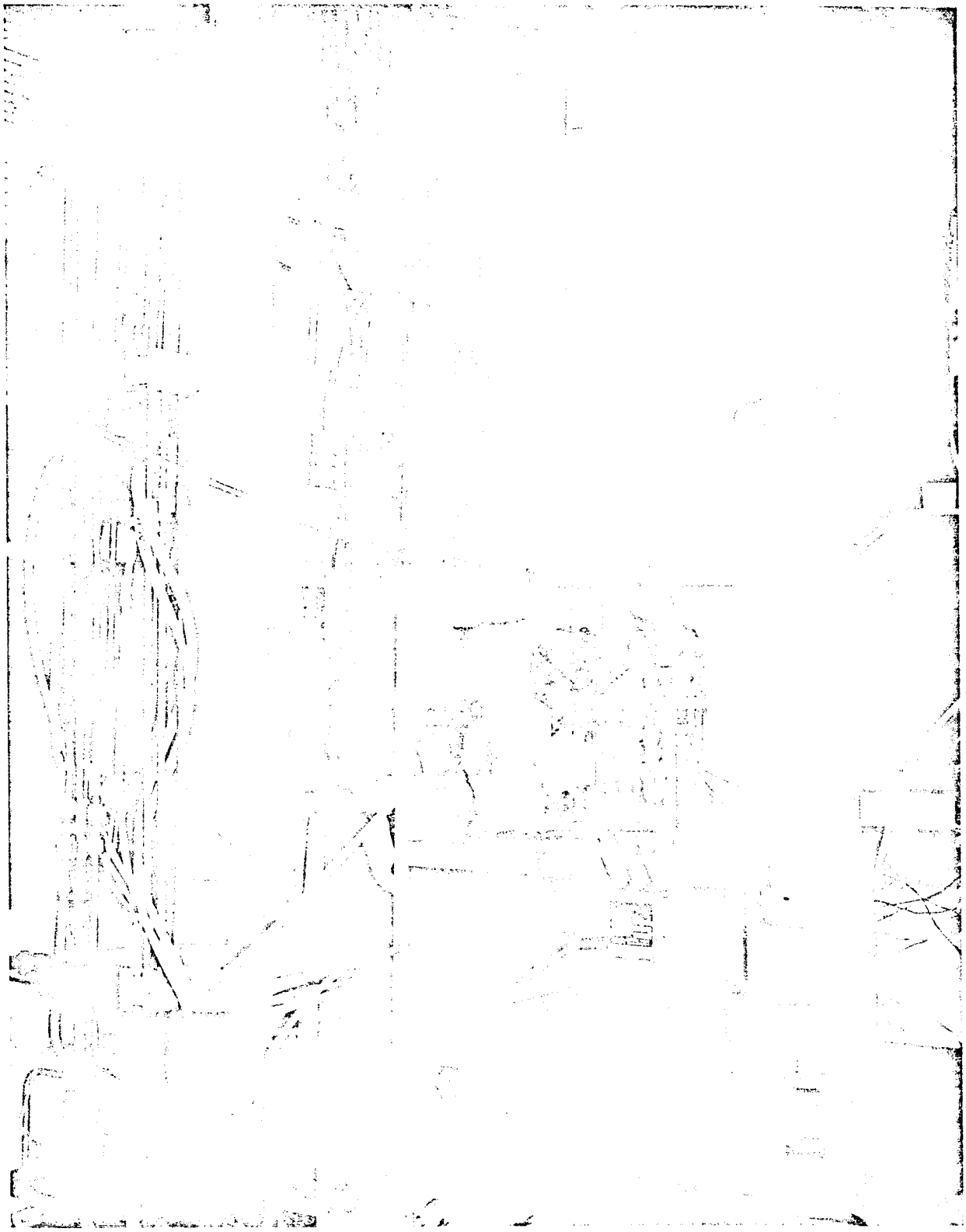
1HD34-8/31/64-C1

Figure 18. 25-Pound-Thrust RCS TCA DAT Unit 1A, Y-Axis Random Vibration Test Setup



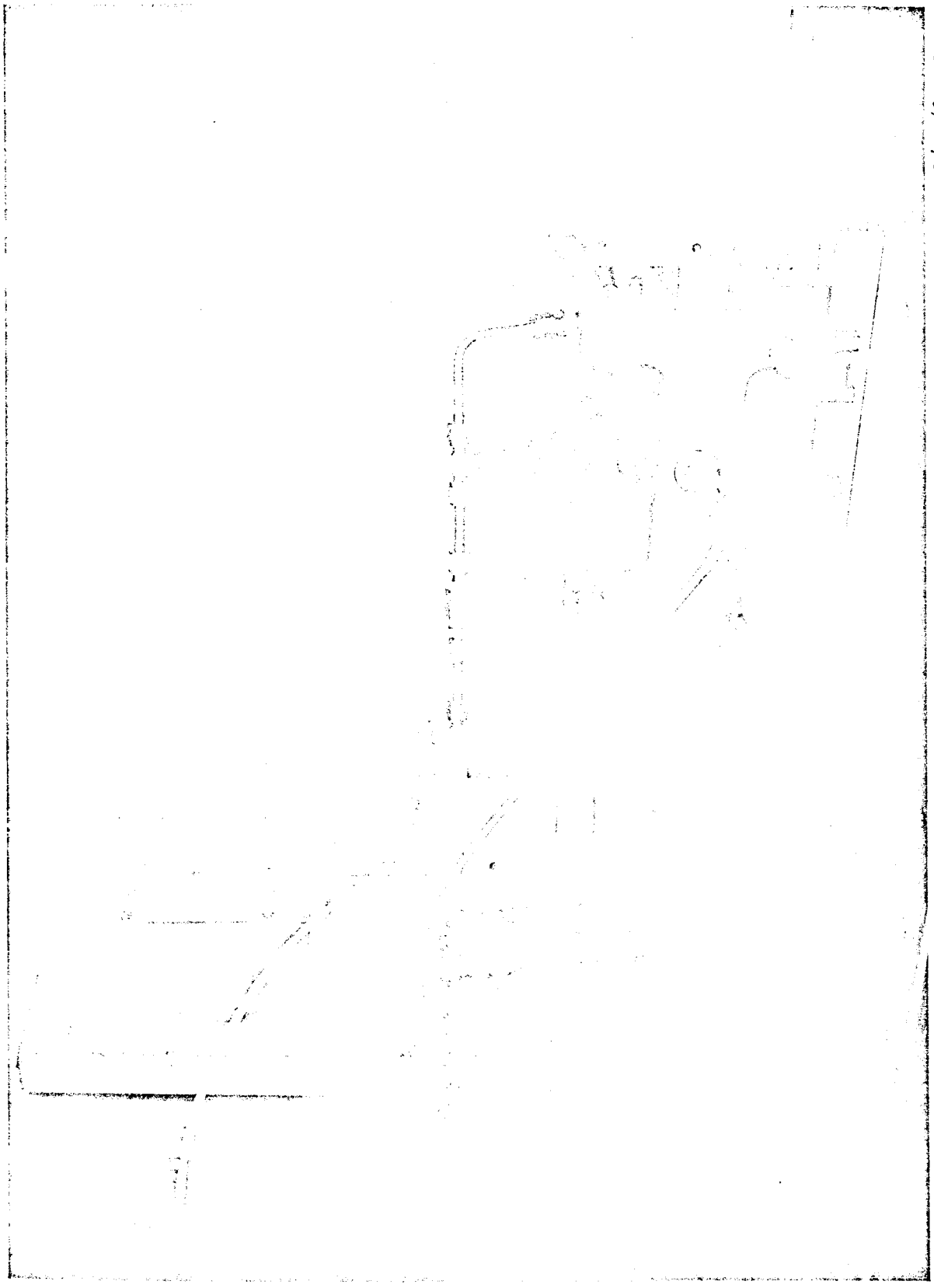
1HD34-9/4/64-C1B

Figure 19. 25-Pound-Thrust RCS TCA DAT Unit 1A, Mechanical Shock Test Setup



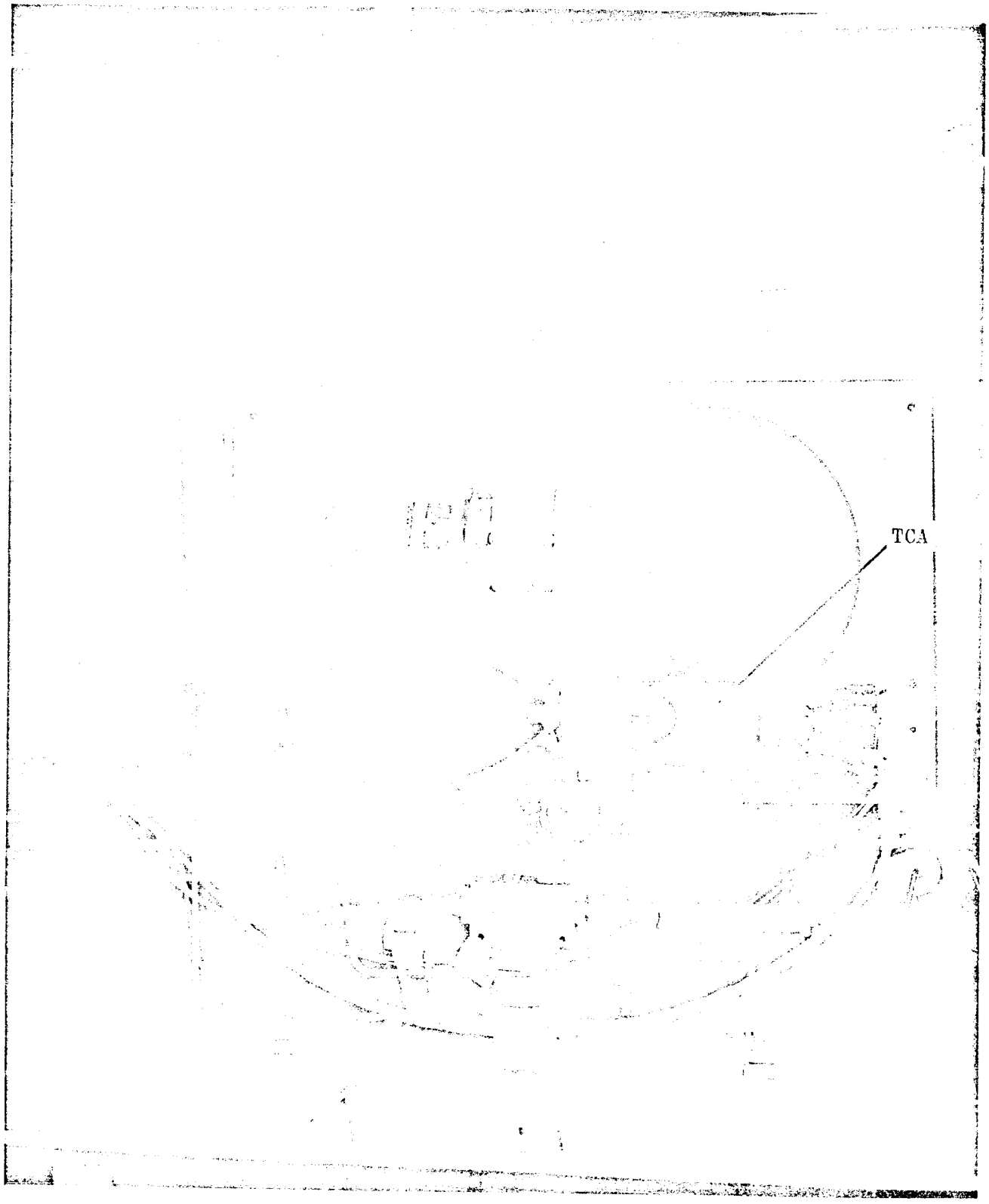
1HE23-9/21/64-S2

Figure 20. 25-Pound-Thrust RCS TCA DAT Unit 1A, Hot-Fire Test Installation, CTL-3, Cell 39J



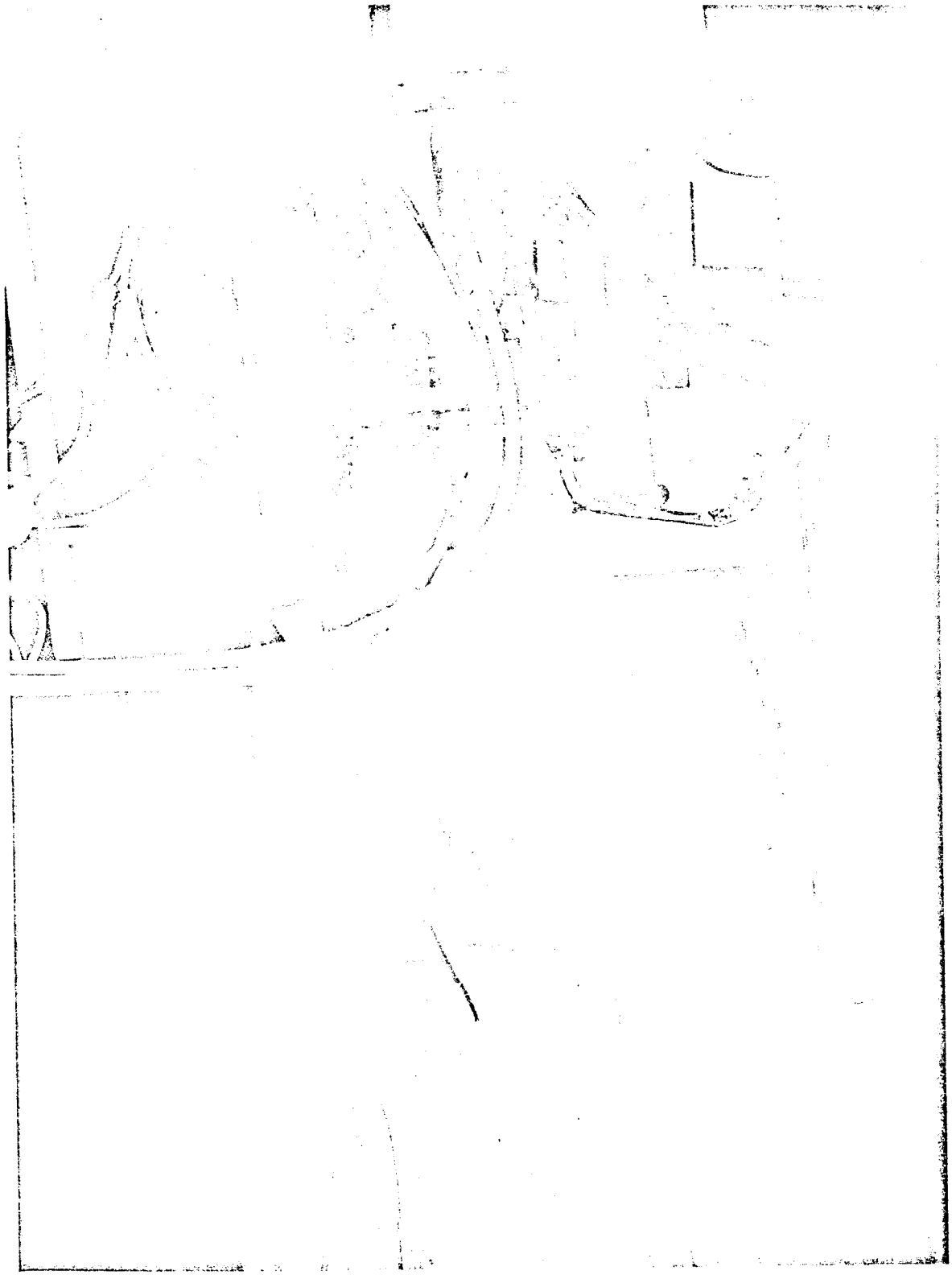
1HD54-6/18/64-C1B

Figure 21. 25-Pound-Thrust RCS TCA DAT Unit 2, Proof Pressure and Leakage Test Setup



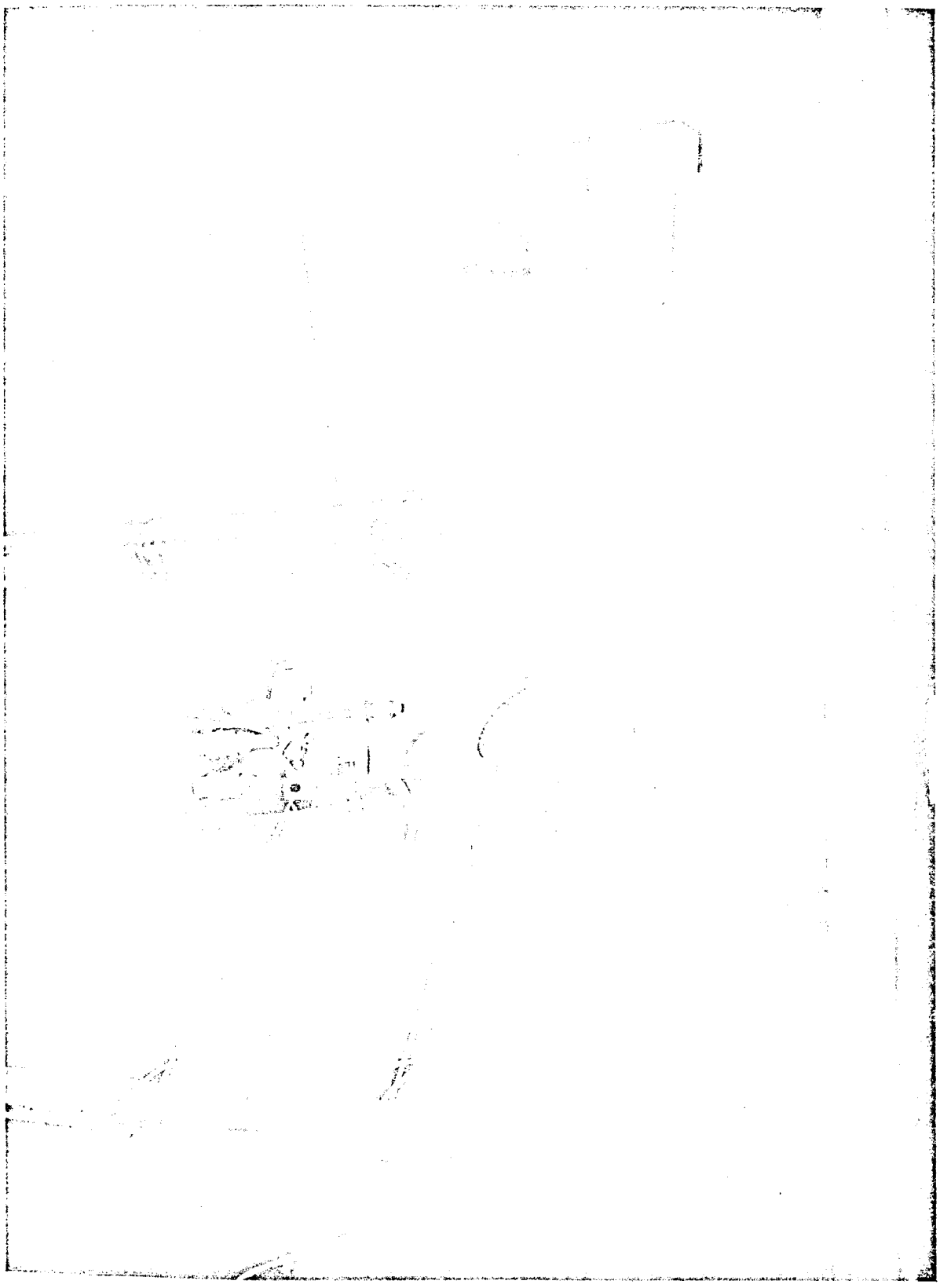
1HD35-11/10/64-C1B

Figure 22. 25-Pound-Thrust RCS TCA DAT Unit 3A, Propellant Valve Service-Life Test Installation



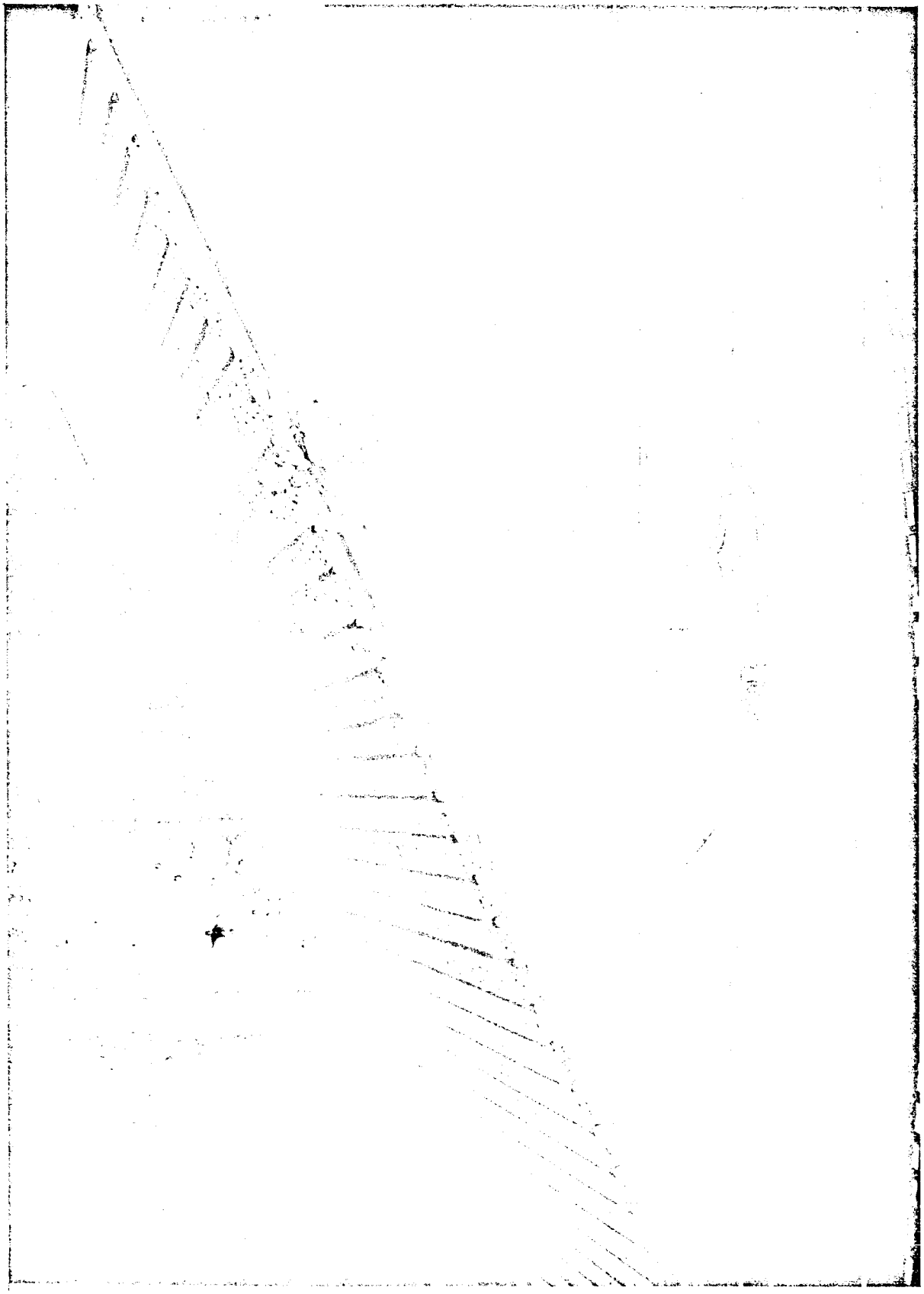
1HD23-10/31/64-S1C

Figure 23. 25-Pound-Thrust RCS TCA DAT Unit 2A, Hot-Fire Test Installation, CTL-3, Cell 39J (With Exhaust Collection Cone)



1HD24-6/25/64-C1E

Figure 24. 25-Pound-Thrust RCS TCA DAT Unit 3, Salt-Spray Test Installation



1HD34-8/28/64-C1B

Figure 25. 25-Pound-Thrust RCS TCA DAT Unit 3, Humidity Test Installation

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APPENDIX B

APPENDIX B

OPERATION AND FAILURE REPORTS AND FAILURE ANALYSIS REPORTS

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Operation and Failure Report
ROCKETDYNE

X FAILURE | OPERATION | PART CHANGE | X FAILED ITEM | ☐ TIME EXPIRED | ☐ TO DIRECTED

SE 6 DAT | LOCATION 596-148 | № 06856F

PART IDENTIFICATION

1 PART NO	208130-61
2 PART NAME	TCA
3 SERIAL NO	4059276
4 MFG NAME	ROCKETDYNE
5 MFR CODE	02602
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.	SE6
12 REJ. TAG NO.	
13 ENG/AGE SERIAL NO.	
14 SYSTEM CODE	
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: OFR CRIB

40

41

FAILURE/OPERATION DATA

17 FAILURE DATE	64 6 17 (YR MO DAY)
18 TEST OPER DATE	64 6 17 (YR MO DAY)
19 TEST/OPER. NO.	
20 ITEMS	1
21 PROCEDURE—SPEC. & PARAGRAPH	208130-401 PARA. 6.5.7
22 FS	
23 SV	
24 NC	
25 FAIL. TYPE	
26 FAIL. CODE	
27 SECONDS	—
28 STARTS	—
29 MONTHS	
30 INITIAL REPORT NO	
31	
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	L.B. JOHNSON
43 GROUP	944
44 SUPPLEMENT SHEET	1 ☐ YES 2 ☑ NO
45 APPROVED BY	M.B. LENIK
46 ACTIVITY	A8
47 STAND/AREA	

ANALYSIS ASSIGNED TO

48 NAME	D JUKOFF
49 GROUP	389
50 CODE	AR
51 PART REQ.	X YES ☐ NO
DATE REPORT RECEIVED	52 YR MO DAY
DATE REPORT DISTRIBUTED	53 YR MO DAY
USE ONLY	54 TEST OPER NO
55 1/2	
57 NTH CODE	
58 TAPE CODE	

DESCRIPTION OF FAILURE

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

FAILED CLØSING RESPØNSE TIMING TEST. THE VØLTAGE TRACE WAS .0030 SECØNDS. THE MAXIMUM VALVE CLØSING RESPØNSE TIME SHØULD BE .0020 SECØNDS. THIS FAILURE ØCCURED DURING PRØPELLANT VALVE FUNCTIØNAL AFTER TEMPERATURE SHØCK. ØXIDIZER VALVE SIDE.

71 TEST OPER NO. 06856F | 78 A | 79 80

78 B

78 C

78 D

78 E

78 F

36 REF. OFR | 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	
36 NTH	
COMP	
40 ASSY	
RS-2	
CD	
46	
65 DELETE	
1 REPLACEMENT PART NO.	
13 REPLACEMENT S/N	
22 NAME	
25 TYPE	
31 MFR.	
36 INSTALLATION PART NO.	R-15019-2
50 CONFIG. CODE	
57 NAME	
60 GR. RESP.	CH CL M R

78 G

78 80

06856F

FORM 610-C 60 REV. 6-65

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
06856R	L. B. Johnson	944	596-148	6-17-64

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
407557	9193194	Oxidizer Valve	Rocketdyne
ENG/AGE MODEL NO.	**ENG/AGE SERIAL NO.**	**TEST/OPERATION NO.**	
SE-6			

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
W. D. Boyce	896-389	7-6-64	[signature]	

RECEIVED 28 JUL 1964 RELIABILITY

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. During performance of propellant valve functional test following temperature shock, the oxidizer valve failed closing response time test. The drop-out voltage trace indicated valve closing at 0.003 seconds; procedure calls for 0.002 seconds maximum. These tests were performed as a part of SE-6 DAT procedure 208130-401.

2. It was learned that a recent revision to the DAT procedure, at the request of McDonnell, was the addition of surge suppression diodes in the test setup electrical wiring. From other tests, it is known that the surge suppression diodes, when installed in the wiring across a propellant valve, cause a delay in valve closing time of approximately 0.001 second.

   To verify this delay in closing time, concurrence was obtained from the McDonnell engineering representative and customer inspection to remove the diodes and obtain a valve drop-out voltage trace in this configuration.

   Valve closing time without the surge suppression diodes was found to be 0.0017 seconds as compared to 0.0031 seconds with the diodes installed. Valve acceptance test procedures allow 0.002 seconds maximum for valve closing (no surge suppression diodes).

3. Valve closing time of 0.003 seconds was caused by the addition of customer surge suppression diodes in the test setup electrical wiring.

4. DAT procedure 208130-401 paragraph 6.5.7 was revised to allow 0.0035 seconds maximum closing time for the propellant valves with customer surge suppression diodes in the electrical circuit. Other DAT procedures will be reviewed and revised as necessary to prevent recurrence of this type of failure reporting.

Item 31
52-52700

FAILURE ANALYSIS ACCEPTED
W. Pasker 8/7/64
Scott J. Zech 8/7/64

RELIABILITY DEPT. 261
McDONNELL AIRCRAFT CORP.

06856R

FORM 609 P-2 REV. 2-62

R-15019-2

Operation and Failure Report
ROCKETDYNE

PART CHANGE: X FAILED ITEM | ☐ TIME EXPIRED | ☐ T.O. DIRECTED

SE6 DAT | 148 | № 06875F

PART IDENTIFICATION

1 PART NO. 208130-61		2 PART NAME TCA	
3 SERIAL NO. 4059276	4 MFG. NAME ROCKETDYNE	5 MFR CODE 02602	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. SE6	14 SYSTEM CODE	
		15 COMPONENT CODE	
12 REJ. TAG NO.	13 ENG/AGE SERIAL NO.	16 HARDWARE CODE	

PART DISPOSITION

25
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: OFR CRIB

40

41

FAILURE/OPERATION DATA

17 FAILURE DATE 64 6 19 (YR MO DAY)	18 TEST OPER DATE 64 6 19 (YR MO DAY)	19 TEST/OPER. NO.	20 ITEMS 1

21 PROCEDURE—SPEC. & PARAGRAPH 208130-401 PARA. 6.5.7

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 L.B. JOHNSON	43 GROUP 944	44 SUPPLEMENT SHEET 1 ☐ YES 2 ☑ NO
45 APPROVED BY M.B. LEWIK	46 ACTIVITY A8	47 STAND AREA

ANALYSIS ASSIGNED TO

48 NAME D. JOYOFF	49 GROUP	50 CODE AR	51 ART REQ. ☑ YES ☐ NO

DATE REPORT RECEIVED	52 YR MO DAY	DATE REPORT DISTRIBUTED	53 YR MO DAY

TEST 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?

⊙ DURING FAILURE ANALYSIS FUNCTIØNAL TEST ØN ØXIDIZER VALVE P/N 407557 (REF ØFR NØ. 06856F). THE FUEL PRØPELLANT VALVE P/N 407558 FAILED CLØSING RESPØNE TIME. NØ TIME CØULD BE RECØRED FRØM PØLARØID PHØTØGRAPH.

71 TEST OPER. NO. 06875F — 78 A

78 B

78 C

78 D

78 E

78 F

36 REF OFR | 42 REF. OFR | 48 REF. OFR | 54 FAILED DETAIL PART NO. 407557

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
36 NTH	COMP	40 ASSY	RS-2	CD	46					65 DELETE

78 G

1 REPLACEMENT PART NO.	15 REPLACEMENT S/N	22 NAME	28 TYPE	31 MFR.	35
36 INSTALLATION PART NO. R-15019-2	50 CONFIG. CODE	57 NAME	60 GR. RESP.	CH CL M R	78 60

06875F

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
06875F	L. B. Johnson	944	596-148	6-19-64

PART IDENTIFICATION

DAT

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
407558	9205846	Fuel Valve	Rocketdyne
ENG/AGE MODEL NO.	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	
SE6			

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
W. D. Royce	896-335	7-13-64	W. Smith 7-13-64	

FAILURE ANALYSIS

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

R 12758

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

During performance of DAT procedure 208130-401 the fuel propellant valve failed to indicate a closing point on the drop-out voltage trace shown on an oscilloscope. Prior to the propellant valve functional test, the Thrust Chamber assembly had undergone temperature shock test. Less than 600 cycles of operation had been accumulated on the valve.

2. ANALYSIS

The fuel valve was connected to a propellant valve checkout panel for drop-out test. The failure mode was confirmed, as the drop-out voltage trace showed no drop-out point on initial valve actuations. After actuating the valve several times, the drop-out voltage trace began to indicate a drop-out at 4.8 milliseconds (allowable time is 2 milliseconds). A few more actuations brought the drop-out time down to 1.6 milliseconds, with a good closing indication on the voltage trace.

The valve was then cycled six times at 300 psig inlet pressure. Pressure was reduced to zero, the valve actuated and drop-out trace again examined. Drop-out time had increased to 4 milliseconds.

An attempt was then made to obtain minimum drop-out current. This is done by actuating the valve at nominal current and zero psig, then decreasing the current slowly until the valve closes. On the first attempt, there was no indication of the valve closing. An inlet pressure of 30 psig was applied to the valve, so that an audible check on valve closure could be made, and the test was repeated. The valve remained open as the current was decreased to zero.

OFR NO. 06875F

R-15019-2

FORM 609 P-2 REV. 2-62

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
06875F	L. B. Johnson	944	596-143	6-19-64

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
407558	9205346	Fuel Valve	Rocketdyne
ENG/AGE MODEL NO.	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
W. D. Boyce	896-335	7-13-64	W. Smith 8-10-64	

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.

The bracket attaching the fuel valve to the thrust chamber was then cut, on one side of the valve only, to determine if the valve armature would be freed. On retest, the valve was found to be closed. The valve was then actuated open and closed; voltage trace indicated valve drop-out at 2.4 milliseconds. Minimum drop-out current test was made, and drop-out current was found to be .014 amp (minimum allowable is .025 amp).

The valve was then completly removed from the thrust chamber and disassembled. The parts were examined under a microscope at 30X magnification. Some particles of contamintion were found inbedded in the Teflon seat (see photograph No. 1). Galled area was found on the armature (photograph No. 2) and a matching galled area inside the bobbin bore. No burrs were found on the valve parts.

The detailed parts were sent to the Metrology Laboratory for dimensional and concentricity checks. The only dimensional discrepancy found was the I.D. of the bobbin bore inside the seat weld area. The I.D. was measured as 0.0005 less than drawing requirement minimum, and 0.0008 less than other sections of the bore. (Report attached)

3. CONCLUSIONS

It is concluded that the cause of failure (no drop-out indication) was a slow closing action of the valve armature. Slow armature movement was caused by the galled areas of the armature and bobbin. Galling was probably initiated by contamination entering the clearance between armature and bobbin, and was aggravated by the stresses imposed on the valve as the valve bracket was welded to the thrust chamber, and by a shrinking of the bobbin I.D. upon cooling of the seat weld.

4. CORRECTIVE ACTION

Effective on Spacecraft 6 configuration valves, the following design changes are incorporated:

a. Increased clearance between the armature and bobbin bore. Clearance has been increased from .0016 - .0022 to .0023 - .0033. This will make the clearance less sensitive to contamination and reduce galling from this source.

OFR NO. 06875F

FORM 609 P-2 REV. 2-62

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
06875F	L. B. Johnson	944	596-148	6-19-64

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
407558	9205846	Fuel Valve	Rocketdyne
ENG/AGE MODEL NO.	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
W. D. Boyce	896-335	7-13-64	W. Smith 8-19-64	

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.

b. Length of the reduced diameter portion of the armature, of the ball end, had been increased. This moves the sliding portion of the armature away from the seat weld area, where binding may occur from seat weld shrinkage effect on the bobbin I.D., and or from stresses imposed during welding the valve bracket to the TCA.

c. To eliminate built-in contamination from the valves, the corrective action of FAR 12878R is applicable to this FAR.

OFR NO. 06875F

R-15019-2

FORM 609 P-2 REV. 2-62

ANALYTICAL MEASUREMENT REPORT
THIS BLOCK AND RIGHT COLUMN TO BE COMPLETED
ANALYTICAL ROOM PERSONNEL

LOG NO. 210
MEAS. BY R. NORRIS
G. RABLISKA
DATE COMP. 7-30-64

PART NO. _____ DATE July 15, 1964. CONTRACT NO. 5222
PART NAME DIMENSIONAL CHECK, GEMINI PROP VALVE E.W.R. NO. R-514474 ACCOUNT NO. 3769
REQ. BY W.D. BOYCE. DEPT. 1389 EXT. 6281 DEPT. FOR 389
QUANTITY 3 PARTS. INDEX NO. _____
ITEM OR RELEASE 6600

THIS BLOCK AND LEFT COLUMN TO BE FILLED IN COMPLETE BY REQUESTOR

REQ'D. MEASUREMENT (REQUESTOR)	(APMR) ACTUAL MEASUREMENT
SEE E.W.R. FOR INSTRUCTIONS	"FAILURE ANALYSIS FOR DAT QER."
	—SEE ATTACHED SHEETS—

TOP 1.		CENTER 2.		BOTTOM 3.	
12-6 O'CLOCK	3-9 O'CLOCK	12-6 O'CLOCK	3-9 O'CLOCK	12-6 O'CLOCK	3-9 O'CLOCK
.28044	.28048	.28110	.28120	.28126	.2811[illegible]

BORE DIAS AT POSITIONS NOTED
NOTE- TUBING LOCATES 12 O'CLOCK POSITION
.2815 - .2810

R-15019-2

FORM 619-D

TITLE OF JOB	DATE	No. R 514474
GEMINI PROP. VALVE DIMENSIONAL CHECKS	7/1/64	

INSPECTION REQUIRED	APPLICABLE DRAWINGS (ATTACH IF REQUIRED)	REQUESTED COMPLETION DATE
YES ☐ NO ☒		7/10/64

DOING DEPT.	LEDGER ACCOUNT	GENERAL ORDER	G.O. ITEM & MCR	INIT. GROUP	HDW. OR TASK	DOING GROUP	ACTUAL COMPLETION DATE
554	3721	5222	1600	389			

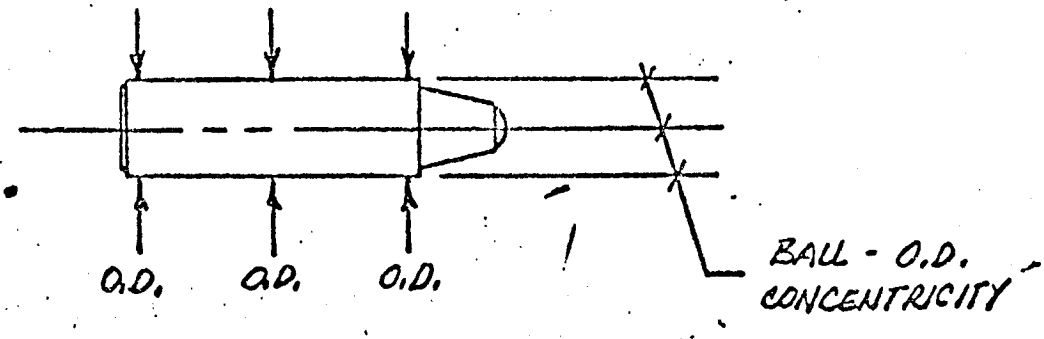
REQUESTED BY	EXT.	FACILITY	SHIFT	REQ. SUPERVISION	ESTIMATOR	ESTIMATE HOURS REQUIRED	ESTIMATE MATERIALS REQUIRED
W. D. BOYCE	6281	VN II	1	[illegible]	R. HEISELBY		$

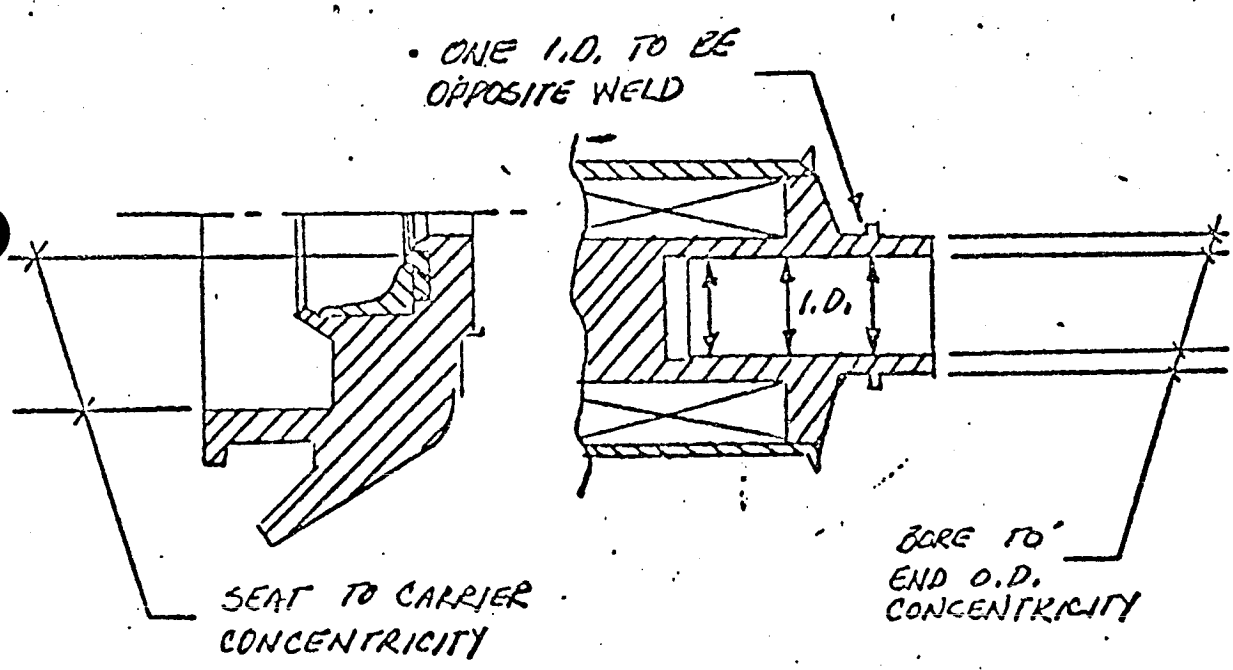
LAB SUPERVISION	ASSIGNED TO:	LEADMAN	MECHANIC
[illegible]	SHOP ☐ LAB ☐		

INSTRUCTIONS (BE SPECIFIC) NOTE: THIS FORM WILL BE USED FOR NON-DELIVERABLE ARTICLES ONLY.

PLEASE PERFORM DIMENSIONAL CHECKS ON VALVE PARTS AS INDICATED:

ARMATURE:





REASON: FAILURE ANALYSIS FOR DAT OFR-06875F

LIST OF MATERIALS

FORM R 54-L REV. 6-57

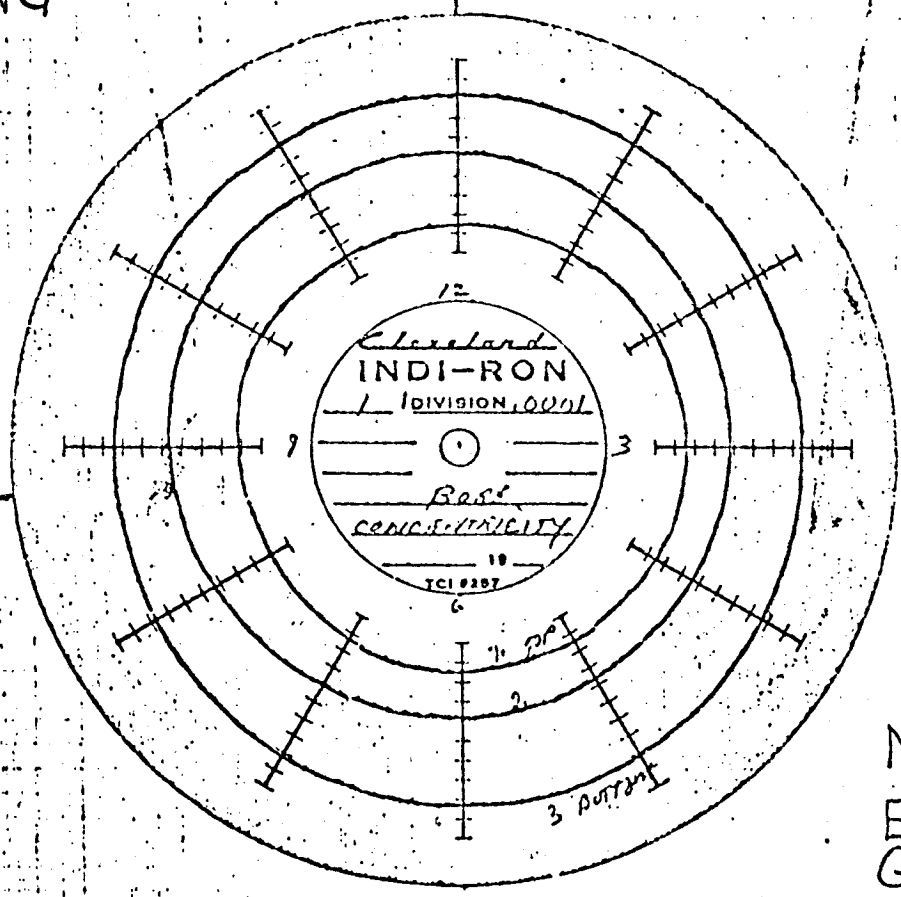
R-15019-2

EWR R 514474 LOG NO. 210,

VALVE HOUSING

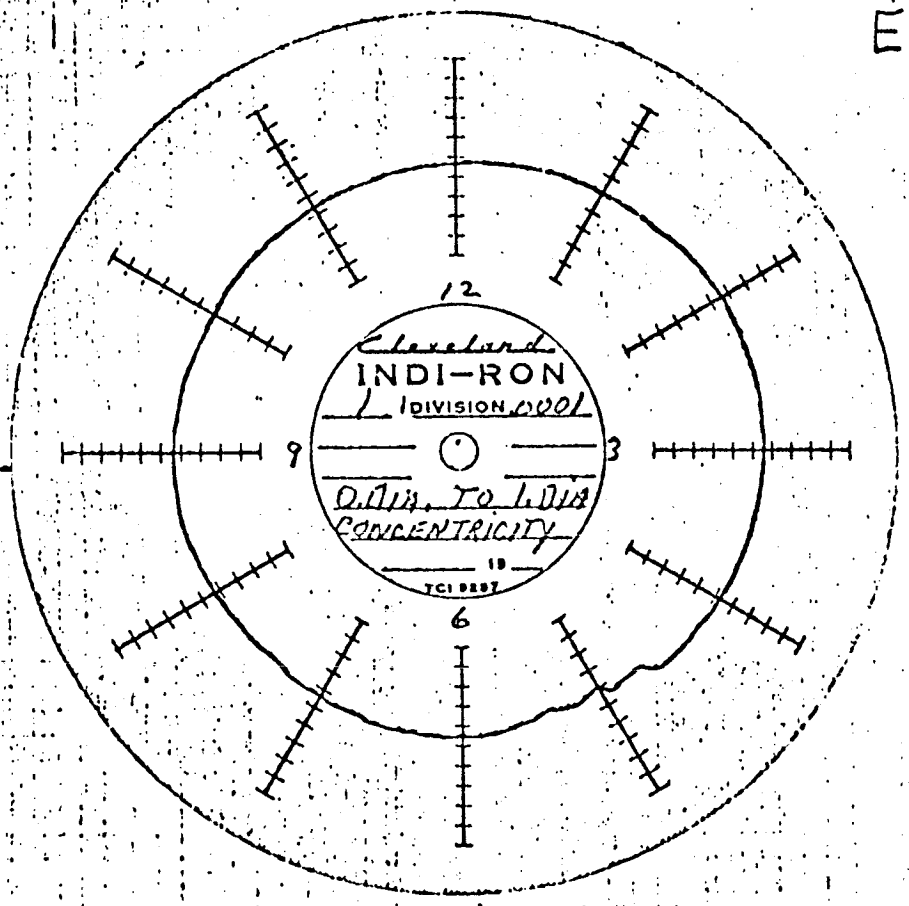
"CONCENTRICITY" I.D. TO O.D.

BORE: TOP CENTER BOTTOM



NOTE: EACH GRADUATION EQUALS -.0001

OUTSIDE DIA.

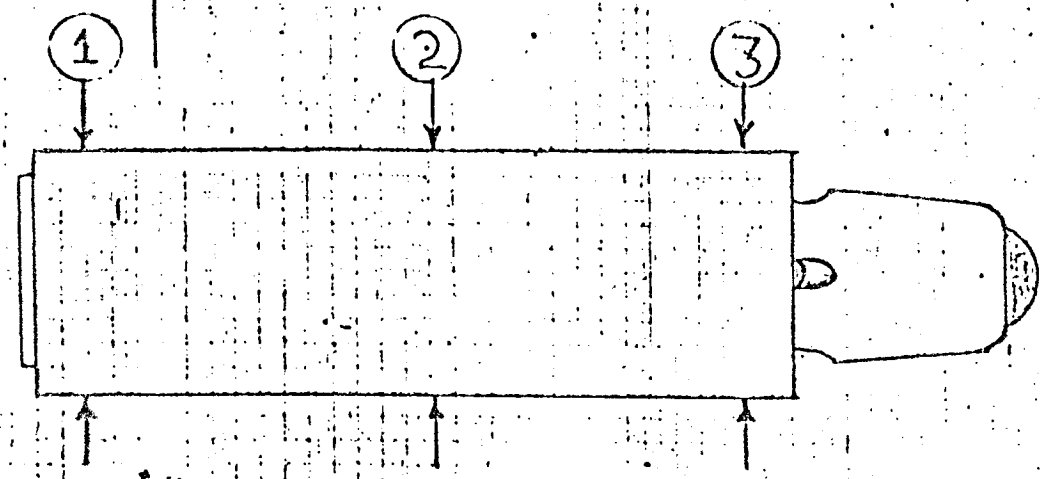


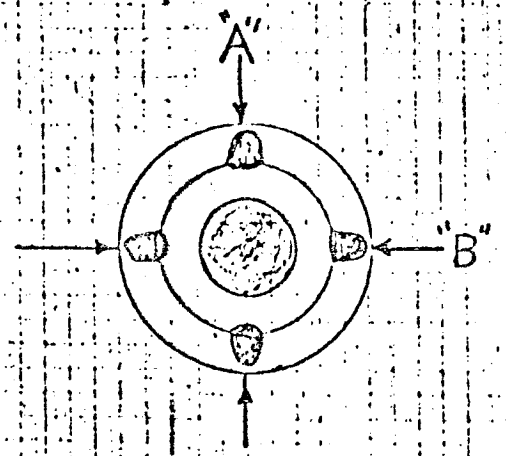
R-15019-2

OFR-06375F

EWR R 514474 LOG NO. 210

ARMATURE





#	"A"	"B"
1.	.27995	.27998
2.	.27995	.28003
3.	.27993	.28004

OUTSIDE DIA. IS CONCENTRIC TO BALL OUTSIDE DIA. WITHIN .0001 T.I.R.

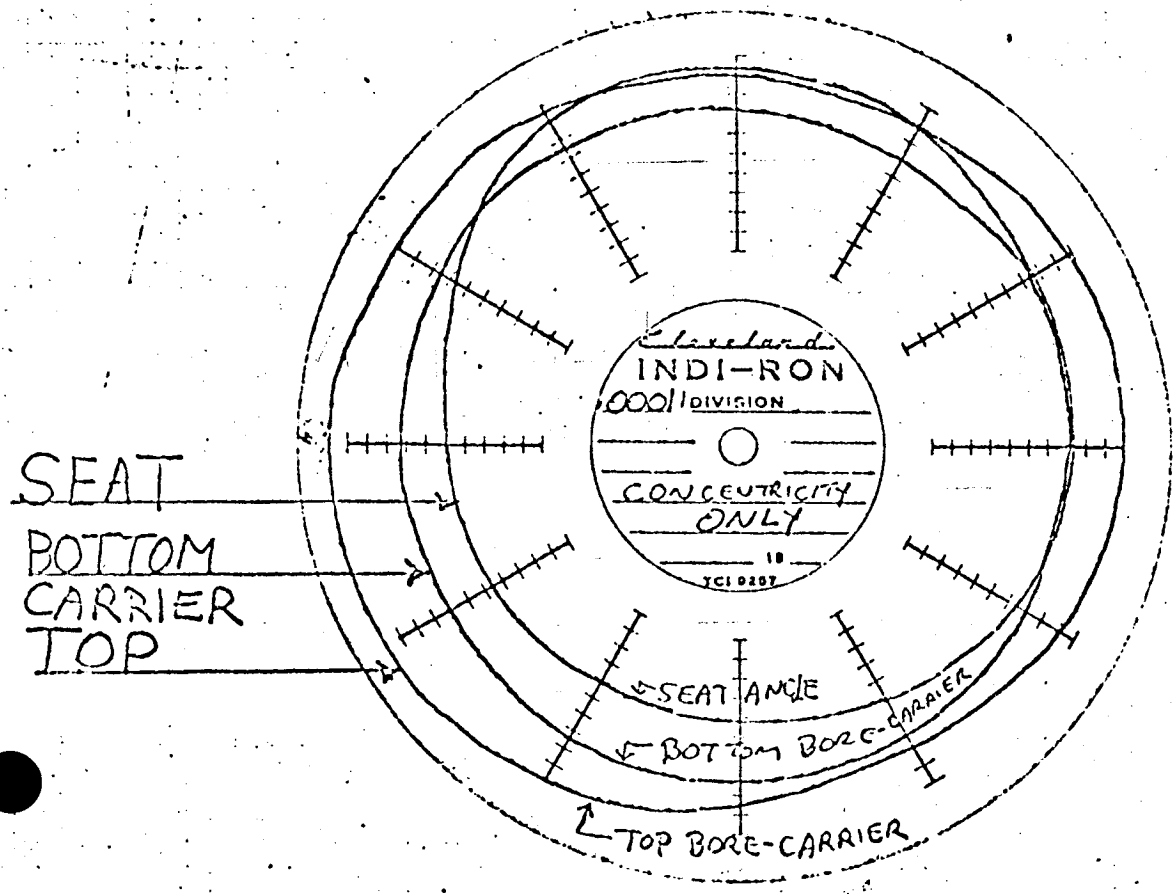
.2800 - .2798

R-15019-2

OFR 06875F

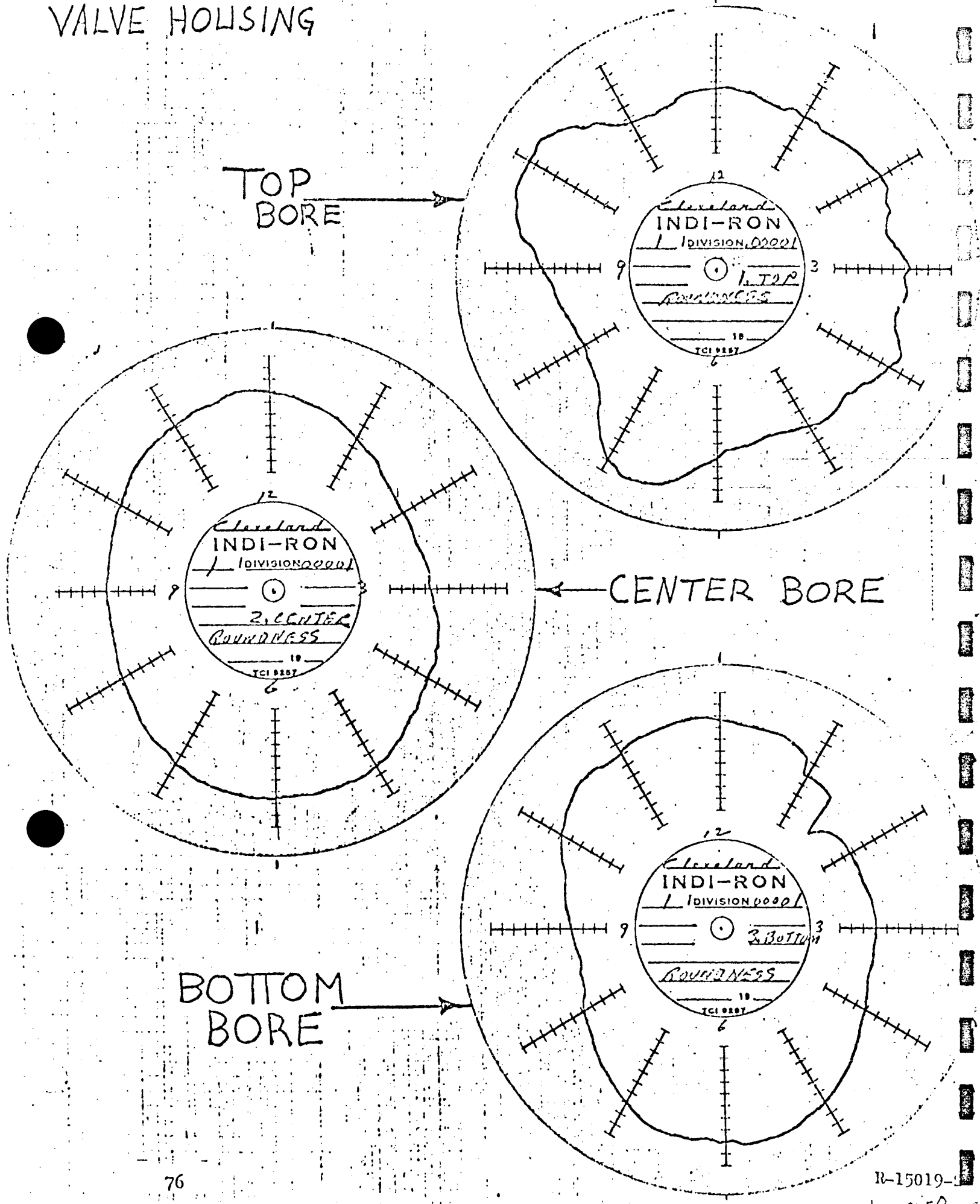
EWR R 514474 LOG 210

"SEAT TO CARRIER CONCENTRICITY"



EA. DIV. = .0001

EWRR 514474 "ROUNDNESS" LOG NO. 210
VALVE HOUSING



MCDONNELL AIRCRAFT CORPORATION
BOX 516, ST. LOUIS, MISSOURI · 63166

DRAWING AND DATA TRANSMITTAL

KEM
WSR C/F
T/E

Date 24 September 1964

TO: Rocketdyne
Division of North American Aviation
6633 Canoga Avenue
Canoga Park, California

Reference 261-378-605

Purchase Order No. Y20161

MAC SCD No. 52-52700 & 701

Attention: Mr. F. H. Rubald
Group Leader, Engineering Data

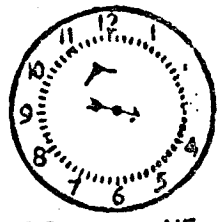
MAC Report 8392

Gentlemen:

MAC is returning the following for reason(s) shown in "Approval Code" column.

DRAWING/DOCUMENT NO.	REVISION	MAC REPORT ITEM NO.	APPROVAL CODE	REMARKS
17311R		31	B	
16875F		31	B.	
20411R		31	C	"See Affixed Comments"
12881R		31	B	
18243R	Amd.1	31	B	
17390R		31	C	"See Affixed Comments"
17441R		31	B	
17385R		31	C	"See Affixed Comments"
15974R		31	C	"See Affixed Comments"

OCT 05 '64



RECEIVED
CORRESPONDENCE
D/598

"Please forward one copy to:

Reliability Engineer
Van Nuys, California

APPROVAL CODE
A - FINAL APPROVAL *WITH* CHANGE: INCORPORATE CHANGES AND RESUBMIT FOR APPROVAL.
B - FINAL APPROVAL *WITHOUT* CHANGE: ENCLOSED COPIES FOR INFORMATION AND FILES.
C - PRELIMINARY APPROVAL *WITH* CHANGE: INCORPORATE CHANGES AND RESUBMIT FOR APPROVAL.
D - PRELIMINARY APPROVAL *WITHOUT* CHANGE:

CC:
R-15019-2

19125 RC

Victor L. Lammers
Victor L. Lammers
Reliability Engineering Dept. 261

77

Operation and Failure Report
ROCKETDYNE

[X] FAILURE [ ] OPERATION
PART CHANGE
[X] FAILED ITEM [ ] TIME EXPIRED [ ] T.O. DIRECTED

PROGRAM: DAT SE6 | LOCATION: [illegible] | № 12909R

PART IDENTIFICATION

1 PART NO: 407558	2 PART NAME: FUEL PROP. VALVE
3 SERIAL NO: 9202598	4 MFG NAME: ROCKETDYNE
5 MFR. CODE: 02602	6 REF. DESIG.
7 NEXT ASSY PART NO.: 207B0-61	8 NEXT ASSY SERIAL: 4055298
9 NEXT ASSY NAME: T.C.A.	
10 MISSILE SERIAL NO.	11 ENG AGE MODEL NO.: SE6
14 SYSTEM CODE	15 COMPONENT CODE
12 REJ. TAG NO.: 805583	13 ENG/AGE SERIAL NO.
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 [X] FAILURE ANALYSIS
9 [ ] USED AS IS

PART REPLACEMENT

36
1 [ ] IDENTICAL ITEM
2 [ ] SUBSTITUTE PART
3 [X] NONE
4 [ ] NONE AVAILABLE

37 REPLACEMENT PART NO.

38 REPLACEMENT SERIAL NO.

39 FAILED PART SENT TO: OFR CRIB UN #1

40

41

FAILURE/OPERATION DATA

17 FAILURE DATE: 64 MO 8 DAY 21	18 TEST OPER DATE: 64 MO 8 DAY 21	19 TEST OPER NO.	20 ITEMS: 1
21 PROCEDURE - SPEC & PARAGRAPH: DAT SPEC 283130-401			
22 FS	25 FAIL. TYPE	26 FAIL. CODE	27 SECONDS: 10
28 STARTS: 5			
23 SV	29 MONTHS	30 INITIAL REPORT NO	31
24 NC			33

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 [X] LEAK & FUNCTION
J [ ] SIM. LAUNCH
K [ ] MISSILE ACCEPT.
L [ ] STAT. MISS. TEST
M [ ] PROPEL. LOADING
N [ ] PERIODIC INSP.

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

REPORTED BY

42 NAME: T. H. Cole	43 GROUP: [illegible]	44 SUPPLEMENT SHEET: 1 [ ] YES 2 [X] NO
45 APPROVED BY: R. [illegible]	46 ACTIVITY: A8	47 STAND. AREA

ANALYSIS ASSIGNED TO

48 NAME: W. SMITH	49 GROUP: 335	50 CODE: AR	51 PART REQ.: [X] YES [ ] NO
DATE REPORT RECEIVED: 52 YR MO DAY	DATE REPORT DISTRIBUTED: 53 YR MO DAY		
TIME USE ONLY	54 TEST OPER. NO.	55 1/2 56	57 NTH CODE	58 TAPE CODE

DESCRIPTION OF FAILURE

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

FAR DUE D/[illegible] 9-11-6

FUEL PROPELLANT VALVE FAILED PARA. 6.5.4 AS IT WAS NOT POSSIBLE TO MEASURE RESPONSE TIME. THE TRACE DID NOT SHOW THE POPPET TRAVEL. WHEN THE VALVE WAS LATER PUT IN THE DE-ENERGIZED POSITION IT FAILED TO CLOSE

71 TEST OPER NO.: 12909R | 78 A | 79 AC

78 B

78 C

78 D

78 E

78 F

78 G

36 REF. OFR | 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	RS-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

R-15019-2

78

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
12909R	R. A. Cole	896-388	Canoga Park	8/29/64

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
1.07558	9202598	Fuel Prop. Valve	Rocketdyne
ENG/AGE MODEL NO.	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	
SE-6 DAT		12909R	

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
D. R. Fizz	896-335	17 Sept. 64		

FAILURE ANALYSIS

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

RECEIVED 17 DEC 1964 RELIABILITY

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

During Design Approval Testing, the noted fuel propellant valve failed the response test of Paragraph 6.5.4 of the DAT specification 208130-401. The oscilloscope trace showed no evidence of poppet travel. When the valve was later de-energized, there was no evidence of the valve closing. The thrust chamber assembly had previously undergone salt spray and humidity tests in the DAT program just prior to the reported failure. Assembly and Operations Records show the valve was manufactured prior to critical parts chip and burr control.

2. Analysis

To eliminate as a cause, stresses in mounting bracketry causing valve distortion and armature hang-up, it was verified that the valve was stuck in the open position before removing it from any mounting bracketry. Verification was accomplished by applying GN_2 pressure slowly using a thrust chamber throat plug and the water displacement test method. Flow of GN_2 was found to be unrestricted. One side of the mounting bracketry was cut, and the same test was performed to determine if the valve remained open. The valve remained in the open position.

The subject valve was removed from the thrust chamber assembly, and again the valve was pressurized to determine the armature condition. Again it was verified that the valve remained stuck open. By cutting off the seat and filter closure welds, the valve was disassembled and the details were examined under a microscope. The following conditions were seen to exist:

a. The outlet end of the armature was contaminated with a rust-colored residue, which was also found on other parts of the armature.

b. The internal bore of the valve was found to be similarly contaminated at the outlet end.

c. Considerable deposits were found in the filter housing where the filter press fits into the bottom of the filter housing.

Item 31
52-62700

FAILURE ANALYSIS ACCEPTED
W. Parker 1/7/65
RELIABILITY DEPT. 261

FORM 671 P-2 REV. 2-62
R-15019-2

d. The wire mesh of the filter appeared clean but rust-colored deposits were found on the ends which are pressed into the valve and filter housing.

e. Caps used on the inlet and outlet tubes during the salt spray and humidity tests were found to be severely corroded internally including the sealing surfaces.

Chemical analysis of the residues found in the valve showed the presence of ferric ions. The presence of ferric ions means that the contaminants were rust deposits. Pits were noted in the bore, on the armature, and in the filter housing indicating that the corrosion which had taken place was of the parent material and not of foreign particles.

3. Conclusion

It is concluded that:

a. The rust-colored deposits caused the failure (valve hang-up).

b. The rust-colored deposits were products of corrosion and in this case rust.

c. Corrosion was caused by introduction of corrosive fluids into the valve during the salt spray and humidity tests.

d. Introduction of the fluids into the valve was permitted by the end caps not being tightened as evidenced by heavy corrosion on the cap sealing surfaces.

4. Corrective Action

Since the noted failure mode would not occur in operation without a similar error permitting internal parts of the valve or system to be exposed to corrosive liquids and/or vapors, no corrective action is warranted.

ROCKETDYNE

PART CHANGE — X FAILED ITEM ☐ TIME EXPIRED ☐ TO DIRECTED

SE-6 | 7IL | № 12918R

PART IDENTIFICATION

1 PART NO: 202130-61	2 PART NAME: 25 LB TCA-RCS		
3 SERIAL NO: 060150	4 MFG. NAME: ROCKETDYNE	5 MFR CODE: 02602	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-6	14 SYSTEM CODE	
12 REJ. TAG NO.	13 ENG/AGE SERIAL NO.	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 X FAILURE ANALYSIS
- 9 ☐ USED AS IS

PART REPLACEMENT

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

37 REPLACEMENT PART NO.

38 REPLACEMENT SERIAL NO.

39 FAILED PART SENT TO: OFR C.R.B

40 E-III

41

FAILURE/OPERATION DATA

17 FAILURE DATE (YR MO DAY)	18 TEST OPER DATE (YR MO DAY)	19 TEST OPER NO.	20 ITEMS
64 10 15	64 10 5	957/092	1

21 PROCEDURE—SPEC. & PARAGRAPH: 202130-401 / 7.3.4

22 FS	23 SV	24 NC	25 FAIL. TYPE	26 FAIL. CODE	27 SECONDS	28 STARTS	29 MONTHS	30 INITIAL REPORT NO	31
					100	1212	6	NONE	

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 X STAT. MISS. TEST
- M ☐ PROPEL. LOADING
- N ☐ PERIODIC INSP.

33

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

REPORTED BY

42 NAME	43 GROUP	44 SUPPLEMENT SHEET
John A Bunger	322	1 ☐ YES 2 X NO
45 APPROVED BY: [illegible]	46 ACTIVITY: 139	47 STAND AREA: 957

ANALYSIS ASSIGNED TO

48 NAME	49 GROUP	50 CODE	51 PART REQ.
H. MARSDEN	335	AR	X YES ☐ NO

DATE REPORT RECEIVED (YR MO DAY)	52	DATE REPORT DISTRIBUTED (YR MO DAY)	53

IBM 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?

FAR DUE D/696-394 — RELIABILITY 10-25

1 ⊙ RCS GEMINI TCA, DAT UNIT NO. 3, FA 35
36 ILED TO MEET THE THROAT STA. SHELL 70 — 71 TEST OPER NO 9570092 — 77 — 78 A — 79 80

1 TEMP. REQUIREMENT AT 100 SEC. B.T. 35
36 DURING THE RC-103 MDC. THE TEST WAS 70 — 78 B

1 CONTINUED UNTIL TEMPS. REACHED 700 35
36 F. NO INCIPIENT MECHANICAL FAILURE 70 — 78 C

1 WAS OBSERVED. THE TEMPS. WERE 50 - 35
36 100 DEG. F HIGHER THROUGHOUT THE MD 70 — 78 D

1 C THAN PREVIOUS MDC'S. THE PAST HIS 35
36 TORY WAS OBTAINED IN A LARGER ALT. 70 — 78 E

1 CHAMBER. ANALYSIS REQUIRED. 34

36 REF. OFR | 42 REF. OFR | 48 REF. OFR | 54 FAILED DETAIL PART NO. 70 — 78 F

RELIABILITY ANALYSIS USE ONLY

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	RS-2	CD	46	68 DELETE 70	78 G

REPLACEMENT PART NO.	18 REPLACEMENT S/N	22 NAME	28 TYPE	31 MFR. 35

16 INSTALLATION PART NO.	50 CONFIG. CODE	57 NAME	60 GR. RESP.	CH	CL	M	R	78 80
R-15019-2								81

OFR № 12918R

FORM 810-C-80 REV. 8-68

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
12918R	J. A. Ganger	896-388	CTL-III	10-15-64

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
208130-61	40601,50	Thrust Chamber Assy	Rocketdyne
ENG/AGE MODEL NO.	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	
SE-6	None	957-092	

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
J. N. Sheingold	896-335	10-30-64		

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. Gemini 25 lb RCS DAT Unit No. 3 failed to meet the SCD temperature requirements at 100 seconds of accumulated firing time during the RC-103 mission duty cycle. The temperature recorded was 50°F greater than the allowable maximum of 550°F. The test was continued to 136 seconds of accumulated RC-103 mission duty cycle firing time with no structural failure. The test was conducted in the Tri-Mod test facility.

2. Analysis of the temperature-time data showed the outer shell skin temperatures to be greater throughout the mission duty cycle than anticipated from previous R&D tests. The R&D data was obtained from tests conducted in the large altitude simulator.

Post-test x-ray analysis showed the condition of the TCA to be like R&D chambers similarly tested. It was thought that the recirculation of exhaust gases in the smaller altitude can (Tri-Mod) could account for the difference in temperature. To determine the extent of artificial skin heating during mission duty cycle testing as a result of hot gas recirculation in the Tri-Mod facility, a controlled test series was conducted using a 25 lb OAMS slave chamber. The test series consisted of both limited steady state and pulse testing at a simulated altitude of 170,000 feet and local ambient temperature. Four (4) strips of 0.375 inch square, 0.10 thick plastic packing material were suspended from each corner of the thrust measuring system housing with 4.5 inches of fiberglass string. Motion pictures taken during testing showed the four strips to fluctuate considerably during pulse testing and to stand out at an angle of 45 degrees during steady state testing. A velocity calculation was made on the basis of the steady state results and the velocity required to displace the plastic strips 45 degrees at 170,000 feet was seen to be on the order of 700 mph.

3. The inability of the TCA to meet the SCD temperature requirements is attributed to artificial skin heating resulting from hot exhaust gas recirculation. The motion picture clearly pointed out the existence of a considerable environmental gas velocity which would not exist in the spacecraft. The hot gas recirculation is seen to be a result of incomplete pick up of the TCA exhaust gases from the Tri-Mod test housing. The TCA would have satisfactorily completed the mission duty cycle within the temperature requirements had the hot gas recirculation not occurred.

Item 31
52-52700

FAILURE ANALYSIS
REJECTED
11/18/64
11/18/64

SEE SHT #2 FOR MAC COMMENT

OFR NO. 12918R

FORM 607 P-2 REV. 2-62 R-15019-2

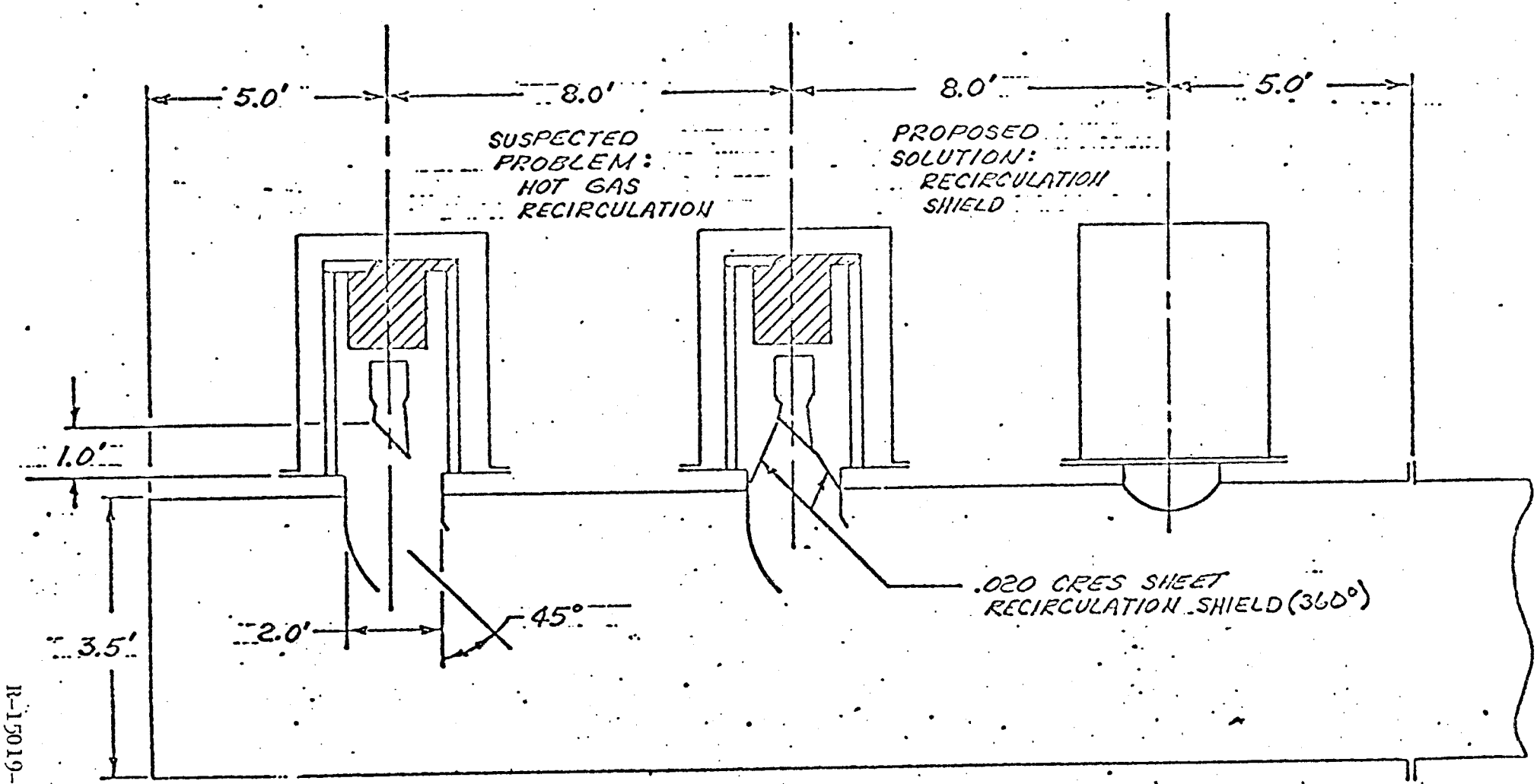
4. In order to eliminate artificial TCA skin heating in the Tri-Mod facility, a cylindrical shield has been fabricated for all TCA configurations with next part tested effectivity. The shield, fabricated of .020 stainless steel sheet, will be attached to the TCA flange through a formica base plate such that the test environment will more closely simulate that which the TCA would see during Gemini spacecraft operation. (See Figure I.)

A. PLEASE PROVIDE TEMP.-TIME DATA CURVES FOR THIS TEST VS. THE TEMP.-TIME DATA CURVES EVALUATED FROM THE R & D TESTING IN AN AMENDMENT TO THIS FAR.

B. MAC ENGINEERING WAS INFORMED THAT THE CONTROL UNIT ACCIDENTLY SHUTDOWN FOR 2 MIN.'S DURING THE MARGIN PORTION OF THE MDC. WHAT EFFECT DID THIS HAVE ON TEST RESULTS?

FIGURE I

Tri-Mod Altitude Test Chamber



FAR 12918R
30 October 1964
J.M.Sheingold

Amendment No. 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
12918R	J. A. Ganger	896-388	CTL-III	10-15-64

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
208130-61	4060450	Thrust Chamber Assy	Rocketdyne
ENG/AGE MODEL NO.	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	
SE-6	None	957-092	

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
J. N. Sheinfeld	896-335	1-22-65		

RECEIVED 11 FEB 1965 RELIABILITY DEPT. 261

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.

Para. 1, 3, and 4 - No change.

Para. 2 - In answer to questions raised concerning this FAR, Para. 2 is amended to read as follows:

"Analysis of the temperature-time data showed the outer shell skin temperatures to be greater than anticipated from previous R&D tests (see Figures 1 and 2). The R&D data was obtained from tests conducted in the large altitude simulator. Figure 2 also indicates a more rapid rate of temperature increase with time during the re-entry portion of the mission duty cycle (the most severe portion of the test). The loss of approximately 4.9 seconds of accumulated burn time in the re-entry mode appeared to have little or no effect on the overall test results.

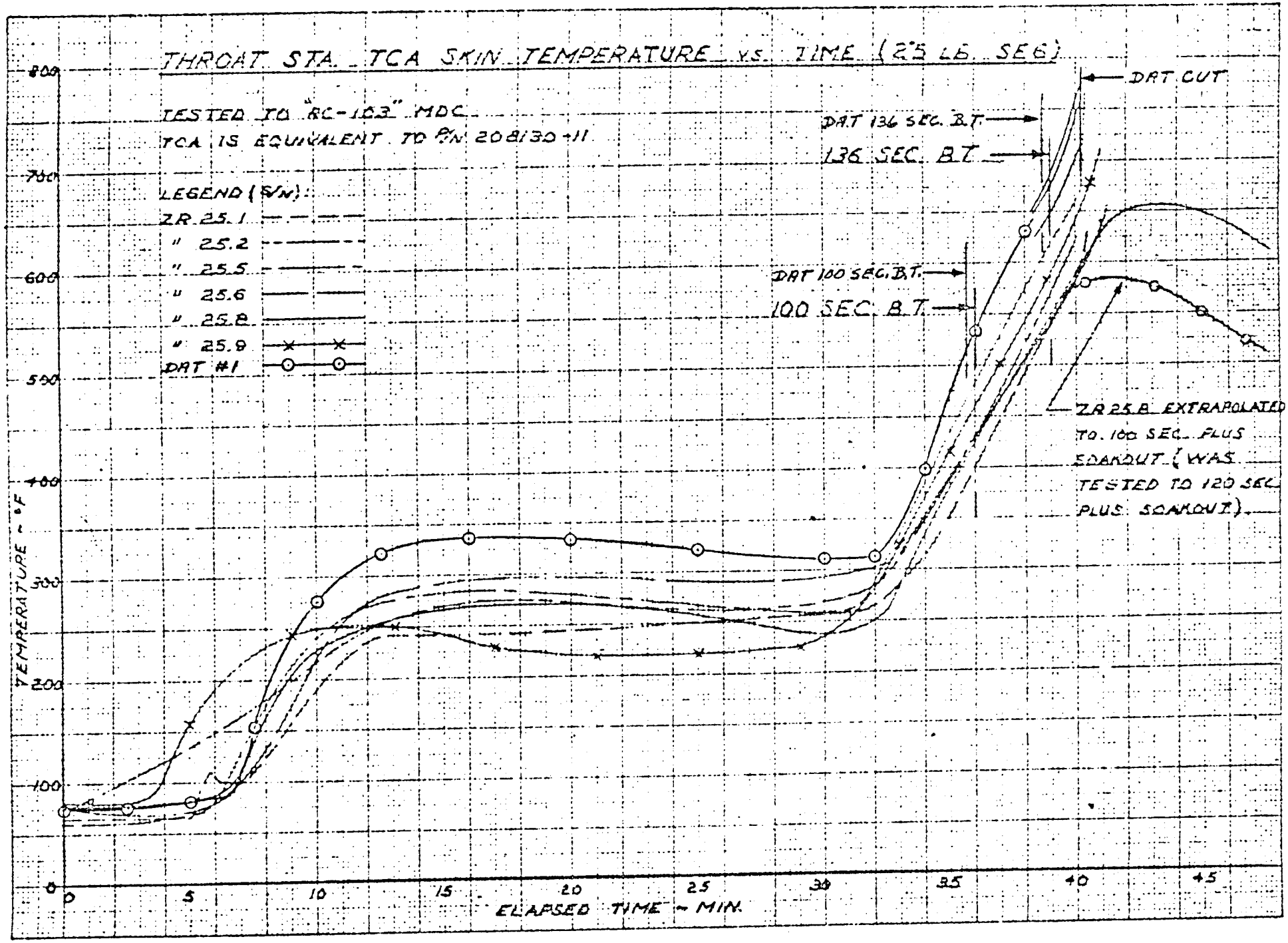
Post-test x-ray analysis showed the condition of the TCA to be like R&D chambers simularly tested. It was thought that the recirculation of exhaust gases in the smaller altitude can (Tri-Mod) could account for the difference in temperature. To determine the extent of artificial skin heating during mission duty cycle testing as a result of hot gas recirculation in the Tri-Mod facility, a controlled test series was conducted using a 25 lb OAMS slave chamber. The test series consisted of both limited steady state and pulse testing at a simulated altitude of 170,000 feet and local ambient temperature. Four (4) strips of 0.375 inch square, 0.10 thick plastic packing material were suspended from each corner of the thrust measuring system housing with 4.5 inches of fiberglass string. Motion pictures taken during testing showed the four strips to fluctuate considerably during pulse testing and to stand out at an angle of 45 degrees during steady state testing. A velocity calculation was made on the basis of the steady state results and the velocity required to displace the plastic strips 45 degrees at 170,000 feet was seen to be on the order of 700 mph.

FAILURE ANALYSIS ACCEPTED
W. Pasfield 3/1/65
Joseph Gelinski 3/1/65

Item 31-52-52700

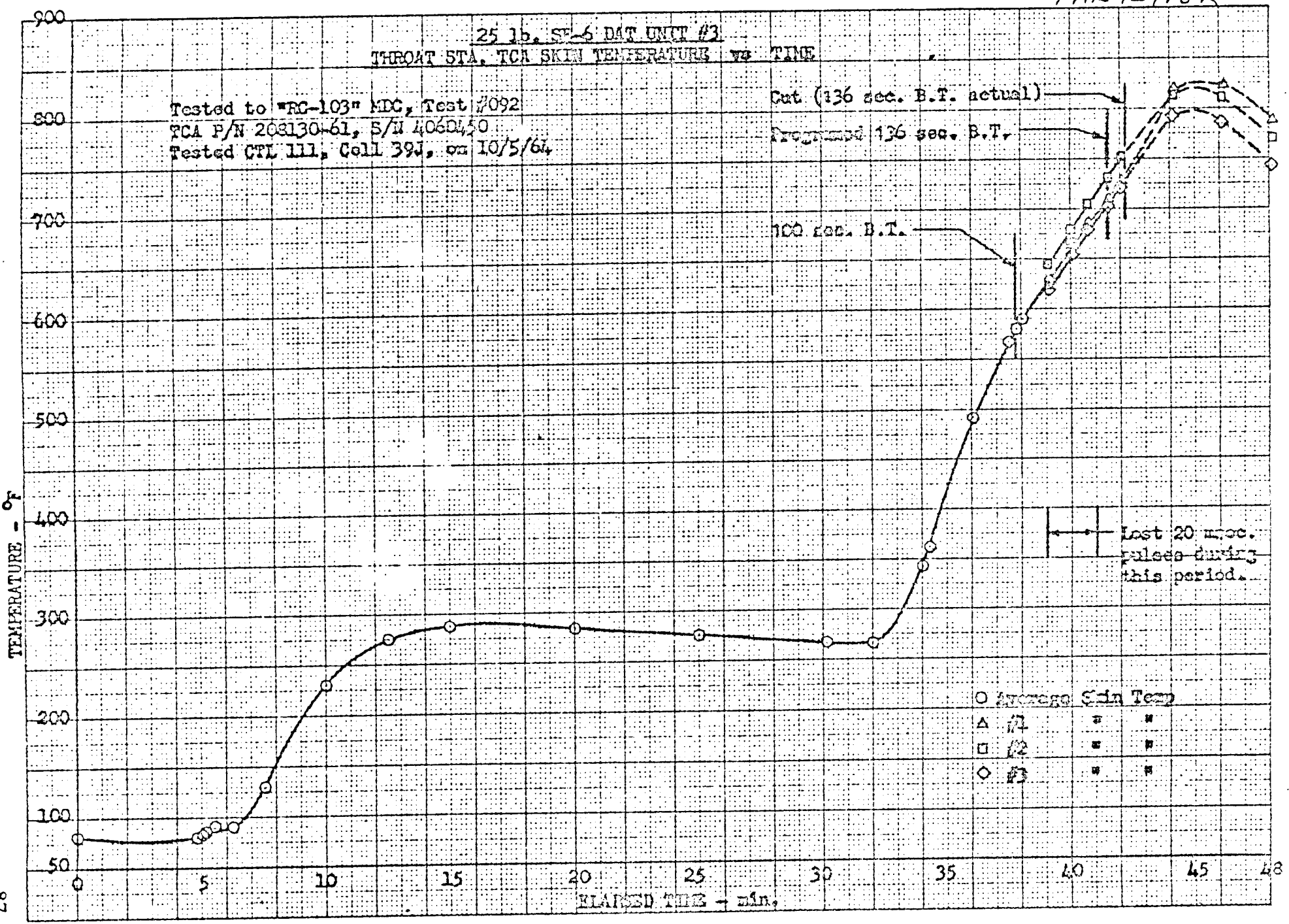
OFR NO. 12918R

FAR 12-918R


THROAT STA. TCA SKIN TEMPERATURE vs. TIME (25 LB. SEG)
TESTED TO "RC-103" MDC
TCA IS EQUIVALENT TO P/N 208130-11
LEGEND (S/N):
ZR 25.1
" 25.2
" 25.5
" 25.6
" 25.8
" 25.9
DAT #1
DAT CUT
DAT 136 SEC. B.T.
136 SEC. B.T.
DAT 100 SEC. B.T.
100 SEC. B.T.
ZR 25.8 EXTRAPOLATED TO 100 SEC. PLUS SOAKOUT (WAS TESTED TO 120 SEC. PLUS SOAKOUT).
TEMPERATURE ~ °F
ELAPSED TIME ~ MIN.
0
100
200
300
400
500
600
700
800
5
10
15
20
25
30
35
40
45

K&E 10 TO THE CM. 359T-14
FELL & ESSER CO.

FAR 12918R



ROCKETDYNE

PART CHANGE: [X] FAILED ITEM [ ] TIME EXPIRED [ ] T.O. DIRECTED

DAT | 12952R

PART IDENTIFICATION

1 PART NO. 407557	2 PART NAME Oxid. propellant valve
3 SERIAL NO. 875-471	4 MFG NAME ROCKETDYNE; 5 MFR. CODE 02602; 6 REF. DESIG.
7 NEXT ASSY PART NO. 208130-31	8 NEXT ASSY SERIAL 406-148; 9 NEXT ASSY NAME ICA
10 MISSILE SERIAL NO.	11 ENG/AGE MODEL NO. SEC; 14 SYSTEM CODE
12 REJ. TAG NO.	13 ENG/AGE SERIAL NO.; 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
- [X] 8 FAILURE ANALYSIS
- [ ] 9 USED AS IS

PART REPLACEMENT

36
- [ ] 1 IDENTICAL ITEM
- [ ] 2 SUBSTITUTE PART
- [X] 3 NONE
- [ ] 4 NONE AVAILABLE

37 REPLACEMENT PART NO.

38 REPLACEMENT SERIAL NO.

39 FAILED PART SENT TO: OFR CRIB

40 A-I

41

FAILURE/OPERATION DATA

17 FAILURE DATE	18 TEST OPER. DATE	19 TEST/OPER. NO.	20 ITEMS
YR 14 MO 7 DAY 6	YR 14 MO 10 DAY 6		1

21 PROCEDURE—SPEC & PARAGRAPH 208130-49 Para. 7.1.5.12

22	23 FAIL. TYPE	26 FAIL. CODE	27 SECONDS	28 STARTS
24 SV / NC	29 MONTHS	30 INITIAL REPORT NO	31	

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 [X] 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	43 GROUP	44 SUPPLEMENT SHEET
R. Cole	386	1 [ ] YES 2 [X] NO
45 APPROVAL	46 ACTIVITY	47 STAND/AREA
[illegible]	A8	

ANALYSIS ASSIGNED TO

48 NAME	49 GROUP	50 CODE	51 PART REQ.
W. SMITH	335	AR	[X] YES [ ] NO

DATE REPORT RECEIVED	52 YR MO DAY	DATE REPORT DISTRIBUTED	53 YR MO DAY

IBM 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?

FAR DUE D/S96-394 RELIABILITY 10-16

71 TEST OPER. NO. 12952R

UNABLE TO CYCLE OXID. PROPELLANT VALVE 3 TIMES (REF. PARA. 6.1.7) WHEN DOING STEP 7.1.5.1.2 OF THE EXPLOSIVE ATMOSPHERE. PRETEST. THE VALVE DID NOT OPEN FOR THE FIRST TWO CYCLES. AS NO EVIDENCE OF A PRESSURE DROP EXISTED ON THE HELIUM GAUGE. LATER AN OSCILLOSCOPE TRACE DID NOT SHOW A CHARACTERISTIC POPPET TRAVEL HOWEVER THE VALVE WAS SLIGHTLY OPEN AS A SMALL DELTA P EXISTED

36 REF. OFR | 42 REF. OFR | 48 REF. OFR | 54 FAILED DETAIL PART NO.

78 A | 78 B | 78 C | 78 D | 78 E | 78 F | 78 G

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

36 NTH	COMP	40 ASSY	RS-2	CD	48	68 DELETE

1 REPLACEMENT PART NO.	18 REPLACEMENT S/N	22 NAME	28 TYPE	31 MFR.

36 INSTALLATION PART NO.	50 CONFIG. CODE	57 NAME	60 GR. RESP.	CH	CL	M	R
88							

R-15019-2

OFR NO. 12952R

FORM 610-C-68 REV. 6-63

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
12952R	R. Cole	Canoga	10-6-64

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
407557	8759999	Oxid. Valve	Rocketdyne
ENG/AGE MODEL NO. SE-6	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
Ray Clark	896-335	11-10-64	11/30/64	

FAILURE ANALYSIS

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

RECEIVED 28 DEC 196 RELIABILITY

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

It was reported on the OFR that the oxidizer valve on TCA, P/N 208130-61 S/N 4060448 would not actuate during the DAT pre-explosive atmosphere functional test. The failure description of the OFR stated: "unable to cycle oxidizer propellant valve three times (Ref. para. 6.1.7) when doing step 7.1.5.1.2 of the explosive atmosphere pre-test. The valve did not open for the first two cycles as no evidence of a pressure drop existed on the helium gauge. Later an oscilloscope trace did not show a characteristic poppet travel, however, the valve was slightly open as a small delta P existed."

Prior to the pre-explosive atmosphere functional test the TCA was subjected to an MDC hot firing test. (A plot of TCA skin temperature vs elapsed time during the MDC test is shown in enclosure 1 which is attached to this report).

2. Analysis

The TCA was sent to the D/596-149 laboratory for failure analysis which consisted of:

A. 300 psig was applied to the valve inlet and the valve was actuated with .37 amps. Current was monitored on an oscilloscope to determine energize time. Energize time could not be obtained from the current trace.

B. Helium leakage was checked at 300 psig. No leakage occurred.

C. It was noted that when the valve was energized only a slight amount of gas flowed from the outlet.

D. It was noted that only a slight "click" was heard when the valve was actuated with no inlet pressure.

The tests above were all indications of short armature stroke, so at this point the valve was removed from the TCA to complete the analysis.

OFR NO. 12952R

52-52700

Rocketdyne
Report # 12952R

Item 31 52-52700

FAILURE ANALYSIS
REJECTED

[illegible]	1/28/65
W. Parker	1/28/65
[illegible]	

RELIABILITY DEPT. 261
McDONNELL AIRCRAFT CORP.

THE MODIFICATIONS TO THE TEST CHAMBER HAVE NOT PREVENTED HIGH TEMP. ON LATER FIRINGS. THIS FAR SHOULD BE AMENDED TO INCLUDE THE MODIFICATIONS REQUIRED ON THE TEST FACILITY TO PREVENT RECURRENCE OF THIS PROBLEM ON FUTURE TESTING!.

E. The injector button was removed and the stroke was checked with a dial indicator. The armature travel was found to be less than .001 in. (normal stroke is .010 $\pm$ .0012). The valve was then disassembled by cutting away the seat weld.

F. The valve parts were examined under a microscope. No discrepancies were observed on the valve parts, except for the seat. The Teflon seat had extruded out from under the retainer. This extruded Teflon had pushed the armature towards the inlet end of the bore, which accounts for the decreased stroke. The seat was sectioned and a photograph (which is enclosed) was taken showing the extruded Teflon.

From previous R & D Tests it is known that a badly extruded Teflon seat is a good indication that the seat has been subjected to temperatures in excess of 400°F. The DAT unit was contacted for temperature data. A plot of TCA skin temperature vs elapsed time during the MDC test was furnished. (See enclosure 1). The plot revealed that the TCA was operated beyond the required design life of 136 seconds and that the TCA skin temperature exceeded the maximum allowable of 700°F at cutoff. Because of the lack of thermocouple data near the seat on this particular test additional data on other TCA tests were analyzed. This additional analysis was made on R & D TCA's run on similar MDC tests.

The temperature vs time data revealed that temperatures near the valve seat have in some instances exceeded 400°F after hot fire cutoff when the MDC exceeded required design life.

Continued investigation to determine the cause of the excessive temperature revealed that the TCA was tested in the Tri-mod Test Facility. DAT Unit No. 3 was also tested in the Tri-mod and overheating occurred. The overheating was attributed to artifical skin heating resulting from incomplete pickup of the hot TCA exhaust gases from the Tri-mod test housing. A detailed account of the attached FAR 12918R, (enclosure 2). A plot of temperature vs time for the test described in FAR 12918R is also attached (enclosure 3).

3 Conclusion

It is concluded that:

A. The extruded Teflon seat was caused by excessive temperature, which occurred after MDC and hot fire cutoff.

B. The abnormal excessive temperature was caused by hot recirculating exhaust gases and heat soakback after hot fire cutoff.

C. The recirculating exhaust gas condition will not occur on the spacecraft.

D. The valve is not required to operate after hot fire cutoff when the TCA has exceed the required design life requirements.

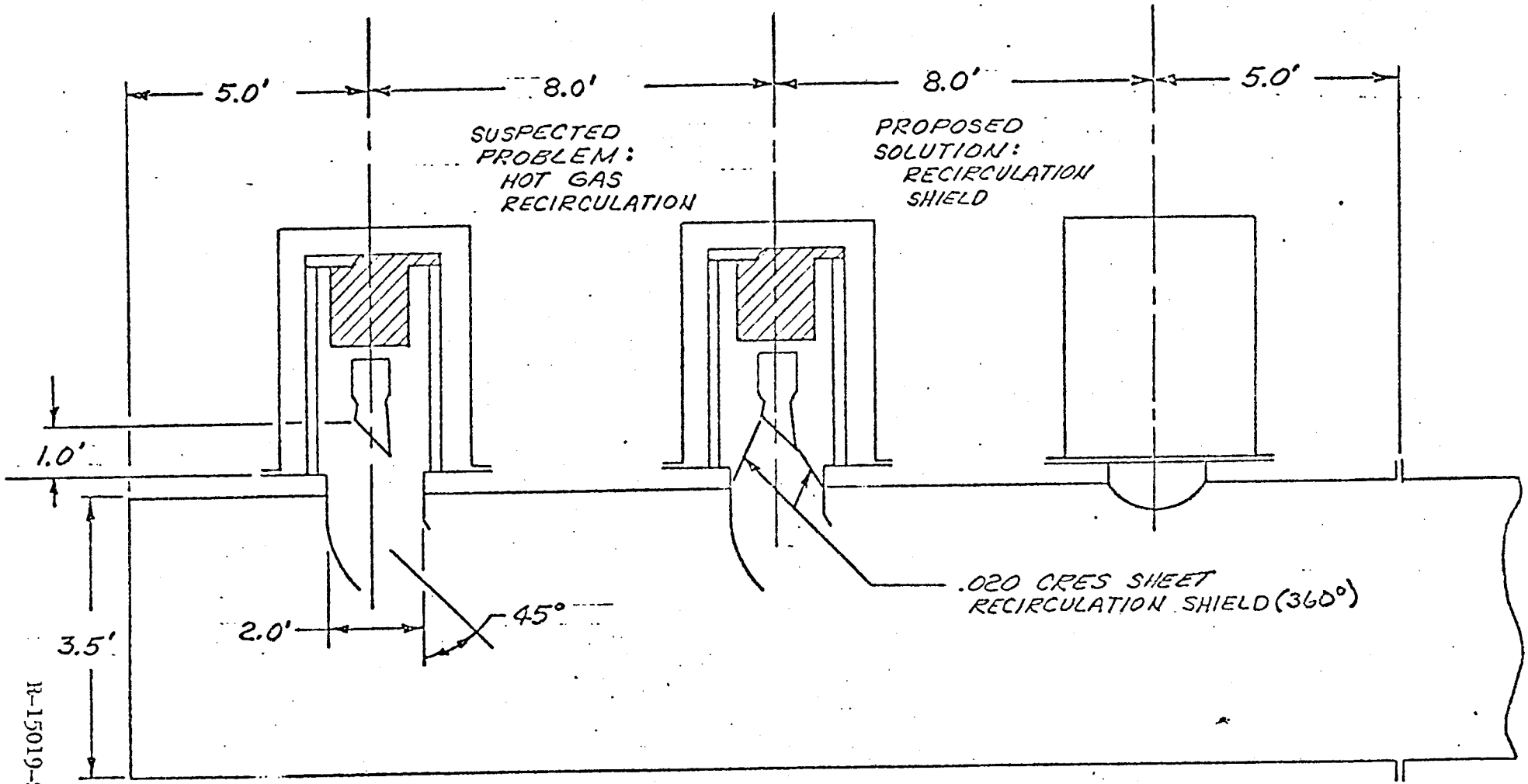
E. The valve operated satisfactorily during MDC.

4. Corrective Action

The corrective action in the enclosed FAR 12918R which requires a modification of the Tri-mod facility is applicable to this FAR.

FIGURE I

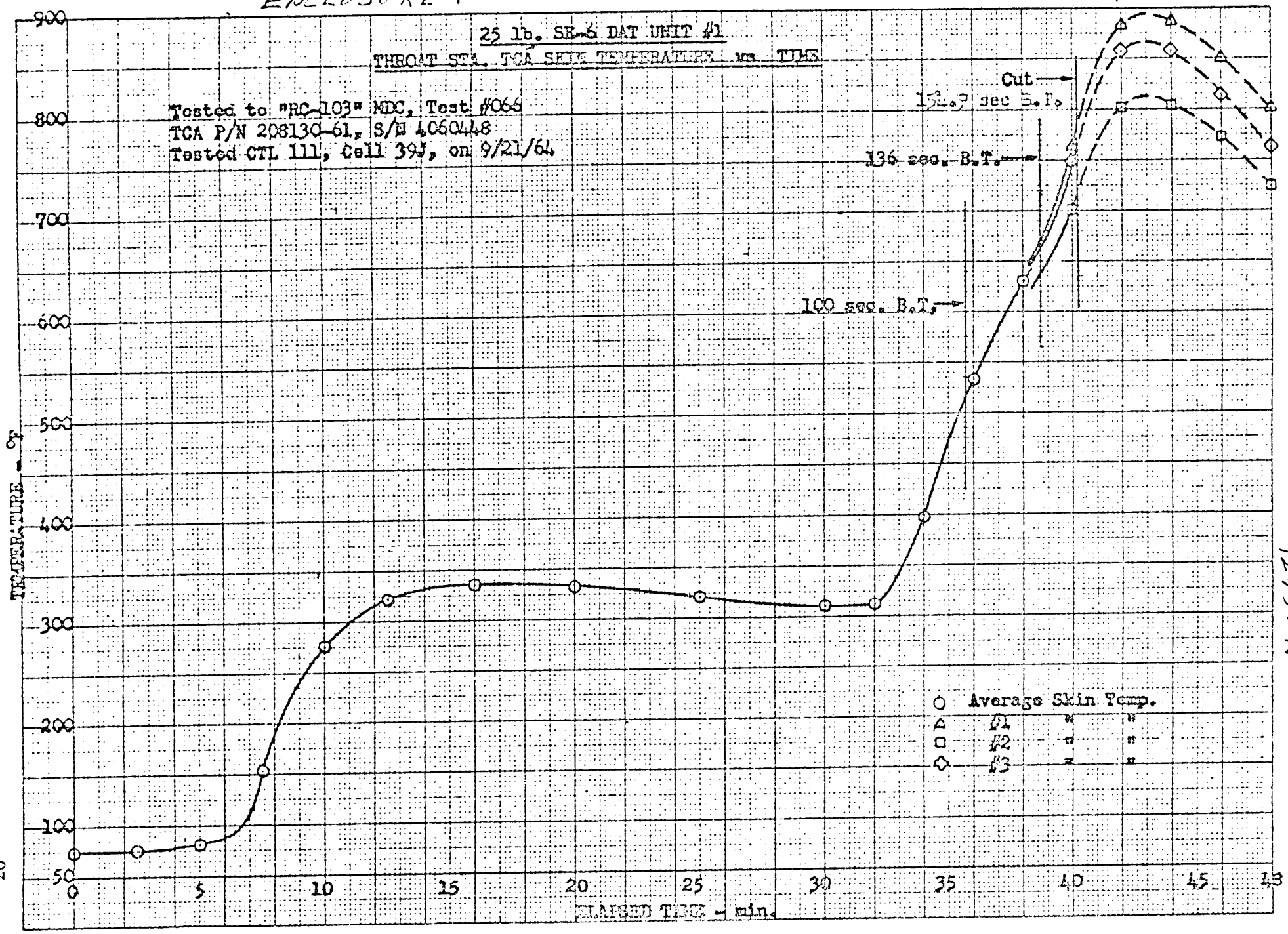
Tri-Mod Altitude Test Chamber



R-15019-2

FAR 12952

ENCLOSURE 1



11-15019-2

12957R

AMENDMENT #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
12952R	R. Cole	896-335	Canoga	10-6-65

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
407557	8759999	Oxidizer Valve	Rocketdyne
ENG/AGE MODEL NO. SE-6 DAT	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
R. Clark RSC	896-335	2-26-65	W. Smith	

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.

This amendment is being issued in reply to McDonnell's rejection of the original FAR. The rejection stated: "The modifications to the test chamber have not prevented high temperature on later firings. This FAR should be amended to include the modifications required on the test facility to prevent re-occurrence of this problem."

The original FAR referenced the corrective action in FAR 12918R as being applicable. FAR 12918R has now been accepted by McDonnell, therefore, the corrective action of the original FAR (12952R) still applies.

Item 31 52-52700

FAILURE ANALYSIS ACCEPTED	
W. Pashea	3/1/65
F. Beale	3/1
[illegible]	3/1/65

RELIABILITY DEPT. 261
McDONNELL AIRCRAFT CORP.

OFR NO. 12952R

R-15019-2

FORM 607 N2 REV. 2-62

Operation and Failure Report
ROCKETDYNE

PART CHANGE: X FAILED ITEM ☐ TIME EXPIRED ☐ T.O. DIRECTED

DAT SE-6 | CTL III | № 12953R

PART IDENTIFICATION

1 PART NO. 208130-61	2 PART NAME 25 LB TCA-RCS		
3 SERIAL NO. 1054995	4 MFG NAME ROCKETDYNE	5 MFR CODE 52602	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 SE6	14 SYSTEM CODE	
		15 COMPONENT CODE	
12 REJ TAG NO.	13 ENG/AGE SERIAL NO.	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 X FAILURE ANALYSIS
- 9 ☐ USED AS IS

PART REPLACEMENT

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

37 REPLACEMENT PART NO.

38 REPLACEMENT SERIAL NO.

39 FAILED PART SENT TO:

40 C-IV

41

FAILURE/OPERATION DATA

17 FAILURE DATE YR 64 MO 11 DAY 13	18 TEST OPER. DATE YR 64 MO 11 DAY 2	19 TEST OPER NO 957/124	20 ITEMS 1
PROCEDURE—SPEC. & PARAGRAPH 208130-401 / 7.2.3			
22 FS	25 FAIL. TYPE	26 FAIL. CODE	27 SECONDS 100 / 28 STARTS 1212
23 SV	29 MONTHS 11	30 INITIAL REPORT NO NONE	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 X STAT. MISS. TEST
- M ☐ PROPEL. LOADING
- N ☐ PERIODIC INSP.

33

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

REPORTED BY

42 NAME J. GANGER	43 GROUP 588	44 SUPPLEMENT SHEET 1 ☐ YES 2 X NO
45 APPROVED BY [illegible]	46 ACTIVITY 59	47 STAND AREA 957

ANALYSIS ASSIGNED TO

48 NAME R. SIDE	49 GROUP 335	50 CODE AR	51 PART REQ. X YES ☐ NO
DATE REPORT RECEIVED 52 YR MO DAY	DATE REPORT DISTRIBUTED 53 YR MO DAY		
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?

ORDC GEMINI TCA, DAT UNIT NO. 5, FAILED TO MEET THE THROAT STA. SHELL TEMP. REQUIREMENT AT 100 SEC. R. T. DURING THE RC-103 MDC BY 115 DEG. THE SKIN TEMPS. WERE HIGH THROUGHOUT THE MDC. NO INCIPIENT MECHANICAL FAILURE WAS OBSERVED. THE TCA WAS TESTED WITH A CONICAL SHIELD EXTENDING FROM THE FACILITY EXIT TO WITHIN 1 IN. OF THE TCA EXIT. ANALYSIS REQUIRED

36 REF OFR 12917R	42 REF OFR 12918R	48 REF. OFR	54 FAILED DETAIL PART NO.

71 TEST OPER NO. 77 957 0124 | 78 A | 79 | 80

78 B | 78 C | 78 D | 78 E | 78 F | 78 G | 78

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
36 NTH	COMP	40 ASSY	RS-2	CD	46					65 DELETE
1 REPLACEMENT PART NO.			15 REPLACEMENT S/N		22 NAME		28 TYPE		31 MFR.	
36 INSTALLATION PART NO. R-15019-2			50 CONFIG. CODE		57 NAME		60 GR. RESP.		CH / CL / M / R	

95

208 AND C 40 REV 8-63

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
12953R	J. Ganger	896-388	CTL-III -DAT	11-13-64

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
208130-61	4054995	Thrust Chamber Assy	Rocketdyne
ENG/AGE MODEL NO.	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	
SF-6		957-124	

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
J. N. Sheingold JNS	896-335	12-18-64	[illegible]	

RECEIVED 18 JAN 1965 RELIABILITY

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. Gemini 25 lb RCS DAT Unit No. 2 failed to meet the SCD temperature requirements at 100 seconds of accumulated firing time during the RC-103 mission duty cycle. The temperature recorded was 115°F greater than the allowable maximum of 550°F. The mission duty cycle test was followed by a burst pressure test with no structural failure of the TCA. Testing was conducted in the Tri-Mod test facility utilizing a heat shield as shown in Figure 1.

2. Analysis of the temperature-time data showed the outer shell skin temperature to be greater throughout the mission duty cycle than anticipated from previous R&D and DAT component testing. The temperature recorded was also in excess of that obtained in testing RCS DAT Unit No. 3 in the Tri-Mod facility with no heat shield (Figure 2).

The failure of DAT Unit No. 3 reported under OFR 12918R was seen in analysis to be a direct result of artificial TCA skin heating caused by recirculating hot TCA exhaust gases. The corrective action recommended was to install a heat shield which would enclose the thrust chamber. It was decided, however, to install a more permanent shield which would lend itself readily to all TCA configurations. No R&D tests were conducted prior to the subject DAT test for purposes of heat shield checkout. However, two strips of plastic packing material were suspended from the thrust measuring system in a similar fashion to that described in OFR 12918R except that the strips were larger for this test.

Analysis of the motion pictures taken during the test showed these plastic strips to exhibit nearly the same magnitude of displacement as those in the referenced OFR. Since the mass of these strips was greater, it would require an equal or greater gas velocity to displace the strips by the amount noted. Also, the TCA exit was approximately 1.5" above the heat shield cone entrance possibly precipitating some exhaust "spill-over" due to gas expansion at the TCA nozzle exit.

3. The inability of the TCA to meet the SCD temperature requirements is attributed to artificial skin heating resulting from the inability of the facility heat shield to prevent thehot TCA exhaust gases from recirculating. The motion pictures clearly showed the existence of a considereble environmental gas velocity which would not exist in the spacecraft. The TCA would have satisfactorily completed the mission duty cycle within the temperature requirements had the hot gas recirculation not occurred.

OFR NO. 12953R

R-15019-2

FORM 607 P-2 REV. 2-62

4. Tests are being conducted to determine methods of eliminating recirculation of hot exhaust gases with resultant artificial TCA skin temperatures. The final corrective action will be implemented prior to further DAT testing.

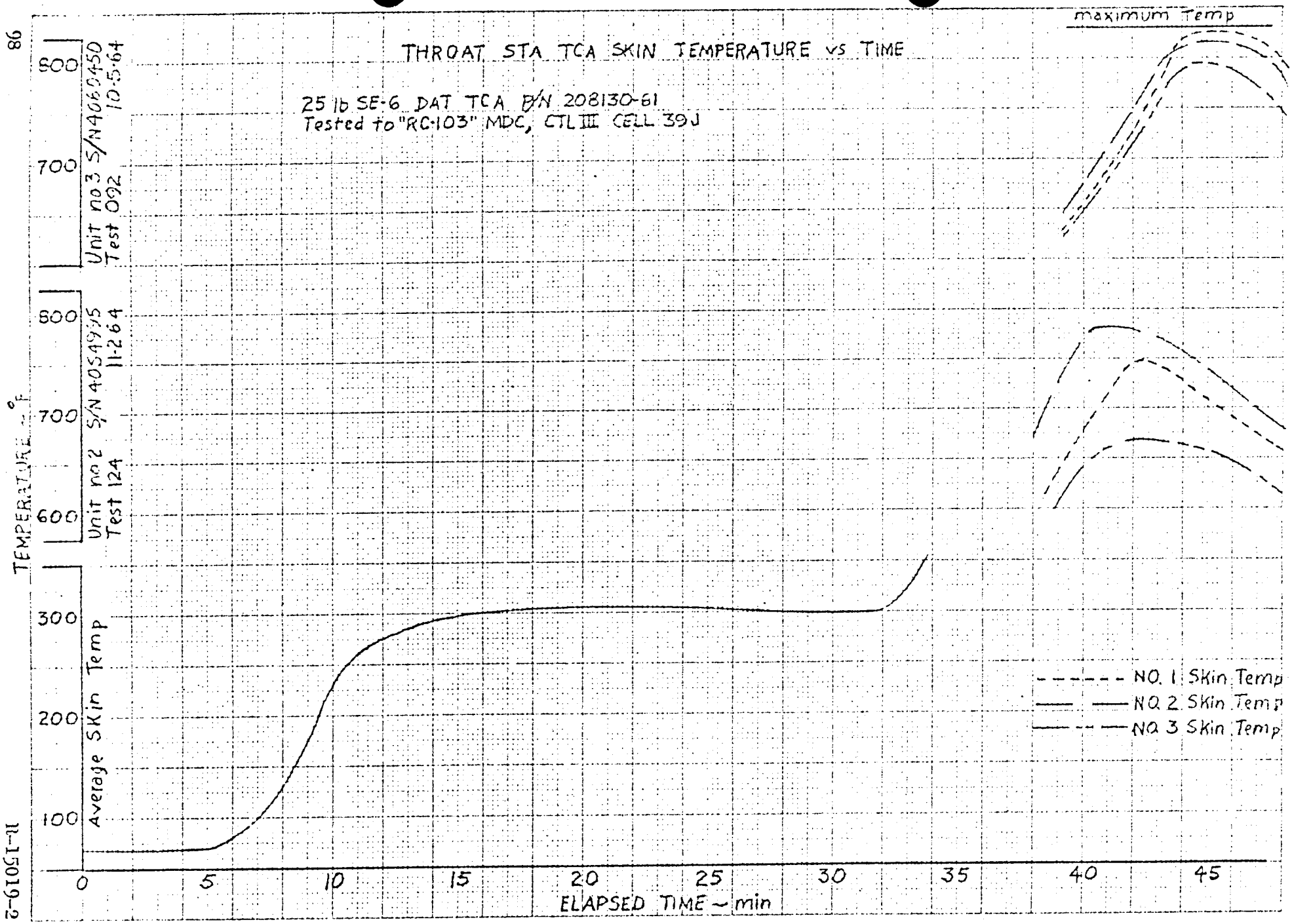
SEE FAR 12923 FOR APPLICABLE MAC COMMENT.

Item 31 52-52700

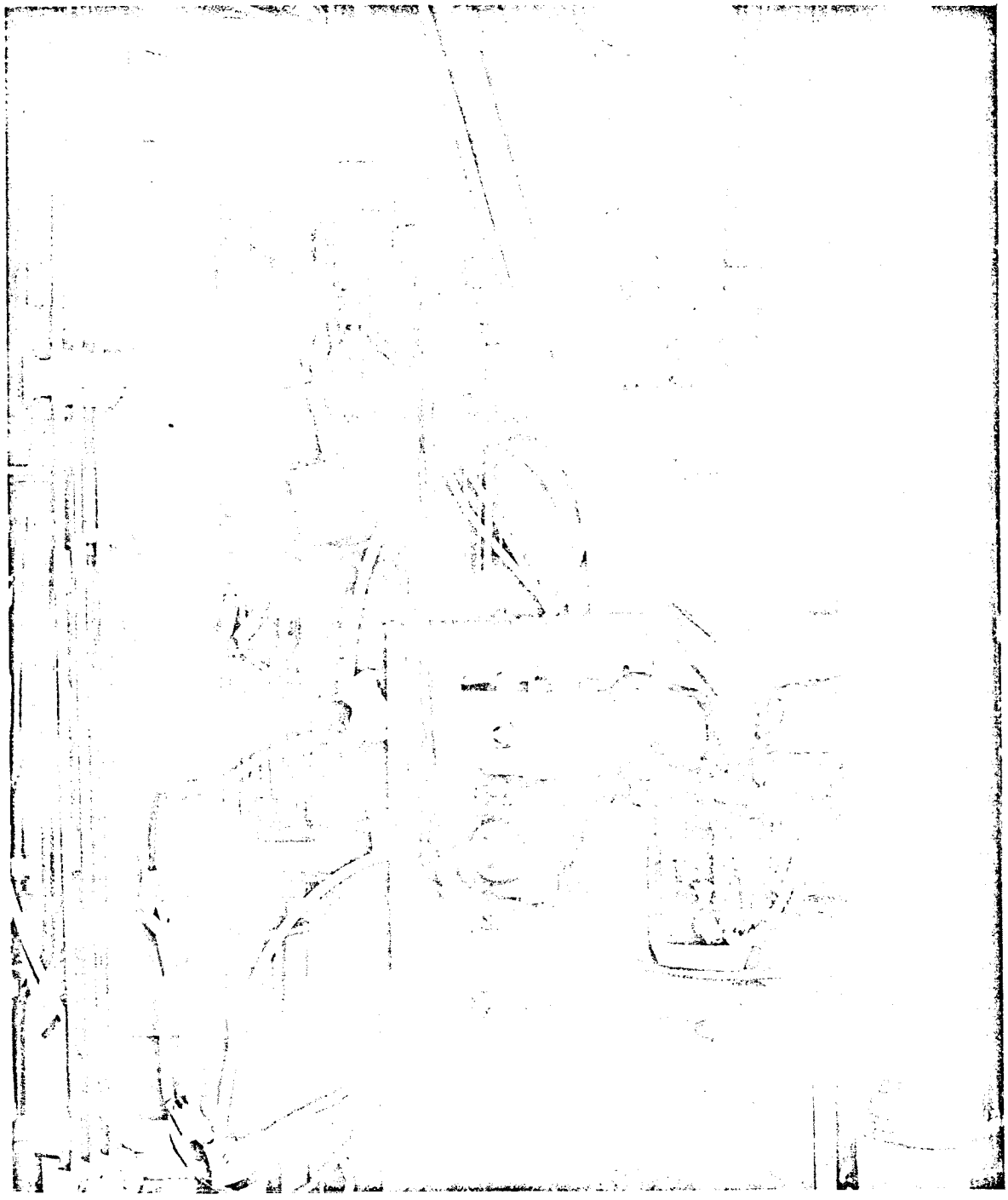
FAILURE ANALYSIS
ACCEPTED

W. Pashin	2/4/65
[illegible]	2/4/65

RELIABILITY DEPT. 261
McDONNELL AIRCRAFT CORP.


THROAT STA TCA SKIN TEMPERATURE vs TIME
25 lb SE-6 DAT TCA P/N 208130-61
Tested to "RC-103" MDC, CTL III CELL 39J
maximum Temp
Unit no 3 S/N 4060450
Test 092
10-5-64
Unit no 2 S/N 4054995
Test 124
11-2-64
Average Skin Temp
TEMPERATURE ~ °F
800
700
600
300
200
100
0
5
10
15
20
25
30
35
40
45
ELAPSED TIME ~ min
NO. 1 Skin Temp
NO. 2 Skin Temp
NO. 3 Skin Temp

FAR 12953R
Figure 4



1HD23-10/31/64-S1A

Operation and Failure Report
ROCKETDYNE

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

PROGRAM: 546 DAT | LOCATION: CP | № 20413R

PART IDENTIFICATION

1 PART NO. 208130-61	2 PART NAME RCS TCA		
3 SERIAL NO. 40561174	4 MFR. NAME ROCKETDYNE	5 MFR. CODE 02202	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-6	14 SYSTEM CODE	
12 REJ. TAG NO. D805791	13 ENG/AGE SERIAL NO.	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: OFR CRIB U/N #1

40

41

FAILURE/OPERATION DATA

17 FAILURE DATE (YR. MO. DAY)	18 TEST/OPER. DATE (YR. MO. DAY)	19 TEST/OPER. NO.	20 ITEMS
64 7 6	64 7 6	208130-401	1

21 PROCEDURE—SPEC. & PARAGRAPH: 208130-401, 7.1.2.1.9

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	43 GROUP	44 SUPPLEMENT SHEET
E. ADAMS	388	1 ☐ YES 2 ☒ NO
45 APPROVED BY: E. Adams	46 ACTIVITY A8	47 STAND/AREA

ANALYSIS ASSIGNED TO

48 NAME	49 GROUP	50 CODE	51 PART REQ.
N. MARSDEN	390	AR	☒ YES ☐ NO

DATE REPORT RECEIVED	52 (YR. MO. DAY)	DATE REPORT DISTRIBUTED	53 (YR. MO. DAY)

IBM USE ONLY	54 TEST/OPER. NO.	55 1/2 56	57 NTH CODE	58 TAPE CODE

DESCRIPTION OF FAILURE

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

⊙DURING PRØP. VALVE PRØØF PRESSURE TEST FØLLØWING VIBRATIØN TEST EXCESSIVE LEAKAGE WAS DETECTED AT WELD JØINT ØN FUEL INLET TUBE ADJACENT TØ FUEL VALVE BØDY.

71 TEST/OPER. NO. 20413R | 78 A | 79 A0

78 B

78 C

78 D

78 E

78 F

34

36 REF. OFR | 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

36 NTH	COMP	40 ASSY	RS-2	CD	46	65 DELETE

1 REPLACEMENT PART NO.	15 REPLACEMENT S/N	22 NAME	28 TYPE	31 MFR.

36 INSTALLATION PART NO.	50 CONFIG. CODE	57 NAME	60 GR. RESP.	CH	CL	M	R

78 G

78 80

OFR № 20413R

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
20113 R	E. Adams	896-388	CP	7/6/64

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
208130-61	4056174	RCS TCA	Rocketdyne
ENG/AGE MODEL NO.	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	
SE-6		208130-401	

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
W. Boyce	896-335	8/11/64	W. Smith 9-15-64	

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

Following DAT vibration test proof pressure test on fuel propellant valve revealed excessive leakage at weld joint on inlet tube adjacent to the fuel valve body. Tube contained visible crack in this area (see photo No. 1). Crack occured during resonant dwells in Z axis held for 7 minutes each with up to 175 "g" at 707 Cps.

2. ANALYSIS

Analysis of the failure consisted of performing the following:

A. Functional test on the oxidizer valve, at operating pressure.

B. Functional test on the fuel valve, at 0 psig inlet pressure.

C. Photographing the failed area.

D. Sectioning a portion of the valve housing and inlet tubing as required to provide affected surfaces for polish and etch, microscopic examination, and microhardness tests.

E. Stress analysis of the inlet tube and weld configuration, utilizing the DAT test data for imposed "g" loads.

F. Review of weld prodedures, design, and materials.

Functional tests of both valves showed them to be operating normally. There was no leakage, internal or external from the oxidizer valve or connecting tubing, with 300 psig hilium applied.

After functional tests a portion of the fuel valve was cut away, containing the inlet tube and the failed area. This section was submitted for metallurgical analysis of the inlet tube to valve joint.

20113 R

FAILURE ANALYSIS REPORT

• ANALYST FILL OUT COVER SHEET ONLY

OFR IDENTIFICATION

OFR NO.	OFR BY (NAME)	DEPT. & GROUP	LOCATION	FAILURE DATE
20413 R	E. Adams	896-388	CP	7/6/64

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
208130-61	4056174	RCS TCA	Rocketdyne
ENG/AGE MODEL NO.	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	
SE-6		208130-401	

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
W. Boyce	896-335	8/11/64	W. Smith 9-15-64	

FAILURE ANALYSIS

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.

A section was cut across the weld and crack for microscopic examination of the weld and metal grain in the weld, heat affected zone, and the crack (see photo No. 2 and 3). This examination revealed a second crack in the weld Material (see Photo No. 4). From these photographs it is also apparent that two passes were made in welding the inlet tube to the body of the valve. Blending of the weld into the parent material of the tube is poor in the area of the section, leaving a notch.

A stress analysis was made of the installation, using DAT data of 175 "g" Maximum load imposed in the Z axis during sinusoidal vibration (see photograph No. 5 for the vibration test setup). A computor program (Space Frame Program), which employs Fortran 11 code deck No. 7R-528, was used for the solution. The program solution showed that the inlet tubing as installed in the test setup was sustaining a dynamic load (fatigue condition) with a margin of safety of minus 0.11.

3. CONCLUSIONS

It is concluded that the cause of failure (crack in the fuel valve inlet tube) was metal fatigue resulting from a dynamic load with a margin of safety of minus 0.11. The negative margin of safety resulted from the combined conditions of the inlet tube configuration (simulating customer installation), the vibration plane, and the dwell time at resonant frequency during sinusoidal vibration.

The tube to valve weld, though not of good quality, isnot considered to be the primary cause of failure. The poor blending of weld bead into parent material is in violation of Rocketdyne welding specification RAO 107-027, and is considered to have caused stress concentrations resulting in the secondary crack of photograph No. 4.

4. CORRECTIVE ACTION

Future vibration tests of the Thrust Chamber Assembly, with inlet tubing, will be run using a random vibration spectrum in place of a sinusoidal

OFR NO. 20413 R

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
20413 R	E. Adams	896-388	CP	7/6/64

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
208130-61	4056174	RCS TCA	Rocketdyne
ENG/AGE MODEL NO.	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	
SE-6		208130-401	

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
W. Boyce	896-335	8/11/64	W. Smith 9-15-64	

FAILURE ANALYSIS

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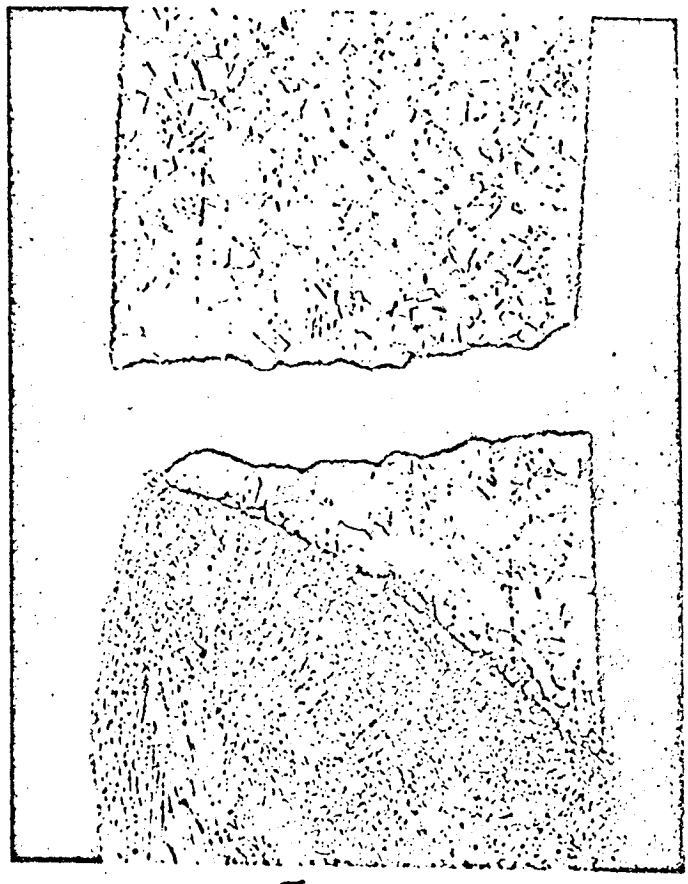
sweep and dwell. This is authorized by NCI RD - 504.

The condition of poor blending of weld bead into adjacent material, leaving a weld notch, is in violation of the Rocketdyne welding specification RAO 107-027. QC inspection has been alerted to inspect these welds for notches, overlay, undercut and suckback in conformance to specification RAO 107-027.

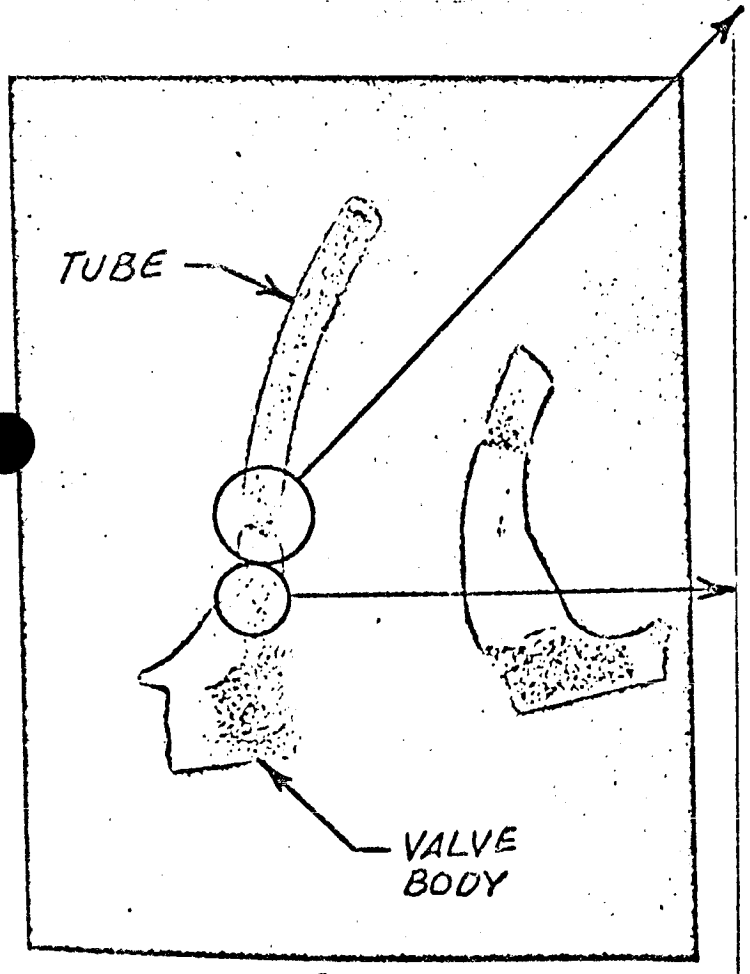
OFR NO. 20413 R

FORM 601 P-2 REV. 2-62

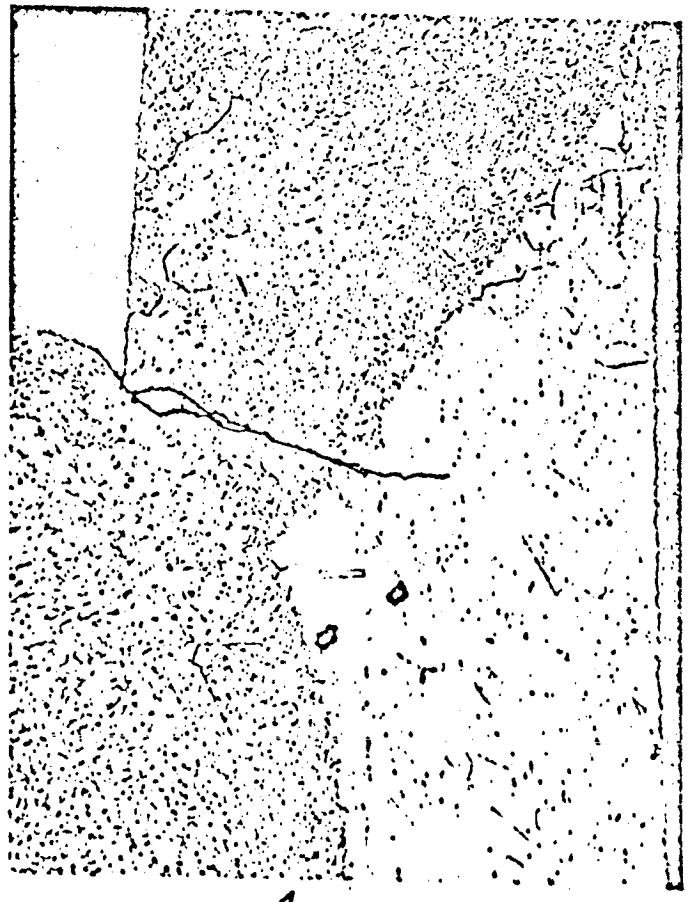
1



3

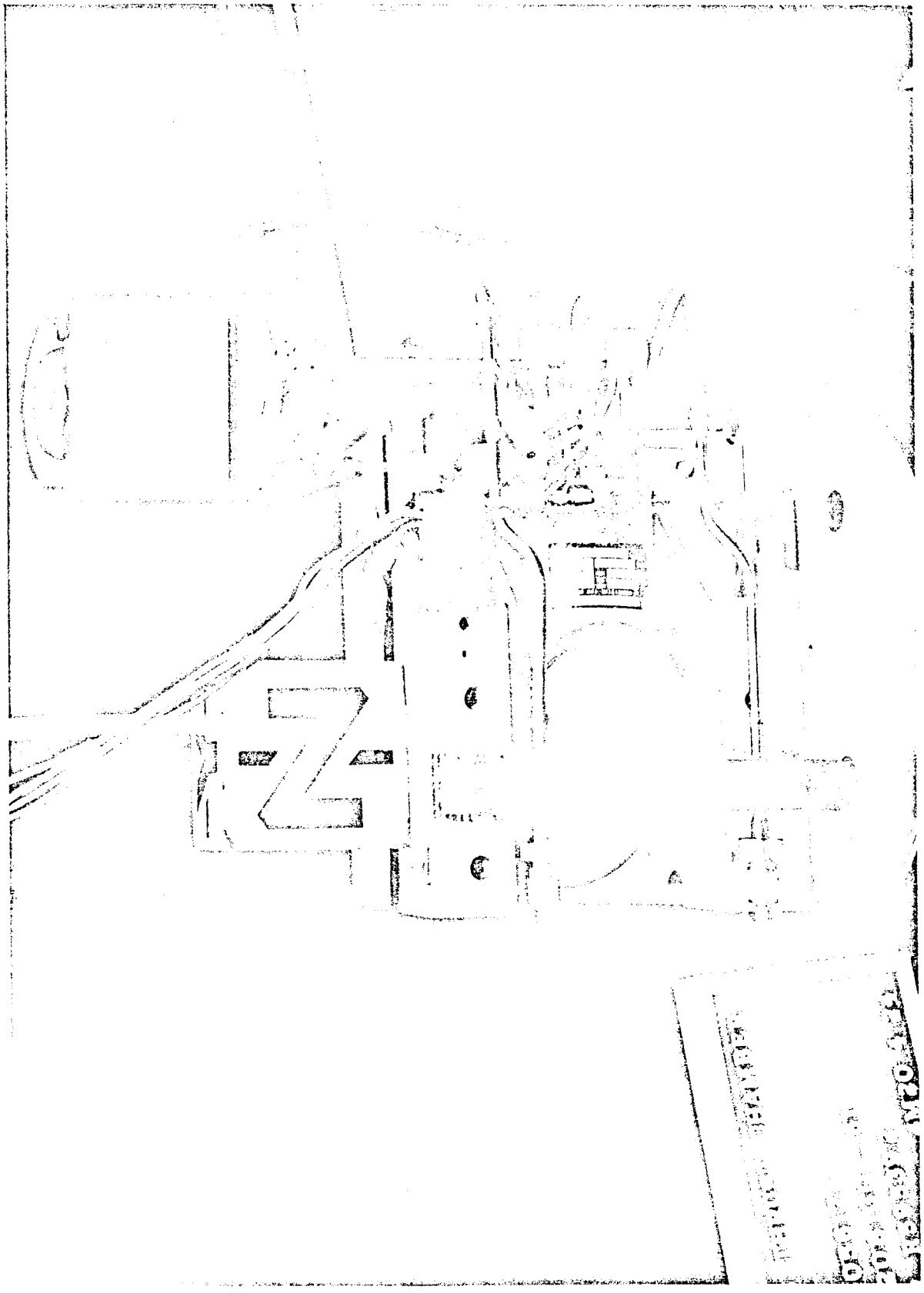


2



4

Figure 5



1HD33-7/2/64-C1B

25-Pound-Thrust RCS TCA DAT Unit 1, Z-Axis Sinusoidal Vibration Test

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

AMENDMENT #1

FAILURE ANALYSIS REPORT

• ANALYST FILL OUT COVER SHEET ONLY

OFR IDENTIFICATION

OFR NO.	OFR BY (NAME)	DEPT. & GROUP	LOCATION	FAILURE DATE
20413R	E. Adams	896-388	CP	7-6-64

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
208130-61	1056174	RCS TCA	Rocketdyne
ENG/AGE MODEL NO.	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	
SE6		208130-401	

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
W. Boyce	896-335		W. Smith 12/15/64	12/22/64

RECEIVED 8 JAN 1965 RELIABILITY

FAILURE ANALYSIS

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

1. HISTORY 2. ANALYSIS 3. CONCLUSIONS 4. CORRECTIVE ACTION
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• BE SPECIFIC IN CORRECTIVE ACTION STATEMENT AND STATE EFFECTIVITY DATE AND/OR ENGINE SERIAL NUMBER WHERE APPLICABLE

1. HISTORY

Following DAT vibration test of the subject thrust chamber assembly, a proof pressure test was performed. Leakage was discovered at the weld joint of the fuel valve inlet tube at the valve body. A visible crack was noted in the tube as shown in photograph number 1. The crack occurred during resonant dwells in the Z axis which were held for 7 minutes each with up to 175 g's at 707 cps.

This revision was made to incorporate a revised corrective action paragraph.

2. ANALYSIS

Analysis of the failure consisted of performing the following:

A. Functional test on the oxidizer valve, at operating pressure.
B. Functional test on the fuel valve, at 0 psig inlet pressure.
C. Photographing the failed area.
D. Sectioning a portion of the valve housing and inlet tubing as required to provide affected surfaces for polish and etch, microscopic examination, and microhardness tests.
E. Stress analysis of the inlet tube and weld configuration, utilizing the the DAT test data for imposed "g" loads.
F. Review of weld procedures, design, and materials.

Functional tests of both valves showed them to be operating normally. No leakage was observed through the valve seat or from external sources when the oxidizer valve was tested at 300 psig of helium. The water displacement test method was used during a test period of approximately 3 minutes.

After functional tests a portion of the fuel valve was cut away, containing the inlet tube and the failed area. This section was submitted for metallurgical analysis of the inlet tube to valve joint.

OFR NO. 20413R

FORM 69 R2 REV. 2-62

Pg 1 of 2

3. CONCLUSIONS

It is concluded that the cause of failure (crack in the fuel valve inlet tube) was metal fatigue resulting from a dynamic load with a margin of safety of minus 0.11. The negative margin of safety resulted from the combined conditions of the inlet tube configuration (simulating customer installation), the vibration plane, and the dwell time at resonant frequency during sinusoidal vibration.

The tube to valve weld, though not of good quality, is not considered to be the primary cause of failure. The poor blending of weld bead into parent material is in violation of Rocketdyne welding specification RAO 107-027, and is considered to have caused stress concentrations resulting in the secondary crack of photograph No. 4.

4. CORRECTIVE ACTION

Future vibration tests of the Thrust Chamber Assembly, with the subject inlet tubing, will be run using a random vibration spectrum in place of a sinusoidal sweep and dwell. This change has been authorized by NCI number RD-504.

In regard to the quality of the weld, an investigation was conducted by all departments concerned and weld quality requirements were reviewed. An agreement was reached by parties concerned that there was nothing peculiar about this weld or similar welds which would prevent meeting all requirements of Rocketdyne Specification RA0107-027.

A series of seminars will be held during December 1964 for all in-plant and Source Inspection personnel concerned with welding. Aspects of welding processes as related to weld quality and interpretation of welding specifications and drawing call-outs will be reviewed in detail.

THE C/A CALLED OUT IN PARA. 4 OF THE ORIGINAL SUBMITTAL OF THIS FAR INDICATED THAT THE INSPECTORS HAD BEEN SPECIFICALLY INSTRUCTED WHAT TO CHECK FOR IN ORDER TO PREVENT RECURRENCE OF THIS TYPE MALFUNCTION. WERE THE UNITS WHICH HAVE NOT BEEN DELIVERED RE-INSPECTED? SHOULD THE DELIVERED UNITS BE RE-INSPECTED BY MAC? WERE CHECKOFF BLOCKS ADDED TO THE AOR BOOKS REQUIRING THE INSPECTORS TO STAMP OFF ACCEPTABLE WELDS? IF THE STAMPOFF BLOCKS WERE NOT INCORPORATED, THEY SHOULD BE.

Item 31 52-52700

FAILURE ANALYSIS
REJECTED

W. Parker	1/21/65
[illegible]	1/21/65

RELIABILITY DEPT. 261
McDONNELL AIRCRAFT CORP.

pg 2 of 2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

FAILURE ANALYSIS REPORT

• ANALYST FILL OUT COVER SHEET ONLY

OFR IDENTIFICATION Amendment #2

OFR NO.	OFR BY NAME	DEPT. & GROUP	LOCATION	FAILURE DATE
20413R	E. Adams	896-388	Canoga Park	7/6/64

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
[illegible]30-61	4056174	RCS TCA	Rocketdyne
ENGINE MODEL NO.	ENGINE SERIAL NO.	TEST/OPERATION NO.	
GE-6		208130-401	

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
P. Iaria	896-394	2/19/65	P. Martin 2-19	

FAILURE ANALYSIS

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

1. HISTORY 2. ANALYSIS 3. CONCLUSIONS 4. CORRECTIVE ACTION
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4. CORRECTIVE ACTION

"Future vibration tests of the Thrust Chamber Assembly, with the subject inlet tubing, will be run using a random vibration spectrum in place of a sinusoidal sweep and dwell. This change has been authorized by NCI No. RD-504.

In regard to the quality of the weld, an investigation was conducted by all departments concerned and weld quality requirements were reviewed. An agreement was reached by parties concerned that there was nothing peculiar about this weld or similar welds which would prevent meeting all requirements of Rocketdyne Specification RA0107-027.

A series of seminars will be held during December 1964 for all in-plant and Source Inspection personnel concerned with welding. Aspects of welding processes as related to weld quality and interpretation of welding specifications and drawing call-outs will be reviewed in detail."

An additional inspection point has been added to the AOR book to verify that Para. 6.1.2 of RA0107-027, which defines "Weld undercut and suck-back" has been complied with.

It is also recommended that all units delivered be inspected for this condition.

FAILURE ANALYSIS ACCEPTED
[illegible] 2/19/65
[illegible] 2/19/65
RELIABILITY DEPT. 201
McDONNELL AIRCRAFT CORP.

OFR NO. 20413R

R-15019-2

FORM 609 P-2 REV. 2-62

APPENDIX C

APPENDIX C

MODULE/COMPONENT LOG BOOK AND ACCEPTANCE TEST DATA

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R-15019-2

~~CONFIDENTIAL~~

SCD52-52700-217

"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

SPACE ENGINES ENGINEERING	SPACE ENGINES QUALITY CONTROL	McDONNELL QUALITY REPRESENTATIVE	GOV'T INSPECTION AGENCY QUALITY REPRESENTATIVE
D. J. Seary	C. H. Kalbacher	Lowell Lewis	Albert Moore
DATE 19 May 64	DATE 19 May 1964	DATE 19 May 64	DATE 19 MAY 1964

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
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. TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.		
	LOG BOOK DATE	19 MAY 1964
Y-20161R	DWG CHG LTR	DNA
	CONTRACT NO.	
	GEN ORDER NO.	5252
SCD52-52700-217	SPEC NO	—
DNA	SERIAL NO.	4056174
52-52700-217	PART NO.	208130-61

SE-6 DELIVERABLE END ITEM – LOG BOOK IDENTIFICATION

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

1.C

111

~~CONFIDENTIAL~~

DELIVERABLE END ITEM (DEI)

THIS LOG BOOK CONTAINS INFORMATION PERTINENT TO THE DELIVERABLE END ITEM (DEI) AS SPECIFIED HEREIN BY SERIAL NO. AND PART NO. 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 QUALITY CONTROL.

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
5.2	CALIBRATED PERFORMANCE DATA
5.2.1	CALIBRATED PERFORMANCE DATA
5.2.2	CALIBRATED PERFORMANCE DATA
5.3	INFORMATION - CONTAMINATION

SECTION I

	52-52700-217 PART NO. 203130-61
SE-6 MODULE / COMPONENT ASSEMBLY LOG	PART NAME THRUST CHAMBER, 25 LB., ASS'Y OF 1.0

IND. NO.	PART NUMBER	REV. LTR.	PART NAME	SERIAL NO.	AGE CONTROL DATE OF MFG.	INSP.
1	208130-61	DNA	THRUST CHAMBER, 25 LB., ASSY OF	4056174	1 Q 64	
2	208131-11	DNA	BODY, THRUST CHAMBER, ASSY OF	4050011	1 Q 64	
2	208142	DNA	SHELL, THRUST CHAMBER, ASSY OF	8502403		
3	208530	DNA	INJECTOR, THRUST CHAMBER, ASSY OF	7017867		
2	407557	DNA	VALVE, OXIDIZER, T/C, ASSY OF	9198091		
2	407558	DNA	VALVE, FUEL, T/C, ASSY OF	9202617		

DNA
52-52700-217

SERIAL NO. 4056174
PART NO. 208130-61

SE-6 CONFIGURATION & SERIALIZATION LOG

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

4.1

MCR / ECP NO.	DATE	TITLE	DATE	INSP.
SE6-062	6 JAN 64	COMPONENT CLEANING; PROVISIONS FOR	19 MAY 64	
SE6-064	30 JUL 63	TCA, ACCEPTANCE TESTING; REVISION OF	19 MAY 64	
SE6-155	28 OCT 63	TCA FLANGE MOUNTING HOLES; COUNTERSINKING OF	19 MAY 64	
SE6-133	22 APR 64	TCA PROPELLANT VALVES; ADDITIONAL REQUIREMENTS FOR	19 MAY 64	
SE6-139	15 APR 64	PLACEMENT OF HAYNES STELLITE #3 SAND CAST ON APPROVED MATERIAL LIST	19 MAY 64	
SE6-144	15 APR 64	TCA INJECTORS; REDESIGN OF	19 MAY 64	
SE6-179	13 MAR 64	TUBE STUBS; MARKING OF	19 MAY 64	

DNA 52-52700-217 SERIAL NO. [illegible]6174 PART NO. 208130-61

SE-6 DELIVERABLE END ITEM - MCR VERIFICATION

PART NAME THRUST CHAMBER, 25 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.
MAC MR #55385	TCA 25#	208130-61	4056244	DISCREPANCY: CONDITION A: THROAT INSERT IS CRACKED IN ONE PLACE: CRACK EXTENDS FROM UPSTREAM TO DOWNSTREAM OF THROAT INSERT. MAX. WIDTH OF CRACK IS .0002 AT ANY ONE PLACE ON CRACK. CRACK IS LOCATED 2° COUNTERCLOCK-WISE IN RELATION TO ℄ OF MOUNTING FLANGE. CRACK IS LOCATED 21° COUNTERCLOCK-WISE AT UPSTREAM END OF THROAT. SEE SKETCH ATTACHED. DISPOSITION: DISCREPANCY IS NOT CONSIDERED SUFFICIENT TO MATERIALLY AFFECT THE PHYSICAL AND FUNCTIONAL DESIGN REQUIREMENTS, THEREFORE, ACCEPTABLE TO USE.	

DNA 52-52700-217 SERIAL NO. 4056174 PART NO. 208130-61

SE-6 DELIVERABLE END ITEM — VARIATION LOG

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

4.3

PART NO.	PART NAME	SERIAL NO.	REASON FOR REPLACEMENT	REPLACED BY		INSP.
				PART NO.	SERIAL NO.	
			NONE THIS DATE 19 MAY 64			

DNA	SERIAL NO.	4056174	
52-52700-217	PART NO.	203130-61	
PART NAME THRUST CHAMBER, 25 LB., ASSY OF			4.4

SE- 6 DELIVERABLE END ITEM -- REPLACEMENT LOG

SECTION II

	52-52700-217 PART NO. 208130-61
SE-6 COMPONENT ACCEPTANCE TEST LOG	PART NAME THRUST CHAMBER, 25 LB., ASSY OF 5.0

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
ELECTRICAL RESISTANCE TESTS	4.2				
VALVE BODY TEMPERATURE	4.2.4				
OXIDIZER		DEGREES F	70 ± 5	65	AHR 645
FUEL		DEGREES F	70 ± 5	68	AHR 645
VALVE COIL RESISTANCE	4.2.5				
OXIDIZER		OHMS	42 ± 2	40.23	AHR 645
FUEL		OHMS	42 ± 2	40.03	AHR 645
CONTINUITY RESISTANCE	4.2.9				
OXIDIZER		OHMS	1.0 MAX.	.157	AHR 645
FUEL		OHMS	1.0 MAX.	.150	AHR 645
DIELECTRIC STRENGTH TEST	4.3				
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICRO AMPS	500 MAX.	40	AHR 645
FUEL	4.3.8	MICRO AMPS	500 MAX.	43	AHR 645
PROOF PRESSURE TEST - TCA PROPELLANT VALVES	4.4				
VALVE PRESSURIZED FOR MINIMUM OF 3 MINUTES AT 500 ± 10 PSIG	4.4.3	DNA	VERIFY	VERIFIED	AHR 645
VALVE DE-PRESSURIZED AND VALVE HOUSING INSPECTED FOR DAMAGE OR DEFORMATION	4.4.4	DNA	VERIFY	VERIFIED	AHR 645
PARAGRAPHS 4.4.3 AND 4.4.4 REPEATED	4.4.5	DNA	VERIFY	VERIFIED	AHR 645

* NC AMEND. #1	SPECIFICATION NUMBER * RA0220-350	DNA / 52-52700-217	SERIAL NO. 4056174 / PART NO. 203130-61
SE-6 COMPONENT ACCEPTANCE TEST		PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE TEST - TCA PROPELLANT VALVES (CONTINUED)					
CONFORMANCE TO PARAGRAPHS 4.4.3, 4.4.4 AND 4.4.5 VERIFIED					
OXIDIZER		DNA	VERIFY	VERIFIED	
FUEL		DNA	VERIFY	VERIFIED	
PROOF PRESSURE AND LEAKAGE TEST - THRUST CHAMBER	4.5				
CHAMBER PRESSURIZED FOR A MINIMUM OF 5 MINUTES AT 392 ± 10 PSIG. NO LEAKAGE DETECTED	4.5.8	DNA	VERIFY	VERIFIED	
CHAMBER DE-PRESSURIZED AND PARAGRAPH 4.5.8 REPEATED	4.5.8	DNA	VERIFY	VERIFIED	
TCA INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	VERIFY	VERIFIED	
FUNCTIONAL TEST - TCA PROPELLANT VALVES	4.6				
OPENING RESPONSE TIME	4.6.8				
OXIDIZER		SEC.	.0065 MAX.	.0042	
FUEL		SEC.	.0065 MAX.	.0042	
CLOSING RESPONSE TIME	4.6.10				
OXIDIZER		SEC.	.002 MAX.	.0014	
FUEL		SEC.	.002 MAX.	.0015	
CLOSING DROP OUT VOLTAGE	4.6.13				
OXIDIZER		VOLT (DC)	1 MIN.	1.8	
FUEL		VOLT (DC)	1 MIN.	1.5	

* N/C AMEND. #1	SPECIFICATION NUMBER * RA0220-350	DNA 52-52700-217	SERIAL NO. 4056174 / PART NO. 203130-61	
SE- 6 COMPONENT ACCEPTANCE TEST		PART NAME THRUST CHAMBER, 25 LB., ASSY OF		5.1.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAKAGE TEST - TCA PROPELLANT VALVES	4.8				
SEAT LEAKAGE RATE	4.8.16				
OXIDIZER	4.8.17	SCC/MIN	2.21 MAX.	LESS THAN 0.1	AIR 645
FUEL	4.8.17	SCC/MIN	2.21 MAX.	LESS THAN 0.1	AIR 645
PRE-TEST DATA					
DRY WEIGHT	4.1.3	LB.	DNA	2.41	AIR 645
NOZZLE EXIT DIAMETER SECTION A-A		INCH	DNA	1.607	AIR 645
THROAT DIAMETER SECTION A-A		INCH	DNA	.3633	AIR 645
B-B		INCH	DNA	.3634	AIR 645
C-C		INCH	DNA	.3634	AIR 645
D-D		INCH	DNA	.3633	AIR 645
POST HOT-FIRE DATA					
PROOF PRESSURE AND LEAKAGE TEST - THRUST CHAMBER	4.5				
CHAMBER PRESSURIZED FOR A MINIMUM OF 5 MINUTES AT 392 ± 10 PSIG. NO LEAKAGE DETECTED	4.5.8	DNA	VERIFY	VERIFIED	AIR 645
CHAMBER DE-PRESSURIZED AND PARAGRAPH 4.5.8 REPEATED	4.5.8	DNA	VERIFY	VERIFIED	AIR 645
TCA INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	VERIFY	VERIFIED	AIR 645

* N/C AMEND. #1	SPECIFICATION NUMBER * RA0220-350	DNA / 52-52700-217	SERIAL NO. 1056174 / PART NO. 208130-61
SE-6 COMPONENT ACCEPTANCE TEST		PART NAME THRUST CHAMBER, 25 LB., ASSY OF	3.1.2

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
POST HOT-FIRE DATA (CONTINUED)					
DRY WEIGHT	4.18.2	LB.	DNA	2.21	AHR 645
NOZZLE EXIT DIAMETER SECTION A-A		INCH	DNA	1.609	AHR 645
THROAT DIAMETER SECTION A-A	4.18.1	INCH	DNA	.3637	AHR 645
B-B		INCH	DNA	.3637	AHR 645
C-C		INCH	DNA	.3637	AHR 645
D-D		INCH	DNA	.3637	AHR 645

* N/C AMEND. #1	SPECIFICATION NUMBER * RA0220-350	DNA 52-52700-217	SERIAL NO. 105617 PART NO. 208130-61
SE-6 COMPONENT ACCEPTANCE TEST		PART NAME THRUST CHAMBER, 25., ASSY OF	5.1.3

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CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 026 TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 081 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	NTF	-	-	NTF	
CELL LOCATION	-	-	1-D	-	-	1-B	
CELL NUMBER	-	-	379	-	-	379	
TEST DATE	-	-	27 JAN 64	-	-	1 FEB 64	
TEST DURATION	SEC.	2 MIN.	3.0	-	-	3.0	
ENVIRONMENTAL Pc	PSIA	.16 MAX.	.0520	-	-	.0460	
AMBIENT PRESSURE	PSIA	DNA	12.09	-	-	12.16	
AMBIENT TEMPERATURE	°F	DNA	34.0	-	-	33.0	
TIME OF DATA SLICE-START	SEC.	DNA	2.8	-	-	2.8	
TIME OF DATA SLICE-END	SEC.	DNA	2.8	-	-	2.8	
OXIDIZER TEMPERATURE	°F	DNA	60.0	-	-	38.5	
FUEL TEMPERATURE	°F	DNA	54.2	-	-	38.0	
OXIDIZER DENSITY	LB/FT^3	DNA	91.08	-	-	92.72	
FUEL DENSITY	LB/FT^3	DNA	55.31	-	-	55.57	

*NC AMEND.#1

SPECIFICATION NUMBER
* RA0220-350

DNA
52-52700-217

SERIAL NO. 4056174
PART NO. 208130-61

SE- 6 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

5.2

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CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 026 TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 081 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	NTF	-	-	NTF	
OXIDIZER INLET PRESSURE	PSIA	287 ± 10	284.4	-	-	286.7	
FUEL INLET PRESSURE	PSIA	291 ± 10	286.5	-	-	293.0	
OXIDIZER FLOWRATE	LB/SEC.	DNA	.0488	-	-	.0482	
FUEL FLOWRATE	LB/SEC.	DNA	.0371	-	-	.0367	
THRUST	LB.	DNA	22.7	-	-	23.1	
MIXTURE RATIO	O/F	DNA	1.31	-	-	1.31	
SPECIFIC IMPULSE	SEC.	DNA	265.	-	-	272.	
INJECTOR END Pc	PSIA	DNA	132.6	-	-	136.8	
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	5149.	-	-	5376.0	
THROAT DIAMETER	IN.	DNA	.363	-	-	.363	
FUEL ORIFICE DIAMETER	IN.	DNA	.04190	-	-	.04190	
OXIDIZER ORIFICE DIAMETER	IN.	DNA	.03850	-	-	.03850	
TCA FIRING TIME (TOTAL)	SEC.	10 MAX.	3.0	-	-	6.0	
OXIDIZER SAMPLE NUMBER	-	-	131	-	-	136	
FUEL SAMPLE NUMBER	-	-	132	-	-	137	

* N/C AMEND. # 1	SPECIFICATION NUMBER * RA0220-350	DNA 52-52700-217	SERIAL NO. 4056174 PART NO. 208130-61
SE-6 (REA) CALIBRATED PERFORMANCE DATA		PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.2.1

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CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 026 TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 081 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	NTF	-	-	NTF	
ADJUST TO STANDARD CONDITIONS							
THRUST	LB.	23 ± 1.2	22.9	-	-	22.9	
MIXTURE RATIO	O/F	1.30 ± .04	1.30	-	-	1.31	
SPECIFIC IMPULSE	SEC.	DNA	266.	-	-	273.	
INJECTOR END Pc	PSIA	DNA	133.0	-	-	135.5	
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	5147.	-	-	5376.	
ADJUST TO RATED CONDITIONS							
THRUST	LB.	23	23.0	-	-	23.0	
MIXTURE RATIO	O/F	1.3	1.30	-	-	1.30	
SPECIFIC IMPULSE	SEC.	266 MIN.	266.	-	-	273.	

*NC AMEND. #1
** NC AMEND. #1

SPECIFICATION NUMBER
*RA0220-350 and **RA0220-229

DNA
52-52700-217

SERIAL NO. 1056174
PART NO. 203130-61

SE- 7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER, 25 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.
	5 - 10	*	403	185
	10 - 25	500	228	59
	25 - 50	100	31	5
	50 - 100	18	5	2
	100 - 300	6	1	0
	300 - 1000	1	0	0
	> 1000	0	0	0
FIBERS	300 - 3000	4	0	0
FIBERS	> 3000	0	0	0

* NOTE: TO BE COUNTED BUT NOT RESTRICTED TO NUMBER.

CLASS 7

INSP. ANA 545

* REV. B	SPECIFICATION NUMBER * RA0615-003	DNA 52-52700-217	SERIAL NO. 40565 PART NO. 208130-61
SE-6 INFORMATION - CONTAMINATION		PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.3

"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

(DRD #6) (DAT UNIT #6)

SPACE ENGINES ENGINEERING	SPACE ENGINES QUALITY CONTROL	McDONNELL QUALITY REPRESENTATIVE	GOV'T INSPECTION AGENCY QUALITY REPRESENTATIVE
[illegible]	S. A. [illegible]	C. W. Michaelis	[illegible]
DATE 20/AUG/1964	DATE 20 Aug. '64	DATE 20 August 1964	DATE 20 Aug 64

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
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 AUG 64
	DWG CHG LTR	DNA
Y-20161R	CONTRACT NO.	
	GEN ORDER NO.	5252
SCD52-52700-217	SPEC NO.	
DNA	SERIAL NO.	4060448
52-52700-217	PART NO.	208130-61

SE -6 DELIVERABLE END ITEM – LOG BOOK IDENTIFICATION

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

1.0

R-15019-2

DELIVERABLE END ITEM (DEI)

THIS LOG BOOK CONTAINS INFORMATION PERTINENT TO THE DELIVERABLE END ITEM (DEI) AS SPECIFIED HEREIN BY SERIAL NO. AND PART NO. 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 QUALITY CONTROL.

	52-52700-217 PART NO. 208130-61	
FOREWORD--SE-6 LOG BOOK	PART NAME THRUST CHAMBER, 25 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

SECTION I

52-52700-217 PART NO. 208130-61

SE-6 MODULE / COMPONENT ASSEMBLY LOG

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

4.0

IND. NO.	PART NUMBER	REV. LTR.	PART NAME	SERIAL NO.	AGE CONTROL DATE OF MFG.	INSP.
	208130-61	DNA	THRUST CHAMBER, 25 LB., ASSY OF	4060448	2 Q 64	ANR 721
	208131-11	DNA	BODY, THRUST CHAMBER, ASSY OF	4057812	2 Q 64	ANR 721
	208142	DNA	SHELL, THRUST CHAMBER, ASSY OF	8506136		ANR 721
	208530	DNA	INJECTOR, THRUST CHAMBER, ASSY OF	7049240		ANR 721
	407557	DNA	VALVE, OXIDIZER, T/C, ASSY OF	8759999		ANR 721
	407558	DNA	VALVE, FUEL, T/C, ASSY OF	9202637		ANR 721

DNA SERIAL NO. 4060448

52-52700-217 PART NO. 208130-61

SE-6 CONFIGURATION & SERIALIZATION LOG

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

4.1

MCR / ECP NO.	DATE	TITLE	DATE	INSP.
SE6-062	6 JAN 64	COMPONENT CLEANING; PROVISION FOR	20 AUG 64	ANR 721
SE6-064	30 JUL 63	TCA, ACCEPTANCE TESTS; REVISION OF	20 AUG 64	ANR 721
SE6-155	28 OCT 63	TCA FLANGE MOUNTING HOLES; COUNTERSINKING OF	20 AUG 64	ANR 721
SE6-133	22 APR 64	TCA PROPELLANT VALVES; ADDITIONAL REQUIREMENTS FOR	20 AUG 64	ANR 721
SE6-139	15 APR 64	PLACEMENT OF HAYNES STELLITE #3 SAND CAST ON APPROVED MATERIAL LIST	20 AUG 64	ANR 721
SE6-144	15 APR 64	TCA INJECTORS; REDESIGN OF	20 AUG 64	ANR 721
SE6-179	16 JUN 64	TUBE STUBS; MARKING OF	20 AUG 64	ANR 721
SE6-080	28 DEC 63	THRUST CHAMBER ASSEMBLIES, FABRICATION MATERIAL; APPROVAL OF	20 AUG 64	ANR 721
SE6-085	30 JUL 63	CUSTOMER TEST SURVEILLANCE; REQUIREMENTS FOR	20 AUG 64	ANR 721
SE6-260	23 JUN 64	SIX DEGREE ABLATIVE MATERIAL; USE OF	20 AUG 64	ANR 721

DNA 52-52700-217 SERIAL NO. 4060448 PART NO. 208130-61

SE-6 DELIVERABLE END ITEM - MCR VERIFICATION

PART NAME THRUST CHAMBER, 25 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.
134				NONE THIS DATE 20 AUG 64	ANR 721

R-15019-2

DNA SERIAL NO. 4060448

52-52700-217 PART NO. 208130-61

SE-6 DELIVERABLE END ITEM — VARIATION LOG

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

4.3

PART NO.	PART NAME	SERIAL NO.	REASON FOR REPLACEMENT	REPLACED BY		INSP.
				PART NO.	SERIAL NO.	
R-15019-2			NONE THIS DATE 20 AUG 64			AWR 721

DNA	SERIAL NO.	4060448	
52-52700-217	PART NO.	208130-61	
PART NAME THRUST CHAMBER, 25 LB., ASSY OF			4.4

SE-6 DELIVERABLE END ITEM--REPLACEMENT LOG

SECTION II

	52-52700-217 PART NO. 208130-61	
SE-6 COMPONENT ACCEPTANCE TEST LOG	PART NAME THRUST CHAMBER, 25 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	
FUEL	4.2.11	DEGREES F	70 ± 5	70	
COIL RESISTANCE					
OXIDIZER	4.2.5	OHMS	42 ± 2	41.37	
FUEL	4.2.11	OHMS	42 ± 2	40.96	
CONTINUITY RESISTANCE					
OXIDIZER	4.2.9	OHMS	1.0 MAX.	.034	
FUEL	4.2.11	OHMS	1.0 MAX.	.048	
DIELECTRIC STRENGTH TEST--TCA PROPELLANT VALVES	4.3				
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICROAMPS	500 MAX.	31	
FUEL	4.3.11	MICROAMPS	500 MAX.	38	
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	
STEP II	4.4.5	PSIG	500 ± 10	VERIFIED	

R-15019-2

SPECIFICATION NUMBER RA0220-350	REVISION N/C	AMENDMENT #3	DNA 52-52700-217
SERIAL NO. 4060448	PART NO. 208130-61		
SE-6 COMPONENT ACCEPTANCE TEST	PART NAME THRUST CHAMBER, 25 LB., ASSY OF		5.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE TEST--TCA PROPELLANT VALVES (CONTINUED)					
FUEL					
STEP I	4.4.7	PSIG	500 ± 10	VERIFIED	
STEP II	4.4.7	PSIG	500 ± 10	VERIFIED	
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION					
OXIDIZER					
STEP I	4.4.4	DNA	NONE ALLOWED	NONE DETECTED	
STEP II	4.4.5	DNA	NONE ALLOWED	NONE DETECTED	
FUEL					
STEP I	4.4.7	DNA	NONE ALLOWED	NONE DETECTED	
STEP II	4.4.7	DNA	NONE ALLOWED	NONE DETECTED	
PROOF PRESSURE AND LEAKAGE TEST--THRUST CHAMBER	4.5				
PROOF PRESSURE TEST					
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES AT					
STEP I	4.5.8	PSIG	392 ± 10	VERIFIED	
STEP II	4.5.10	PSIG	392 ± 10	VERIFIED	

SPECIFICATION NUMBER	REVISION	AMENDMENT
RA0220-350	N/C	#3

SE-6 COMPONENT ACCEPTANCE TEST

DNA 52-52700-217 SERIAL NO. 4060448 PART NO. 208130-61

PART NAME THRUST CHAMBER 25 LB., ASSY OF 5.1.1

R-15019-2

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE AND LEAKAGE TEST—THRUST CHAMBER (CONTINUED)					
LEAKAGE TEST					
STEP I	4.5.8	DNA	NONE ALLOWED	NONE DETECTED	
STEP II	4.5.10	DNA	NONE ALLOWED	NONE DETECTED	
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	NONE ALLOWED	NONE DETECTED	
FUNCTIONAL TEST--TCA PROPELLANT VALVES	4.6				
OPENING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.0065 MAX.	.0042	
FUEL	4.6.8	SEC.	0.0065 MAX.	.0042	
CLOSING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.002 MAX.	.0014	
FUEL	4.6.10	SEC.	0.002 MAX.	.0014	
CLOSING DROP OUT VOLTAGE					
OXIDIZER	4.6.17	VOLT (DC)	1 MIN.	1.3	
FUEL	4.6.13	VOLT (DC)	1 MIN.	1.2	

SPECIFICATION NUMBER RA0220-350 | REVISION N/C | AMENDMENT #3

DNA 52-52700-217 | SERIAL NO. 4060448 | PART NO. 208130-61

SE-6 COMPONENT ACCEPTANCE TEST | PART NAME THRUST CHAMBER, 25 LB., ASSY OF | 5.1.2

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAKAGE TEST--TCA PROPELLANT VALVES	4.8				
SEAT LEAKAGE RATE					
OXIDIZER	4.8.17	SCC/MIN	2.21 MAX.	LESS THAN 0.1	ANR 721
FUEL	4.8.22	SCC/MIN	2.21 MAX.	LESS THAN 0.1	ANR 721
PRE-TEST DATA					
DRY WEIGHT (EXCLUDING PROTECTIVE CLOSURES)	4.1.3	LB.	DNA	2.43	ANR 721
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	1.605	ANR 721
THROAT DIAMETER					
SECTION A-A		INCH	DNA	.363	ANR 721
B-B		INCH	DNA	.363	ANR 721
C-C		INCH	DNA	.363	ANR 721
D-D		INCH	DNA	.363	ANR 721
POST HOT-FIRE DATA					
PROOF PRESSURE TEST					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.17.1	LB.	DNA	2.43	ANR 721
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES					
STEP I	4.17.4	PSIG	392 ± 10	392	ANR 721
STEP II	4.17.4	PSIG	392 ± 10	392	ANR 721

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-350	N/C	#3	DNA	SERIAL NO.	4060448
			52-52700-217	PART NO.	208130-61
SE-6 COMPONENT ACCEPTANCE TEST			PART NAME	THRUST CHAMBER, 25 LB., ASSY OF	5.1.3

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
POST HOT-FIRE DATA (CONTINUED)					
LEAKAGE TEST					
STEP I	4.17.4	DNA	NONE ALLOWED	NONE DETECTED	ANR 721
STEP II	4.17.4	DNA	NONE ALLOWED	NONE DETECTED	ANR 721
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.17.4	DNA	NONE ALLOWED	NONE DETECTED	ANR 721
LEAK TEST -- WELDED JOINTS					
LEAK TEST					
INLET TUBE PRESSURIZED WITH GASEOUS HELIUM					ANR 721
OXIDIZER	4.17.5	PSIG	500 ± 10	500	ANR 721
FUEL	4.17.8	PSIG	500 ± 10	500	
JOINT LEAKAGE RATE					
OXIDIZER	4.17.6	SCC/SEC.	10^{-6} MAX.	LESS THAN 10^{-6}	ANR 721
FUEL	4.17.8	SCC/SEC.	10^{-6} MAX.	LESS THAN 10^{-6}	ANR 721
LEAKAGE TEST -- TCA PROPELLANT VALVES					
SEAT LEAKAGE RATE					
OXIDIZER	4.17.9	SCC/SEC.	2.21 MAX.	LESS THAN 0.1	ANR 721
FUEL	4.17.9	SCC/SEC.	2.21 MAX.	LESS THAN 0.1	ANR 721

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0220-350	N/C	#3	DNA	SERIAL NO. 4060448
			52-52700-217	PART NO. 208130-61
SE-6 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.1.4

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	1.615	AMR 721
THROAT DIAMETER (DELIVERED CONDITION)	4.18.1				
SECTION A-A		INCH	DNA	.363	AMR 721
B-B		INCH	DNA	.363	AMR 721
C-C		INCH	DNA	.363	AMR 721
D-D		INCH	DNA	.363	AMR 721
DRY WEIGHT IN DELIVERED CONDITION (EXCLUDING PROTECTIVE COVERS AND CLOSURES)	4.18.2	LB.	DNA	2.23	AMR 721

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0220-350	N/C	#3	DNA	SERIAL NO. 4060448
			52-52700-217	PART NO. 208130-61
SE-6 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.1.5

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN **** TEST DATA	RUN **** TEST DATA	RUN **** TEST DATA	RUN 192 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	-	-	-	NFL	ANR 995
CELL LOCATION	-	-	-	-	-	1-C	ANR 995
CELL NUMBER	-	-	-	-	-	379	ANR 995
TEST DATE	-	-	-	-	-	11 AUG 64	ANR 995
TEST DURATION	SEC.	2 MIN.	-	-	-	3.0	ANR 995
ENVIRONMENTAL Pc	PSIA	0.16 MAX.	-	-	-	.0553	ANR 995
AMBIENT PRESSURE	PSIA	DNA	-	-	-	12.21	ANR 995
AMBIENT TEMPERATURE	°F	DNA-	-	-	-	76.0	ANR 995
TIME OF DATA SLICE-START	SEC.	DNA	-	-	-	2.8	ANR 995
TIME OF DATA SLICE-END	SEC.	DNA	-	-	-	2.8	ANR 995
OXIDIZER TEMPERATURE	°F	DNA	-	-	-	70.5	ANR 995
FUEL TEMPERATURE	°F	DNA	-	-	-	72.4	ANR 995
OXIDIZER DENSITY	LB/FT^3	DNA	-	-	-	90.85	ANR 995
FUEL DENSITY	LB/FT^3	DNA	-	-	-	54.53	ANR 995

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RAO 220-350	NC	3	DNA 52-52700-217	SERIAL NO. 4060448 PART NO. 208130-61
SE-6 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.2

CONFIDENTIAL

THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, [illegible] MISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

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

144

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN **** TEST DATA	RUN **** TEST DATA	RUN **** TEST DATA	RUN 192 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	-	-	-	NFL	ANR 935
OXIDIZER INLET PRESSURE	PSIA	287 ± 10	-	-	-	292.2	ANR 935
FUEL INLET PRESSURE	PSIA	291 ± 10	-	-	-	286.7	ANR 935
OXIDIZER FLOWRATE	LB/SEC.	DNA	-	-	-	.0483	ANR 935
FUEL FLOWRATE	LB/SEC.	DNA	-	-	-	.0355	ANR 935
THRUST	LB.	DNA	-	-	-	23.0	ANR 935
MIXTURE RATIO	O/F	DNA	-	-	-	1.36	ANR 935
SPECIFIC IMPULSE	SEC.	DNA	-	-	-	275.	[illegible]
INJECTOR END Pc	PSIA	DNA	-	-	-	135.7	ANR 935
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	-	-	-	5390.	ANR 935
THROAT DIAMETER	INCH	DNA	-	-	-	.363	ANR 935
FUEL ORIFICE DIAMETER	INCH	DNA	-	-	-	.04590	ANR 935
OXIDIZER ORIFICE DIAMETER	INCH	DNA	-	-	-	.03978	ANR 935
TCA FIRING TIME (TOTAL)	SEC.	10 MAX.	-	-	-	3.0	ANR 935
OXIDIZER SAMPLE NUMBER	-	-	-	-	-	278	ANR 935
FUEL SAMPLE NUMBER	-	-	-	-	-	279	ANR 935

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RAO 220-350	NC	3	DNA 52-52700-217	SERIAL NO. 4060448 PART NO. 208130-61
SE-6 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.2.1

R-15019-2

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	*	*	*
	10 - 25	100	60	40
	25 - 50	20	7	5
	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. _____

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0615-003	B	#2	52-52700-217	PART NO. 208130-61
SE-6 INFORMATION - CONTAMINATION			PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.3

CONFIDENTIAL

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.

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

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN **** TEST DATA	RUN **** TEST DATA	RUN **** TEST DATA	RUN 192 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	-	-	-	NFL	ANR 905
ADJUST TO STANDARD CONDITIONS							
THRUST	LB.	23 ± 1.2	-	-	-	23.0	ANR 905
MIXTURE RATIO	O/F	1.30 ± .04	-	-	-	1.31	ANR 905
SPECIFIC IMPULSE	SEC.	DNA	-	-	-	276.	ANR 905
INJECTOR END Pc	PSIA	DNA	-	-	-	134.9	ANR 905
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	-	-	-	5379.	ANR 905
ADJUST TO RATED CONDITIONS							
THRUST	LB.	23	-	-	-	23.0	ANR 905
MIXTURE RATIO	O/F	1.3	-	-	-	1.30	ANR 905
SPECIFIC IMPULSE	SEC.	266 MIN.	-	-	-	275.	ANR 905

SPECIFICATION NUMBER	REVISION	AMENDMENT
RA0220-350	N/C	#3
RA0220-229	N/C	#2

DNA 52-52700-217 SERIAL NO. 4060448 PART NO. 208130-61

SE-6 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

5.2.2

CONFIDENTIAL Downgraded at 3 year intervals: declassified after 12 years

~~CONFIDENTIAL~~

SCD 52-52700-217

"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

SPACE ENGINES ENGINEERING	SPACE ENGINES QUALITY CONTROL	McDONNELL QUALITY REPRESENTATIVE	GOV'T INSPECTION AGENCY QUALITY REPRESENTATIVE
D J Deary	C H Kubelach	Lonnie L Hanes	[illegible]
DATE 19 May 67	DATE 19 May 1964	DATE 19 May 64	DATE 19 MAY 1964

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
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 [illegible] AND [illegible] OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.		
	LOG BOOK DATE	19 MAY 1964
Y-20161R	DWG CHG LTR	DNA
	CONTRACT NO.	
	GEN ORDER NO.	5252
SCD52-52700-217	SPEC NO	
DNA	SERIAL NO	4059276
52-52700-217	PART NO.	208130-61

SE-6 DELIVERABLE END ITEM - LOG BOOK IDENTIFICATION

PART NAME THRUST CHAMBER, 25 LB., ASSY OF 1.0

~~CONFIDENTIAL~~

DELIVERABLE END ITEM (DEI)

THIS LOG BOOK CONTAINS INFORMATION PERTINENT TO THE DELIVERABLE END ITEM (DEI) AS SPECIFIED HEREIN BY SERIAL NO. AND PART NO. 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 QUALITY CONTROL.

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
5.2	CALIBRATED PERFORMANCE DATA
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5.2.2	CALIBRATED PERFORMANCE DATA
5.3	INFORMATION - CONTAMINATION

SECTION I

52-52700-217 PART NO. 208130-61

SE-6 MODULE / COMPONENT ASSEMBLY LOG

PART NAME THRUST CHAMBER, 25 LB., ASSY OF 4.0

IND. NO.	PART NUMBER	REV. LTR.	PART NAME	SERIAL NO.	AGE CONTROL DATE OF MFG.	INSP.
1	208130-61	DNA	THRUST CHAMBER, 25 LB., ASSY OF	4059276	4 Q 63	AHR 142
2	208131-11	DNA	BODY, THRUST CHAMBER, ASSY OF	4057765	4 Q 63	AHR 142
2	208142	DNA	SHELL, THRUST CHAMBER, ASSY OF	8500528		AHR 142
3	208530	DNA	INJECTOR, THRUST CHAMBER, ASSY OF	7017870		AHR 142
2	407557	DNA	VALVE, OXIDIZER, T/C, ASSY OF	9193194		AHR 142
2	407558	DNA	VALVE, FUEL, T/C, ASSY OF	9205846		AHR 142

M NASA

DNA
52-52700-217

SERIAL NO. 4059276
PART NO. 208130-61

SE-6 CONFIGURATION & SERIALIZATION LOG

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

4.1

MCR / ECP NO.	DATE	TITLE	DATE	INSP.
SE6-062	6 JAN 64	COMPONENT CLEANING; PROVISIONS FOR	19 MAY 64	AMS 142
SE6-064	30 JUL 63	TCA, ACCEPTANCE TESTING; REVISION OF	19 MAY 64	AMS 142
SE6-155	28 OCT 63	TCA FLANGE MOUNTING HOLES; COUNTERSINKING OF	19 MAY 64	AMS 142
SE6-133	22 APR 64	TCA PROPELLANT VALVES; ADDITIONAL REQUIREMENTS FOR	19 MAY 64	AMS 142
SE6-139	15 APR 64	PLACEMENT OF HAYNES STELLITE #3 SAND CAST ON APPROVED MATERIAL LIST	19 MAY 64	AMS 142
SE6-144	15 APR 64	TCA INJECTORS; REDESIGN OF	19 MAY 64	AMS 142
SE6-179	13 MAR 64	TUBE STUBS; MARKING OF	19 MAY 64	AMS 142

DNA 52-52700-217 SERIAL NO. 4059276 PART NO. 208130-61

SE-6 DELIVERABLE END ITEM-MCR VERIFICATION

PART NAME THRUST CHAMBER, 25 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.
23H R19920	THRUST CHAMBER ASSY 25 LB.	208130-61	4059276	DISCREPANCY: OXIDIZER TUBE IS CRACKED THRU CIRCUMFERENTIALLY BETWEEN WELDS. CRACK EXTENDS HALF WAY AROUND TUBE. DISPOSITION: REWORKED PER 23H R19920	

DNA 52-52700-217 SERIAL NO. 4059276 PART NO. 208130-61

SE-6 DELIVERABLE END ITEM — VARIATION LOG

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

4.3

PART NO.	PART NAME	SERIAL NO.	REASON FOR REPLACEMENT	REPLACED BY		INSP.
				PART NO.	SERIAL NO.	
			NONE THIS DATE 19 MAY 1964			

	DNA 52-52700-217	SERIAL NO.	4059276
		PART NO.	203130-61
SE- 6 DELIVERABLE END ITEM--REPLACEMENT LOG	PART NAME THRUST CHAMBER, 25 LB., ASSY OF		4.4

SECTION II

	52-52700-217 PART NO. 203130-61
SE-6 COMPONENT ACCEPTANCE TEST LOG	PART NAME THRUST CHAMBER, 25 LB., ASSY 02 — 5.0

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
ELECTRICAL RESISTANCE TESTS	4.2				
VALVE BODY TEMPERATURE	4.2.4				
OXIDIZER		DEGREES F	70 ± 5	70	ANR 14.2
FUEL		DEGREES F	70 ± 5	70	ANR 14.2
VALVE COIL RESISTANCE	4.2.5				
OXIDIZER		OHMS	42 ± 2	41.79	ANR 14.2
FUEL		OHMS	42 ± 2	41.74	ANR 14.2
CONTINUITY RESISTANCE	4.2.9				
OXIDIZER		OHMS	1.0 MAX.	.370	ANR 14.2
FUEL		OHMS	1.0 MAX.	.337	ANR 14.2
DIELECTRIC STRENGTH TEST	4.3				
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICRO AMPS	500 MAX.	35	ANR 14.2
FUEL	4.3.8	MICRO AMPS	500 MAX.	36	ANR 14.2
PROOF PRESSURE TEST - TCA PROPELLANT VALVES	4.4				
VALVE PRESSURIZED FOR MINIMUM OF 3 MINUTES AT 500 ± 10 PSIG	4.4.3	DNA	VERIFY	VERIFIED	ANR 14.2
VALVE DE-PRESSURIZED AND VALVE HOUSING INSPECTED FOR DAMAGE OR DEFORMATION	4.4.4	DNA	VERIFY	VERIFIED	ANR 14.2
PARAGRAPHS 4.4.3 AND 4.4.4 REPEATED	4.4.5	DNA	VERIFY	VERIFIED	ANR 14.2

*N/C AMEND. # 1	SPECIFICATION NUMBER * RA0220-350	DNA / 52-52700-217	SERIAL NO. 4059276 / PART NO. 203130-61
SE-G COMPONENT ACCEPTANCE TEST		PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE TEST - TCA PROPELLANT VALVES (CONTINUED)					
CONFORMANCE TO PARAGRAPHS 4.4.3, 4.4.4 AND 4.4.5 VERIFIED					
OXIDIZER		DNA	VERIFY	VERIFIED	ANR 142
FUEL		DNA	VERIFY	VERIFIED	ANR 142
PROOF PRESSURE AND LEAKAGE TEST - THRUST CHAMBER	4.5				
CHAMBER PRESSURIZED FOR A MINIMUM OF 5 MINUTES AT 392 ± 10 PSIG. NO LEAKAGE DETECTED	4.5.8	DNA	VERIFY	VERIFIED	ANR 142
CHAMBER DE-PRESSURIZED AND PARAGRAPH 4.5.8 REPEATED	4.5.8	DNA	VERIFY	VERIFIED	ANR 142
TCA INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	VERIFY	VERIFIED	ANR 142
FUNCTIONAL TEST - TCA PROPELLANT VALVES	4.6				
OPENING RESPONSE TIME	4.6.8				
OXIDIZER		SEC.	.0065 MAX.	.0044	ANR 142
FUEL		SEC.	.0065 MAX.	.0041	ANR 142
CLOSING RESPONSE TIME	4.6.10				
OXIDIZER		SEC.	.002 MAX.	.0013	ANR 142
FUEL		SEC.	.002 MAX.	.0012	ANR 142
CLOSING DROP OUT VOLTAGE	4.6.13				
OXIDIZER		VOLT (DC)	1 MIN.	1.9	ANR 142
FUEL		VOLT (DC)	1 MIN.	1.1	ANR 142

* N/C AMEND. # 1	SPECIFICATION NUMBER * RA0220-350	DNA 52-52700-217	SERIAL NO. 1059276 PART NO. 130-0	
SE- 6 COMPONENT ACCEPTANCE TEST		PART NAME THRUST CHAMBER, 25 LB., ASSY OF		5.1.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
* LEAKAGE TEST - TCA PROPELLANT VALVES	4.8				
SEAT LEAKAGE RATE	4.8.16				
OXIDIZER	4.8.17	SCC/MIN	2.21 MAX.	LESS THAN 0.1	AMA 142
FUEL	4.8.17	SCC/MIN	2.21 MAX.	LESS THAN 0.1	AMA 142
** PRE-TEST DATA					
DRY WEIGHT	4.1.3	LB.	DNA	2.41	AMA 142
NOZZLE EXIT DIAMETER SECTION A-A		INCH	DNA	1.600	AMA 142
THROAT DIAMETER SECTION A-A		INCH	DNA	.3638	AMA 142
B-B		INCH	DNA	.3638	AMA 142
C-C		INCH	DNA	.3637	AMA 142
D-D		INCH	DNA	.3638	AMA 142
** POST HOT-FIRE DATA					
PROOF PRESSURE AND LEAKAGE TEST - THRUST CHAMBER	4.5				
CHAMBER PRESSURIZED FOR A MINIMUM OF 5 MINUTES AT 392 ± 10 PSIG. NO LEAKAGE DETECTED	4.5.8	DNA	VERIFY	VERIFIED	AMA 142
CHAMBER DE-PRESSURIZED AND PARAGRAPH 4.5.8 REPEATED	4.5.8	DNA	VERIFY	VERIFIED	AMA 142
TCA INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	VERIFY	VERIFIED	AMA 142

* N/C AMEND. #1 ** N/C AMEND. #3	SPECIFICATION NUMBER * RA0220-350	DNA 52-52700-217	SERIAL NO. 4059276 PART NO. 203130-61
SE-6 COMPONENT ACCEPTANCE TEST		PART NAME THRUST CHAMBER, 25 LB., ASSY OF	3.1.2

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 272 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	-	-	-	SSFL	
CELL LOCATION	-	-	-	-	-	39-F	
CELL NUMBER	-	-	-	-	-	980	
TEST DATE	-	-	-	-	-	20 APR 64	
TEST DURATION	SEC.	2 MIN.	-	-	-	3.0	
ENVIRONMENTAL Pc	PSIA	.16 MAX.	-	-	-	.0204	
AMBIENT PRESSURE	PSIA	DNA	-	-	-	13.83	
AMBIENT TEMPERATURE	°F	DNA	-	-	-	55.0	
TIME OF DATA SLICE-START	SEC.	DNA	-	-	-	2.3	
TIME OF DATA SLICE-END	SEC.	DNA	-	-	-	2.8	
OXIDIZER TEMPERATURE	°F	DNA	-	-	-	50.0	
FUEL TEMPERATURE	°F	DNA	-	-	-	51.5	
OXIDIZER DENSITY	LB/FT^3	DNA	-	-	-	92.04	
FUEL DENSITY	LB/FT^3	DNA	-	-	-	54.96	

* N/C AMEND. #3	SPECIFICATION NUMBER *RA0220-350	DNA 52-52700-217	SERIAL NO. 4059276 PART NO. 2[illegible]130-61
SE- 6 (REA) CALIBRATED PERFORMANCE DATA		PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.2

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 272 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	-	-	-	SSFL	
OXIDIZER INLET PRESSURE	PSIA	287 ± 10	-	-	-	289.5	
FUEL INLET PRESSURE	PSIA	291 ± 10	-	-	-	287.7	
OXIDIZER FLOWRATE	LB/SEC.	DNA	-	-	-	.0473	
FUEL FLOWRATE	LB/SEC.	DNA	-	-	-	.0361	
THRUST	LB.	DNA	-	-	-	22.7	
MIXTURE RATIO	O/F	DNA	-	-	-	1.31	
SPECIFIC IMPULSE	SEC.	DNA	-	-	-	272.	
INJECTOR END Pc	PSIA	DNA	-	-	-	133.2	
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	-	-	-	5342.	
THROAT DIAMETER	IN.	DNA	-	-	-	.3638	
FUEL ORIFICE DIAMETER	IN.	DNA	-	-	-	.04590	
OXIDIZER ORIFICE DIAMETER	IN.	DNA	-	-	-	.04060	
TCA FIRING TIME (TOTAL)	SEC.	10 MAX.	-	-	-	3.0	
OXIDIZER SAMPLE NUMBER	-	-	-	-	-	4-289	
FUEL SAMPLE NUMBER	-	-	-	-	-	4.288	

*NC AMEND. #3	SPECIFICATION NUMBER * RA0220-350	DNA 52-52700-217	SERIAL NO. 4059276 PART NO. 208130-61
SE- 6 (REA) CALIBRATED PERFORMANCE DATA		PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.2.1

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 272 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	-	-	-	SSFL	
ADJUST TO STANDARD CONDITIONS							
THRUST	LB.	23 ± 1.2	-	-	-	22.6	
MIXTURE RATIO	O/F	1.30 ± .04	-	-	-	1.27	
SPECIFIC IMPULSE	SEC.	DNA	-	-	-	272.	
INJECTOR END Pc	PSIA	DNA	-	-	-	132.3	
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	-	-	-	5331.	
ADJUST TO RATED CONDITIONS							
THRUST	LB.	23	-	-	-	23.0	
MIXTURE RATIO	O/F	1.3	-	-	-	1.30	
SPECIFIC IMPULSE	SEC.	266 MIN.	-	-	-	272.	

* N/C AMEND. #3
** N/C AMEND. #1

SPECIFICATION NUMBER
* RA0220-350 and ** RA0220-229

DNA
52-52700-217

SERIAL NO. 4059276
PART NO. 208130-61

SE- 7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

5.2.2

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.
	5 - 10	*	*	*
	10 - 25	500	51	71
	25 - 50	100	7	6
	50 - 100	18	1	2
	100 - 300	6	1	0
	300 - 1000	1	0	0
	> 1000	0	0	0
FIBERS	300 - 3000	4	0	0
FIBERS	> 3000	0	0	0

* NOTE: TO BE COUNTED BUT NOT RESTRICTED TO NUMBER.

CLASS 7

INSP. [illegible]

"B" CHANGE	SPECIFICATION NUMBER RA0615-003	DNA 52-52700-217	SERIAL NO. 4059276 PART NO. 208130-61
SE-6 INFORMATION - CONTAMINATION		PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.3

~~CONFIDENTIAL~~

SCD 52-52700-217
S/N 4054995

R-15019-2

"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 #1 (DRD #1)

SPACE ENGINES ENGINEERING	SPACE ENGINES QUALITY CONTROL	McDONNELL QUALITY REPRESENTATIVE	GOV'T INSPECTION AGENCY QUALITY REPRESENTATIVE
N. B. Mirsden Jr.	[illegible]	C. W. Michaelis	Chester A. Mrednicks
DATE 27 August 64	DATE 27 August 64	DATE 27 AUGUST 1964	DATE 27 Aug. 64

CONTENTS

SECTION I – DELIVERABLE END ITEM ASSEMBLY LOG

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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	27 AUG 64
	DWG CHG LTR	DNA
Y-20161R	CONTRACT NO.	
	GEN ORDER NO.	5252
SCD52-52700-217	SPEC NO.	
DNA	SERIAL NO.	4054995
52-52700-217	PART NO.	208130-61

SE-6 DELIVERABLE END ITEM – LOG BOOK IDENTIFICATION

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

1.0

.163

~~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 QUALITY CONTROL.

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SECTION I

	52-52700-217 PART NO. 208130-61
SE-6 MODULE / COMPONENT ASSEMBLY LOG	PART NAME THRUST CHAMBER, 25 LB., ASSY OF 4.0

IND. NO.	PART NUMBER	REV. LTR.	PART NAME	SERIAL NO.	AGE CONTROL DATE OF MFG.	INSP.
1	208130-61	DNA	THRUST CHAMBER, 25 LB., ASSY OF	4054995	1 Q 64	ANR 645
2	208131-11	DNA	BODY, THRUST CHAMBER, ASSY OF	4050010	1 Q 64	ANR 645
2	208142	DNA	SHELL, THRUST CHAMBER, ASSY OF	8500158		ANR 645
3	208530	DNA	INJECTOR, THRUST CHAMBER, ASSY OF	7017869		ANR 645
2	407557	DNA	VALVE, OXIDIZER, T/C, ASSY OF	9160557		ANR 645
2	407558	DNA	VALVE, FUEL, T/C, ASSY OF	9198083		ANR 645

DNA SERIAL NO. 4054995

52-52700-217 PART NO. 208130-61

SE-6 CONFIGURATION & SERIALIZATION LOG

PART NAME THRUST CHAMBER, 25 LB., ASSY OF 4.1

MCR / ECP NO.	DATE	TITLE	DATE	INSP.
SE6-62	6 JAN 64	COMPONENT CLEANING; PROVISION FOR	27 AUG 64	ANR 545
SE6-64	30 JUL 63	TCA, ACCEPTANCE TESTS; REVISION	27 AUG 64	ANR 545
SE6-133	22 APR 64	TCA PROPELLANT VALVES; ADDITIONAL REQUIREMENTS FOR	27 AUG 64	ANR 545
SE6-139	15 APR 64	PLACEMENT OF HAYNES STELLITE #3 SAND CAST ON APPROVED MATERIAL LIST	27 AUG 64	ANR 545
SE6-144	15 APR 64	TCA INJECTORS; REDESIGN OF	27 AUG 64	ANR 545
SE6-155	28 OCT 63	TCA FLANGE MOUNTING HOLES; COUNTERSINKING OF	27 AUG 64	ANR 545
SE6-179	13 MAR 64	TUBE STUBS; MARKINGS OF	27 AUG 64	ANR 545
SE6-80	28 DEC 63	THRUST CHAMBER ASSEMBLIES, FABRICATION MATERIAL; APPROVAL OF	27 AUG 64	ANR 545
SE6-85	30 JUL 63	CUSTOMER TEST SURVEILLANCE; REQUIREMENT FOR	27 AUG 64	ANR 545
SE6-233	18 AUG 64	ELECTRICAL CONNECTOR "O" RINGS REPLACEMENTS OF	27 AUG 64	ANR 545

DNA 52-52700-217	SERIAL NO.	4054995	
	PART NO.	208130-61	
SE-6 DELIVERABLE END ITEM-MCR VERIFICATION	PART NAME	THRUST CHAMBER, 25 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.
MRR #58711	SE-6	208130-61	4054995	DISCREPANCY: CONDITION A-TCA DOES NOT MEET THE REQUIREMENTS OF ICF T-5034519. TCA WILL NOT ACCEPT DETAIL 406 BETWEEN SHELL FLANGE AND TOOL CHECK PLATE. FUEL SIDE SHOULD BE .140 CHECKS FROM .115 LONG END TO .120 MIDDLE. OXID. SIDE SHOULD BE .140 CHECKS FROM .110 LONG END TO .120 MIDDLE. DISPOSITION: ACCEPTABLE TO USE: REF: 600N-5 C 24194	ANR 208
MRR #58777	SE-6	208130-61	4054995	DISCREPANCY: THRUST CHAMBER ASSEMBLY HAS EXCEEDED MAXUMUM ALLOWABLE TIME FOR HOT FIRE PER RA0220-350. ACTUAL HOT FIRE TIME IS 12.0 SEC., SHOULD NOT EXCEED 10.0 SEC., MAXIMUM. MAC MRR 55315 IS APPLICABLE TO THIS UNIT. DISPOSITION: ACCEPTABLE TO USE. REF: 600N-5 C 24103	ANR 208
MRR #55315	SE-6	208130-61	4054995	DISCREPANCY: MIXTURE RATIO OF PROPELLANTS NOT TO REQUIREMENTS PER DATA REDUCTION SPEC. RA0220-229 PARA.4.6.2 IS 1.25 S/B 1.26 MIN. DISPOSITION: USE FOR DAT. PRIOR TO STARTING DAT, REPEAT PDA TO CONFIRM QUALITY OF TCA. REF: 23H 16464 23H 16464 NOR#1	ANR 208

DNA SERIAL NO. 4054995
52-52700-217 PART NO. 208130-61

SE-6 DELIVERABLE END ITEM — VARIATION LOG

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

4.3

MR NO.	PART OR COMP. INVOLVED	PART NUMBER	SERIAL NUMBER	BRIEF DESCRIPTION OF VARIATION AND MATERIAL REVIEW BOARD DISPOSITION	INSP.
600N-5 C 17307	SE-6	208130-61	4054995	DISCREPANCY: TCA WAS DROPPED CAUSING ABLATIVE TO CHIP OFF AT EXIT END. CHIPPED AREA IS ONE INCH IN LENGTH AND 1/4 INCH IN WIDTH AND 1/16" in depth. NOTE: TCA HAS BEEN X-RAYED X-RAY C/N B191. REF. 617D #7229Q DISPOSITION: USE AS IS.	

DNA SERIAL NO. 4054995

52-52700-217 PART NO. 208130-61

SE-6 DELIVERABLE END ITEM — VARIATION LOG

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

4.3

PART NO.	PART NAME	SERIAL NO.	REASON FOR REPLACEMENT	REPLACED BY		INSP.
				PART NO.	SERIAL NO.	
R-15019-2			NONE THIS DATE 27 AUG 64			

171	DNA 52-52700-217	SERIAL NO.	4054995
		PART NO.	208130-61
SE-6 DELIVERABLE END ITEM--REPLACEMENT LOG	PART NAME THRUST CHAMBER, 25 LB., ASSY OF		4.4

SECTION II

	52-52700-217 PART NO. 208130-61
SE-6 COMPONENT ACCEPTANCE TEST LOG	PART NAME THRUST CHAMBER, 25 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	71	ANR 545
FUEL	4.2.11	DEGREES F	70 ± 5	71	ANR 545
COIL RESISTANCE					
OXIDIZER	4.2.5	OHMS	42 ± 2	40.80	ANR 545
FUEL	4.2.11	OHMS	42 ± 2	41.45	ANR 545
CONTINUITY RESISTANCE					
OXIDIZER	4.2.9	OHMS	1.0 MAX.	.250	ANR 545
FUEL	4.2.11	OHMS	1.0 MAX.	.180	ANR 545
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICROAMPS	500 MAX.	56	ANR 545
FUEL	4.3.11	MICROAMPS	500 MAX.	40	ANR 545
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 545
STEP II	4.4.5	PSIG	500 ± 10	VERIFIED	ANR 545

SPECIFICATION NUMBER RA0220-350	REVISION N/C	AMENDMENT NONE	DNA 52-52700 -217
SE-6 COMPONENT ACCEPTANCE TEST			SERIAL NO. 4054995
			PART NO. 208130 -61
			PART NAME THRUST CHAMBER, 25 LB., ASSY OF

5.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE TEST--TCA PROPELLANT VALVES (CONTINUED)					
FUEL					
STEP I	4.4.7	PSIG	500 ± 10	VERIFIED	ANR 545
STEP II	4.4.7	PSIG	500 ± 10	VERIFIED	ANR 545
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION					
OXIDIZER					
STEP I	4.4.4	DNA	NONE ALLOWED	NONE DETECTED	ANR 545
STEP II	4.4.5	DNA	NONE ALLOWED	NONE DETECTED	ANR 545
FUEL					
STEP I	4.4.7	DNA	NONE ALLOWED	NONE DETECTED	ANR 545
STEP II	4.4.7	DNA	NONE ALLOWED	NONE DETECTED	ANR 545
PROOF PRESSURE AND LEAKAGE TEST--THRUST CHAMBER	4.5				
PROOF PRESSURE TEST					
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES AT					
STEP I	4.5.8	PSIG	392 ± 10	VERIFIED	ANR 545
STEP II	4.5.10	PSIG	392 ± 10	VERIFIED	ANR 545

SPECIFICATION NUMBER RA0220-350	REVISION N/C	AMENDMENT NONE	DNA 52-52700-217	SERIAL NO. 4054995 PART NO. 208130-61
SE-6 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER 25 LB., ASSY OF	5.1.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE AND LEAKAGE TEST—THRUST CHAMBER (CONTINUED)					
LEAKAGE TEST					
STEP I	4.5.8	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
STEP II	4.5.10	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
FUNCTIONAL TEST--TCA PROPELLANT VALVES	4.6				
OPENING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.0065 MAX.	.0044	ANR 645
FUEL	4.6.8	SEC.	0.0065 MAX.	.0043	ANR 645
CLOSING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.002 MAX.	.0018	ANR 645
FUEL	4.6.10	SEC.	0.002 MAX.	.0016	ANR 645
CLOSING DROP OUT VOLTAGE					
OXIDIZER	4.6.17	VOLT (DC)	1 MIN.	1.8	ANR 645
FUEL	4.6.13	VOLT (DC)	1 MIN.	1.5	ANR 645

SPECIFICATION NUMBER RA0220-350	REVISION N/C	AMENDMENT NONE	DNA 52-52700-217
SE-6 COMPONENT ACCEPTANCE TEST			SERIAL NO. 4054995
			PART NO. 208130-61
			PART NAME THRUST CHAMBER, 25 LB., ASSY OF

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
* LEAKAGE TEST--TCA PROPELLANT VALVES	4.8				
SEAT LEAKAGE RATE					
OXIDIZER	4.8.17	SCC/MIN	2.21 MAX.	LESS THAN 0.1	ANR 645
FUEL	4.8.22	SCC/MIN	2.21 MAX.	LESS THAN 0.1	ANR 645
** PRE-TEST DATA					
DRY WEIGHT (EXCLUDING PROTECTIVE CLOSURES)	4.1.3	LB.	DNA	2.40	ANR 645
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	1.605	ANR 645
THROAT DIAMETER					
SECTION A-A		INCH	DNA	.3640	ANR 645
B-B		INCH	DNA	..3639	ANR 645
C-C		INCH	DNA	.3640	ANR 645
D-D		INCH	DNA	.3640	ANR 645
** POST HOT-FIRE DATA					
PROOF PRESSURE TEST					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.17.1	LB.	DNA	2.41	ANR 645
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES					
STEP I	4.17.4	PSIG	392 ± 10	392	ANR 645
STEP II	4.17.4	PSIG	392 ± 10	392	ANR 645

	SPECIFICATION NUMBER	REVISION	AMENDMENT
*	RA0220-350	N/C	NONE
**	RA0220-350	N/C	#3

SE-6 COMPONENT ACCEPTANCE TEST

DNA SERIAL NO. 4054995

52-52700-217 PART NO. 208130-61

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

5.1.3

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
POST HOT-FIRE DATA (CONTINUED)					
LEAKAGE TEST					
STEP I	4.17.4	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
STEP II	4.17.4	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.17.4	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
LEAK TEST -- WELDED JOINTS					
LEAK TEST					
INLET TUBE PRESSURIZED WITH GASEOUS HELIUM					
OXIDIZER	4.17.5	PSIG	500 ± 10	VERIFIED	ANR 645
FUEL	4.17.8	PSIG	500 ± 10	VERIFIED	ANR 645
JOINT LEAKAGE RATE					
OXIDIZER	4.17.6	SCC/SEC.	10^{-6} MAX.	4.1×10^{-7}	ANR 645
FUEL	4.17.8	SCC/SEC.	10^{-6} MAX.	1.1×10^{-7}	ANR 645
LEAKAGE TEST -- TCA PROPELLANT VALVES					
SEAT LEAKAGE RATE					
OXIDIZER	4.17.9	SCC/SEC.	2.21 MAX.	LESS THAN 0.1	ANR 645
FUEL	4.17.9	SCC/SEC.	2.21 MAX.	LESS THAN 0.1	ANR 645

SPECIFICATION NUMBER RA0220-350	REVISION N/C	AMENDMENT #3	DNA 52-52700-217	SERIAL NO. 4054995 PART NO. 208130-61
SE-6 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.1.4

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	1.610	
THROAT DIAMETER (DELIVERED CONDITION)	4.18.1				
SECTION A-A		INCH	DNA	.3635	
B-B		INCH	DNA	.3640	
C-C		INCH	DNA	.3635	
D-D		INCH	DNA	.3640	
DRY WEIGHT IN DELIVERED CONDITION (EXCLUDING PROTECTIVE COVERS AND CLOSURES)	4.18.2	LB.	DNA	2.21	

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-350	N/C	#3	DNA 52-52700-217	SERIAL NO. 4054995 PART NO. 208130-61	
SE-6 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 25 LB., ASSY OF		5.1.5

GROUP 4
Dow[illegible]aded at 3 year intervals:
declassified after 12 years

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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.

R-15519-2

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 041 TEST DATA	RUN 049 TEST DATA	RUN 060 TEST DATA	RUN 177 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE			NFL	NFL	NFL	NFL	
CELL LOCATION			1-D	1-D	1-D	1-C	
CELL NUMBER			379	379	379	379	
TEST DATE			6 Feb 1964	11 Feb 1964	18 Feb 1964	21 July 1964	
TEST DURATION	SEC.	2 MIN.	3.0	3.0	3.0	3.0	
ENVIRONMENTAL Pc	PSIA	0.16 MAX.	.04200	.04720	.05960	.05660	
AMBIENT PRESSURE	PSIA	DNA	12.15	12.06	12.21	12.09	
AMBIENT TEMPERATURE	°F	DNA	25.8	34.0	36.0	88.0	
TIME OF DATA SLICE-START	SEC.	DNA	2.8	2.8	2.8	2.8	
TIME OF DATA SLICE-END	SEC.	DNA	2.8	2.8	2.8	2.8	
OXIDIZER TEMPERATURE	°F	DNA	29.0	30.0	40.0	67.5	
FUEL TEMPERATURE	°F	DNA	22.0	29.0	40.0	67.3	
OXIDIZER DENSITY	LB/FT^3	DNA	92.62	93.80	92.63	91.08	
FUEL DENSITY	LB/FT^3	DNA	55.40	55.80	55.41	54.28	

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SPECIFICATION NUMBER	REVISION	AMENDMENT		
RAO 220-350	NC	+3	DNA	SERIAL NO. 4054995
			52-52700-217	PART NO. 208130-61
SE-6 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.2

~~CONFIDENTIAL~~

GROUP 4
Do. graded at 3 year intervals:
declassified after 12 years

~~CONFIDENTIAL~~

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.

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 041 TEST DATA	RUN 049 TEST DATA	RUN 060 TEST DATA	RUN 177 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE			NFL	NFL	NFL	NFL	
OXIDIZER INLET PRESSURE	PSIA	287 ± 10	287.7	285.6	288.7	295.1	
FUEL INLET PRESSURE	PSIA	291 ± 10	296.2	291.1	283.7	291.5	
OXIDIZER FLOWRATE	LB/SEC.	DNA	.05085	.04936	.04808	.04843	
FUEL FLOWRATE	LB/SEC.	DNA	.03566	.03564	.03710	.03523	
THRUST	LB.	DNA	22.7	23.2	22.7	23.8	
MIXTURE RATIO	O/F	DNA	1.43	1.38	1.30	1.37	
SPECIFIC IMPULSE	SEC.	DNA	263.	273.	267.	285.	
INJECTOR END Pc	PSIA	DNA	136.3	136.9	134.3	135.7	
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	5273.	5393.	5280.	5433.	
THROAT DIAMETER	INCH	DNA	.364	.364	.364	.364	
FUEL ORIFICE DIAMETER	INCH	DNA	.04323	.04323	.04600	.04480	
OXIDIZER ORIFICE DIAMETER	INCH	DNA	.03950	.03950	.03865	.03945	
TCA FIRING TIME (TOTAL)	SEC.	10 MAX.	3.0	6.0	9.0	12.0	
OXIDIZER SAMPLE NUMBER			136.	142.	144.	258.	
FUEL SAMPLE NUMBER			137.	143.	145.	256.	

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RAO 220-350	NC	+3	DNA	SERIAL NO. 4054995
			52-52700- 217	PART NO. 208130- 61
SE-6 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.2.1

R-1501C-2

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

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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.

R-15019-2

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 041 TEST DATA	RUN 049 TEST DATA	RUN 060 TEST DATA	RUN 177 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE			NFL	NFL	NFL	NFL	
ADJUST TO STANDARD CONDITIONS							
THRUST	LB.	23 ± 1.2	22.5	23.1	22.7	23.6	
MIXTURE RATIO	O/F	1.30 ± .04	1.43	1.38	1.25	1.33	
SPECIFIC IMPULSE	SEC.	DNA	264.	274.	267.	286.	
INJECTOR END Pc	PSIA	DNA	134.4	135.6	133.7	133.8	
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	5274.	5392.	5264.	5423.	
ADJUST TO RATED CONDITIONS							
THRUST	LB.	23	23.0	23.0	23.0	23.0	
MIXTURE RATIO	O/F	1.3	1.30	1.30	1.30	1.30	
SPECIFIC IMPULSE	SEC.	272 MIN.	262.	273.	268.	285.	

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SPECIFICATION NUMBER	REVISION	AMENDMENT
RAO 220-350	NC	+3
RAO 220-229	NC	#2

DNA SERIAL NO. 4054995
52-52700-217 PART NO. 208130-61

SE-6 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER, 25 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	28	87
	25 - 50	20	4	9
	50 - 100	5	2	4
	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. AMR 645

R-15019-2

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0615-003	B	#2	52-52700-217	PART NO. S/N 4054995 208130-61
SE-6 INFORMATION - CONTAMINATION			PART NAME THRUST CHAMBER, 25 LB. , ASSY OF	5.3

R-15019-2

"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

(DRD 4)

SPACE ENGINES ENGINEERING	SPACE ENGINES QUALITY CONTROL	McDONNELL QUALITY REPRESENTATIVE	GOV'T INSPECTION AGENCY QUALITY REPRESENTATIVE
W. A. Bonner	C. A. Kubelach	Lowell J. Thomas	John C. Moore
DATE 22 May 1964	DATE 22 May 64	DATE 21 May 64	DATE 22 MAY 1964

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
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	19 MAY 1964
Y-20161R	DWG CHG LTR	DNA
	CONTRACT NO.	
	GEN ORDER NO.	5252
SCD52-52700-217	SPEC NO	
DNA	SERIAL NO.	1055298
52-52700-217	PART NO.	208130-61

SE-6 DELIVERABLE END-ITEM - LOG BOOK IDENTIFICATION

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

1.0

183

DELIVERABLE END ITEM (DEI)

THIS LOG BOOK CONTAINS INFORMATION PERTINENT TO THE DELIVERABLE END ITEM (DEI) AS SPECIFIED HEREIN BY SERIAL NO. AND PART NO. 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 QUALITY CONTROL.

	52-52700-217	PART NO. 208130-61	
FOREWORD--SE-6 LOG BOOK	PART NAME THRUST CHAMBER, 25 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~~ NOT REQUIRED
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
5.2	CALIBRATED PERFORMANCE DATA
5.2.1	CALIBRATED PERFORMANCE DATA
5.2.2	CALIBRATED PERFORMANCE DATA
5.3	INFORMATION - CONTAMINATION

SECTION I

	52-52700-217 PART NO. 200130-61
SE-6 MODULE / COMPONENT ASSEMBLY LOG	PART NAME THRUST CHAMBER, 25 LB., ASSY OF 1.0

IND. NO.	PART NUMBER	REV. LTR.	PART NAME	SERIAL NO.	AGE CONTROL DATE OF MFG.	INSP.
1	208130-61	DNA	THRUST CHAMBER, 25 LB., ASSY OF	4055298	1 Q 64	ANR 142
2	208131-11	DNA	BODY, THRUST CHAMBER, ASSY OF	4050008	4 Q 63	ANR 142
2	208142	DNA	SHELL, THRUST CHAMBER, ASSY OF	8500518		ANR 142
3	208530	DNA	INJECTOR, THRUST CHAMBER, ASSY OF	7017837		ANR 142
2	407557	DNA	VALVE, OXIDIZER, T/C, ASSY OF	9193134		ANR 142
2	407558	DNA	VALVE, FUEL, T/C, ASSY OF	9202598		ANR 250

DNA
52-52700-217

SERIAL NO. 4055298
PART NO. 208130-61

SE-6 CONFIGURATION & SERIALIZATION LOG

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

4.1

MCR / ECP NO.	DATE	TITLE	DATE	INSP.
SE6-062	6 JAN 64	COMPONENT CLEANING; PROVISIONS FOR	19 MAY 64	AVCO 142
SE6-064	30 JUL 63	TCA, ACCEPTANCE TESTING; REVISION OF	19 MAY 64	AVCO 142
SE6-155	28 OCT 63	TCA FLANGE MOUNTING HOLES; COUNTERSINKING OF	19 MAY 64	AVCO 142
SE6-133	22 APR 64	TCA PROPELLANT VALVES; ADDITIONAL REQUIREMENTS FOR	19 MAY 64	AVCO 142
SE6-139	15 APR 64	PLACEMENT OF HAYNES STELLITE #3 SAND CAST ON APPROVED MATERIAL LIST	19 MAY 64	AVCO 142
SE6-144	15 APR 64	TCA INJECTORS; REDESIGN OF	19 MAY 64	AVCO 142
SE6-179	13 MAR 64	TUBE STUBS; MARKING OF	19 MAY 64	AVCO 142

DNA 52-52700-217 SERIAL NO. 4055298 PART NO. 208130-61

SE-6 DELIVERABLE END ITEM-MCR VERIFICATION

PART NAME THRUST CHAMBER, 25 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.
23H #R 19622	TCA 25#	208130-61	4053699	DISCREPANCY: HOT-FIRE DATA INDICATES THE TCA DID NOT RECEIVE NTO DURING THE TEST. OSCILLOGRAPH TRACES SHOW THE PROPELLANT VALVES HAD VOLTAGE AND DID DRAW CURRENT. THE EA RECORDER VERIFIED THAT THE PRE VALVES WERE OPEN, INLET PRESSURES AND PROPELLANT TEMPS. WERE NORMAL. POST HOT-FIRE CHECKS REVEALED INTERMITTENT OXID. VALVE OPERATION. DISPOSITION: REWORK PER 23H #R 19622.	
23H #R 19622 NOR #1	TCA 25#	208130-61	4055298	DISCREPANCY: TO CHANGE PART SERIAL NUMBER 4053699 TO 4055298 ON ORIGINAL 23H 19622. DISPOSITION: USE AS IS.	

DNA 52-52700-217 SERIAL NO. 4055298 PART NO. 208130-61

SE-6 DELIVERABLE END ITEM — VARIATION LOG

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

4.3

SECTION II

	52-52700-217 PART NO. 208130-61
SE-6 COMPONENT ACCEPTANCE TEST LOG	PART NAME THRUST CHAMBER, 25 LB., ASSY OF 5.0

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
ELECTRICAL RESISTANCE TESTS	4.2				
VALVE BODY TEMPERATURE	4.2.4				
OXIDIZER		DEGREES F	70 ± 5	70	
FUEL		DEGREES F	70 ± 5	70	
VALVE COIL RESISTANCE	4.2.5				
OXIDIZER		OHMS	42 ± 2	41.30	
FUEL		OHMS	42 ± 2	41.45	
CONTINUITY RESISTANCE	4.2.9				
OXIDIZER		OHMS	1.0 MAX.	.110	
FUEL		OHMS	1.0 MAX.	.055	
DIELECTRIC STRENGTH TEST	4.3				
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICRO AMPS	500 MAX.	49.5	
FUEL	4.3.8	MICRO AMPS	500 MAX.	39.5	
PROOF PRESSURE TEST - TCA PROPELLANT VALVES	4.4				
VALVE PRESSURIZED FOR MINIMUM OF 3 MINUTES AT 500 ± 10 PSIG	4.4.3	DNA	VERIFY	VERIFIED	
VALVE DE-PRESSURIZED AND VALVE HOUSING INSPECTED FOR DAMAGE OR DEFORMATION	4.4.4	DNA	VERIFY	VERIFIED	
PARAGRAPHS 4.4.3 AND 4.4.4 REPEATED	4.4.5	DNA	VERIFY	VERIFIED	

*MC AMEND. #1

SPECIFICATION NUMBER *RA0220-350

DNA SERIAL NO. 1 3298

52-52700-217 PART NO. 208130-61

SE-6 COMPONENT ACCEPTANCE TEST

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

5.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE TEST - TCA PROPELLANT VALVES (CONTINUED)					
CONFORMANCE TO PARAGRAPHS 4.4.3, 4.4.4 AND 4.4.5 VERIFIED					
OXIDIZER		DNA	VERIFY	VERIFIED	ANA 142
FUEL		DNA	VERIFY	VERIFIED	ANA 142
PROOF PRESSURE AND LEAKAGE TEST - THRUST CHAMBER	4.5				
CHAMBER PRESSURIZED FOR A MINIMUM OF 5 MINUTES AT 392 ± 10 PSIG. NO LEAKAGE DETECTED	4.5.8	DNA	VERIFY	VERIFIED	ANA 142
CHAMBER DE-PRESSURIZED AND PARAGRAPH 4.5.8 REPEATED	4.5.8	DNA	VERIFY	VERIFIED	ANA 142
TCA INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	VERIFY	VERIFIED	ANA 142
FUNCTIONAL TEST - TCA PROPELLANT VALVES	4.6				
OPENING RESPONSE TIME	4.6.8				
OXIDIZER		SEC.	.0065 MAX.	.0040	ANA 142
FUEL		SEC.	.0065 MAX.	.0039	ANA 142
CLOSING RESPONSE TIME	4.6.10				
OXIDIZER		SEC.	.002 MAX.	.0013	ANA 142
FUEL		SEC.	.002 MAX.	.0016	ANA 142
CLOSING DROP OUT VOLTAGE	4.6.13				
OXIDIZER		VOLT (DC)	1 MIN.	1.5	ANA 142
FUEL		VOLT (DC)	1 MIN.	1.5	ANA 142

*NC AMEND. #1

SPECIFICATION NUMBER
* RA0220-350

DNA
52-52700-217

SERIAL NO. L055298
PART NO. 208130-61

SE- 6 COMPONENT ACCEPTANCE TEST

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

5.1.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAKAGE TEST - TCA PROPELLANT VALVES	4.8				
SEAT LEAKAGE RATE	4.8.16				
OXIDIZER	4.8.17	SCC/MIN	2.21 MAX.	LESS THAN 0.1	AMN 142
FUEL	4.8.17	SCC/MIN	2.21 MAX.	LESS THAN 0.1	AMN 142
PRE-TEST DATA					
DRY WEIGHT	4.1.3	LB.	DNA	2.41	AMN 142
NOZZLE EXIT DIAMETER SECTION A-A		INCH	DNA	1.6181	AMN 142
THROAT DIAMETER SECTION A-A		INCH	DNA	.3640	AMN 142
B-B		INCH	DNA	.3642	AMN 142
C-C		INCH	DNA	.3641	AMN 142
D-D		INCH	DNA	.3641	AMN 142
POST HOT-FIRE DATA					
PROOF PRESSURE AND LEAKAGE TEST - THRUST CHAMBER	4.5				
CHAMBER PRESSURIZED FOR A MINIMUM OF 5 MINUTES AT 392 ± 10 PSIG. NO LEAKAGE DETECTED	4.5.8	DNA	VERIFY	VERIFIED	AMN 142
CHAMBER DE-PRESSURIZED AND PARAGRAPH 4.5.8 REPEATED	4.5.8	DNA	VERIFY	VERIFIED	AMN 142
TCA INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	VERIFY	VERIFIED	AMN 142

*NC AMEND. #2	SPECIFICATION NUMBER *RA0220-350	DNA 52-52700-217	SERIAL NO. 4055298 PART NO. 200130-61
SE-6 COMPONENT ACCEPTANCE TEST		PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.1.2

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
POST HOT-FIRE DATA (CONTINUED)					
DRY WEIGHT	4.18.2	LB.	DNA	2.27	
NOZZLE EXIT DIAMETER SECTION A-A	4.18.1	INCH	DNA	1.603	
THROAT DIAMETER SECTION A-A		INCH	DNA	.363	
B-B		INCH	DNA	.3635	
C-C		INCH	DNA	.364	
D-D		INCH	DNA	.363	
DRY WEIGHT (DELIVERABLE CONDITION)		LB.	DNA	2.22	

*NC AMEND. #2	SPECIFICATION NUMBER *RA0220-350	DNA 52-52700-217	SERIAL NO. 4055298 PART NO. 208130-61
SE-6 COMPONENT ACCEPTANCE TEST		PART NAME THRUST CHAMBER, 25., ASSY OF	5.1.3

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CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN D007 TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 277 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	SSFL	-	-	SSFL	APR 721
CELL LOCATION	-	-	*	-	-	39-F	APR 721
CELL NUMBER	-	-	*	-	-	980	APR 721
TEST DATE	-	-	*	-	-	21 APR 64	APR 721
TEST DURATION	SEC.	2 MIN.	*	-	-	3.0	APR 721
ENVIRONMENTAL Pc	PSIA	.16 MAX.	*	-	-	.0264	APR 721
AMBIENT PRESSURE	PSIA	DNA	*	-	-	13.80	APR 721
AMBIENT TEMPERATURE	°F	DNA	*	-	-	45.0	APR 721
TIME OF DATA SLICE-START	SEC.	DNA	*	-	-	2.3	APR 721
TIME OF DATA SLICE-END	SEC.	DNA	*	-	-	2.8	APR 721
OXIDIZER TEMPERATURE	°F	DNA	*	-	-	45.5	APR 721
FUEL TEMPERATURE	°F	DNA	*	-	-	45.5	APR 721
OXIDIZER DENSITY	LB/FT^3	DNA	*	-	-	92.38	APR 721
FUEL DENSITY	LB/FT^3	DNA	*	-	-	55.15	APR 721

* DATA NOT REDUCED
**NC AMEND. #2

SPECIFICATION NUMBER
**RA0220-350

DNA
52-52700-217

SERIAL NO. 4055298
PART NO. 208130-61

SE- 6 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

~~CONFIDENTIAL~~

R-15019-2

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CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN D007 TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 277 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	SSFL	-	-	SSFL	AMR 721
OXIDIZER INLET PRESSURE	PSIA	287 ± 10	*	-	-	289.1	AMR 721
FUEL INLET PRESSURE	PSIA	291 ± 10	*	-	-	289.2	AMR 721
OXIDIZER FLOWRATE	LB/SEC.	DNA	*	-	-	.0483	AMR 721
FUEL FLOWRATE	LB/SEC.	DNA	*	-	-	.0363	AMR 721
THRUST	LB.	DNA	*	-	-	23.5	AMR 721
MIXTURE RATIO	O/F	DNA	*	-	-	1.33	AMR 721
SPECIFIC IMPULSE	SEC.	DNA	*	-	-	278.	AMR 721
INJECTOR END Pc	PSIA	DNA	*	-	-	134.8	AMR 721
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	*	-	-	5330.	AMR 721
THROAT DIAMETER	IN.	DNA	*	-	-	.3638	AMR 721
FUEL ORIFICE DIAMETER	IN.	DNA	*	-	-	.05060	AMR 721
OXIDIZER ORIFICE DIAMETER	IN.	DNA	*	-	-	.04050	AMR 721
TCA FIRING TIME (TOTAL)	SEC.	10 MAX.	3.0	-	-	6.0	AMR 721
OXIDIZER SAMPLE NUMBER			*	-	-	4-289	AMR 721
FUEL SAMPLE NUMBER			*	-	-	4-288	AMR 721

* DATA NOT REDUCED
** NC AMEND. #2

SPECIFICATION NUMBER
** RA0220-350

DNA
52-52700-217

SERIAL NO. 4055298
PART NO. 208130-61

SE- 6 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

5.2.1

~~CONFIDENTIAL~~

CONFIDENTIAL

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN D007 TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 277 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	SSFL	-	-	SSFL	AMR 721
ADJUST TO STANDARD CONDITIONS							
THRUST	LB.	23 ± 1.2	*	-	-	23.3	AMR 721
MIXTURE RATIO	O/F	1.30 ± .04	*	-	-	1.30	AMR 721
SPECIFIC IMPULSE	SEC.	DNA	*	-	-	278.	AMR 721
INJECTOR END Pc	PSIA	DNA	*	-	-	133.7	AMR 721
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	*	-	-	5323.	AMR 721
ADJUST TO RATED CONDITIONS							
THRUST	LB.	23	*	-	-	23.0	AMR 721
MIXTURE RATIO	O/F	1.3	*	-	-	1.30	AMR 721
SPECIFIC IMPULSE	SEC.	266 MIN.	*	-	-	278.	AMR 721

* DATA NOT REDUCED
** NC AMEND. #2
***NC AMEND. #1
...

SPECIFICATION NUMBER
** RA0220-350 and *** RA0220-229

DNA
52-52700-217

SERIAL NO. 4055298
PART NO. 208130-61

SE- 7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

5.2.2

CONFIDENTIAL

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	*	*	*
	10 - 25	100	51	71
	25 - 50	20	7	6
	50 - 100	5	1	2
	100 - 300	1	1	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	DNA	SERIAL NO.	4055298
RA0615-003	"B"	#1	52-52700-217	PART NO.	208130-61
SE-6 INFORMATION - CONTAMINATION			PART NAME THRUST CHAMBER, 25 LB., ASSY OF		5.3

CONFIDENTIAL

SCD 52-52700-217
S/N 4060450

"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 #7 (DRD #7)

ROCKETDYNE ENGINEERING	ROCKETDYNE QUALITY ASSURANCE	McDONNELL QUALITY REPRESENTATIVE	GOV'T INSPECTION AGENCY QUALITY REPRESENTATIVE
N. H. Marsden RH	Wm E Kirk	J. E. [illegible]	N. J. [illegible]
DATE 8-31-64	DATE 9/1/64	DATE 9-1-64	DATE 1 Sep 64

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.

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

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

LOG BOOK SPECIFICS

McDONNELL	ITEM	ROCKETDYNE
THIS MATERIAL CO[illegible]TAINS INFORMATIO[illegible] AFFECTING THE NATIONAL [illegible] OF THE [illegible]ED STATES WITHIN THE MEA[illegible] OF THE [illegible]GE LAWS, TITLE 18 U.S.C., S[illegible]TIONS 793 AND [illegible] ITS TRANSMISSION OR THE [illegible]VELATION OF ITS [illegible]ONTENTS IN ANY MANNER TO [illegible]AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW		
	LOG BOOK DATE	31 AUG 64
	DWG CHG LTR	DNA
Y-20161R	CONTRACT NO.	
	GEN ORDER NO.	5252
SCD 52-52700-217	SPEC NO.	
DNA	SERIAL NO.	4060450
52-52700-217	PART NO.	208130-61

SE-6 DELIVERABLE END ITEM – LOG BOOK IDENTIFICATION

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

1.0

CONFIDENTIAL

R-15019-2

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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.

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52-52700-217 PART NO. 208130-61	
PART NAME THRUST CHAMBER, 25 LB., ASSY OF	2.0

R-15019-2

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

SECTION I

	52-52700-217 PART NO. 208130-61	
SE-6 MODULE / COMPONENT ASSEMBLY LOG	PART NAME THRUST CHAMBER, 25 LB., ASSY OF	4.0

IND. NO.	PART NUMBER	REV. LTR.	PART NAME	SERIAL NO.	AGE CONTROL DATE OF MFG.	INSP.
1	208130-61	DNA	THRUST CHAMBER, 25 LB., ASSY OF	4060450	2 Q 64	ANR 208
2	208131-11	DNA	BODY, THRUST CHAMBER, ASSY OF	4057064	2 Q 64	ANR 208
2	208142	DNA	SHELL, THRUST CHAMBER, ASSY OF	8501905		ANR 208
3	208530	DNA	INJECTOR, THRUST CHAMBER, ASSY OF	7070550		ANR 208
2	407557	DNA	VALVE, OXIDIZER, T/C, ASSY OF	9294000		ANR 208
2	407558	DNA	VALVE, FUEL, T/C, ASSY OF	8759958		ANR 208

DNA SERIAL NO. 4060450

52-52700-217 PART NO. 208130-61

SE-6 CONFIGURATION & SERIALIZATION LOG

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

4.1

MCR / ECP NO.	DATE	TITLE	DATE	INSP.
SE6-062	6 JAN 64	COMPONENT CLEANING; PROVISION FOR	31 AUG 64	ANR 208
SE6-064	30 JUL 63	TCA, ACCEPTANCE TESTS; REVISION OF	31 AUG 64	ANR 208
SE6-155	28 OCT 63	TCA FLANGE MOUNTING HOLES; COUNTERSINKING OF	31 AUG 64	ANR 208
SE6-133	22 APR 64	TCA PROPELLANT VALVES; ADDITIONAL REQUIREMENTS FOR	31 AUG 64	ANR 208
SE6-139	15 APR 64	PLACEMENT OF HAYNES STELLITE #3 SAND CAST ON APPROVED MATERIAL LIST	31 AUG 64	ANR 208
SE6-144	15 APR 64	TCA INJECTORS; REDESIGN OF	31 AUG 64	ANR 208
SE6-179	16 JUN 64	TUBE STUBS; MARKING OF	31 AUG 64	ANR 208
SE6-080	28 DEC 63	THRUST CHAMBER ASSEMBLIES, FABRICATION MATERIAL; APPROVAL OF	31 AUG 64	ANR 208
SE6-085	30 JUL 63	CUSTOMER TEST SURVEILLANCE; REQUIREMENT FOR	31 AUG 64	ANR 208
SE6-233	18 AUG 64	ELECTRICAL CONNECTOR "O" RINGS; REPLACEMENT OF	31 AUG 64	ANR 208

DNA 52-52700-217 SERIAL NO. 4060450 PART NO. 208130- 61

SE-6 DELIVERABLE END ITEM-MCR VERIFICATION

PART NAME THRUST CHAMBER, 25 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.
MAC MRR #58747	SE-6 T.C.A	208130-61	4060450	DISCREPANCY: CONDITION A: TCA'S DID NOT MEET THE REQUIREMENTS OF SCD 52-52700 WHICH CALLS FOR ± 3% ABSOLUTE ERROR IN MIXTURE RATIO. TEST RESULTS WERE AS FOLLOWS: S/N 4056283 STD 1.27 SHOULD BE 1.30 ± .01 S/N 4060446 STD 1.32, 1.36, 1.30 SHOULD BE 1.30 ± .01 S/N 4054995 STD 1.43, 1.38, 1.25, 1.33 SHOULD BE 1.30 ± .01 S/N 4060450 STD 1.33 SHOULD BE 1.30 ± .01 DISPOSITION: ACCEPTABLE TO USE NO TWX SENT TO MAC: DISPOSITIONED IN-HOUSE AT ROCKETDYNE.	ANR 208

DNA	SERIAL NO.	4060450	
52-52700-217	PART NO.	208130-61	
SE-6 DELIVERABLE END ITEM — VARIATION LOG	PART NAME	THRUST CHAMBER, 25 LB., ASSY OF	4.3

PART NO.	PART NAME	SERIAL NO.	REASON FOR REPLACEMENT	REPLACED BY		INSP.
				PART NO.	SERIAL NO.	
			NONE THIS DATE 31 AUG 64			

DNA 52-52700 -217

SERIAL NO. 4060450

PART NO. 208130 -61

SE-6 DELIVERABLE END ITEM--REPLACEMENT LOG

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

4.4

SECTION II

	52-52700-217 PART NO. 208130-61	
SE-6 COMPONENT ACCEPTANCE TEST LOG	PART NAME THRUST CHAMBER, 25 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	69	ANR 208
FUEL	4.2.11	DEGREES F	70 ± 5	69	ANR 208
COIL RESISTANCE					
OXIDIZER	4.2.5	OHMS	42 ± 2	40.370	ANR 208
FUEL	4.2.11	OHMS	42 ± 2	40.720	ANR 208
CONTINUITY RESISTANCE					
OXIDIZER	4.2.9	OHMS	1.0 MAX.	.045	ANR 208
FUEL	4.2.11	OHMS	1.0 MAX.	.140	ANR 208
DIELECTRIC STRENGTH TEST--TCA PROPELLANT VALVES	4.3				
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICROAMPS	500 MAX.	32	ANR 208
FUEL	4.3.11	MICROAMPS	500 MAX.	32	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 RA0220-350	REVISION N/C	AMENDMENT #3	DNA 52-52700-217	SERIAL NO. 4060450 PART NO. 208130-61
SE-6 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE TEST--TCA PROPELLANT VALVES (CONTINUED)					
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					
STEP I	4.5.8	PSIG	392 ± 10	VERIFIED	ANR 208
STEP II	4.5.10	PSIG	392 ± 10	VERIFIED	ANR 208

SPECIFICATION NUMBER RA0220-350	REVISION N/C	AMENDMENT #3	DNA 52-52700-271	SERIAL NO. 4060450 PART NO. 208130-61
SE-6 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER 25 LB., ASSY OF	5.1.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE AND LEAKAGE TEST—THRUST CHAMBER (CONTINUED)					
LEAKAGE TEST					
STEP I	4.5.8	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
STEP II	4.5.10	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
FUNCTIONAL TEST--TCA PROPELLANT VALVES	4.6				
OPENING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.0005 MAX.	[illegible]	[illegible]
FUEL	4.6.8	SEC.	0.0005 MAX.	[illegible]	[illegible]
CLOSING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.002 MAX.	.0013	[illegible]
FUEL	4.6.10	SEC.	0.002 MAX.	.0016	[illegible]
CLOSING DROP OUT VOLTAGE					
OXIDIZER	4.6.17	VOLT (DC)	1 MIN.	1.75	[illegible]
FUEL	4.6.13	VOLT (DC)	1 MIN.	1.5	[illegible]

SPECIFICATION NUMBER RA0220-350	REVISION N/C	AMENDMENT #3	DNA	SERIAL NO [illegible]
			52-[illegible]	PART NO [illegible]
SE-6 COMPONENT ACCEPTANCE TEST			PART NAME [illegible]	

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAKAGE TEST--TCA PROPELLANT VALVES	4.8				
SEAT LEAKAGE RATE					
OXIDIZER	4.8.17	SCC/MIN	2.21 MAX.	LESS THAN 0.1	ANR 208
FUEL	4.8.22	SCC/MIN	2.21 MAX.	LESS THAN 0.1	ANR 208
PRE-TEST DATA					
DRY WEIGHT (EXCLUDING PROTECTIVE CLOSURES)	4.1.3	LB.	DNA	2.43	ANR 208
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	1.609	ANR 208
THROAT DIAMETER					
SECTION A-A		INCH	DNA	.364	ANR 208
B-B		INCH	DNA	.364	ANR 208
C-C		INCH	DNA	.364	ANR 208
D-D		INCH	DNA	.364	ANR 208
POST HOT-FIRE DATA					
PROOF PRESSURE TEST					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.17.1	LB.	DNA	2.55	ANR 208
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES					
STEP I	4.17.4	PSIG	392 ± 10	393	ANR 208
STEP II	4.17.4	PSIG	392 ± 10	395	ANR 208

SPECIFICATION NUMBER RA0220-350	REVISION N/C	AMENDMENT #3	DNA / 52-52700-271	SERIAL NO. 4060450 / PART NO. 208130-61
SE-6 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.1.3

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
POST HOT-FIRE DATA (CONTINUED)					
LEAKAGE TEST					
STEP I	4.17.4	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
STEP II	4.17.4	DNA	NONE ALLOWED	NONE DETECTED	ANR 203
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.17.4	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
LEAK TEST -- WELDED JOINTS					
LEAK TEST					
INLET TUBE PRESSURIZED WITH GASEOUS HELIUM					
OXIDIZER	4.17.5	PSIG	500 ± 10	VERIFIED	ANR 208
FUEL	4.17.8	PSIG	500 ± 10	VERIFIED	ANR 208
JOINT LEAKAGE RATE					
OXIDIZER	4.17.6	SCC/SEC.	10^{-6} MAX.	1.8×10^{-7}	ANR 209
FUEL	4.17.8	SCC/SEC.	10^{-6} MAX.	1.0×10^{-7}	ANR 208
LEAKAGE TEST -- TCA PROPELLANT VALVES					
SEAT LEAKAGE RATE					
OXIDIZER	4.17.9	SCC/SEC.	2.21 MAX.	LESS THAN 0.1	ANR 208
FUEL	4.17.9	SCC/SEC.	2.21 MAX.	LESS THAN 0.1	ANR 208

SPECIFICATION NUMBER	REVISION	AMENDMENT
RA0220-350	N/C	#3

DNA SERIAL NO. 4060450

52-52700-217 PART NO. 208130-61

SE-6 COMPONENT ACCEPTANCE TEST

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

5.1.4

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	1.609	ANR 208
THROAT DIAMETER (DELIVERED CONDITION)	4.18.1				
SECTION A-A		INCH	DNA	.3635	ANR 208
B-B		INCH	DNA	.364	ANR 208
C-C		INCH	DNA	.364	ANR 208
D-D		INCH	DNA	.364	ANR 208
DRY WEIGHT IN DELIVERED CONDITION (EXCLUDING PROTECTIVE COVERS AND CLOSURES)	4.18.2	LB.	DNA	2.24	ANR 208

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-350	N/C	#3	DNA	SERIAL NO.	4060450
			52-52700-217	PART NO.	208130-61
SE-6 COMPONENT ACCEPTANCE TEST			PART NAME	THRUST CHAMBER, 25 LB., ASSY OF	5.1.5

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN ***** TEST DATA	RUN ***** TEST DATA	RUN ***** TEST DATA	RUN 202 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	-	-	-	NFL	ANR 205
CELL LOCATION	-	-	-	-	-	1-C	ANR 205
CELL NUMBER	-	-	-	-	-	379	ANR 205
TEST DATE	-	-	-	-	-	14 AUG 64	ANR 205
TEST DURATION	SEC.	2 MIN.	-	-	-	3.0	ANR 205
ENVIRONMENTAL Pc	PSIA	0.16 MAX.	-	-	-	.0722	ANR 205
AMBIENT PRESSURE	PSIA	DNA	-	-	-	12.11	ANR 205
AMBIENT TEMPERATURE	°F	DNA	-	-	-	85.0	ANR 205
TIME OF DATA SLICE-START	SEC.	DNA	-	-	-	2.8	ANR 205
TIME OF DATA SLICE-END	SEC.	DNA	-	-	-	2.8	ANR 205
OXIDIZER TEMPERATURE	°F	DNA	-	-	-	67.0	ANR 205
FUEL TEMPERATURE	°F	DNA	-	-	-	74.0	ANR 205
OXIDIZER DENSITY	LB/FT^3	DNA	-	-	-	90.74	ANR 205
FUEL DENSITY	LB/FT^3	DNA	-	-	-	54.45	ANR 205
							OK MAC 38

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RAO 220-350	NC	3	DNA 52-52700-217	SERIAL NO. 4060450 PART NO. 208130-61
SE-6 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.2

CONFIDENTIAL

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.

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

R 15019-2

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN ***** TEST DATA	RUN ***** TEST DATA	RUN ***** TEST DATA	RUN 202 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	-	-	-	NFL	ANR 005
OXIDIZER INLET PRESSURE	PSIA	287 ± 10	-	-	-	289.1	ANR 005
FUEL INLET PRESSURE	PSIA	291 ± 10	-	-	-	288.7	ANR 005
OXIDIZER FLOWRATE	LB/SEC.	DNA	-	-	-	.0475	ANR 005
FUEL FLOWRATE	LB/SEC.	DNA	-	-	-	.0349	ANR 005
THRUST	LB.	DNA	-	-	-	23.3	ANR 005
MIXTURE RATIO	O/F	DNA	-	-	-	1.36	ANR 005
SPECIFIC IMPULSE	SEC.	DNA	-	-	-	283.	ANR 005
INJECTOR END Pc	PSIA	DNA	-	-	-	134.0	ANR 005
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	-	-	-	5442.	ANR 005
THROAT DIAMETER	INCH	DNA	-	-	-	.364	ANR 005
FUEL ORIFICE DIAMETER	INCH	DNA	-	-	-	.04405	ANR 005
OXIDIZER ORIFICE DIAMETER	INCH	DNA	-	-	-	.04180	ANR 005
TCA FIRING TIME (TOTAL)	SEC.	10 MAX.	-	-	-	3.0	ANR 005
OXIDIZER SAMPLE NUMBER	-	-	-	-	-	284	ANR 005
FUEL SAMPLE NUMBER	-	-	-	-	-	279	ANR 005

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SPECIFICATION NUMBER	REVISION	AMENDMENT			
RAO 220-350	NC	3	DNA 52-52700-217	SERIAL NO. 4060450	PART NO. 208130-61

OP MAC 38

SE-6 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

5.2.1

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

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

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN ***** TEST DATA	RUN ***** TEST DATA	RUN ***** TEST DATA	RUN 202 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	-	-	-	NFL	
ADJUST TO STANDARD CONDITIONS	-	-	-	-	-	-	-
THRUST	LB.	23 ± 1.2	-	-	-	23.4	ANR 995
MIXTURE RATIO	O/F	1.30 ± .04	-	-	-	1.33	ANR 995
SPECIFIC IMPULSE	SEC.	DNA	-	-	-	284.	ANR 995
INJECTOR END Pc	PSIA	DNA	-	-	-	133.6	ANR 995
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	-	-	-	5436.	ANR 995
ADJUST TO RATED CONDITIONS	-	-	-	-	-	-	-
THRUST	LB.	23	-	-	-	23.0	ANR 995
MIXTURE RATIO	O/F	1.3	-	-	-	1.30	ANR 995
SPECIFIC IMPULSE	SEC.	266 MIN.	-	-	-	284.	ANR 995
							OP 31 AC 38

SPECIFICATION NUMBER	REVISION	AMENDMENT	DNA	SERIAL NO. 4060450
RAO 220-350	NC	3	52-52700-217	PART NO. 208130-61
SE-6 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.2.2

R-15019-2

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

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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	52	63
	25 - 50	20	6	16
	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. ANR 208

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0615-003	B	#2	52-52700-217 PART NO. 208130-61	
SE-6 INFORMATION - CONTAMINATION			PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.3

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APPENDIX D

APPENDIX D

DESIGN APPROVAL TEST SPECIFICATION AND DATA

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DESIGN APPROVAL TEST OF COMPONENTS

FOR THE RE-ENTRY CONTROL SYSTEM

(SE-6)

THRUST CHAMBER ASSEMBLY

McDonnell Part Number - 52-52700-217
Rocketdyne Part Number - 208130-61
Test Number - 208130-401

EXCEPT PP 12, 29, 75, 117, 118, 135, 233, 234, 258, 336 & 350

THESE PP #'S VOID BY REV. B

(PRELIMINARY) (FINAL) APPROVAL

This drawing is ~~[illegible]~~ approved ~~[illegible]~~ (without) changes. Such approval does not relieve Seller warranty as provided in M A C. purchase order conditions.

EFF: PAT | CONT. DWG: 52-52700-217

[illegible] | 2 May 64

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

PREPARED BY

T.G.Kniffin

APPROVED BY

R. W. Helsel
Sr. Project Engineer
Gemini

NO. OF PAGES 354

REVISIONS

DATE 31 January 1964

DATE	REV. BY	PAGES AFFECTED	REMARKS	
May 25, 1964	[illegible]	5, 6, 20, 47, 48	Added extended inlet tube adapters to	A
		287, 288, 346	component for Vibration Tests.	
		,		
May 25, 1964	[illegible]	39 & 41	Revised procedure to include valve	A
			actuation during vacuum drying	
May 25, 1964	[illegible]	118	Changed 10 ±5 min to 20 ±5 min	A
May 25, 1964	[illegible]	7	Revised to read ±2% accuracy of full scale	A
May 25, 1964	[illegible]	9	Added sentence to cover reduced data presentation	A

Date	Rev. By	Pages Affected	Remarks	
6-5-64	E. Adams	105	Changed maximum to minimum.	A
6-8-64	E. Adams	8	Changed Class V to Class IV,	A
			changed Report 344A to PEM 25.C1G.	
6-8-64	E. Adams	9	Changed RA0616-009 to RA0610-009	A
			and RA615-003 to RA0610-003.	
6-8-64	E. Adams	340,341,342,349 & 352	Added Check Valve to Figures 2, 3,	A
			4, 10, & 13	
6-12-64	E. Adams	342	Removed propellant valve test	A
			panel, added diodes and closing	
			and opening time callouts on	
			Figure 4.	
6-18-64	E. Adams	343	Changed Figure 5 to show effect of	A
			zener diode on voltage trace.	
6-18-64	E. Adams	27,28	Added paragraph 6.1.6 and 6.1.9	A
			and revised paragraph numbers.	
6-22-64	E. Adams	62,71,113,186,193,213,	Changed psia to psig	A
		229,265,268,271,277,285,		
		302,308		
6-22-64	E. Adams	58,67,109,171,176,184,	Added voltage (26 ±0.5)	A
		196,204,210,226,262,267,		
		270,276,282,298		
6-22-64	E. Adams	59,68,110,299	Added voltage (12 ±2)	A
6-23-64	E. Adams	33,62,71,113,174,179,186,	Changed 0.002 to 0.0035	A
		193,202,213,225,229,265,		
		268,271,277,285,302,308		
6-26-64	E. Adams	25	Added paragraph 5.6.8	A
6-26-64	E. Adams	34	Change paragraph 6.5.11 and 6.5.13	A
6-26-64	E. Adams	342	Added milliammeter	A

FORM R 18-8-4

DESIGN APPROVAL TEST OF COMPONENTS

FOR THE RE-ENTRY CONTROL SYSTEM

(SE-6)

THRUST CHAMBER ASSEMBLY

McDonnell Part Number 52-52700-217
Rocketdyne Part Number 208130-61
Test Number 208130-401

Date	Rev. By	Page Affected	Remarks	
8-3-64	EA	4 & Subs	Revised Test Program	B
	EA	17,18 & 213 thru 331	Deleted TCA Unit #4 and #5	
	EA	15,113,114,115 & 116	Deleted Thrust Vector Tests	
	EA	14,166 thru 178, 179 thru 189 & 206 thru 212	Added Ex. Atmos; Fuel & Ox. Resist; and P.V. Cont. Duty Tests to Unit #1	
	EA	49 thru 63	Changed Vibration Test to Random	
	EA	16,217 thru 228,303 thru 307, 257 thru 285 & 233 thru 256	Revised Test Sequence on Unit #3	
	EA	77,79,81,83,85,87,89 91,93,95,151,153,155 159,161,163,195,197, 199,201,203,205,209, 211 & 213	Added Prop Valve Voltage & Currents on Data Sheets	
	EA	132,133,167,168,243 & 244	Added Disassembly & Inspection	B

~~(PRELIMINARY)~~ (FINAL) APPROVAL — B revision except pp 73-96, 147 & 166, 191-214, & 247 & 248.

This drawing is ~~dimensionally~~ approved ~~(with)~~ (without) changes. Such approval does not relieve Seller warranty as provided in M. A. C. purchase order conditions.

EFF: DAT | CONT. DWG: 52-52700-217

R L Martles | 15 Aug 64

FORM R 18-0-4

Date	Rev. By	Pages Affected	Remarks	
9-17-64	E. Adams	35, 36, 37 & 256	Revised firing procedure	C
8-28-64	E. Adams	52, 54, 56 & 58	Changed time of data sample	C
9-17-64	E. Adams	73	Revised procedure	C
9-22-64	E. Adams	97,98,99 & 105	Revised procedure	C
9-17-64	E. Adams	245 & 246	Revised Table I	C
9-17-64	E. Adams	246.1	Added Page No.	C
9-17-64	E. Adams	262	Revised Figure 11	C
10-21-64	E. Adams	38, 39, 40 & 41	Revised procedure	C
11-20-64	E. Adams	243, 243.1 & 244.1	Revised procedure and added page	C
10-26-64	E. Adams	245, 246	Revised Table I	D
10-26-64	E. Adams	256	Revised Figure 6	D

FORM R 18-0-4

THRUST CHAMBER ASSEMBLY

McDonnell Part Number	52-52700-217
Rocketdyne Part Number	208130-61
Test Number	208130-401

DESCRIPTION OF COMPONENT

The RCS Thrust Chamber Assembly consists of an ablation cooled thrust chamber and expansion nozzle segments, 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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4.		Schematic - Propellant Valve Functional
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6.		Schematic - TCA Hot Fire Propellant Feed System
7.		Drawing - Vibration and Shock
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ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

TEST NO. 208130-401 SHEET 1 OF 267

Reference: MAC SCD 52-52700, Rev. G

1.0 SCOPE

This specification establishes the method of test and the test equipment required to conduct the Design Approval Tests of three Thrust Chamber Assemblies for the McDonnell Aircraft Corporation Model 133P Re-Entry Control System as specified in McDonnell Aircraft Corporation Specification Control Drawing 52-52700, Rev. G, paragraph 6.3.1.3.2. A

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FORM 608-B-41 NEW 6-63

REVISION A Dated 26 May 64

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

TEST NO. 280130-401 SHEET 2 OF 267

Reference: a) MAC SCD 52-52700 Revision G

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 52-52700 which is the contractual controlling document.

2.1 McDonnell Aircraft Specifications

SCD 52-52700	Specification Control Drawing, MAC Model 133P, Re-Entry Control System Rev. G, dated 9 August 1963. (CONFIDENTIAL)
*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 Military Specifications

MIL-E-5272C-1	Environmental Testing, Aero and Associated Equipment, General Specification for, dated 20 January 1960.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

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2.2 d)	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
	*Federal Test Method Standard 151a, Method 811.1	Salt Spray Test, dated 6 May 1959
2.3	Rocketdyne Specifications	
	*RA0112-002	Lubricants, Anti-Seize Compounds and Gasketing Type Seal Compounds for Rocket Engines, dated 29 July 1963.
	RA0220-229	SE6 208130 Assembly Data Reduction and Adjustments, dated 23 July 1963.. (CONFIDENTIAL)
	*RA0220-350	SE6 Acceptance Testing, Thrust Chamber Assembly, dated 15 January 1964..
	*RA0220-290	SE6 Weight Determination, dated Oct 2, 1963.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

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2.3 (cont'd)	*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 Engine Hardware, dated 20 June 1963	
	*RA0610-003	Cleaning Space Engine Hardware by Liquid Flushing, dated 24 October 1963	A
	*RA0610-009	Chemical Cleaning of Filter Elements for Space Engines, dated 22 April 1964	
	*PEM 25.01G	Environmentally Controlled Areas, Definitions and Specifications for, dated 2 December 1963	A
	*RA0616-004	SE6 Propulsion System Inter and Intra Plant Handling, dated 20 March 1963	
	*SEM 4388-4040	Pulse Performance Data Reduction Procedure dated 22 July 1964	A
2.4	Rocketdyne Drawings		
	Drawing 208130 (-61)	Thrust Chamber, 25 lbs, 3 Min., Assy of, dated 26 September 1963	
	Drawing T5034526	Pressure Test and Water Fixture, dated 11 July 1963	
	Drawing 99-106040	Test Fixture Assy. - 25 lb Propellant Valve, dated 25 October 1963	

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

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2.4 (cont'd)	Drawing 99-106126	Adapter - Fitting, Assy of, dated 22 October 1963	
	Drawing RK395-38001	Protective Nozzle Cover	
	Drawing 99-106691	Tube, Assy of, dated 10 April 1964	A
	Drawing 99-106692	Tube, Assy of, dated 10 April 1964	A
	Drawing 99-106712	Thrust Chamber Installation 25# RCS, dated 17 April 1964	A
	Packaging Control Drawing RK 394-00011	Container, 25# RCS 3 min, with tubes extended, dated 27 April 1964	A
	Drawing 99-106728	Propellant Valve Orifice Adapter dated 23 September 1964	

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

TEST NO. 208130-401 SHEET 6 OF 267

Reference: (a) MAC SCD 52-52700, Revision G

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 RA0616-004 when the TCA is being transported, or stored between tests, except that components with extended Inlet tube adapters shall be packaged in container RK 394-00011. Adequate measures shall be taken to prevent accidental damage to the TCA at all times. A

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) 233

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

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REVISION A D. Marsden DATED 26 May 64

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

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

Calibration records shall be maintained and made available to authorized personnel upon request. Hot fire instrumentation shall be in accordance with specification RAO 201-050 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.

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)

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.

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DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

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3.7 (cont'd) 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 enclosure.

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 25.010. 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. The entire test setup shall be assembled and disassembled in a Class IV area. A A B

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DESIGN APPROVAL TEST OF COMPONENTS
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3.8 (cont'd) Cleaning of Test Setup Hardware:

The ten micron absolute stainless steel wire mesh filters shall be cleaned per Rocketdyne Specification RA0610-009 and stored in polyethylene bags until ready for use. Millipore filter housings shall be cleaned per Rocketdyne Specification RA0610-003 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. A A

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. A

Discussion of Data

In the final report all pertinent data obtained in the DAT series shall be analyzed and discussed. Any significant trends leading to pertinent conclusions or recommendation for further testing shall be covered.

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REVISION A J.D. Montgomery DATED 26 May 64

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

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3.9 (cont'd) Acceptance Test Data

Acceptance test data shall be retained and be included as part of the final report for this component.

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. 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 data of the most recent analysis shall be recorded for each hot fire test. However, in the event that propellant tanks are filled between DAT hot fire test subsequent hot fire testing shall be delayed pending the results of the analysis of the new propellant.

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DESIGN APPROVAL TEST OF COMPONENTS
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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
Prop	-	Propellant
psia	-	Pounds per Square Inch Absolute
psig	-	Pounds per Square Inch Gauge
RCS	-	Re-Entry Control System
RMS	-	Root - Mean - Square
SCC	-	Standard Cubic Centimeters
SCD	-	Specification Control Drawing
Sec	-	Seconds
TCA	-	Thrust Chamber Assembly
U	-	Upper
V	-	Volts or Valve
F_m	-	Maximum Thrust

3.13 Post Test Hardware Disposition

Upon successful completion of all Design Approval Test, the components shall be cleaned as required for shipment, packaged in accordance with RA0616-007, and shipped directly to MAC, St. Louis. This shall not include components which fail during DAT and for which a failure analysis is required, except that B

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DESIGN APPROVAL TEST OF COMPONENTS
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3.13 (cont'd) components showing unusual failure modes shall be made available to MAC following Rocketdyne failure analysis.

3.14 Definitions

*Duration - Total time from "first indication" in starting sequence to 2%-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, 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. B

* See Figure 11

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3.14 (cont'd) Soakout Period - Time required for slowest TCA skin temperature to stabilize and drop 5°F to verify that peak temperature has been reached. B

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

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Reference: MAC SCD 52-52700, Revision G, Figure 10

4.0 Test Program

Three Thrust Chamber Assemblies (P/N 208130-61), having passed the acceptance tests of RA0220-350, shall be subjected to Design Approval Tests in accordance with the requirements herein specified. For purposes of identification during the DAT program, the three TCA's shall be designated "one" through "Three", respectively. B B

4.1 Test Sequence

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

NOTE: Unit No. 4 of the original DAT program , which completed Salt Spray , shall be re-identified as Unit No. 3 in the revised DAT program. The next test sequence for Unit No.3 shall be Humidity. B

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

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4.1.1 Thrust Chamber Assembly Number One B

	Para.	SCD Page Reference
Pre-Test Inspection	7.1.1	6.2.2.1
Weight Determination	6.6	6.3.1.4.1
Vibration	7.1.2	6.2.3.17.3
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
Shock	7.1.3	6.2.3.1
Propellant Valve Proof Pressure & Leakage	6.1	6.2.3.1
Thrust Chamber Proof Pressure and 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 Failure	7.1.4	6.3.1.3.2.2
Explosive Atmosphere (Prop valves only)	7.1.5	6.2.3.13
Propellant Valve Proof Pressure and Leakage	6.1	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

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4.1.1 (cont'd)	Para.	Page	SCD Reference
Fuel and Oxidizer Resistance (Prop valves only)	7.1.6		6.2.3.18
Propellant Valve Electrical Resistance	6.3		6.2.3.2
Propellant Valve Functional	6.5		6.3.1.3.1
Propellant Valve Dielectric Strength	6.4		6.2.3.3
Propellant Valve Proof Pressure & Leakage	6.1		6.2.3.1
Propellant Valve Load Analysis	6.9		6.2.3.26
Propellant Valve Continuous Duty (Valves only)	7.1.7		6.3.1.3.2.2
Propellant Valve Proof Pressure & Leakage	6.1		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
Disassembly and Inspection	7.1.8		6.2.3.20.1

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4.1.2 Thrust Chamber Assembly Number Two B

	Para.	Page	SCD Reference
Pre-Test Inspection	7.2.1		6.2.2.1
Weight Determination	6.6		6.3.1.4.1
Temperature Shock	7.2.2		6.2.3.7
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 100 Seconds	7.2.3		6.3.1.3.2.2
Burst Pressure	7.2.4		6.3.1.3.2.2
Weight Determination	6.6		6.3.1.4.1
Disassembly and Inspection	7.2.5		6.2.3.20.1

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4.1.4 Thrust Chamber Assembly Number Three B

	Para.	Page	SCD Reference
Pre-Test Inspection	7.3.1		6.2.2.1
Weight Determination	6.6		6.3.1.4.1
Salt Spray	7.3.2		6.2.3.8
Propellant Valve Proof Pressure & Leakage	6.1		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		6.3.1.3.1.2
Humidity	7.3.3		6.2.3.10
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 136 Seconds	7.3.4		6.3.1.3.2.2
Weight Determination	6.6		6.3.1.4.1
Propellant Valve Service Life	7.3.5		6.3.1.3.2.2
Propellant Valve Proof Pressure and Leakage	6.1		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
Disassembly and Inspection	7.3.6		6.2.3.20.1

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

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Reference: MAC SCD 52-52700, Revision G

5.0 EQUIPMENT AND MATERIAL (Equivalent items may be used)

5.1 Material

5.1.1	Nitrogen Tetroxide	- MIL-P-26539A (Oxidizer) (0.3% H_2O permitted for Hot-Fire Tests only)
5.1.2	Monomethyl Hydrazine	- MIL-P-27404A (Fuel)
5.1.3	Nitrogen Gas	- MIL-P-27401A
5.1.4	Freon TF	- Commercial Grade
5.1.5	Butane	- Commercial Grade
5.1.6	Helium	- Federal Stock Number 6830-263-9842
5.1.7	Alcohol	- MIL-A-6091B (Reagent grade isopropyl alcohol, AM CHEM SOC standard is considered equivalent)
5.1.8	Leak Test Compound	- MIL-L-25567
5.1.9	Water	- Distilled and/or De-ionized (pH: 6.5 to 7.5)

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.

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

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5.2.1 (cont'd) The facility shall be equipped to meet the instrumentation requirements of Table I.

The facility shall be equipped with a high natural frequency thrust mount for axial thrust determination during DAT Duty Cycle operation. B

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 52-52700, Rev. G, 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. B

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. B

The facility shall be equipped with a rigid jig test fixture to which the TCA can be rigidly attached by use of those 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 rigidly attaching the propellant valve extended inlet tube lines to the test fixture. B

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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. B

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

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

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

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

5.2.3 Temperature Chamber

An enclosure in which the TCA propellant valves can be exposed to air temperatures of -40 to 200F. The temperature chamber shall be capable of maintaining any specified temperature within this range to ±5F. The air temperature shall be continuously recorded. The internal volume shall be sufficient so that all applicable test procedures can be accomplished. Instrumentation shall be provided for continuous recording of chamber temperatures.

5.2.4 Explosion Testing Chamber

An enclosure in which the TCA propellant valves can be exposed to a potentially explosive atmosphere, obtained by introducing butane in proper quantity, at simulated pressure altitudes from sea level to 50,000 feet. The facility shall include a spark igniter for demonstrating combustibility of the atmosphere. An environmental temperature of 160 ±5F shall be required with provision for continuous recording of the air temperature and propellant valve temperature.

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5.2.5 Humidity Chamber

An enclosure in which the TCA can be exposed to a relative humidity of 95 to 100 per cent at air temperatures of 68 to 160F. The humidity chamber shall be capable of maintaining any specified temperature within this range to ±5F. The humidity chamber air temperature shall be continuously recorded.

5.2.6 Salt Spray Chamber

An enclosure capable of subjecting the TCA to a corrosive atmosphere in accordance with the requirements of Federal Test Method Standard 151a, Method 811.1.

5.2.7 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 can be rigidly attached by use of those attach points shown in Figure 7. The test fixture shall be capable of being mounted on the shock machine such that the TCA can be shocked along the plus and minus direction of each of the three mutually perpendicular axes shown in Figure 7. Provision shall be made for rigidly attaching the propellant valve inlet lines to the test fixture.

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

The facility shall be equipped with an oscilloscope (Tektronix, Model 535 or 564) for monitoring the accelerometer output.

5.2.8 Electronic Cycler

A device which can be used to cycle the propellant valves at cycle rates of 1,2,3,4 and 5 cycles per second. A cycle shall consist of poppet closed to poppet open to poppet closed. The cycler shall

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5.2.8(cont'd) include a counter for counting the cycles.

5.2.9 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, ±1/4 % accuracy, full scale

G_3 - 0 to 1000 psig, ±1% accuracy, full scale

G_4 - 0 to 1000 psig, ±1/4% accuracy, full scale

G_{10} - 0 - 300 psig, ±3% accuracy, propellant compatible

5.3.2 Valves

V_1, V_2, V_3 - 1/4" hand valve, 0 to 1000 psig

V_{10}, V_{20}, V_{30} - 1/4" hand valve, propellant compatible, 0 to 500 psig

5.3.3 Regulators

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

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5.3.4 Filters

F_1 - Filter, 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 Propellant Valve Test Panel - P/N 99-9020285-11

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

5.4.5 Oscillograph - 2000 cps frequency response, ±2% accuracy (for Load Analysis)

5.4.6 Switch - 40 watt minimum power rating

5.4.7 High Voltage Leak Detector - Associated Research, Model 411

5.4.8 Impedance Bridge - 0 to 50 ohms, ±1/10% accuracy

5.4.9 Voltmeter - Hewlett Packard, Model 412A, 0 to 30 VDC and 0 to 100 VDC, ±1% full scale accuracy

5.4.10 Temperature Recorder - Leeds and Northrop, ±3% accuracy

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5.4.11	Thermocouple - Bare wire junction, accuracy class D per RA0201-050	
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	Pressure Test and Water Flow Fixture (Throat Plug) - P/N T5034526	
5.6.2	Protective Nozzle Cover - P/N RK395-38001	
5.6.3	Camera-Polaroid (with oscilloscope adapter)	
5.6.4	Adapter-Fitting, Assy of (Propellant Valve Inlet Adapter) P/N 99-106126	
5.6.5	Test Fixture Assy - 25 lb Propellant Valve (Propellant Valve Outlet Adapter) - P/N 99-106040	
5.6.6	Scale - 0 to 25 pounds, 0.01 pound subdivisions	
5.6.7	Stop Watch - One second subdivisions	
5.6.8	Milliammeter- Weston Model 1951, 0-200 MA.	A
5.6.9	Seal Assembly - 9017831	A

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REVISION A J.D. Mangus Dated 6/26/64

REVISION A _____ Dated _____

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST OPERATIONAL TESTS AND PROCEDURES TEST NO. 208130-401 SHEET 25 OF 267

Reference: NAC SCD 52-52700, 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 REENTRY CONTROL SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY — PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST: PROPELLANT VALVE PROOF PRESSURE AND LEAKAGE — TEST NO. 208130-401 SHEET 26 OF 267

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.2.3.1

6.1 Propellant Valve Proof Pressure and Leakage

6.1.1 Install the TCA in a test setup as shown in 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.

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

6.1.2 Slowly adjust the regulated helium supply pressure at the oxidizer 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 oxidizer 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. A

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

6.1.8 Attach the leakage sensing line and arrange the leakage testing equipment as shown in Figure 2. A

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

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REVISION A J. D. Morgan Dated 6/18/64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

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NAME OF TEST: PROPELLANT VALVE PROOF PRESSURE AND LEAKAGE — TEST NO. 208130-401 SHEET 27 OF 267

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. A

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

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

6.1.13 Repeat the above procedure on the fuel propellant valve. A

6.1.14 Remove the TCA from the test setup. Replace all protective covers. A

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

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NAME OF TEST: THRUST CHAMBER PROOF PRESSURE AND LEAKAGE — TEST NO. 208130-401 SHEET 28 OF 267

Reference: MAC SCD 52-52700 Revision G, paragraph 6.2.3.1

6.2 Thrust Chamber Proof Pressure and Leakage

6.2.1 Install the TCA in a test setup as shown in 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 welds on the TCA and to the transition joint between the stainless steel shell and the ablative material on the TCA nozzle exterior.

6.2.4 Energize the fuel propellant valve with 12±2 VDC

6.2.5 Slowly increase the regulated GN_2 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 GN_2 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.

6.2.9 Wash residual leak test compound from the TCA with 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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COMPONENT NAME: THRUST CHAMBER ASSEMBLY — PART NO. MAC 52-52700-217 / NAA 208130-61 -401

NAME OF TEST: PROPELLANT VALVE ELECTRICAL RESISTANCE — TEST NO. 208130 SHEET 29 OF 267

Reference: MAC SCD 52-52700 Revision G, paragraph 6.2.3.2

6.3 Propellant Valve Electrical Resistance

6.3.1 Install the electrical harness on the propellant valves. Provide an environmental 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 oxidizer valve. The acceptable resistance is as shown on Figure 15

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

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

6.3.6 Repeat paragm phs 6.3.3 and 6.3.4 on the fuel valve. B

6.3.7 Remove the electrical harness from the propellant valves and reinstall the protective covers on the propellant valve electrical connectors.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY — PART NO. MAC 52-52700-217, NAA 208130-61

NAME OF TEST: PROPELLANT VALVE DIELECTRIC STRENGTH — TEST NO. 208130-401 SHEET 30 OF 267

Reference: MAC SCD 52-52700 Revision G, paragraph 6.2.3.3

6.4 Propellant Valve Dielectric Strength

6.4.1 Install the electrical harness on the propellant valves. Attach ground leads to each of the propellant valve electrical connector bodies 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 oxidizer valve and the other lead to the oxidizer 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 microamps 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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NAME OF TEST PROPELLANT VALVE DIELECTRIC STRENGTH — TEST NO. 208130-401 SHEET 31 OF 267

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 oxidizer valve and the other lead to the oxidizer 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 oxidizer valve and the other to lead C of the oxidizer 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 oxidizer valve. See paragraph 3.6. B

6.4.17 Repeat paragraphs 6.4.2 through 6.4.16 on the fuel valve.

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

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NAME OF TEST PROPELLANT VALVE FUNCTIONAL TEST NO. 208130-401 SHEET 32 OF 267

Reference: MAC SCD 52-52700, Revision G, paragraph 6.3.1.3.1

6.5 Propellant Valve Functional A

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 oxidizer 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 0.0065 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 GN_2 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 oxidizer 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 0.0035 seconds from electrical signal to poppet closed. A

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6.5.8 Adjust the GN_2 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 oxidizer valve opens as indicated by a pressure drop. The maximum acceptable pull in voltage is 16 VDC as indicated on the output voltmeter. A

6.5.12 Reduce the GN_2 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. A

6.5.14 Open the mercury switch.

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

6.5.16 Repeat paragraphs 6.5.1 through 6.5.15 on the fuel propellant valve.

6.5.17 Remove electrical leads and the GH_2 supply.

6.5.18 Replace all protective closures.

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COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST WEIGHT DETERMINATION TEST NO. 208130-401 SHEET 34 OF 267

Reference: MAC SCD 52-52700, Revision G, 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 RA02[illegible]-290 and record.

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T.G. Kniffin	4/30/64				
CHECKED BY:	DATE				
	4-2-64		4-30-64		

FORM 608-B-44 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY — PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST THRUST CHAMBER ASSEMBLY FIRING PROCEDURE — TEST NO. 208130-401 SHEET 35 OF 267

Reference: MAC SCD 52-52700 Revision G, paragraph 6.3.1.3.2.2

6.7 Thrust Chamber Assembly Firing Procedures

6.7.1 Install the TCA in a thrust mount located in a hot fire test installation equipped with instrumentation per Table I. Pressure check all connections using GN_2 at 50 ±10 psig, seal assembly 9017831, and leak test compound.

6.7.1.1 For cape cycle firings, the firing duration shall be controlled automatically. The required propellant feed system is shown schematically in Figure 6 .

6.7.1.2 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. The required propellant feed system is shown schematically in Figure 6 . B

6.7.2 Open facility propellant valves.

6.7.3 Pressurize facility propellant tanks to approximate run pressures. C

6.7.4 Open the oxidizer bleed valve to bleed entrained gas from the oxidizer feed system. Continue bleeding until entrained gas is eliminated as evidenced by a steady oxidizer flowmeter signal.

6.7.5 Close oxidizer bleed valve.

6.7.6 Repeat paragraphs 6.7.4 and 6.7.5 on the fuel feed system.

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T.G. Kniffin	8-12-64				
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	8-12-64		8-12-64		

FORM 603-B-44 NEW 6-63

REVISION C J.D. Mangles, Dated 9-17-64

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST THRUST CHAMBER ASSEMBLY FIRING PROCEDURE TEST NO. 208130-401 SHEET 36 OF 267

C

6.7.7 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.

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

Oxidizer Inlet Pressure	287 ±10 psia
Fuel Inlet Pressure	291 ±10 psia

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

6.7.10 Fire TCA as required to accomplish test objectives.

6.7.11 Immediately following termination of firing reduce pressure altitude to local ground level conditions. Close the facility propellant valves and adjust GN_2 purge pressurant to 120 ±10 psig.

NOTE: (1) Maintain altitude following the completion of the DAT Duty Cycle to minimum duration. Record temperature data during the soak out period of 20 ±5 minutes. After soak out temperature is reached complete the Hot Fire Burst Pressure Test procedure of paragraph 7.2.4. TCA skin temperature must not exceed 650 °F after MDC soakout.

(2) Maintain altitude following the completion of the DAT Duty Cycle to Guaranteed Life. Record temperature data during the soak out period of 20 ±5 minutes. No failure criteria shall be attached to the soakout temperature after the MDC to guaranteed life.

C

PREPARED BY: J. Ganger	DATE 9/17/64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: R W Dinius Lc	DATE 9-17-64	[signature]	9-17-64		

FORM 608-B-44 NEW 6-63

REVISION C [signature] Dated 9-17-64

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST THRUST CHAMBER ASSEMBLY FIRING PROCEDURE TEST NO. 208130-401 SHEET 37 OF 267

6.7.12 Open the propellant bleed valves and purge with GN_2 for a period of 30 seconds (minimum). C

6.7.13 Close the propellant bleed valves.

6.7.14 Cycle the TCA oxidizer and fuel valves three times simultaneously and leave in the open position.

6.7.15 Continue to purge for two minutes.

6.7.16 Close the TCA oxidizer and fuel valves.

6.7.17 Secure the test facility.

6.7.18 Remove the TCA from the Hot Fire Test installation. C

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PREPARED BY: J. Ganger	DATE 9/17/64	APPROVED FOR NAA: [signature]	DATE 9-17-64	APPROVED FOR McDONNELL:	DATE
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FORM 608-B-44 NEW 6-63

REVISION C J.D. Marrogino Dated 9-17-64

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-01 -401

NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 208130 SHEET 38 OF 267

6.8 Decontamination Procedure

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

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

6.8.2 Attach 10 VDC (nominal) electrical power supply leads to the oxidizer valve 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 for ten minutes using 12 $\pm$2 VDC to open the oxidizer valve. C

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

6.8.5 Open the GN_2 supply valve and purge the oxidizer side as follows for ten (10) cycles. C

(a) 5 $\pm$1 seconds on-time
(b) 5 $\pm$1 seconds off-time

NOTE: The GN_2 pressure and temperature, will be same as paragraph 6.8.4.

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

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FORM 608-B-44 NEW 6-63

Rev. C J. D. Marrogeni dated 10/21/64

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 208130-401 SHEET 39 OF 267

6.8.7 Disconnect the supply line from the oxidizer valve.

6.8.8 Cap the valve adapter and disconnect the electrical connector.

6.8.9 Repeat paragraph 6.8.1 through 6.8.8 on the fuel valve.

6.8.10 Install the TCA in the decontamination facility.

6.8.11 Attach the facility alcohol supply line to the TCA fuel valve.

6.8.12 Cap the TCA oxidizer inlet line.

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

6.8.14 Energize the TCA fuel valve to the open position with 12 ±2 VDC.

6.8.15 Flow alcohol through the TCA for 2 $^{+1}_{-0}$ minutes. The alcohol shall be flowed at a TCA inlet pressure of 35 to 50 psig.

6.8.16 Flow alcohol through the TCA as follows for ten (10) cycles, using 26 ±1 VDC at a TCA inlet pressure of 35 to 50 psig. C

(a) 5 ±1 seconds on-time
(b) 5 ±1 seconds off-time

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

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

6.8.19 Energize the TCA fuel valve to the open position with 12 ±2 VDC.

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Rev. C J. D. Mavrogenis dated 10/21/64

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 208130-401 SHEET 40 OF 267

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

6.8.21 Cycle valve ten (10) times with GN_2 at a pressure of 120 ±10 psig as follows using 26 ±1 VDC. C

(a) 5 ±1 seconds on-time
(b) 5 ±1 seconds off-time

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

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

6.8.24 Remove cap from TCA oxidizer valve inlet.

6.8.25 Attach Freon TF supply line to TCA oxidizer valve inlet.

6.8.26 Energize TCA oxidizer valve to open position with 12 ±2 VDC.

6.8.27 Flow Freon TF through the TCA for 2 $^{+1}_{-0}$ minutes. The Freon shall be flowed at a TCA inlet pressure of 35 to 50 psig.

6.8.28 Flow Freon TF through the TCA as follows for ten (10) cycles, using 26 ±1 VDC at a TCA inlet pressure of 35 to 50 psig. C

(a) 5 ±1 seconds on-time
(b) 5 ±1 seconds off-time

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

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

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R. Cole	[signature] 10-20-64	
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[signature] 10-20-64		

FORM 608-B-44 NEW 6-63

Rev. C J. D. Mavrogenis dated 10/21/64

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 208130-401 SHEET 41 OF 267

6.8.31 Energize the TCA oxidizer valve to open position with 12 ±2 VDC.

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

6.8.33 Cycle valve ten (10) times with GN_2 at a pressure of 120 ±10 psig as follows using 26 ±1 VDC. C

(a) 5 ±1 seconds on-time
(b) 5 ±1 seconds off-time

6.8.34 De-energize the TCA oxidizer valve to closed position.

6.8.35 Remove the GN_2 supply line from the TCA oxidizer valve and cap the oxidizer valve inlet.

6.8.36 Connect 10 VDC (nominal) power supply to the TCA fuel valve so that the propellant valves may be energized simultaneously.

6.8.37 Uncap both TCA propellant inlets and place TCA in a vacuum oven.

6.8.38 Attach temperature sensing elements to one propellant valve and the injector upper face.

6.8.39 Heat the TCA to indicated temperature of 150 ±10 F.

6.8.40 Energize both TCA propellant valves and activate the vacuum equipment so that the TCA is subjected to an internal pressure of one (1) psia or less for a period of not less than fifteen (15) minutes. The TCA valve and injector temperature shall be maintained at 150 ±10 F during the specified time period.

6.8.41 Remove electrical leads and install all protective covers.

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PREPARED BY: R. Cole	DATE	APPROVED FOR NAA: R J Eide	DATE 10-20-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY: [signature]	DATE 10-20-64				

FORM 608-B-44 NEW 6-63

Rev. C J. D. Marrogeois dated 10/21/64

R-15019-2

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE LOAD ANALYSIS TEST NO 208130-401 SHEET 41 OF 267

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.1.2

6.9 Propellant Valve Load Analysis

6.9.1 Install the propellant valve in a test setup as shown in Figure 14. Connect the oscillograph to monitor propellant valve current and voltage versus time. Set the "PULL IN - DROP OUT" switch of the propellant valve test panel to "PULL IN". Leave the line switch in the open position. See paragraph 3.8.

6.9.2 Adjust the regulated GN_2 supply pressure to 300 ±10 psig.

6.9.3 Set "VALVE DC POWER" switch to "ON".

6.9.4 Adjust DC power supply so that 20 ±0.5 VDC is indicated on the output voltmeter.

6.9.5 Set "VALVE DC POWER" switch to "OFF" and close the line switch.

6.9.6 Adjust oscillograph paper speed for 60 inches per second. Activate the oscillograph.

6.9.7 By use of the "VALVE DC POWER" switch energize the propellant valve for approximately 200 milliseconds or more to obtain oscillograph traces of current and voltage versus time. The trace shall include energize and de-energize transients and steady state conditions.

6.9.8 Deactivate the oscillograph and inspect the oscillograph traces to determine the voltage and the current at that point in time which makes the power a maximum. Power in watts is defined as the product of voltage in volts and current in amps. Record the current, voltage and power on the data sheet.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Griffin	1-31-64	P. Eide	1-31-64		
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	1-31-64				

FORM 608-B-44 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST PROPELLANT VALVE LOAD ANALYSIS TEST NO 208130-401 SHEET ~~42~~ OF ~~267~~

6.9.8.1 Load analysis is performed primarily for information purposes. However, a requirement exists that when this test is run at valve body temperatures of 160F the power consumption of the propellant valve shall not exceed 20 watts when the energizing voltage is 26 ± 4 VDC. Failure to pass this requirement shall constitute a failure of the propellant valve.

6.9.9 Record on the oscillograph trace the propellant valve serial number, the applied voltage and the environmental temperature.

6.9.10 Repeat paragraphs 6.9.3 through 6.9.9 for voltages of 22, 24, 26, 28, 30 and 33 VDC.

6.9.11 Reduce the regulated GN_2 supply pressure to zero.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	1-31-64	R. Eide	1-31-64		
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	1-31-64				

FORM 608-B-44 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE REMOVAL TEST NO 208130-401 SHEET 43 OF 267

6.10 Propellant Valve Removal

6.10.1 See Figure 7. Separate the propellant valves from the thrust chamber by cutting the propellant valve brackets and feed tubes along the line AB. All cutting shall be done by saw.

6.10.2 Separate the propellant valves from each other by cutting the bracket which joins them.

6.10.3 Attach to each propellant valve a propellant valve outlet adapter. (P/N 99-106040). Cut excess bracket and feed tube material from the valve as necessary to install the valve into the outlet adapter.

6.10.4 Package the thrust chamber for storage per RA0615-004.

PREPARED BY: T.G. Kniffin	DATE 1-31-64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
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FORM 608-B-44 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 208130-401 SHEET 43.1 OF 267

6.11 Propellant Valve Orifice Removal. B

6.11.1 Remove oxidizer and fuel valve tube assemblies (P/N 407571) from TCA.

6.11.2 Remove retaining rings and orifices.

NOTE: Use caution in removing orifice to prevent damage. (Reference Paragraph 3.8 for cleanliness requirements)

6.11.3 Package and identify each orifice and retaining ring.

6.11.4 Reweld tube assemblies to propellant valves.

6.11.5 Secure packaged orifices and retaining rings to the applicable valves.

6.11.6 Perform 500 psig leak check to verify structural integrity of weld joints.

6.11.7 Reidentify TCA 208130-61 as 208130-61 DAT.

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PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
E. Adams	10-1-64	R H Eide	10-8-64		
CHECKED BY: R C C	DATE 10-1-64				

FORM 608-B-44 NEW 6-63

REVISION B _____ Dated _____

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 208130-401 SHEET 44 OF 267

Reference: MAC SCD 52-52700, Revision G, Figure 10

7.0 Environment and Service Life Tests

In this section the required environment and service life tests are specified for each of the three TCA's. 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
T.G. Kniffin	1-31-64	R. Eide	1-31-64		
CHECKED BY:	DATE				
	1-31-64				

FORM 608-B-44 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 208130-401 SHEET 45 OF 267

Reference: MAC SCD 52-52700, Revision G, Figure 10

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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PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	1-31-64	R. Eide	1-31-64		
CHECKED BY:	DATE				
W.H. Plank	1-31-64				

FORM 608-B-44 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PRE-TEST INSPECTION TEST NO. 208130-401 SHEET 47 OF 254

Reference: MAC SCI 52-52700, Revision G, Paragraph 6.2.2.1

7.1.1 Pre-Test Inspection - TCA #1

7.1.1.1 Test Procedure

7.1.1.1.1 Verfiy 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 RA0220-350. Only those TCA's meeting the above requirements shall be accepted for DAT.

7.1.1.1.2 Braze the extended propellant valve inlet tube adapters (P/N 99-106691 and 99-106692) to the oxidizer and fuel propellant valves per RA0607-009. Remove after vibration test and braze basic inlet tube adapters (P/N 99-106126) to TCA. A

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

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	5/22/64	R.M. Eide	5/22/64		
CHECKED BY:	DATE				

FORM 608-B-44 NEW 6-63

REVISION A DATED 26 May 64

R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY — PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST: PRE-TEST INSPECTION — TEST NO. 208130-401 SHEET 18 OF 354

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.	52-52700-217		
Rocketdyne Part No.	208130-61	401551	401558
Component Serial No.	4056174	9198041	9202617

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, 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 RA0220-350. YES (yes or no) 6-26-64 ANR 815

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. YES (yes or no) 6-26-64 ANR 815 A

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. NO (yes or no) A

7.1.1.2.2.4 Inspection Remarks

NONE.

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T.G. Kniffin 5/22/64			VERIFIED BY USAF: DATE

FORM 608-B-43 NEW 6-63

REVISION A J.D. Thompson DATED 26 May 64

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO 208130-401 SHEET 4 OF 35

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.2.3.17.1

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 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. A

7.1.2.1.2 Activate the oscillograph.

7.1.2.1.3 Vibrate the TCA sinusoidally with the frequency varying logarithmically from 5 to 2000 cps and back to 5 cps in 15 minutes per Figure 8.

7.1.2.1.4 Repeat paragraph 7.1.2.1.3.

7.1.2.1.5 Deactivate the oscillograph.

7.1.2.1.6 Analyze the oscillograph records to determine whether resonance occurred. Record for each resonant condition the frequency, accelerometer output and the response axis.

7.1.2.1.6.1 Resonance shall be defined as an amplitude response of 1.5 times the input.

7.1.2.1.6.2 If resonant frequencies were not indicated, repeat paragraphs 7.1.2.1.3 and 7.1.2.1.4.

7.1.2.1.6.3 If more than six resonant frequencies occurred, vibration testing shall be stopped. Authorization to continue shall be subject to coordination with MAC engineering.

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T.G. Griffin	1-31-64	R. Eder	1-31-64		
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	1-31-64				

FORM 608-B-44 NEW 6-63

Revision A J. D. Bourgeois Dated 6/29/64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 51 OF 54

7.1.2.1.7	Vibrate the TCA for seven minutes at each of the resonant frequencies noted in paragraph 7.1.2.1.6. In the case of more than six resonant frequencies, vibrate at those frequencies which were specified by MAC. In the event of a structural failure, see paragraph 3.6.	A
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.	
7.1.2.1.9	Repeat paragraphs 7.1.2.1.1 through 7.1.2.1.7 except that the direction of vibration input shall be along the Z axis.	
7.1.2.1.10	Remove the TCA from the test setup.	
7.1.2.1.11	Perform Propellant Valve Proof Pressure and Leakage Test per paragraph 6.1.	
7.1.2.1.12	Perform Thrust Chamber Proof Pressure and Leakage Test per paragraph 6.2.	
7.1.2.1.13	Perform Propellant Valve Electrical Resistance Test per paragraph 6.3.	
7.1.2.1.14	Perform Propellant Valve Dielectric Strength Test per paragraph 6.4.	
7.1.2.1.15	Perform Propellant Valve Functional Test per paragraph 6.5.	

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T. G. Kniffin	1-31-64	R. Eide	1-31-64		
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	1-31-64				

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 53 OF 354

7.1.2.2 Test Data - TCA #1

7.1.2.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52700-217

Rocketdyne Part No. 208130-61

Component Serial No. 4056174

7.1.2.2.2 Vibration test (reference paragraph 7.1.2.1)

7.1.2.2.2.1 Resonant Survey - X Axis

First Scan				Second Scan			
Freq. cps	Input g's	Output g's	Location X,Y,Z or bracket (Yb)	Freq. cps	Input g's	Output g's	Location X,Y,Z or bracket (Yb)
432	5.0	15.0	Y	420	5.0	12.0	Y
550	8.0	35.0	Z	535	8.0	25.0	Z
720	8.0	35.0	Z	715	8.0	40.0	Z
760	8.0	40.0	X	750	8.0	30.0	X
775	8.0	35.0	Z	775	8.0	40.0	Z
925	8.0	30.0	YB	905	8.0	32.0	YB
1475	8.0	22.0	YB	1470	8.0	20.0	YB
1750	8.0	20.0	Y	1840	8.0	20.0	Y

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 1-31-64	R. A. Koch 7/1/64	M. J. Fogarty 7/1/64	James D. Marrogeni 7/1/64
			VERIFIED BY USAF: DATE 7/1/64

FORM 608-B-43 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 52 OF 354

7.1.2.2.2.2 Resonant Vibration - X Axis

	Freq. cps	Input g's	Output g's	Duration ~~10~~ +0.1 -0 minutes
	437	5.0	30.0	7.0 MIN.
* START FINISH	555 452	8.0	70.0	7.0 MIN.
	705	8.0	46.0	7.0 "
	741	8.0	19.0	7.0 "
	849	8.0	58.0	7.0 "
	898	8.0	18.0	7.0 "
	1425	8.0	17.0	7.0 "
	1810	8.0	14.0	7.0 "

Inspection Remarks

*THE FREQUENCY GRADUALLY SHIFTED FROM 555 CPS. TO 452 CPS DURING 7.0 MIN. DWELL.

DYE PENETRANT TEST (RUN AFTER "X" AXIS) REVEALED NO DAMAGE TO T.C.A.

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR ROCKETDYNE: DATE
T.G.Kniffin 1-31-64	[illegible] 7/1/64	M. J. Fogarty 7/1/64	[illegible] 7/1/64
			VERIFIED BY USAF: 7/1/64 DATE [illegible]

FORM 608-D-43 REV 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET ~~54~~ OF ~~354~~

7.1.2.2.2.3 Resonant Survey - Y Axis

First Scan				Second Scan			
Freq. cps	Input g's	Outlet g's	Location X,Y,Z or bracket (Yb)	Freq. cps	Input g's	Output g's	Location X,Y,Z or bracket (Yb)
544	8.0	30.0	X	550	8.0	40.0	X
630	8.0	20.0	X	620	8.0	20.0	X
730	8.0	40.0	Z	748	8.0	40.0	Z
810	8.0	55.0	Z	818	8.0	70.0	Z
1010	8.0	30.0	X	1010	8.0	35.0	Z
1380	8.0	30.0	X	1430	8.0	30.0	X

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 1-31-64	R.A. Hoch 7/2/64	M. J. Fogarty 7/2/64	S L Mantler 7 Jul 64
			VERIFIED BY USAF: DATE
			Chas C Phelps 7-2-64

FORM 608-B-43 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 25 OF 354

7.1.2.2.2.4 Resonant Vibration - Y Axis

Freq. cps	Input g's	Output g's	Duration ~~10~~ 7 ±0.1 minutes
544	8.0	30.0	7.0 MIN.
619	8.0	19.5	7.0 "
736	8.0	41.0	7.0 "
813	8.0	110.0	7.0 "
886	8.0	36.0	7.0 "
1424	8.0	22.0	7.0 "

Inspection Remarks

THE DYE PENETRANT TEST DID NOT REVEAL ANY CRACKS IN THE WELD JOINTS 7/2/64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR MCDONNELL: DATE
T.G.Kniffin 1-31-64	R.A. Hook 7/2/64	M. J. Fogarty 7/2/64	R L Martin 7 Jul 64
			VERIFIED BY USAF: DATE 7-2-64

FORM 608-D-43 NEW 6-63

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 56 OF 351

7.1.2.2.2.5 Resonant Survey - Z Axis

	First Scan					Second Scan				
	Freq. cps	Input g's	Output g's	Location X,Y,Z or bracket (Yb)		Freq. cps	Input g's	Output g's	Location X,Y,Z or bracket (Yb)	
ANR 921	397	5	20	X	ANR 921	401	5	12	X	
ANR 921	430	5	15	X	ANR 921	408	5	20	Z	
ANR 921	466	5	12	X	ANR 921	446	5	20	Z	
ANR 921	543	8	25	Z	ANR 921	503	8	129	Z	
ANR 921	592	8	119	Z	ANR 921	689	8	157	Z	
ANR 921	690	8	150	Z	ANR 921	728	8	147	Z	
ANR 921	731	8	147	Z	ANR 921	878	8	98	Z	
ANR 921	879	8	80	Z	ANR 921	1396	8	30	Z	
ANR 921	1395	8	15	X	ANR 921	1435	8	14	X	
ANR 921	1620	8	24.5	Z	ANR 921	1630	8	30	Z	

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 1-31-64	M.E. KING	ANR 921	VERIFIED BY USAF: DATE

FORM 608-D-43 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET ~~51~~ OF ~~354~~

7.1.2.2.2.6 Resonant Vibration - Z Axis

Freq. cps	Input g's	Output g's	Duration ~~10~~ 7 +0.1 -0 minutes
402	5.0	13.2	7.0 MIN.
408	5.0	20.0	7.0
435	5.0	12.2	7.0
619	8.0	70.0	7.0
684	8.0	160.0	7.0
707	8.0	175.0	7.0
875	8.0	110.0	7.0
1383	8.0	18.0	7.0
1425	8.0	15.5	7.0
1624	8.0	22.5	7.0

Inspection Remarks

* DYE PENETRANT TEST (AFTER Z AXIS) REVEALED A CRACK AT WELD JOINT OF TUBE STUB AND FUEL PROP. VALVE, ALSO AT CORNERS OF MOUNTING BRKT. AND INJECTOR FACE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 1-31-64	R. A. Hoch 7/6/64	* 7/6/64	K L Mantler 7 Jul 64
			VERIFIED BY USAF: DATE

FORM 608-B-43 NEW 6-63

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UNIT #1

DEVIATION RECORD

~~STRUCTURAL APPROVAL & MATERIALS REVIEW~~

UNIT, SERIAL ~~OR SHIP~~ NO. 1 (CIRCLE ONE) S/N 4056174 PART ~~ASSEMBLY~~ NO. 208130-61

INSP. AUTH.	MAT. REV. ENG.	PART NO.	TYPE OF REPAIR	MECH. NO.	INSP. ACCEPT.	CUST.
X	DATE 6-30-64	208130-61	NONE	DATE 6-30-64	6/30/64	6/30/64

Discrepancy	Disposition
A DEVIATION TO THE DAT SPECIFICATION 208130-401 IS REQUESTED TO PERFORM A ONE "G" SWEEP TO CALIBRATE ACCELEROMETERS PRIOR TO INITIATION OF	PERFORM ONE "G" SWEEP TO CALIBRATE ACCELEROMETERS PRIOR TO INITIATION OF VIBRATION TEST, EACH AXIS. HOLE CK. X MAT. CK.

INSP. AUTH.	MAT. REV. ENG.	PART NO.	TYPE OF REPAIR	MECH. NO.	INSP. ACCEPT.	CUST.
X	DATE	S/N 4056174	NONE	DATE		

Discrepancy	Disposition
VIBRATION TEST, IN ADDITION, THE DWELL TIME OF PARAGRAPH 7.1.2.1.7 SPECIFIES TEN MINUTES AT EACH RESONANT FREQ. IT IS REQUESTED TO	James D. Monaghan MAC Engineering 6/30/64 CHANGED DWELL TIME FROM TEN MINUTES TO SEVEN MINUTES HOLE CK. X MAT. CK.

INSP. AUTH.	MAT. REV. ENG.	PART NO.	TYPE OF REPAIR	MECH. NO.	INSP. ACCEPT.	CUST.
X	DATE	X	NONE	DATE	6/30/64	6/30/64

Discrepancy	Disposition
CHANGE THE DWELL TIME FROM TEN MINUTES TO SEVEN MINUTES	MAC 6/30/64 HOLE CK. X MAT. CK.

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FORM R 60-W

Void If Not Written in Ink

R-15019-2

UNIT #1

UNIT, SERIAL OR SHIP NO S/N 4056174 PART NO 208130-61

INSP AUTH	MAT. REV. ENG.	PART NO.	TYPE OF REPAIR	MECH. NO.	INSP. ACCEPT.	CUST.
	DATE	208130-61	NONE	DATE 7-1-64	7/2/64	

Discrepancy	Disposition
A DEVIATION TO THE DAT SPECIFICATION 208130-401 IS REQUESTED. PARAGRAPH 7.1.2.1.6.3 STATES THAT IF MORE THAN 6 RESONANT FREQUENCIES OCCUR, VIBRATION TESTING SHALL TERMINATE AND AUTHORIZATION FROM MAC TO CONTINUE. EIGHT RESONANT FREQUENCIES OCCURED DURING VIBRATION TESTING IN THE X-AXIS.	VIBRATE THE TCA FOR SEVEN MINUTES DWELL AT EACH OF THE EIGHT RESONANT POINTS Acceptable by MAC James D. Thompson MAC Engrg 7/1/64 HOLE CK. MAT. CK.

INSP. AUTH.	MAT. REV. ENG.	S/N ~~PART NO.~~	TYPE OF REPAIR	MECH. NO.	INSP. ACCEPT.	CUST.
	DATE	4056174	NONE	DATE	7/2/64	

Discrepancy	Disposition
II A DEVIATION TO THE DAT SPECIFICATION 208130-401 IS REQUESTED TO PERFORM A DYE CHECK ON ALL TCA WELD JOINTS FOLLOWING COMPLETION OF EACH VIBRATION AXIS.	PERFORM THE DYE CHECK ON ALL THE TCA WELD JOINTS FOLLOWING THE COMPLETION OF EACH VIBRATION AXIS Requested by James D. Thompson MAC Engrg 7/1/64 HOLE CK. MAT. CK.

INSP. AUTH.	MAT. REV. ENG.	PART NO.	TYPE OF REPAIR	MECH. NO.	INSP. ACCEPT.	CUST.
	DATE			DATE		

Discrepancy	Disposition
TEN (10) RESONANT FREQUENCIES OCCURRED DURING THE VIBRATION TEST IN THE Z AXIS. TESTING TERMINATED AWAITING AUTHORIZATION FROM MAC TO CONTINUE TESTS.	VIBRATE THE TCA FOR SEVEN MINUTES DWELL AT EACH OF THE TEN RESONANT POINTS. [illegible] MAC Engrg 7-1-64 HOLE CK. MAT. CK.

FORM R 60-W

R-15019-2

Void If Not Written in Ink

UNIT #1

STRUCTURAL APPROVAL & MATERIALS REVIEW

UNIT, SERIAL OR SHIP NO. (CIRCLE ONE) 1 S/N 4056174 ASSEMBLY NO. 208130-61

INSP. AUTH.	MAT. REV. ENG.	PART NO.	TYPE OF REPAIR	MECH. NO.	INSP. ACCEPT.	CUST.
	DATE	208130-61	NONE	DATE		

Discrepancy	Disposition
DURING FUEL PROP. VALVE PROOF TEST AFTER VIBRATION, EXCESSIVE LEAKAGE OCCURRED AT WELD JOINT OF FUEL INLET TUBE AND PROP. VALVE, TUBE WAS FOUND TO BE CRACKED AFTER VIB. IN Z AXIS BY DYE PENETRANT TEST, ALSO DYE TEST REVEALED CRACKS AT MATING CORNERS OF MOUNTING BRKT. AND INJECTOR FACE INSIDE CORNERS. 7/6/64	REF OFR # 20413R.
	HOLE CK.
	MAT. CK.

INSP. AUTH.	MAT. REV. ENG.	PART NO.	TYPE OF REPAIR	MECH. NO.	INSP. ACCEPT.	CUST.
	DATE			DATE		

Discrepancy	Disposition
	HOLE CK.
	MAT. CK.

INSP. AUTH.	MAT. REV. ENG.	PART NO.	TYPE OF REPAIR	MECH. NO.	INSP. ACCEPT.	CUST.
	DATE			DATE		

Discrepancy	Disposition
	HOLE CK.
	MAT. CK.

FORM R 60-W

Void if Not Written in Ink

R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 58 OF 354

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

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 ±10)	— psig	* psig
Time Duration (3 minimum)	— minutes	____ minutes
Leakage Voltage (26 ±0.5)	— VDC	____ VDC
Inlet Pressure (500 ±10)	— psig	____ psig
Time Duration (5 minimum)	— minutes	____ minutes
Leakage Rate (2.23 maximum)	— scc He/min	____ scc He/min

A

Inspection Remarks

* WITH 50 PSIG APPLIED EXCESSIVE LEAKAGE OCCURRED AT WELD JOINT OF FUEL VALVE BODY AND INLET TUBE

7/6/64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 4/30/64 6-22-64 1-31-64	F. E. Pope 7-6-64		VERIFIED BY USAF: DATE

FORM 603-B-43 NEW 6-63

REVISION A J.D. Martyn Dated 6/22/64

R-15019-2

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PRE-TEST INSPECTION TEST NO. 208130-401 SHEET 46 OF 267

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.2.2.1

7.1.1 Pre-Test Inspection - TCA #1A

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 RA0220-350. Only those TCA's meeting the above requirements shall be accepted for DAT.

7.1.1.1.2 Braze the extended propellant valve inlet tube adapters (P/N 99-106691 and 99-106692) to the oxidizer and fuel propellant valves per RA0607-009. Remove after vibration test and braze basic inlet tube adapters (P/N 99-106126) to TCA. A

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

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	5/22/64	R.A. Eide	5/26/64		
CHECKED BY:	DATE				
[illegible]	[illegible]				

FORM 608-B-44 NEW 6-63

REVISION A J.D. Mangum DATED 26 May 64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PRE-TEST INSPECTION TEST NO. 208130-401 SHEET 48 OF 267

7.1.1.2 Test Data - TCA #1A

7.1.1.2.1 Component Identification

Component Name	TCA	Oxidizer Valve	Fuel Valve
McDonnell Part No.	52-52700-217 (ANR 815)		
Rocketdyne Part No.	208130-61	407557	407558 (ANR 815)
Component Serial No.	4CC0448	8759999	9202637

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, 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 RA0220-350. YES (yes or no) 6-27-64 (ANR 815)

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. YES (yes or no) 1-27-64 (ANR 815) A

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. YES (yes or no) A

7.1.1.2.2.4 Inspection Remarks

NONE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 5/22/64	9/1/64	9/1/64	9/4/64
			VERIFIED BY USAF: DATE 9/4/64

FORM 608-B-43 REV 6-63

W

REVISION A DATED 26 May 64

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DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PRE-TEST INSPECTION TEST NO. 208130-401 SHEET 48 OF 267

7.1.1.2.3 Weight Determination test (reference paragraph 6.6)

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

The TCA dry weight was 2.36 pounds.
(Record to the nearest one-hundredth pound)

Inspection Remarks TCA WAS WEIGHTED WITH EXTENDED ADAPTER TUBES INSTALLED.

TCA WAS WEIGHTED WITH BASIC INLET ADAPTER TUBES INSTALLED. WEIGHT WAS 2.29 POUNDS 9-2-64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T. G. Kniffin	F. T. Pope 8-28-64	M. J. Fogarty 8/28/64	D. L. Gann 8-28-64
			VERIFIED BY USAF: DATE

FORM 603-B-43 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET ___ OF ___

IL 4388-5342

Deviation Request:

Please continue with paragraph 6.5 even though oxidizer closing time exceeded maximum of .0035 seconds, actual closing time was .0036 seconds.

Recopied from original request dated 1, September 1964.

James D. Mavrogenis
Jim Mavrogenis
MAC Engineering
12-2-64

R. Cole
R. Cole
Gemini DAT-RAT Unit

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FORM 608-B-42 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO 208130-401 SHEET ___ OF ___

IL 4388-5343

Deviation Request:

Please continue with paragraph 6.5 even though fuel closing time exceeded maximum of .0035 seconds, actual closing time was .0037 seconds.

Recopied from original request dated 1, September 1964.

James D. Mavrogenis
Jim Mavrogenis
MAC Engineering
12-2-64

R. Cole
R. Cole
Gemini DAT-RAT Unit

FORM 608-B-42 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61 }

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 49 OF 267

Reference	MAC SCD 52-52700, Revision G, Paragraph 6.2.3.17.3	B
7.1.2	Vibration - TCA #1A	
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	Perform a ten (10) second vibration table equalization run at the test level to verify spectrum shape and tolerance.	
7.1.2.1.3.1	Record and analyze the data.	
7.1.2.1.3.2	The random vibration input shall be per Figure 8.	
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.	

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PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	8-7-64	[illegible]	8-12-64		
CHECKED BY: [illegible]	DATE 8-11-64				

FORM 608-B-44 NEW 6-63

REVISION B _____ Dated _____

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 50 OF 267

7.1.2.1.3.4 The overall RMS acceleration level is to be 8.8 G's, plus fifteen (15) percent, minus zero (0) percent. B

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 verifying 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 ten (10)±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 Repeat paragraphs 7.1.2.1.1 through 7.1.2.1.5.1 except that the direction of vibration input shall be along the Y axis (see Figure 7).

7.1.2.1.7 Repeat paragraphs 7.1.2.1.1 through 7.1.2.1.5.1 except that the direction of vibration input shall be along the Z axis (see Figure 7).

7.1.2.1.8 Remove the TCA from the test setup.

7.1.2.1.9 Perform Propellant Valve Proof Pressure and Leakage Test per paragraph 6.1.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	8-7-64				
CHECKED BY:	DATE				
	8-11-64		8-12-64		

FORM 608-B-44 NEW 6-63

REVISION B _____ Dated _____

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61 -401

NAME OF TEST VIBRATION TEST NO. 208130 SHEET 51 OF 267

7.1.2.1.10	Perform Thrust Chamber Proof Pressure and Leakage Test per paragraph 6.2.	B
7.1.2.1.11	Perform Propellant Valve Electrical Resistance Test per paragraph 6.3.	
7.1.2.1.12	Perform Propellant Valve Dielectric Strength Test per paragraph 6.4.	
7.1.2.1.13	Perform Propellant Valve Functional Test per paragraph 6.5.	
7.1.2.1.14	Remove the extended inlet tube adapters and install the basic inlet tube adapters per paragraph 7.1.1.1.2.	
7.1.2.1.15	Perform Weight Determination per paragraph 7.1.1.1.3.	

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	7-15-64	[illegible]	8-12-64		
CHECKED BY: [illegible]	DATE 8-11-64				

FORM 608-B-44 NEW 6-63

REVISION B _____ Dated _____

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 52 OF 267

7.1.2.2 Test Data - TCA #1A B

7.1.2.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52700-217

Rocketdyne Part No. 208130-61

Component Serial No. 4060448

7.1.2.2.2 Accelerometer Identification (Reference Figure 7)

Location	Sensitive Axis	Identification No.
TCA Input	X	113
TCA Input	Y	113
TCA Input	Z	113
Valve Bracket	Y	1119
Injector Plate	Y	116
TCA Shell at Comb. Zone	X	944
TCA Shell at Comb. Zone	Z	1005

C

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin	C. Gordon 8/29/64	8-29-64	9/4/64
			VERIFIED BY USAF: DATE 8/29/64

FORM 608-D-43 NEW 6-63

REVISION B _____ DATED _____

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REVISION C R.L. Martts DATED 28 Aug 64

53

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 53 OF 267

7.1.2.2.3 Vibration Test (Reference paragraph 7.1.2.1) B

7.1.2.2.3.1 Resonant Survey - X Axis

Freq. cps	Input g's	Output g's	Identification (no)
422	1	9	944
445	1	16	944
463	1	19	944
482	1	31	944
635	1	13.5	944
744	1	13.5	1005
760	1	11	944
853	1	7	1119

WB W

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	8.8 G RMS	27 sec.	27 sec.

WB W

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
COLE	R.A. Hack 8-24-64	8-28-64	J.D. Marrogamis 9/14/64
			VERIFIED BY USAF: DATE
			W.B. Hubschen 9/4/64

FORM 608-B-43 NEW 6-63

W

REVISION B ~~Dated~~

299

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 54 OF 267

7.1.2.2.3.3 Random Vibration Test - X Axis

Accelerometer outputs were recorded for analysis at the following elapsed times for paragraph 7.1.2.1.5:

SAMPLE #1 (1 ±0.5 Minute) 1 MIN WB
SAMPLE #2 (4 ±0.5 Minutes) 4 MIN WB
SAMPLE #3 (7.5±0.5 Minutes) 7.5 MIN WB

The elapsed time at test cutoff was 10.0 minutes. WB

Results of the Analysis:

SAMPLE #1 See 4M20-5-29 X Axis shaped 60-65 second slice time WB

SAMPLE #2 See 4M20-5-29 X Axis shaped 240-245 second slice time WB

SAMPLE #3 See 4M20-5-29 X Axis shaped 450-455 second slice time WB

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
COLE	P. A. Koch 9/8/64	M. J. Fogarty 9/8/64	L.D. Mennegems 9/14/64
			VERIFIED BY USAF: DATE
			[illegible] 9/8/64

FORM 603-B-43 NEW 6-63

REVISION B ——— DATED ———

REVISION C [illegible] DATED 28 Aug 64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRIST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 55 OF 267

B

7.1.2.2.3.4 Resonant Survey - Y Axis

Freq. cps	Input g's	Output g's	Identification (no)
380	1	4.5	944
468	1	3	944
710	1	8	1119
730	1	16	1119
745	1	18	1119
830	1	4.5	1005
1350	1	4	944
1800	1	4	116

TFC 1139

7.1.2.2.3.5 Vibration Table Equalization Test - Y Axis

Test No	Satisfactory Spectrum Shape	Satisfactory RMS G Level	Test Duration	Accumulated Duration
1	YES	5.56 GRMS	28 sec	28 sec

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
COLE	R. A. Hack 8-24-64	M. J. Fogarty 9/8/64	J. D. Mangeris 9/4/64
			VERIFIED BY USAF: DATE

FORM 608-D-43 REV 6-63

REVISION B _____ Dated _____

301

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 56 OF 267

7.1.2.2.3.3 Random Vibration Test - Y Axis

Accelerometer outputs were recorded for analysis at the following elapsed times for paragraph 7.1.2.1.5:

SAMPLE #1 (1 ±0.5 Minute) 1 MIN
SAMPLE #2 (4 ±0.5 Minutes) 4 MIN
SAMPLE #3 (7.5±0.5 Minutes) 7.5 MIN

The elapsed time at test cutoff was 10.0 minutes.

Results of the Analysis:

SAMPLE #1 See 4M20-5-29 Y Axis shaped 60-65 second slice time

SAMPLE #2 See 4M20-5-29 Y Axis shaped 240-245 second slice time

SAMPLE #3 See 4M20-5-29 Y Axis shaped 450-455 second slice Time

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
Cole	R.O. Hack 9/8/64	M. J. Fogarty 9/8/64	J.D. Montgomery 9/14/64
			VERIFIED BY USAF DATE

FORM 608-B-43 NEW 6-63

REVISION B ____ DATED ____

REVISION C R.L. Martin DATED 24 Aug 64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 57 OF 267

7.1.2.2.3.7 Resonant Survey - Z Axis B

Freq. cps	Input g's	Output g's	Identification (no.)
380	1	5	944
415	1	11	1005
580	1	30	1005
630	1	5.5	1005
680	1	32	1005
730	1	9	1005
760	1	6	1005
855	1	4.5	1005

7.1.2.2.3.8 Vibration Table Equalization Test - Axis Z

Test No	Satisfactory Spectrum Shape	Satisfactory RMS G Level	Test Duration	Accumulated Duration
1	NO	8.8 g	30 sec.	30 sec.
2	NO	8.8 g	10 sec.	40 sec.
3	YES	8.8 g	12 sec.	52 sec.

8-31-64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA: DATE	CERTIFIED FOR McDONNELL: DATE
COLE	8-31-64 C. Gordon	8-31-64 J. Hughes	J.D. Marrogenis
			VERIFIED BY USAF: DATE 9/4/64 W. Bollenbacher

FORM 608-B-43 NEW 6-63

REVISION B _____ Dated _____

W 303

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 58 OF 267

7.1.2.2.3.3 Random Vibration Test - Z Axis B

Accelerometer outputs were recorded for analysis at the following elapsed times for paragraph 7.1.2.1.5:

SAMPLE #1 (1 ±0.5 Minute) 1 MIN
SAMPLE #2 (4 ±0.5 Minutes) 4 MIN
SAMPLE #3 (7.5±0.5 Minutes) 7.5 MIN

WEB

C

The elapsed time at test cutoff was 10.0 minutes.

Results of the Analysis:

SAMPLE #1 See 4M20-5-29 Z Axis shaped 60-65 second slice time

SAMPLE #2 See 4M20-5-29 Z Axis shaped 240-245 second slice time

SAMPLE #3 See 4M20-5-29 Z Axis shaped 450-455 second slice time

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
Cole	P. A. Hook 9/8/64	M. J. Fogarty 9/8/64	J. D. Mangenis 9/14/64
			VERIFIED BY USAF: DATE
			[illegible] 9/8/64

FORM 608-B-43 NEW 6-63

REVISION B _____ DATED _____

REVISION C [illegible] DATED 28 Aug 64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 59 OF 267

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

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 ±10)	500 psig	500 psig
Time Duration (3 minimum)	4.0 minutes	4.0 minutes
Leakage Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (500 ±10)	500 psig	500 psig
Time Duration (5 minimum)	8.0 minutes	6.0 minutes
Leakage Rate (2.23 maximum)	ZERO scc He/min	ZERO scc He/min

A

Inspection Remarks

NONE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 4/30/64 6-22-64 1-31-64	A.F. Zavon 9-1-64	M. J. Fogarty 9/1/64	W.E. Hines 9-1-64
			VERIFIED BY USAF: DATE

FORM 608-B-43 NEW 6-63

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REVISION A J.D. Mavrogan Dated 6/22/64

REVISION B _____ Dated _____

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 60 OF 267

.1.2.2.3.11 Thrust Chamber Proof Pressure and Leakage test (reference paragraph 6.2) B

	1st Application	2nd Application
Proof Pressure		
Pressure (392 ±10)	392 psig	392 psig
Time Duration (3 ±0.25)	3.0 minutes	3.0 minutes
Voltage (12 ±2)	12 VDC	12 VDC

A

Inspection Remarks

NO VISIBLE LEAKAGE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 1-31-64	9-1-64	9/1/64	9-1-64
			VERIFIED BY USAF: DATE

FORM 608-B-43 NEW 6-63

REVISION A Dated 6/22/64

REVISION B Dated

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 61 OF 267

7.1.2.2.3.12 Propellant Valve Electrical Resistance test (reference paragraph 6.3) B

Environmental Temperature 70 (70 ±10F). WB

Resistance A - B WB

Oxidizer Valve 42.3 ohms (Acceptable per Figure 15, yes or no YES). WB

Fuel Valve WB 42.8 ohms (Acceptable per Figure 15, yes or no YES). WB

Resistance C - D (1.0 maximum)

Oxidizer Valve 0.10 ohms WB

Fuel Valve 0.26 ohms WB

Inspection Remarks

NONE WB

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G.Kniffin	1-31-64	A.F. Zavan	9-1-64	M. J. Fogarty	9/1/64	J.D. Marrogenis	9/14/64
						VERIFIED BY USAF	DATE
						[illegible]	9/1/64

FORM 608-B-39 NEW 6-63

REVISION B _____ Dated _____

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61 401

NAME OF TEST VIBRATION TEST NO. 208130- SHEET 62 OF 267

7.1.2.2.3.13 Propellant Valve Dielectric Strength test (reference paragraph 6.4) B

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 +10 -0	Current Microamps 500 max.	Voltage Volts 500 +10 -0	Current Microamps 500 max.
A to Ground	500	75	500	42
C to Ground	500	60	500	19
A to C	500	22	500	17

Inspection Remarks

NONE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 1-31-64	A.F. Zavar 9-1-64	M. J. Fogarty 9/1/64	J.D. Mangum 9/14/64
			VERIFIED BY USAF: DATE

FORM 608-B-43 NEW 6-63

REVISION B _____ Dated _____

R-15019-2

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

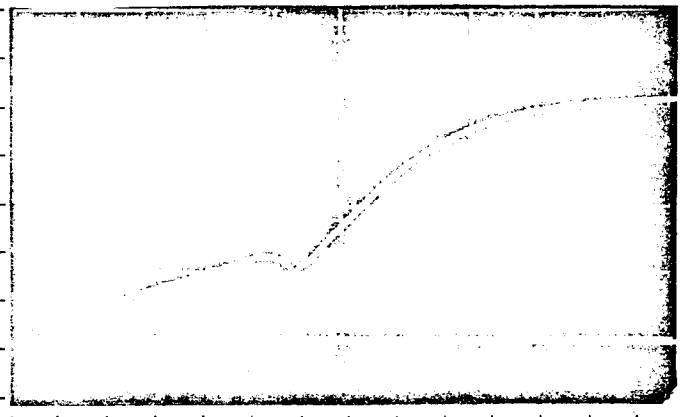
PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
J. Lally	595399	ENV. LAB.	2061	9-1-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #1A) S/N 4060448	208130-61	POST VIBRATION PROP. VALVE FUNCTIONAL (Response time)

OXIDIZER VALVE

P/N 407557 S/N 8759999

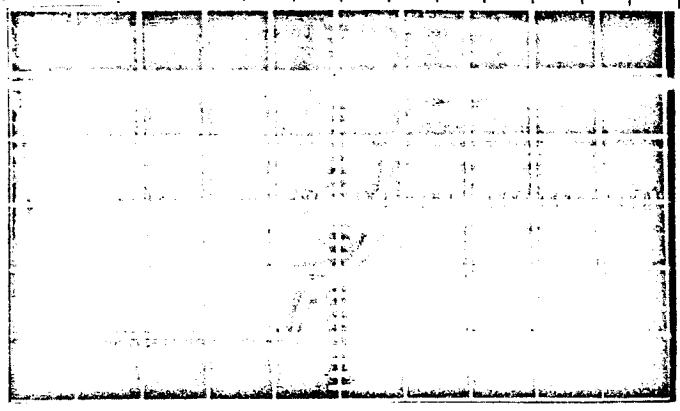
CURRENT TRACE
(Opening time)



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

Requirement = .0065 sec. max.
Actual = .0043 sec.

VOLTAGE TRACE
(Closing time)



Horizontal = 0.5ms/cm
Vertical = 10v/cm

Requirement = .0035 sec. max.
Actual = .0036 sec *

* Reference deviation

Form 600-V-67 Rev. 10-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE ____ OF ____

LAB TEST NO. ____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
J.Lally	595399	ENV.LAB.	2061	9-1-64

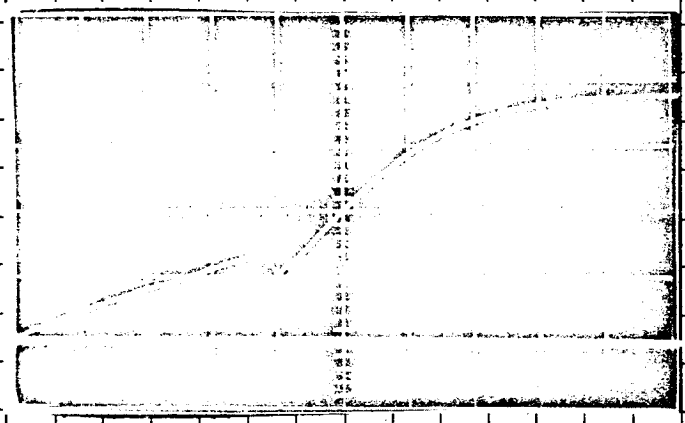
PART	PART NO.	TYPE OF TEST
25# TCA (Unit #1A)	208130-61 S/N 4060448	POST VIBRATION FUNCTIONAL (Time Response)

FUEL VALVE

P/N 407558 S/N 9202637

CURRENT TRACE

(Opening Time)



Horizontal = 1 milli sec/cm

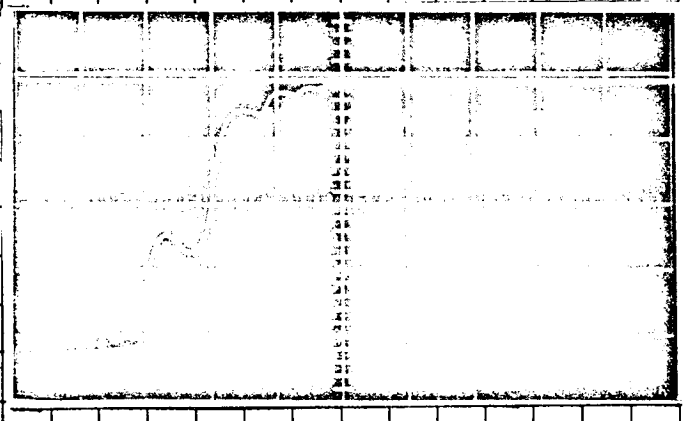
Vertical = 20 milli volt/cm

Requirement = .0065 sec.

Actual = .0040 sec.

VOLTAGE TRACE

(Closing Time)



Horizontal = 1 milli sec/cm

Vertical = 10 volts/cm

Requirement = .0035 sec

Actual = .0037 sec *

* Reference Deviation

R-15019-2

Form 600-W-67 New 10-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION TEST NO. 208130-401 SHEET 63 OF 267

7.1.2.2.3.14 Propellant Valve Functional test (reference paragraph 6.5) B

	Oxidizer Valve	Fuel Valve	
Response Time			
Ambient Temperature (70 ±10)	70 F	70 F	
Energizing Voltage (26 ±0.5)	26 VDC	26 VDC	
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig	A
Opening Time (0.0065 maximum)	0.0043 seconds	.0040 seconds	
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig	
Closing Time (0.0035 maximum)	* 0.0036 seconds REF. DEVIATION	* .0037 seconds REF DEVIATION.	A
Low Voltage Operation			
Ambient Temperature (70 ±10)	70 F	70 F	
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig	A
Opening Voltage (16 maximum)	7.5 VDC	7.0 VDC	
Inlet Pressure (zero for "drop-out")	0 psig	0 psig	
Closing Voltage (1.0 minimum)	1.26 VDC	1.15 VDC	

Inspection Remarks

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 6-22-64 4/30/64 1-31-64	J. Lally 9-1-64	L. Johnson 9-1-64	I.D. Mavrogenis 9/14/64
			VERIFIED BY DOAF: DATE

FORM 608-B-43 NEW 6-63

REVISION A I.D. Mavrogenis Dated 6/22/64
REVISION B _____ Dated _____

311

64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST SHOCK TEST NO. 208130-401 SHEET 64 OF 267

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.2.3.16

7.1.3 Shock - TCA #1A

7.1.3.1 Test Procedure

7.1.3.1.1 Install the TCA into the shock testing facility.

The direction of shock input shall be along the + X Axis of the TCA (see Figure 7).

7.1.3.1.2 Apply a half sine wave shock of $15 \pm {}^{1.5}_{0}$ g magnitude and 11 ± 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. Inspect the TCA for visible evidence of damage following the application of the shock. In the event of a structural failure, see paragraph 3.6.

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.

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.

7.1.3.1.8 Perform Thrust Chamber Proof Pressure and Leakage per paragraph 6.2.

PREPARED BY: T. G. Kniffin	DATE 1-31-64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 1-31-64	R. Eide	1-31-64		

FORM 608-B-44 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST SHOCK TEST NO 208130-401 SHEET 65 OF 267

7.1.3.1.9 Perform Propellant Valve Electrical Resistance per paragraph 6.3.

7.1.3.1.10 Perform Propellant Valve Dielectric Strength per paragraph 6.4.

7.1.3.1.11 Perform Propellant Valve Functional per paragraph 6.5.

PREPARED BY: DATE	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
T.G. Kniffin 1-31-64	R. Eide 1-31-64	
CHECKED BY: DATE		
1-31-64		

FORM 608-B-44 NEW 6-63

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Page 1 of 6
Lab Test No. 4K20-17-21

Prepared by	EWR No.	Facility	Date
V. DAVIS	595399	CANO	9-4-64

Part	Part No.	Serial No.
TCA	208130-61	4060448

Metering Pin Data

Hyge Unit 6401
Acceleration 15.G ± 1.5G
Acc. Waveshape HALF-SINE
Acc. Time 11 m SEC ± 1 m SEC

Accelerated Mass

a. Specimen and fixture 55.0 lbs.
b. Carriage 30.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 185.0 lbs.

Hydraulic Fluid Level

a. 80. ~~inches~~ c.c. as measured down from top of top cylinder.
b.

Operational Data

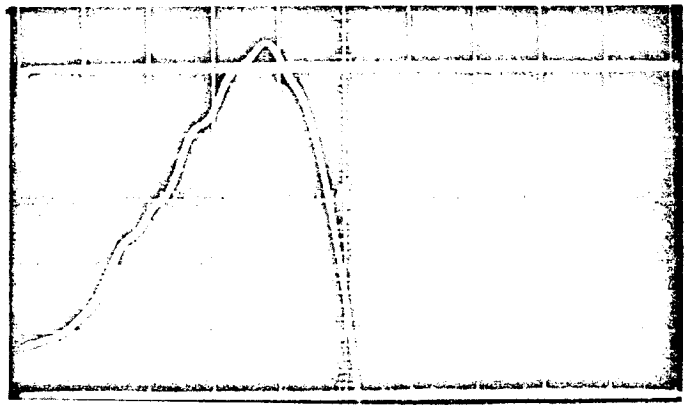
Set Pressure 18. psig
Firing Pressure 250. psig
Brake Pressure 70. psig
Accumulator Pressure — psig
(Alternate Firing)

Deceleration Orifice Position

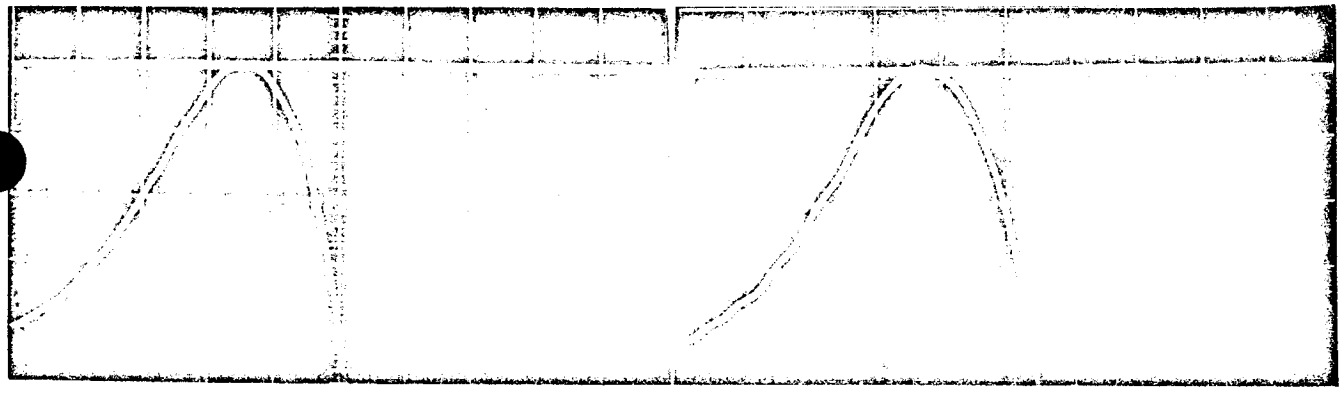
a. ____ Contour side up
b. ✓ Contour side down

Calibration

Vertical (G's/square) 3.
Horizontal (MS/square) 2.
Accelerometer STATHAM
A5TC-50-350; SN 7030



No. 1 +X AXIS 16.2G 10.5 M.S.



No. 2 +X AXIS 15G 10.5 M.S. No. 3 +X AXIS 10G

Remarks: TESTED ACCORDING TO DESIGN APPROVAL OF COMPONENTS FOR THE RE-ENTRY CONTROL SYSTEM (SE-6)
TEST NUMBER 208130-401

Form 600-V-69 New 3-64

R-15019-2

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Lab Test No. HK20-17-21

Prepared by	EWR No.	Facility	Date
V. DAVIS	595389	CANOGA	9-4-64
Part	**Part No.**	**Serial No.**	
TCA	208130-61	4060448	

Metering Pin Data

Hyge Unit 6401
Acceleration 15G ± 1.5G
Acc. Waveshape HALF-SINE
Acc. Time 11 M.SEC ± 1M.SEC

Accelerated Mass

a. Specimen and fixture 55.0 lbs.
b. Carriage 30.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 135.0 lbs.

Hydraulic Fluid Level

a. 80 ~~inches~~ cc as measured down from top of top cylinder.
b.

Operational Data

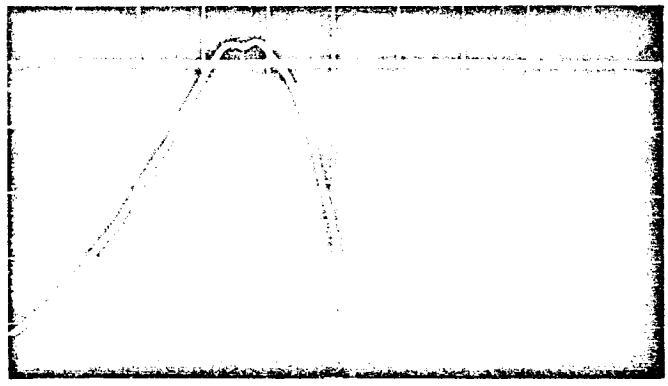
Set Pressure 18 psig
Firing Pressure 250 psig
Brake Pressure 70 psig
Accumulator Pressure — psig
(Alternate Firing) —

Deceleration Orifice Position

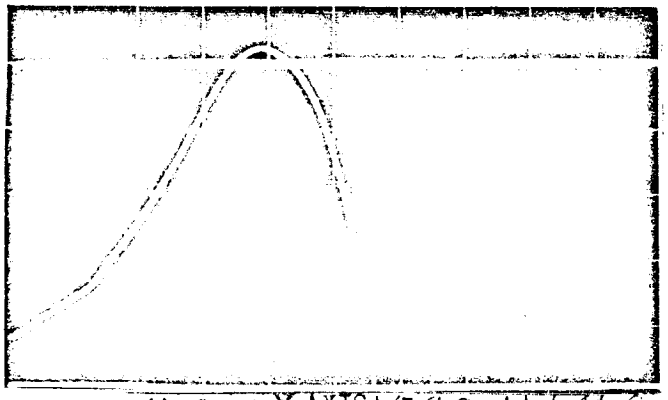
a. _____ Contour side up
b. ✓ Contour side down

Calibration

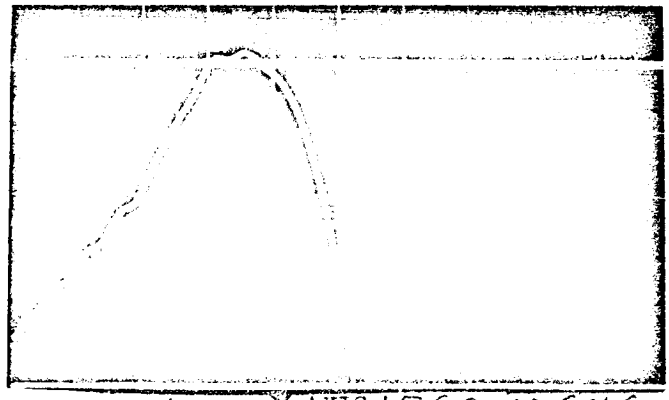
Vertical (G's/square) 3.
Horizontal (MS/square) 2.
Accelerometer STRAIN
ASTC-50-35C SN7030



No. I —X AXIS 16.1 G. 10.9 M.S.



No. 2. —X AXIS 16.8 G. 11.1 M.S.



No. 3 —X AXIS 15.6 G. 10.6 M.S.

Remarks: SAME AS PAGE ONE

Form 600-V-69 New 3-64

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Lab Test No. 4420-12-21

Prepared by	EWR No.	Facility	Date
V. DAVIS		CANO.	9-4-64

Part	Part No.	Serial No.
T.C.A.	208130-61	4060448

Metering Pin Data

Hyge Unit 6401
Acceleration 15G ± 1.5G
Acc. Waveshape HALF-SINE
Acc. Time 11 M.SEC. ± 1 M.SEC.

Hydraulic Fluid Level

a. 80 ~~inches~~ C.C. as measured down from top of top cylinder.
b.

Deceleration Orifice Position

a. ____ Contour side up
b. ✓ Contour side down

Calibration

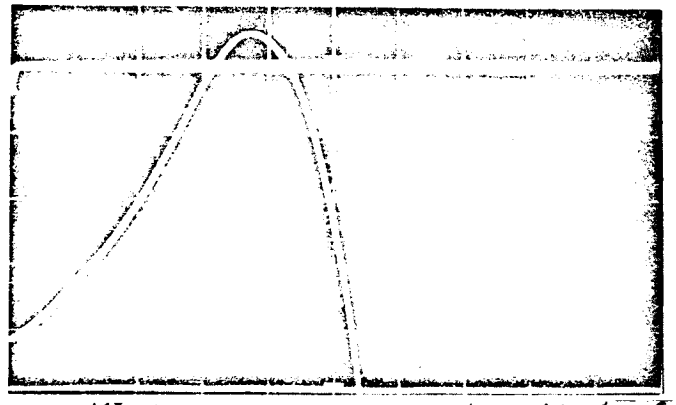
Vertical (G's/square) 3
Horizontal (MS/square) 2
Accelerometer [illegible]
4TTC-50-350 S/N [illegible]

Accelerated Mass

a. Specimen and fixture 55 lbs.
b. Carriage 30.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 185 lbs.

Operational Data

Set Pressure 18 psig
Firing Pressure 250 psig
Brake Pressure 70 psig
Accumulator Pressure — psig
(Alternate Firing)



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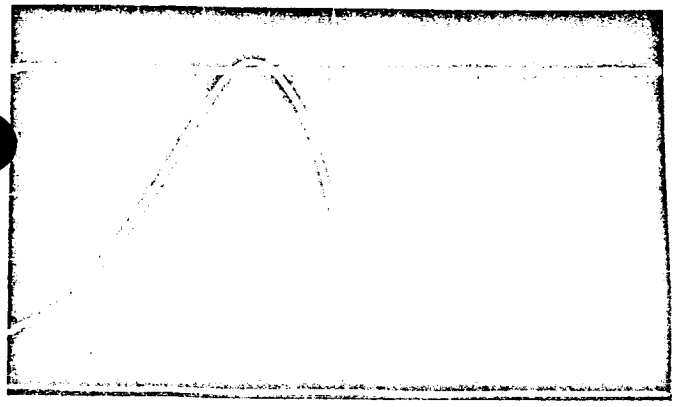
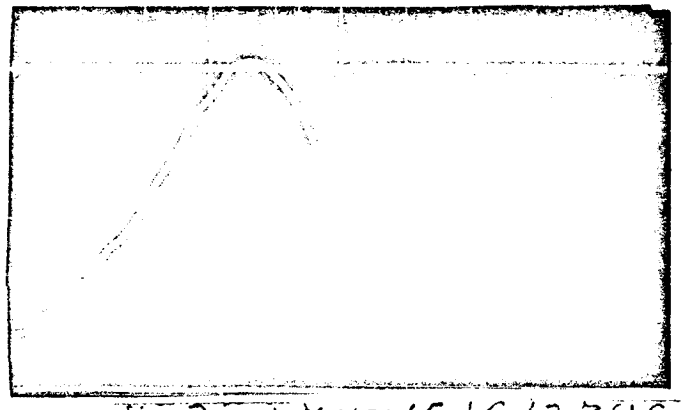


NO. 2 Y AXIS 15.2G 10.[illegible] M.S.



NO. 3 + Y AXIS 15.1G 12.7 M.S.

Remarks: SAME AS PAGE ONE

Form 600-V-69 New 3-64

R-15019-2

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Page 4 of 6
Lab Test No. 4520-17-21

Prepared by	EWR No.	Facility	Date
V. DAVIS	595399	CANO.	9-4-64
Part	**Part No.**	**Serial No.**	
TCA	208130-61	4060448	

Metering Pin Data

Hyge Unit [illegible]
Acceleration [illegible] ± 1.5 G
Acc. Waveshape HALF SINE
Acc. Time 11 MSEC ± 1 MSEC

Hydraulic Fluid Level

a. 80 ~~inches~~ CC as measured down from top of top cylinder.
b. _____

Deceleration Orifice Position

a. _____ Contour side up
b. ✓ Contour side down

Calibration

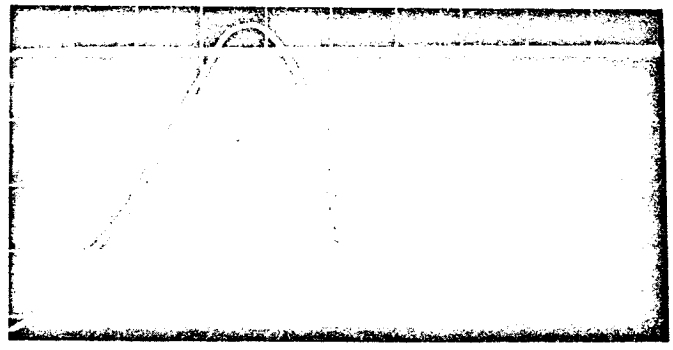
Vertical (G's/square) 3
Horizontal (MS/square) 2
Accelerometer STATHAM
AS[illegible] 50-350 S/N 7030

Accelerated Mass

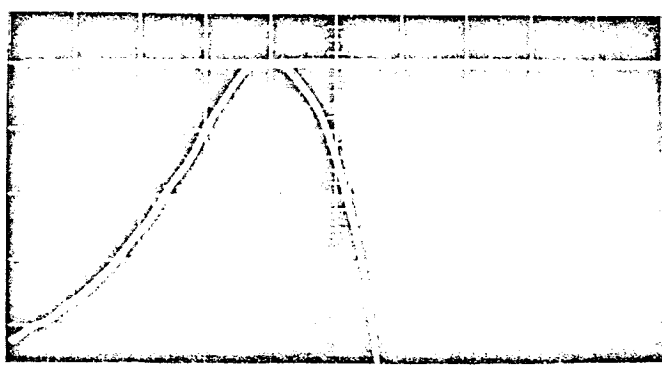
a. Specimen and fixture 55 lbs.
b. Carriage 80.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 185 lbs.

Operational Data

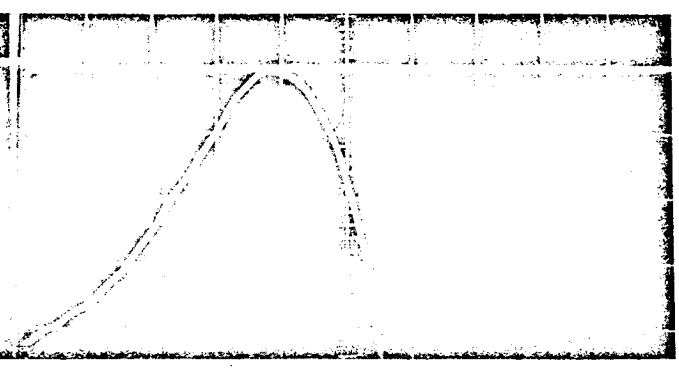
Set Pressure 18 psig
Firing Pressure [illegible] psig
Brake Pressure [illegible] psig
Accumulator Pressure _____ psig
(Alternate Firing)



NO. 1 — Y AXIS 16G 10.1 M.S.



NO. 2 — Y AXIS 15G 11.2 M.S.



NO. 3 — Y AXIS 15G 11.2 M.S.

Remarks: SAME AS PAGE ONE

R-15019-2

Form 600-V-69 New 3-64

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Page 5 of 6
Lab Test No. 4K20-17-21

Prepared by	EWR No.	Facility	Date
V. DAVIS	595399	CANO.	9-4-64
Part	**Part No.**	**Serial No.**	
TCA	208130-61	4066448	

Metering Pin Data

Hyge Unit [illegible]
Acceleration [illegible] ± 1.5 G.
Acc. Waveshape HALF-SINE
Acc. Time 11 ± 1 M.SEC.

Accelerated Mass

a. Specimen and fixture 55 lbs.
b. Carriage 80.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 185 lbs.

Hydraulic Fluid Level

a. 80 ~~inches~~ cc as measured down from top of top cylinder.
b. _____

Operational Data

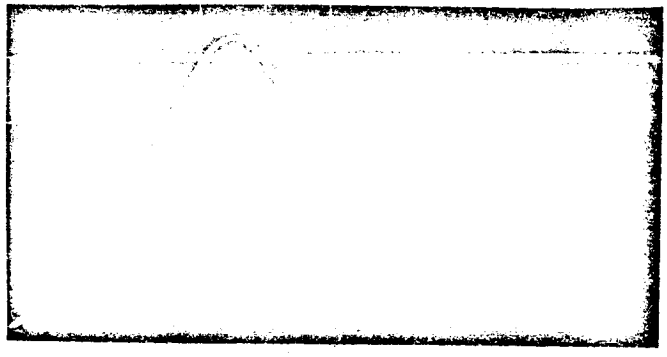
Set Pressure [illegible] psig
Firing Pressure [illegible] psig
Brake Pressure [illegible] psig
Accumulator Pressure _____ psig
(Alternate Firing)

Deceleration Orifice Position

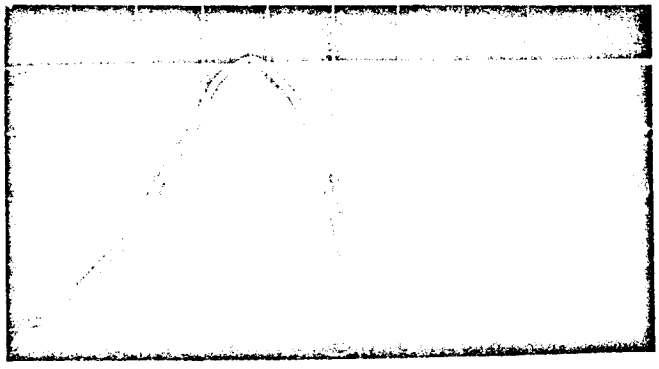
a. _____ Contour side up
b. ✓ Contour side down

Calibration

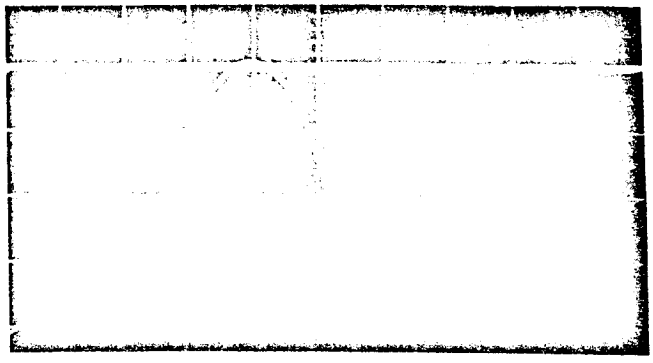
Vertical (G's/square) 3
Horizontal (MS/square) [illegible]
Accelerometer [illegible]
45TC-50-350 S/N [illegible]



NO 1 +Z AXIS 16 G 10.5 MS.



NO 2 +Z AXIS 15.6 G 10.9 MS.



NO 3 +Z AXIS 15.2 G. 11.1 MS.

Remarks: SAME AS PAGE ONE

R-15019-2

Form 600-V-69 New 3-64

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Lab Test No. 4K20-17-21

Prepared by	EWR No.	Facility	Date
V DAVIS	595399	CANO.	8-4-64
Part	**Part No.**	**Serial No.**	
TCA	208130-61	4062448	

Metering Pin Data

Hyge Unit 6401
Acceleration 15G ± 1.5G
Acc. Waveshape HALF-SINE
Acc. Time 11 M.SEC ± 1 M.SEC

Hydraulic Fluid Level

a. 80 ~~inches~~ CC as measured down from top of top cylinder.
b. _____

Deceleration Orifice Position

a. _____ Contour side up
b. ✓ Contour side down

Calibration

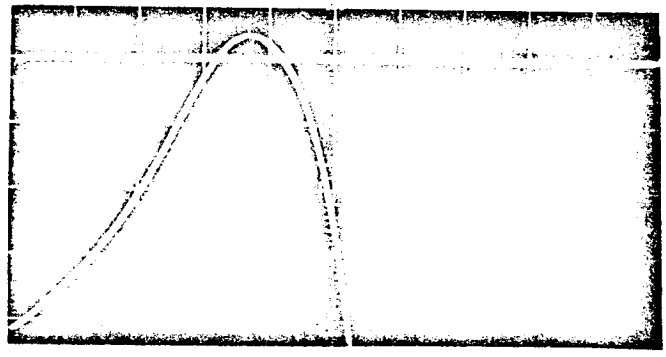
Vertical (G's/square) 2
Horizontal (MS/square) 2
Accelerometer [illegible]
[illegible]

Accelerated Mass

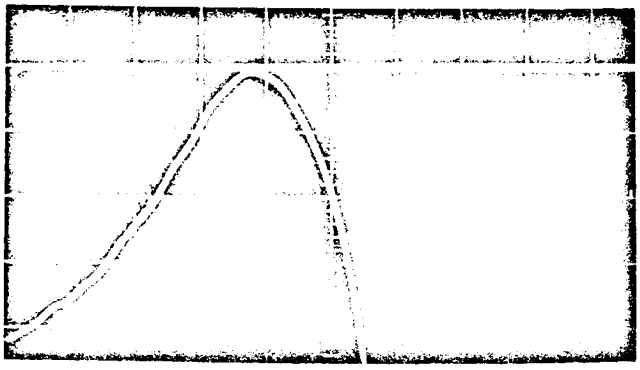
a. Specimen and fixture 55 lbs.
b. Carriage 30.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 185 lbs.

Operational Data

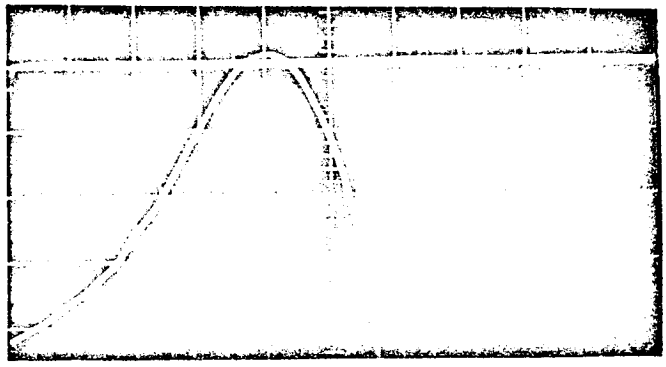
Set Pressure 18 psig
Firing Pressure 250 psig
Brake Pressure 20 psig
Accumulator Pressure — psig
(Alternate Firing)



NO I — Z AXIS [illegible]



NO 2 — Z AXIS 14.9G 11 M.S.



NO 3 — Z AXIS 15.2G 11.2 M.S.

Remarks: [illegible]

R-15019-2

Form 600-V-69 New 3-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST SHOCK TEST NO. 208130-401 SHEET 66 OF 267

7.1.3.2 Test Data - TCA #1A

7.1.3.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52700-217

Rocketdyne Part No. 208130-61

Component Serial No. 4060448

7.1.3.2.2 Shock Test (reference paragraph 7.1.3.1)

Magnitude 15 $\pm^{1.5}_{0}$ g's	Duration 11 $\pm$1.0 milliseconds	
+ X Axis		
16.2 g's	WB 10.5 MS	WB
15.0 g's	WB 10.5 MS	WB
15.0 g's	WB 10.9 MS	WB
- X Axis		
16.1 g's	WB 10.9 MS.	WB
15.8 g's	WB 11.1 MS.	WB
15.6 g's	WB 10.6 MS.	WB

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 1-31-64	C. J. Kudzia 8585 9-4-64	L Johnson 9-4-64	J.D. Mavrogenis 9/14/64
			VERIFIED BY USAF: DATE
			W Bollenbacher 9/4/64

FORM 608-B-43 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST SHOCK TEST NO. 208130-401 SHEET 67 OF 267

7.1.3.2.2 (Con't) Shock Test (reference paragraph 7.1.3.1)

Magnitude 15 ±1.5 g's	Duration 11 ±1.0 milliseconds	Magnitude 15 ±1.5 g's	Duration 11 ±1.0 milliseconds
+Y Axis		+Z Axis	
16.4 g's	10.8 MS	16 g's	10.5 MS.
15.2 g's	10.8 MS	15.5 g's	10.9 MS.
15.1 g's	10.7 MS	15.2 g's	11.1 MS
-Y Axis		-Z Axis	
16 g's	10.8 MS	16.0 g's	10.9 MS.
15 g's	11.2 MS	14.9 g's	11.0 MS.
15 g's	11.2 MS	15.2 g's	11.2 MS.

Inspection Remarks

NONE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 1-31-64	O. J. Kudzia 8585 9-4-64	L Johnson 9-4-64	J.D. Navrazenis 9/14/64
			VERIFIED BY USAF: DATE 9/4/64

FORM 608-B-43 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61 }

NAME OF TEST SHOCK TEST NO. 208130-401 SHEET 68 OF 267

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

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 $^{+10}_{-0}$)	500 psig	500 psig
Time Duration (3 minimum)	3.0 minutes	3.0 minutes
Leakage Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (500 $^{+10}_{-0}$)	500 psig	500 psig
Time Duration (5 minimum)	5.0 minutes	5.0 minutes
Leakage Rate (2.23 maximum)	ZERO scc He / min	ZERO scc He / min

Inspection Remarks

NONE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 4/30/64 1-31-64	F.T. Page 9-4-64	M. J. Fogarty 9/14/64	J.D. Mangeno 9/14/64
			VERIFIED BY USAF: DATE
			9/14/64

FORM 608-B-43 NEW 6-63

REVISION A J.D. Mangeno Dated 6/22/64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST SHOCK TEST NO. 208130-401 SHEET 69 OF 267

7.1.3.2.4 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 ±0.25)	3 minutes	3 minutes
Voltage (12 ±2)	12 VDC	12 VDC

Inspection Remarks

No Evidence of Leakage

PREPARED BY:	DATE	PERFORMED BY:	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL:	DATE
T.G.Kniffin	6-22-64 1-31-64	F.Z. Pope	9-4-64	[signature]	9/4/64	J.D. Mavrogenis	9/14/64
						VERIFIED BY USAF:	DATE
						[signature]	9/4/64

FORM 608-B-43 NEW 6-63

REVISION A J.D. Mavrogenis Dated 6/22/64

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST SHOCK TEST NO. 208130-401 SHEET 70 OF 267

7.1.3.2.5 Propellant Valve Electrical Resistance test (reference paragraph 6.3) WB

Environmental Temperature 70 (70 ±10F).

Resistance A - B WB

Oxidizer Valve 42.9 ohms WB (Acceptable per Figure 15, yes or no yes).

Fuel Valve 42.3 ohms (Acceptable per Figure 15, yes or no yes) WB

Resistance C - D (1.0 maximum)

Oxidizer Valve .08 ohms WB

Fuel Valve .26 ohms WB

Inspection Remarks

None WB

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.C.Kniffin	1-31-64	F. T. Pope	9-4-64	[signature]	9/4/64	A.D. Mavrogenis	9/14/64
						VERIFIED BY USAF	DATE
						[signature]	9/4/64

FORM 603-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST SHOCK TEST NO. 208130-401 SHEET 71 OF 267

7.1.3.2.6 Propellant Valve Dielectric Strength test (reference paragraph 6.4)

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 +10 -0	Current Microamps 500 max.	Voltage Volts 500 +10 -0	Current Microamps 500 max.
A to Ground	500	26	500	47
C to Ground	500	38	500	29
A to C	500	27	500	24

Inspection Remarks

None

PREPARED BY:	DATE	PERFORMED BY:	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL:	DATE
T.G.Kniffin	1-31-64	F. E. Pope	9-4-64	J. F. Murchison	9/4/64	J. D. Mavrogenis	9/14/64
						VERIFIED BY USAF:	DATE
						W. Bollenbach	9/4/64

FORM 608-B-43 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F. Pope	595399	ENV. LAB.	2061	9-4-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #1A) S/N 4060448	208130-61	POST SHOCK FUNCTIONAL (Time Response)

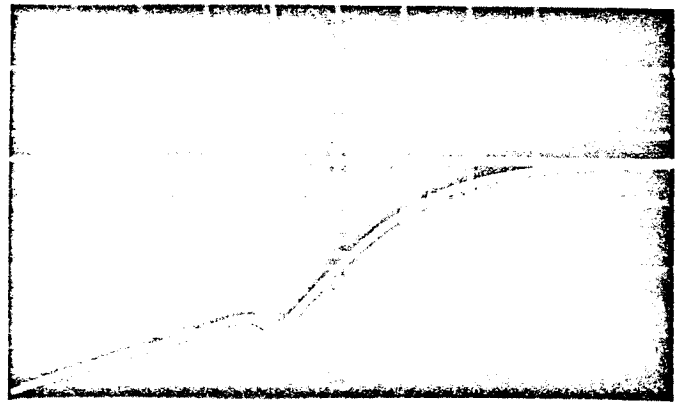
OXIDIZER VALVE

P/N 407557 S/N 8759999

CURRENT TRACE
(Opening Time)

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

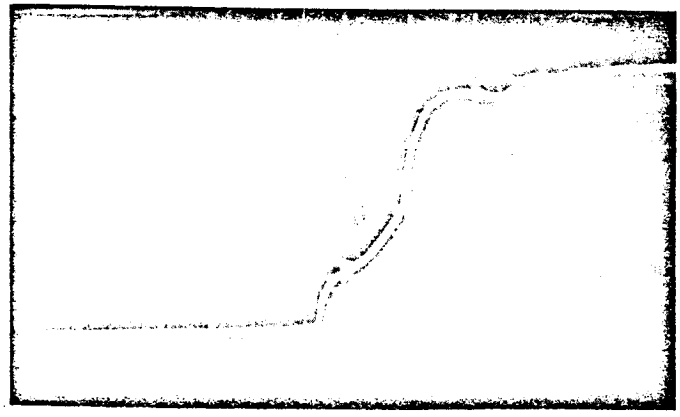
Requirement = 0.0065 sec.Max
Actual = 0.0040 sec.



VOLTAGE TRACE
(Closing Time)

Horizontal = .5ms/cm
Vertical = 10v/cm

Requirement = 0.0035 sec.max.
Actual = 0.0029 sec.



R-15019-2

Form 600-V-67 New 10-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE ____ OF ____

LAB TEST NO. ____

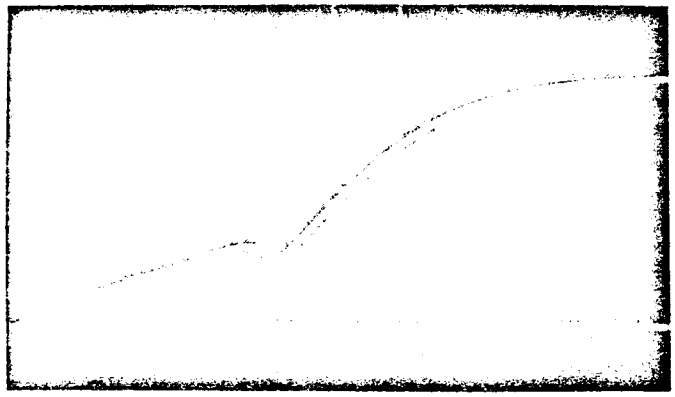
PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F. Pope	595399	ENV.LAB.	2061	9-4-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #1A)	208130-61 S/N 4060448	POST SHOCK FUNCTIONAL (Time Response)

FUEL VALVE

P/N 407558 S/N 9202637

CURRENT TRACE
(Opening Time)



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

Requirement = 0.0065 max.
Actual = 0.0040 sec.

VOLTAGE TRACE
(Closing Time)

Horizontal = 0.5ms/cm
Vertical = 10v/cm

Requirement = 0.0035 sec.max.
Actual = 0.0030 sec.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST SHOCK TEST NO. 208130-401 SHEET 72 OF 267

7.1.3.2.7 Propellant Valve Functional test (reference paragraph 6.5)

	Oxidizer Valve	Fuel Valve
Response Time	Ref CUST DCP #1	
Ambient Temperature (70 ±10)	70° F	70°F
Energizing Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Time (0.0065 maximum)	0.0040 seconds	0.0040 seconds
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Time (0.0035 maximum)	0.0029 seconds	0.0030 seconds
Low Voltage Operation		
Ambient Temperature (70 ±10)	70 F	70 F
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Voltage (16 maximum)	7.3 VDC	7.0 VDC
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Voltage (1.0 minimum)	1.35 VDC	1.2 VDC
Inspection Remarks		

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 4/30/64 1-31-64	F.Z. Papa 9-4-64	9-4-64	J.D. Mangeris 9/14/64
			VERIFIED BY USAF: DATE
			Ref. CUST DCP #1

FORM 608-B-43 NEW 6-63

REVISION A J.D. Mangeris Dated 6/22/64

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. { MAC 52-52700-217 / NAA 208130-61 }

NAME OF TEST PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 208130-401 SHEET ___ OF ___

IL 4388-5341

Deviation Request:

Propellant valve continuous duty cycle paragraph 7.1.7 will be run prior to DAT Duty Cycle to failure paragraph 7.1.4.

Recopied from original request dated 4, September 1964.

James D. Mavrogenis
Jim Mavrogenis
MAC Engineering

R. Cole
R. Cole
Gemini DAT-RAT Unit

12-2-64

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FORM 608-B-42 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST CAPE CYCLE AND MDC TEST NO. 208130-401 SHEET ___ OF ___

IL 4388-5344

Deviation Request:

Reference: Paragraph 7.1.4 and Table I

The requirements for two fine and one coarse altitude transducer shall be reduced for TCA Unit #1A to: One fine and one coarse altitude transducer, for the Cape Cycle and MDC.

Recopied from original request dated 21, September 1964.

James D. Mavrogenis
Jim Mavrogenis
MAC Engineering
12-2-64

John A. Ganger
John A. Ganger
Rocketdyne
Engineering

FORM 608-B-42 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208130-401 SHEET 73 OF 267

Reference:	MAC SCD 52-52700, Revision G, paragraph 6.3.1.3.2.2
7.1.4	DAT Duty Cycle to Failure - TCA #1A
7.1.4.1	Test Procedure
7.1.4.1.1	Perform Cape Cycle Firing Test per paragraph 6.7.
7.1.4.1.1.1	Make a one second firing followed by another one second firing ten minutes later.
7.1.4.1.1.2	Wait sixty minutes and make a one second firing followed by another one second firing ten minutes later.
7.1.4.1.1.3	Repeat paragraph 7.1.4.1.1.2.
7.1.4.1.2	Wait for TCA skin temperature to return to ambient temperature (70 ±20F) and perform the DAT duty cycle Firing Test per paragraph 6.7 and Table II. The Firing Test shall be terminated upon catastrophic failure (defined in Table II, note 4).
7.1.4.1.2.1	The TCA shall not exceed a maximum skin temperature of 550F at the end of the 100 seconds total burn time ("in spec" performance)
7.1.4.1.2.2	The TCA shall not exceed a maximum skin temperature of 650F at 136 seconds total burn time. (guaranteed life).
7.1.4.1.3	Perform decontamination per paragraph 6.8.
7.1.4.1.4	Reduce data per SEM 4388-4040.
7.1.4.1.4.1	The results of significant data shall include but not be limited to the following:
7.1.4.1.4.1.1	Graphical presentation of temperature versus time for all TCA thermocouple locations.
7.1.4.1.4.1.2	Graphical presentation of total impulse versus signal width.
7.1.4.1.4.1.3	Graphical presentation of mean specific impulse versus signal width.
7.1.4.1.4.1.4.	Failure Analysis.

C

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
J. Ganger	9/17/64	[signature]	9-17-64		
CHECKED BY: [signature]	DATE 9-17-64				

FORM 608-B-44 NEW 6-63

REVISION C [signature] Dated 9-17-64

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ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST DUTY CYCLE TOFAILURE TEST NO 208130-401 SHEET 74 OF 267

7.1.4.2 Test Data - TCA #1A

7.1.4.2.1 Component Identification

Component Name 25# SE-6 TCA

McDonnell Part No. 52-52700-217

Rocketdyne Part No. 208130-61

Component Serial No. 4060448

Accumulated Acceptance Test Firing Time, seconds 3.0 sec.

	Pre-Test	Post-Test
Throat Diameter, inches (Average of four measurements)	.3639	.3637
Nozzle Exit Diameter, inches	1.628	1.622

7.1.4.2.2 Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	9/16/64	9/16/64
Sample Batch Number	9-215	9-216
Sample Temperature, F	58°	60°
Sample Specific Gravity	1.460	.881
Met Mil Spec. Requirements (Yes or No)		

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T.G. Kniffin 7-10-64 1-31-64	D. J. Kelly 9/22/64	J. A. Sanger 9/22/64 TFO 930	VERIFIED BY USAF DATE 9-22-64

FORM 608-B-43 NEW 6-63

REVISION B J. D. [illegible] Dated 9-17-64

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R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA [illegible]

NAME OF TEST DUTY CYCLE TO FAILURE TEST NO. [illegible] SHEET 75 OF 267

7.1.4.2.3 Cape Cycle test

Test Cell Location C+L III

Test Cell Number Cell 39J

Test Number .065

Test Date 9/21/64

	Pulse Duration (sec) (1.000 ±.020 sec)	Time Between Pulses, (minutes)
1st Pulse	1.087	10 (10)
2nd Pulse	1.088	60 (60)
3rd Pulse	1.088	10 (10)
4th Pulse	1.086	60 (60)
5th Pulse	1.087	10 (10)
6th Pulse	1.086	
Accumulated Firing Time, seconds	6.52	

333

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.C. Kniffin 7-10-64 1-31-68			VERIFIED BY USAF: DATE

FORM 608-B-43 NEW 6-63

REVISION B J.D. Mavrogenis Dated 9-17-64

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208130-101 SHEET ___ OF ___

PRE-RETRO Phase (Effective firing time of .030 sec ; time between pulses, 22 seconds)

Pulse Number, Pre-Retro Phase	2	3	14
Signal Width, msec	56.2	58.2	54.2
Start Time, msec (25 max)	13.7	14.5	15.7
Shutdown Impulse, lb-sec (.260 max) **	.231	.241	.189
Environmental Pressure, psia	.028	.028	.028
Environmental Temperature, °F (vac chamber)	59	59	59
Oxidizer Temperature, °F	70	70	70
Fuel Temperature, °F	70	70	70
Oxidizer Inlet Pressure, psia	287	287	287
Fuel Inlet Pressure, psia	291	291	291
Total Oxidizer Flow, lbs	*	*	*
Total Fuel Flow, lbs	*	*	*
Mean Mixture Ratio, o/f	*	*	*
Pulse Total Impulse, lb-sec	1.212	1.266	1.138
Mean Specific Impulse, sec	*	*	*
Oxidizer Valve Voltage, volts	26	26	26
Fuel Valve Voltage, volts	26	26	26
Oxidizer Valve Current, amps	.640	.640	.640
Fuel Valve Current, amps	.647	.647	.647
Electrical Power, watts	33.46	33.46	33.46

* Flow Traces unreadable ** Ref: ECN NA-SEG-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
H. Robinson	8/25/65	[signature]	8/25/65		
CHECKED BY: [signature]	DATE 8/25/65				

FORM 608-B-44 NEW 6-63

R-15019-2

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 203130-61

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 203130-401 SHEET ___ OF ___

RETRO Phase (Effective firing time of .070 seconds; time between pulses, .048 seconds)

Pulse Number, Retro Phase	2	91	184
Signal Width, msec	95.2	91.9	90.9
Start Time, msec (25 max)	10.7	9.7	9.7
Shutdown Impulse, lb-sec (.260 max) **	.153	.169	.163
Environmental Pressure, psia	.028	.028	.028
Environmental Temperature, °F (Vac chamber)	60	68	72
Oxidizer Temperature, °F	70	70	70
Fuel Temperature, °F	70	70	70
Oxidizer Inlet Pressure, psia	287	287	287
Fuel Inlet Pressure, psia	291	291	291
Total Oxidizer Flow, lbs	*	*	*
Total Fuel Flow, lbs	*	*	*
Mean Mixture Ratio, o/f	*	*	*
Pulse Total Impulse, lb-sec	2.196	2.117	2.103
Mean Specific Impulse, sec	*	*	*
Oxidizer Valve Voltage, volts	26	26	26
Fuel Valve Voltage, volts	26	26	26
Oxidizer Valve Current, amps	.640	.640	.640
Fuel Valve Current, amps	.647	.647	.647
Electrical Power, watts	33.46	33.46	33.46

* Flow Meters Unrendable ** Ref: ECN NA-SE6-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
Val Robinson	8/25/65	[illegible]	8/25/65		
CHECKED BY: [illegible]	DATE				

FORM 608-B-44 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208130-101 SHEET ___ OF ___

POST-RETRO Phase (Effective firing time of .030 seconds; time between pulses, 22 seconds)

Pulse Number, Post Retro Phase	3	20	68
Signal Width, msec	54.1	52.4	52.8
Start Time, msec (25 max)	13.4	13.7	15.4
Shutdown Impulse, lb-sec (.260 max) **	.218	.226	.238
Environmental Pressure, psia	.028	.028	.028
Environmental Temperature, °F (vac chamber)	65	62	62
Oxidizer Temperature, °F	70	70	70
Fuel Temperature, °F	70	70	70
Oxidizer Inlet Pressure, psia	287	287	287
Fuel Inlet Pressure, psia	291	291	291
Total Oxidizer Flow, lbs	*	*	*
Total Fuel Flow, lbs	*	*	*
Mean Mixture Ratio, o/f	*	*	*
Pulse Total Impulse, lb-sec	1.200	1.147	1.138
Mean Specific Impulse, sec	*	*	*
Oxidizer Valve Voltage, volts	26	26	26
Fuel Valve Voltage, volts	26	26	26
Oxidizer Valve Current, amps	.640	.640	.640
Fuel Valve Current, amps	.647	.647	.647
Electrical Power, watts	33.46	33.46	33.46

* Flow Traces unreadable ** Ref: ECN NA-SEL-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
W. Robinson	8/25/65	[illegible]	8/27/65		
CHECKED BY: [illegible]	8/25/65				

FORM 608-B-44 NEW 6-63

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ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208130-101 SHEET ___ OF ___

RE-ENTRY Subcycle Phase No. 1, Pulse No. 1
(1 second on-time followed by .4 seconds off-time)

	Site Data	Standard Vacuum
Firing Duration, sec	1.0	
Time of Data Slice, sec	.8	
Environmental Pressure, psia	.023	0
Environmental Temperature, °F (VAC chamber)	61	
Oxidizer Temperature, °F	60	70
Fuel Temperature, °F	62	70
Oxidizer Inlet Pressure, psia	278.9	287
Fuel Inlet Pressure, psia	300.7	291
Oxidizer Flowrate, lbs/sec	.04627	.04725
Fuel Flowrate, lbs/sec	.03571	.03454
Mixture Ratio, o/f (1.30 ± 3%)	1.30	1.37
Thrust, lbs (23.5 ± 5%)	23.8	23.9
Specific Impulse, sec (266 min)	291	292
Start Time, msec (25 max)	11	
Shutdown Impulse, lb-sec (.260 max) **	.2264	
Oxidizer Valve Voltage, volts	29.9	
Fuel Valve Voltage, volts	29.3	
Oxidizer Valve Current, amps	.682	
Fuel Valve Current, amps	.680	
Electrical Power, watts	40.3	

** Ref! ECN NA-SEL-28971

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
W. Robinson	8/25/65	[illegible]	8/25/65		
CHECKED BY: [illegible]	DATE 8/25/65				

FORM 608-B-44 NEW 6-63

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A DIVISION OF NORTH AMERICAN AVIATION, INC

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208130-401 SHEET ___ OF ___

RE-ENTRY Sub-Cycle Phase No. 1
(one pulse with effective firing time of 1 second;
17 pulses with effective firing time of .020 seconds;
time between pulses, .4 seconds)

Pulse Number, Re-Entry Sub-Cycle Phase		4	18
Signal Width, msec		38.4	37.8
Start Time, msec (25 max)		13.6	13.7
Shutdown Impulse, lb-sec (.260 max) **		.206	.177
Environmental Pressure, psia		.028	.028
Environmental Temperature, °F (VAC chamber)		61	61
Oxidizer Temperature, °F		70	70
Fuel Temperature, °F		70	70
Oxidizer Inlet Pressure, psia		287	287
Fuel Inlet Pressure, psia		291	291
Total Oxidizer Flow, lbs		*	*
Total Fuel Flow, lbs		*	*
Mean Mixture Ratio, o/f		*	*
Pulse Total Impulse, lb-sec		.845	.792
Mean Specific Impulse, sec		*	*
Oxidizer Valve Voltage, volts		26	26
Fuel Valve Voltage, volts		26	26
Oxidizer Valve Current, amps		.640	.640
Fuel Valve Current, amps		.647	.647
Electrical Power, watts		33.46	33.46

* Flow Traces Unreadable ** Ref: RCN NA-SEL-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
G. Robinson	8/25/65		8/25/65		
CHECKED BY:	DATE				
	8/25/65				

FORM 608-B-44 NEW 6-63

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R-15019-2

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER PART NO. { MAC 52-52700-217 / NAA 208130-61 }

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208130-103 SHEET ___ OF ___

RE-ENTRY Subcycle Phase No. 27, Pulse No. 1
(1 second on-time followed by .4 seconds off-time)

	Site Data	Standard Vacuum
Firing Duration, sec	1.0	
Time of Data Slice, sec	.8	
Environmental Pressure, psia	.024	0
Environmental Temperature, °F (vac chamber)	72	
Oxidizer Temperature, °F	65	70
Fuel Temperature, °F	66	70
Oxidizer Inlet Pressure, psia	281.4	287
Fuel Inlet Pressure, psia	293.9	291
Oxidizer Flowrate, lbs/sec	.04642	.04701
Fuel Flowrate, lbs/sec	.03604	.03559
Mixture Ratio, o/f (1.30 ± 3%)	1.29	1.32
Thrust, lbs (23.5 ± 5%)	23.8	23.9
Specific Impulse, sec (266 min)	288	289
Start Time, msec (25 max)	13	
Shutdown Impulse, lb-sec (.260 max) **	.2292	
Oxidizer Valve Voltage, volts	29.9	
Fuel Valve Voltage, volts	29.3	
Oxidizer Valve Current, amps	.716	
Fuel Valve Current, amps	.703	
Electrical Power, watts	42	

** Ref: ECN NA-SE6-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
W. Robinson	8/25/65	W J Kelly	8/25/65		
CHECKED BY:	DATE				
[illegible]	8/25/65				

FORM 608-B-44 NEW 6-63

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ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208130-401 SHEET ___ OF ___

RE-ENTRY Sub-Cycle Phase No. 27
(Repeat of Re-Entry Sub-Cycle Phase No. 1)

Pulse Number, Re-Entry Sub-Cycle Phase		4	17
Signal Width, msec		37.4	38.2
Start Time, msec (25 max)		12.2	13.7
Shutdown Impulse, lb-sec (.260 max) **		.207	.189
Environmental Pressure, psia		.028	.028
Environmental Temperature, °F (VAC chamber)		72	72
Oxidizer Temperature, °F		70	70
Fuel Temperature, °F		70	70
Oxidizer Inlet Pressure, psia		287	287
Fuel Inlet Pressure, psia		291	291
Total Oxidizer Flow, lbs		*	*
Total Fuel Flow, lbs		*	*
Mean Mixture Ratio, o/f		*	*
Pulse Total Impulse, lb-sec		.826	.802
Mean Specific Impulse, sec		*	*
Oxidizer Valve Voltage, volts		26	26
Fuel Valve Voltage, volts		26	26
Oxidizer Valve Current, amps		.640	.640
Fuel Valve Current, amps		.647	.647
Electrical Power, watts		33.46	33.46

* Flow Traces unreadable ** Ref: ECN NA-SE6-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
H. Robinson	8/25/65	[signature]	8/25/65		
CHECKED BY: [signature]	DATE 8/25/65				

FORM 608-B-44 NEW 6-63

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R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER PART NO. { MAC 52-52700-217 / NAA 208130-61 }

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208130-401 SHEET ___ OF ___

RE-ENTRY Subcycle Phase No. 51, Pulse No. 1 (1 second on-time followed by .4 seconds off-time)	Site Data	Standard Vacuum
Firing Duration, sec	1.0	
Time of Data Slice, sec	.8	
Environmental Pressure, psia	.024	0
Environmental Temperature, °F (VAC chamber)	74	
Oxidizer Temperature, °F	68	70
Fuel Temperature, °F	68	70
Oxidizer Inlet Pressure, psia	280.4	287
Fuel Inlet Pressure, psia	293.9	291
Oxidizer Flowrate, lbs/sec	.04654	.04732
Fuel Flowrate, lbs/sec	.03618	.03572
Mixture Ratio, o/f (1.30 ± 3%)	1.29	1.32
Thrust, lbs (23.5 ± 5%)	23.7	23.9
Specific Impulse, sec (266 min)	287	287
Start Time, msec (25 max)	13	
Shutdown Impulse, lb-sec (.260 max) **	.2060	
Oxidizer Valve Voltage, volts	29.8	
Fuel Valve Voltage, volts	29.3	
Oxidizer Valve Current, amps	.706	
Fuel Valve Current, amps	.695	
Electrical Power, watts	41.4	

** Ref: ECN NA-SEG-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Robinson	8/25/65	[illegible]	8/25/65		
CHECKED BY: [illegible]	DATE 8/25/65				

FORM 608-B-44 REV 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208130-401 SHEET ___ OF ___

RE-ENTRY Sub-Cycle Phase No. 51
(Repeat of Re-Entry Sub-Cycle Phase No. 1)

Pulse Number, Re-Entry Sub-Cycle Phase		3	18
Signal Width, msec		36.9	37.7
Start Time, msec (25 max)		13.5	13.9
Shutdown Impulse, lb-sec (.260 max) **		.1894	.2048
Environmental Pressure, psia		.028	.028
Environmental Temperature, °F (VAC chamber)		74	74
Oxidizer Temperature, °F		70	70
Fuel Temperature, °F		70	70
Oxidizer Inlet Pressure, psia		287	287
Fuel Inlet Pressure, psia		291	291
Total Oxidizer Flow, lbs		*	*
Total Fuel Flow, lbs		*	*
Mean Mixture Ratio, o/f		*	*
Pulse Total Impulse, lb-sec		.764	.809
Mean Specific Impulse, sec		*	*
Oxidizer Valve Voltage, volts		26	26
Fuel Valve Voltage, volts		26	26
Oxidizer Valve Current, amps		.640	.640
Fuel Valve Current, amps		.647	.647
Electrical Power, watts		33.46	33.46

* Flow Times unreadable ** Ref. EON NA-SEL-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
H. Robinson	8/25/65	[illegible]	8/25/65		
CHECKED BY: [illegible]	DATE 8/25/65				

FORM 608-B-44 NEW 6-63

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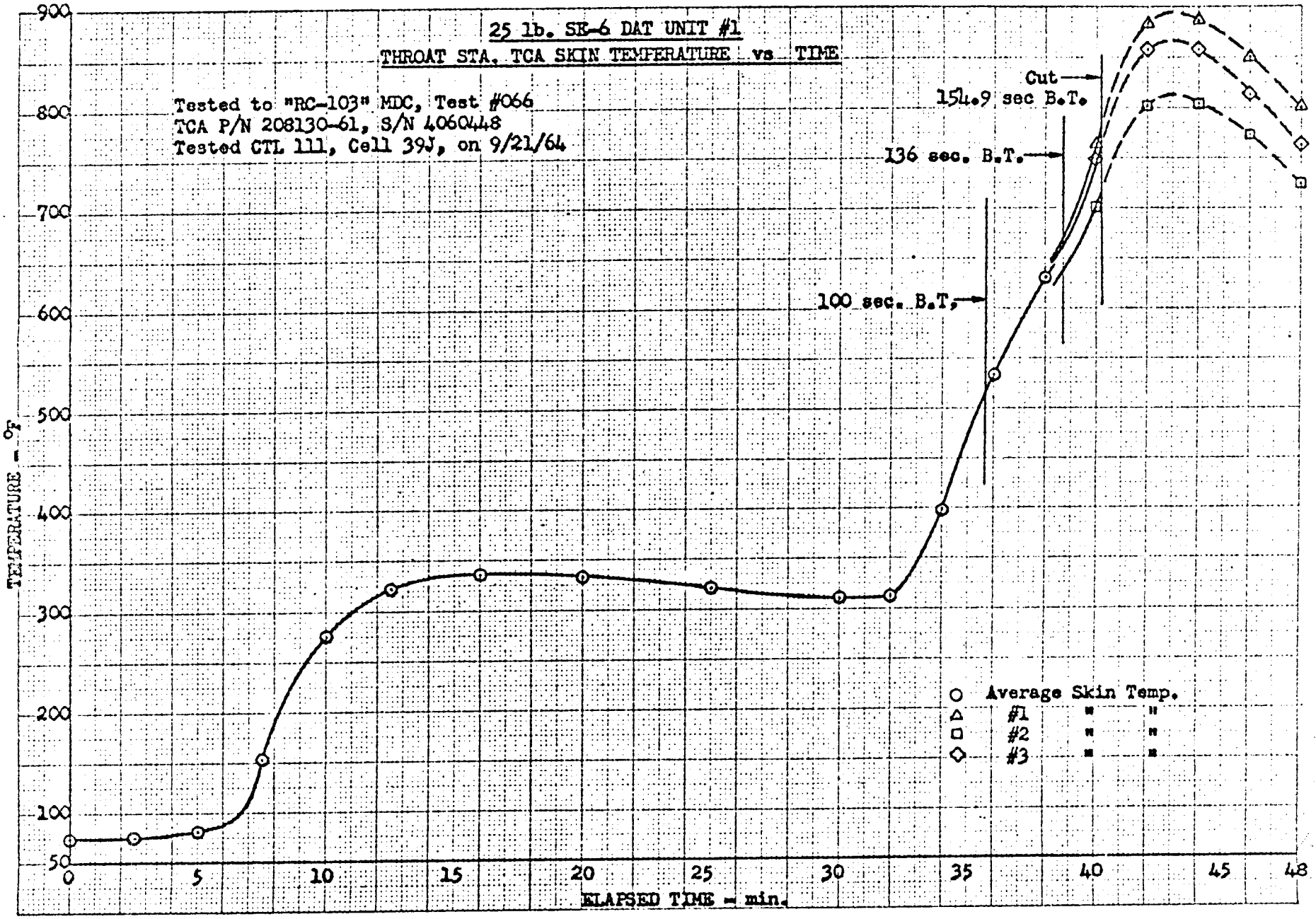
K&E 10 X 10 TO THE CM. 359T-14
KEUFFEL & ESSER CO.



DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST DUTY CYCLE TO FAILURE TEST NO. 208130-401 SHEET 96 OF 267

7.1.4.2.4.11 **Failure Data**

Accumulated Firing Time, Sec. ELAPSED MDC TIME 2415 SEC.

Visual Inspection Results

TCA DISCOLORED FROM OVERHEATING, POTTING COMPOUND BLEADING FROM UNDER METAL JACKET OF T/C. SEVERAL SMALL METALLIC BEADS IN THROAT OF T/C. COMBUSTION LINER HAS SMALL AMOUNT OF EROSION AT 11 O/C D/S OF INJECTOR.

B

PREPARED BY:	PERFORMED BY:	WITNESSED FOR NAA	CERTIFIED FOR McDONNELL	VERIFIED BY USAF
T.G. Kniffin 7-10-64 1-31-64	A.J. Kelly 7/22/64	J.A. Sanga 7/22/64		9-22-64

FORM 608-B-43 NEW 6-63

REVISION B J.D. Marrogenis Dated 9-19-64

344

UNIT #1

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4060448

Dwg. No. 208130-61

Model 25# TCA

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
		CTL PA Cell 37			
1	9/21/64 ANR 930	PART NO. 208130-61 S/N 4060448 TCA. Failed to Reach 100 sec Total Burn Time Prior to Reaching 550° Ref PARA 7.4.1.2.1			
	ACTION TAKEN	TRANSFERED TO SHORTAGE	9-22-64 ANR 930	ANR 930	ANR 930
2	9/21/64 ANR 930	PART NO. 208130-61 S/N 4060448 TCA. MDC Cut After 132.0 sec. Total Accumulative Firing Time do to over-temp.			
	ACTION TAKEN	TRANSFERED TO SHORTAGE	9-22-64 ANR 930	ANR 930	
3	9/21/64 ANR 930	PART NO. 208130-61 S/N 4060448 TCA. Decontaminated up to 6.8.30			
	ACTION TAKEN	DECONTAMINATION COMPLETE THRU 6.8.30	9-22-64	9-22-64 ANR 930	ANR 930
4	9/21/64 ANR 930	PART NO. 407557 S/N 875999 NTO Prop Valve Failed to open Completely during Decontamination Ref 6.8.1			
	ACTION TAKEN	TRANSFERED TO SHORTAGE	9-22-64 ANR 930	ANR 930	
5	10/6/64 ANR 930	PART NO. 407557 S/N 875999 Unable to cycle Oxidizer Valve Per oper 7.1.5.2.2 Ref PARA. 6.1.7 Explosive Atmosphere Test 345			
	ACTION TAKEN	TRANSFERED to Shortage	10-7-64 ANR 930	ANR 930	ANR 930

R-15019-2

Form R 25-U Rev. 12-57

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

IL 4388-5152

INTERNAL LETTER
North American Aviation, Inc.

DATE 22 October 1964

TO Address: Those Concerned

FROM Address: Gemini DAT-RAT Unit D/896-388

PHONE 6608

SUBJECT: Plan of Action - Deviation to Gemini DAT TCA Specifications 208130-401 and 208160-401 for Purpose of Completing Testing Requirements

The pre-functional failure on the RCS DAT Unit #1A oxidizer propellant valve, P/N 405557, S/N 875999, during the explosive atmosphere test necessitates the following deviations in order to accomplish completion of the prescribed testing.

Identical propellant valves are currently available on OAMS 25 lb DAT Unit #1, P/N 208160-61, S/N 4058233, which has completed the prescribed test requirements for that unit. It is proposed that the propellant valves from this unit be utilized to conduct the remaining test requirements, explosive atmosphere and propellant resistance, for RCS 25 lb TCA Unit #1A.

The procedures undertaken to accomplish the aforementioned shall be:

1. The propellant valves shall be removed from OAMS 25 lb TCA Unit #1.
2. The propellant valves of item 1 shall be subjected to a pre-functional test identical to the requirements of the DAT specification 208130-401, explosive atmosphere test. Quality control surveillance shall be required.
3. If the propellant valves successfully demonstrate fulfillment of the test requirements the results of the tests, the data sheets, duly certified, shall be inserted in the DAT specification attesting to the completion of the required explosive atmosphere pre-functionals.

R. Cole
R. Cole
Gemini DAT-RAT Unit

Approved: W. Smith for
W. Smith
Supervisor
Propellant Controls

R. G. Eide
R. G. Eide
Supervisor
Gemini DAT-RAT Unit

R L Mantler 22 Oct 64
R. Mantler
MAC Rep.

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 208130-401 SHEET ___ OF ___

Reference:	MAC SCD 52-52700, Revision G, Paragraph 6.2.3.13
7.1.5	Explosive Atmosphere - TCA #1A
7.1.5.1	Test Procedure
7.1.5.1.1	Perform Propellant Valve Removal per paragraph 6.10.
7.1.5.1.2	Perform Propellant Valve Proof Pressure and Leakage per paragraph 6.1.
7.1.5.1.3	Perform Propellant Valve Electrical Resistance per paragraph 6.3.
7.1.5.1.4	Perform Propellant Valve Dielectric Strength per paragraph 6.4.
7.1.5.1.5	Perform Propellant Valve Functional per paragraph 6.5.
7.1.5.1.6	Install the propellant valves in an explosion test chamber in accordance with Figure 9.
7.1.5.1.7	Instrumentation shall be provided for monitoring propellant valve body temperature and the test chamber ambient air temperature. C
7.1.5.1.8	Seal the explosion test chamber and raise the internal temperature to 160 ±5 F.
7.1.5.1.9	Allow the temperature of the propellant valves and the explosion chamber to rise within 20 F of the temperature of paragraph 7.1.5.1.8. C
7.1.5.1.10	Reduce the pressure within the test chamber to simulate a pressure altitude of 10,000 feet above the desired test altitude. The desired test altitude for the first test is sea level. C

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cola	9/19/64		9-22-64		
CHECKED BY:	DATE				
	9-22-64				

FORM 608-B-44 NEW 6-63

Rev. C J.D. Montgomery Date 9-22-64

347

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 208130-401 SHEET 98 OF 267

.1.5.1.11 Introduce into the test chamber, in proper quantity, commercial butane so that an explosive atmosphere is attained for the desired test altitude.

7.1.5.1.12 Return the test chamber's pressure altitude to 5000 feet above the desired test altitude by admitting air to the chamber.

7.1.5.1.13 Allow the test chamber's explosive mixture to circulate for a period of three minutes.

7.1.5.1.14 Energize the spark exciter within the combustion sampling chamber of the test chamber.

7.1.5.1.15 If combustion is demonstrated within the combustion sampling chamber of the test chamber proceed with paragraph 7.1.5.1.16. If not, vent and purge the test chamber and repeat paragraphs 7.1.5.1.8 through 7.1.5.1.15.

7.1.5.1.16 Energize the oxidizer valve with 26 ±1 VDC for a period of 10 seconds. Then de-energize. Explosion generated by actuation of the oxidizer valve shall constitute a failure. See paragraph 3.6.

7.1.5.1.17 Energize the fuel valve with 26 ±1 VDC for a period of 10 seconds. Then deenergize. Explosion generated by actuation of the fuel valve shall constitute a failure. See paragraph 3.6. C

7.1.5.1.18 Repeat paragraphs 7.1.5.1.16 through 7.1.5.1.17 nine successive times.

7.1.5.1.19 If explosion did not occur during performance of paragraphs 7.1.5.1.16 through 7.1.5.1.18, slowly admit air to the test chamber to produce a simulated pressure altitude of 5000 feet below the desired test altitude. If the desired test altitude is sea level, reduce the test chamber altitude to sea level. As the altitude is being lowered, perform paragraphs 7.1.5.1.16 and 7.1.5.1.17 once during each 1000 feet of drop.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole	9/19/64	[illegible]	9-22-64		
CHECKED BY:	DATE				
[illegible]	9-22-64				

FORM 608-B-44 NEW 6-63

Rev. C [illegible] Date 9-22-64

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 208130-401 SHEET 99 OF 267

7.1.5.1.20 Repeat paragraph 7.1.5.1.14. If combustion is not demonstrated vent and purge test chamber and repeat paragraphs 7.1.5.1.8 through 7.1.5.1.20. C

7.1.5.1.21 Vent and purge the test chamber.

7.1.5.1.22 Repeat paragraphs 7.1.5.1.8 through 7.1.5.1.21 for each of the following desired test altitudes: 5000 feet, 10,000 feet, 20,000 feet, 30,000 feet, 40,000 feet, and 50,000 feet.

7.1.5.1.23 Remove all test equipment, pressurant and electrical connections from the propellant valves.

7.1.5.1.24 Perform Propellant Valve Proof Pressure and Leakage Test per paragraph 6.1.

7.1.5.1.25 Perform Propellant Valve Electrical Resistance Test per paragraph 6.3.

7.1.5.1.26 Perform Propellant Valve Dielectric Strength per paragraph 6.4.

7.1.5.1.27 Perform Propellant Valve Functional Test per paragraph 6.5.

7.1.5.1.28 Replace protective covers.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole	9/19/64		9-22-64		
CHECKED BY:	DATE				
	9-22-64				

FORM 608-B-44 NEW 6-63

Rev. C J. D. [illegible] Date 9-22-64

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 208130-401 SHEET 100 OF 267

7.1.5.2 Test Data - TCA #1A

7.1.5.2.1 Component Identification

Component Name	TCA	Oxidizer Valve	Fuel Valve
McDonnell Part No.	DNA		
Rocketdyne Part No.	DNA	407557	407558
Component Serial No.	DNA	8759999	9201637

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR MCDONNELL DATE
T.G. Kniffin 7-10-64 1-31-64	F. Z. Pope 10-6-64	10-6-64	10-6-64
			VERIFIED BY USAF: DATE

FORM 608-D-43 NOV 6-63

REVISION B: _____ Dated _____

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 208130-401 SHEET 101 OF 267

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

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 ±10)	500 psig	— psig
Time Duration (3 minimum)	3 minutes *	— minutes
Leakage		
Voltage (26 ±0.5)	— VDC	— VDC
Inlet Pressure (500 ±10)	— psig	— psig
Time Duration (5 minimum)	— minutes	— minutes
Leakage Rate (2.23 maximum)	— scc He/min	— scc He/min

A

Inspection Remarks

* Unable to Cycle Oxidizer Valve Per PARA 6.1.7 Ref. Sgk #3

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 7-10-64 4/30/64 6-22-64 1-31-64	F. E. Pope 10-6-64		VERIFIED BY USAF: DATE

FORM 608-B-43 NEW 6-63

REVISION A J.D. Norrgens Dated 6/22/64

REVISION B _____ Dated _____

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52701-217 / NAA 208130-61 }

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208130-401 SHEET 110 OF 267

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.2.3.18 & 19

7.1.6 Fuel and Oxidizer Resistance - TCA #1 A

7.1.6.1 Test Procedure

7.1.6.1.1 Install the oxidizer propellant valve as shown in Figure 12. Close V_{10}.

7.1.6.1.2 Attach to the inlet of V_{10} a Nitrogen Tetroxide propellant supply.

7.1.6.1.3 Adjust the propellant supply pressure to 150 ±15 psig.

7.1.6.1.4 Open V_{10}. Adjust the DC power supply to 26 ±2 VDC. Energize the propellant valve. When propellant (liquid or vapor) appears at the discharge, de-energize the propellant valve.

7.1.6.1.5 Adjust the environmental temperature to 160 ±5 F. When the propellant valve body temperature reaches this temperature record the date and the time on the data sheet. The propellant valve shall be exposed to propellant at the above temperature for a period of two weeks (336 hours).

7.1.6.1.6 Activate oscilloscope to record propellant valve voltage and current traces. (For opening and closing response). Energize the propellant valve with 26 ±2 VDC. When propellant (liquid or vapor) appears at the discharge, de-energize the propellant valve. (As a result the valve "on" time will take place over a relatively short period of time. It is intended this way to avoid the problem of disposing of large amounts of propellant). C

7.1.6.1.7 Repeat paragraph 7.1.6.1.6 three times daily at equally spaced intervals during the two week exposure period.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole	10-6-64	R. J. Eide	10-6-64		
CHECKED BY:	DATE				
[illegible]	10-6-64				

FORM 608-B-44 NEW 6-63

Rev. C J. D. Mangers dated 10-6-64

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208130-401 SHEET 111 OF 267

7.1.6.1.8 At the end of the two week period close V_{10} and record the date and the time on the data sheet.

7.1.6.1.9 Attach a GN_2 supply to the inlet of V_{10}. Open V_{10} and supply GN_2 to the propellant valve at 120 ±10 psig and 160 ±10°F. Energize the propellant valve with 12 ±2 VDC for a period of 3 minutes. Then cycle the valve at the same temperature and pressure as follows for ten (10) times, using 26 ±1 VDC.

(a) 5 ±1 seconds on time
(b) 5 ±1 seconds off time

Close V_{10} and disconnect the GN_2 supply.

7.1.6.1.10 Attach a Freon TF supply to the inlet of V_{10}. Open V_{10} and supply Freon TF to the propellant valve at 35 to 50 psig. Energize the propellant valve with 12 ±2 VDC for a period of 3 minutes. Then cycle the valve at the same pressure as follows for ten (10) times, using 26 ±1 VDC.

(a) 5 ±1 seconds on time
(b) 5 ±1 seconds off time

Close V_{10} and disconnect the Freon TF supply. Repeat paragraph 7.1.6.1.9.

7.1.6.1.11 Remove the propellant valve from the test setup.

7.1.6.1.12 Perform Propellant Valve Electrical Resistance per paragraph 6.3.

7.1.6.1.13 Perform Propellant Valve Functional per paragraph 6.5 on the oxidizer propellant valve at the temperature of paragraph 7.1.6.1.5.

7.1.6.1.14 Perform Propellant Valve Dielectric Strength per paragraph 6.4 on the oxidizer propellant valve at the temperature of paragraph 7.1.6.1.5.

7.1.6.1.15 Perform Propellant Valve Proof Pressure and Leakage per paragraph 6.1 on the oxidizer propellant valve at the temperature of paragraph 7.1.6.1.5.

B

B

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE				
10-20-64		10-20-64			

FORM 608-B-44 NEW 6-63

Rev. B dated 10/20/64

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208130-401 SHEET 112 OF 267

7.1.6.1.16 Perform Propellant Valve Load Analysis per paragraph 6.9 on the oxidizer propellant valve. Adjust the propellant valve body temperature to the temperature specified in paragraph 7.1.6.1.5. B

7.1.6.1.17 Repeat paragraphs 7.1.6.1.12 through 7.1.6.1.15 except that the environmental temperature of paragraph 7.1.6.1.5 shall be changed to 15 $^{+5}_{-8}$ F. B

7.1.6.1.18 Repeat paragraphs 7.1.6.1.1 through 7.1.6.1.16 on the fuel propellant valve except that the propellant as specified in paragraph 7.1.6.1.2 shall be Monomethyl Hydrazine and that the flushing fluid as specified in paragraph 7.1.6.1.10 shall be alcohol. B

PREPARED BY: T.G. Kniffin	DATE 7-10-64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 8-11-64		8-12-64		

FORM 608-B-44 NEW 6-63

REVISION B ——— Dated ———

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. { MAC 52-52700-217 / NAA 208130-61 }

NAME OF TEST PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 208130-401 SHEET ___ OF ___

IL 4388-5346

Deviation Request:

The functional tests (paragraph's 6.1, 6.3, 6.4, 6.5) subsequent to the Propellant Valve Continuous Duty cycle will be run only for the oxidizer valve.

Recopied from original request dated 8 September 1964.

James P. Mavrogenis
Jim Mavrogenis
MAC Engineering
12-2-64

R Cole
R. Cole
Gemini DAT-RAT Unit

35T

FORM 608-B-42 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 208130-401 SHEET 125 OF 267

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.3.1.3.2.2

7.1.7 Propellant Valve Continuous Duty - TCA #1A B

7.1.7.1 Test Procedure

7.1.7.1.1 Install either the oxidizer or the fuel propellant valve in a test setup as shown in Figure 14. Remove the propellant valve from the propellant valve outlet adapter.

7.1.7.1.2 Activate the temperature recorder and thermocouple.

7.1.7.1.3 Adjust the DC power supply (paragraph 5.4.1) to 26 ±4 VDC and energize the propellant valve. Record the date and the time on the data sheet. The valve shall be continuously energized for a period of 24 hours. Following 0.1 seconds but prior to one minute of energize time reduce the DC power supply voltage to 10 ±2 VDC. At the end of the 24 hour period, de-energize the propellant valve and record the date and the time on the data sheet. Record on the data sheet the valve body temperature at each hour of accumulated energize time starting with the time of initial voltage application.

7.1.7.1.4 Remove the propellant valve from the test setup and [illegible] the propellant valve outlet adapter.

7.1.7.1.5 Perform Propellant Valve Proof Pressure and Leakage per paragraph 6.1.

7.1.7.1.6 Perform Propellant Valve Electrical Resistance per paragraph 6.3.

7.1.7.1.7 Perform Propellant Valve Dielectric Strength per paragraph 6.4.

7.1.7.1.8 Perform Propellant Valve Functional per paragraph 6.5.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	1-31-64	R. Eide	1-31-64		
CHECKED BY:	DATE				
	1-31-64				

FORM 608-B-44 NEW 6-63

REVISION B _____ Dated _____

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 208130-401 SHEET 126 OF 267

B

7.1.7.2 Test Data - TCA #1A

7.1.7.2.1 Component Identification

Component Name	TCA	Propellant Valve
McDonnell Part No.	52-52700-217	
Rocketdyne Part No.	208130-61	407557
Component Serial No.	4060418	8759999

7.1.7.2.2 Propellant Valve Continuous Duty test (reference paragraph 7.3.5.1)

Start of energize (date and time) 9-4-64 @ 5:20 PM

Initial energize voltage (26 ±4) 26. VDC

Reduce energize voltage (10 ±2) 10. VDC

End of energize (date and time) 5:22 - 9-5-64

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PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 4/30/64 1-31-64	M.E. Frey 9-5-64	9-5-64 WB Katnerich	J.D. Mavrogenis 9/14/64
			VERIFIED BY USAF: 9/5/64 DATE W. Royal

FORM 608-B-43 NEW 6-63

REVISION B _____ Dated _____

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE CONTINUOUS DUTY TEST NO 208130-401 SHEET 127 OF 267

7.1.7.2.2 (Cont'd) Valve body temperature B

Hour	Temp.	Hour	Temp.	Hour	Temp.
0	81° F	9	115° F	18	112° F
1	113° F	10	114° F	19	113° F
2	115° F	11	114° F	20	115° F
3	117° F	12	112° F	21	116° F
4	119° F	13	111° F	22	117° F
5	119.5° F	14	110° F	23	120° F
6	119° F	15	110° F	24	121° F
7	117° F	16	110° F		
8	115.5° F	17	111° F		

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 1-31-64	F. E. Pope 9-5-64	[signature] 9/8/64	J. D. Mavrogenis 9/14/64
			VERIFIED BY USAF: DATE
			R L McNamee 9/8/64

FORM 608-B-43 NEW 6-63

Rev. B _____ date _____

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 208130-401 SHEET 128 OF 267

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

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 ±10)	500 psig	____ psig
Time Duration (3 minimum)	3 minutes	____ minutes
Leakage Voltage (26 ±0.5)	26 VDC	____ VDC
Inlet Pressure (500 ±10)	500 psig	____ psig
Time Duration (5 minimum)	5 minutes	____ minutes
Leakage Rate (2.23 maximum)	Zero scc He/min	____ scc He/min

A

Inspection Remarks

~~Fuel~~

Fuel Valve D.N.A. As per IL.

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PREPARED BY:	DATE	PERFORMED BY:	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL:	DATE
T.G.Kniffin	6-22-64 4/30/64 1-31-64	Fred Moeller	9/8/64	G.J. Murchison	9/8/64	J.D. Mavrogenis	9/14/64
						VERIFIED BY USAF:	
						[illegible]	9/8/64

FORM 608-E-43 NEW 6-63

REVISION A J.D. Mavrogenis Dated 6/22/64

REVISION B ____ Dated ____

R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 208130-401 SHEET 129 OF 267

7.1.7.2.4 Propellant Valve Electrical Resistance test (reference paragraph 6.3) B

Environmental Temperature 70 (70 ± 10F).

Resistance A - B

Oxidizer Valve 42.2 ohms (Acceptable per Figure 15, yes or no Yes)

Fuel Valve _____ ohms (Acceptable per Figure 15, yes or no _____).

Resistance C - D (1.0 max ohm)

Oxidizer Valve .08 ohms

Fuel Valve _____ ohms

Inspection Remarks

~~None~~

Fuel Valve DNA as per EL

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G.Kniffin	1-31-64	Fred Moeller	9/8/64	[signature]	9/8/64	J.D. Marrugenis	9/14/64
						VERIFIED BY USAF	DATE
						[signature]	9/8/64

FORM 608-B-39 NEW 6-63

Revision B _____ Dated _____

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 208130-401 SHEET 130 OF 267

7.1.7.2.5 Propellant Valve Dielectric Strength test (reference paragraph 6.4) B

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 +10 -0	Current Microamps 500 max.	Voltage Volts 500 +10 -0	Current Microamps 500 max.
A to Ground	500	73		
C to Ground	500	131		
A to C	500	20		

Inspection Remarks

~~None~~

Fuel Valve DNA Asper IL

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 1-31-64	Fred Moeller 9/8/64	J.F. Murdoch 9/8/64	J.D. Monrogamis 9/14/64
			VERIFIED BY USAF: DATE
			R.M. Nawez 9/8/64

FORM 608-B-43 NEW 6-63

Revision B _____ Dated _____

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
Cracraft	595399	C.P.	2061	9-8-64

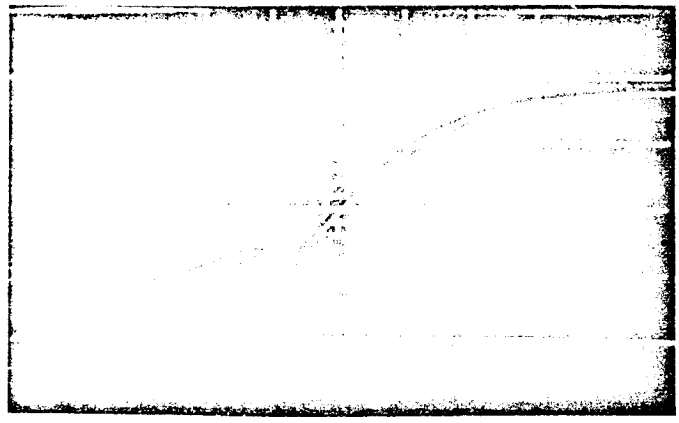
PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #1A)	208130-61 S/N 4060448	POST CONTINUOUS DUTY

OXIDIZER VALVE

P/N 407557 S/N 8759999

CURRENT TRACE

(Opening Time)



Horizontal = 1ms/cm

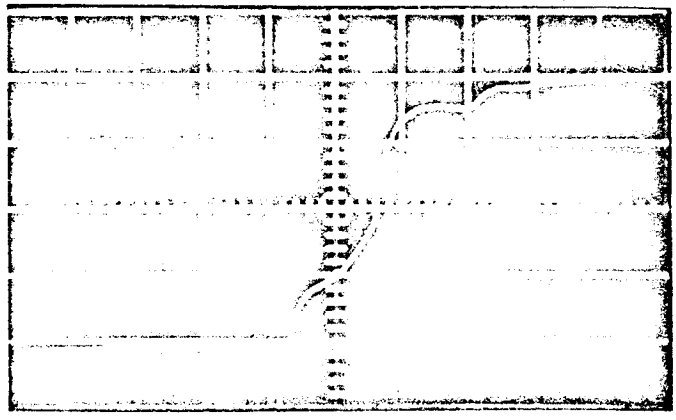
Vertical = 20mv/cm

Requirement = 0.0065 sec.max

Actual = 0.0042 sec.

VOLTAGE TRACE

(Closing Time)



Horizontal = .5ms/cm

Vertical = 10v/cm

Requirement = 0.0035 sec.max

Actual = 0.0028 sec

R-15019-2

Form 600-W-67 Rev 10-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 208130-401 SHEET 131 OF 267

7.1.7.2.6 Propellant Valve Functional test (reference paragraph 6.5) B

	Oxidizer Valve	Fuel Valve	
Response Time			
Ambient Temperature (70 ±10)	70 F	F	
Energizing Voltage (26 ±0.5)	26 VDC	VDC	
Inlet Pressure (300 ±10 for "pull-in")	300 psig	psig	A
Opening Time (0.0065 maximum)	.0042 seconds	seconds	
Inlet Pressure (zero for "drop-out")	Zero psig	psig	
Closing Time (0.0035 maximum)	.0028 seconds	seconds	A
Low Voltage Operation			
Ambient Temperature (70 ±10)	70 F	F	
Inlet Pressure (300 ±10 for "pull-in")	300 psig	psig	A
Opening Voltage (16 maximum)	7.4 VDC	VDC	
Inlet Pressure (zero for "drop-out")	Zero psig	psig	
Closing Voltage (1.0 minimum)	1.1 VDC	VDC	

Inspection Remarks

Fuel Valve DNA As per IL

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 6-22-64 4/30/64 1-31-64	Fred Moeller 9/8/64	J.F. Mendrin 9/8/64	J.D. Manogenis 9/14/64
			VERIFIED BY USAF: 9/8/64

FORM 608-B-43 NEW 6-63

REVISION A J.D. Manogenis Dated 6/22/64

REVISION B _____ Dated _____

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208130-401 SHEET 132 OF 267

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.2.3.20

7.1.8 Disassembly and Inspection

7.1.8.1 Test Procedure

7.1.8.1.1 Prior to sectioning the TCA perform a visual inspection and record the post test condition of the TCA.

7.1.8.1.1.2 Cut the propellant valve mounting bracket and propellant valve feed tubes from the TCA injector face along line A, B as shown in Figure 7. All cutting shall be done by saw. C

7.1.8.1.1.3 Separate the propellant valves from the mounting bracket. C

7.1.8.1.1.4 Section the TCA by cutting along line C-D-E as depicted in Figure 16.

7.1.8.1.1.5 Perform visual inspection ofall detailed parts for evidence of damage, distortion, fluid incompatability, corrosion, broken parts and impending failure.

7.1.8.1.1.6 After test completion identify the sectioned TCA and detailed parts and package and store for reference (except for propellant valves). C

7.1.8.1.1.7 Machine, on the oxidizer propellant valve, the seat assembly to spacer weld to loosen the seat. Only the minimum amount of material to accomplish this shall be removed. The seat assembly P/N 407664 shall not be removed at this time.

7.1.8.1.1.8 Machine the filter assembly to solenoid weld to loosen the filter. Only the minimum amount of material to accomplish this shall be removed. The filter assembly P/N NA5-28097-T1 shall not be removed at this time. C

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole	11-20-64				
CHECKED BY:	DATE				
E Adams	11-20-64		11-20-64		

FORM 608-B-44 NEW 6-63

Rev. C J. D. Mangelini Date 11-20-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO 208130-401 SHEET 132.1 OF 267

7.1.8.1.1.9	Remove, bag and identify the seat assembly.	C
7.1.8.1.1.10	Remove, bag and identify the armature P/N 407569.	
7.1.8.1.1.11	Remove, bag and identify the spring P/N 406806.	
7.1.8.1.1.12	Remove, bag and identify the filter assembly.	
7.1.8.1.1.13	Bag and identify the solenoid assembly.	
7.1.8.1.1.14	Repeat 7.1.8.1.7 thru 7.1.8.1.13 for the fuel propellant valve.	C

NOTE: Only authorized personnel shall have access to stored DAT hardware.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
D. Cole DC	11-20-64	[signature]	11-20-64		
CHECKED BY: E Adams	DATE 11-20				

FORM 608-B-44 NEW 6-63
Rev. C J. D. Marzeni Date 11-20-64

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208130-401 SHEET 133 OF 267

7.1.8.2 Post Test Inspection Data - TCA #1A B

7.1.8.2.1 Component Identification

Component Name TCA

McDonnell Part No. SCD 52-52700-217

Rocketdyne Part No. 208130-61

Component Serial No. 406C448

7.1.8.2.2 Preliminary Inspection (Reference Paragraph 7.1.8.1.1)

7/1/5 ANA 606 The TCA was visually inspected prior to sectioning and the TCA condition was as follows: BRKTS & MOUNT ARE REMOVED AND ARE SCRAP. VALVES ARE MISSING. DC TUBE IS NICKED AT INJ. WELD. SHELL TO INJ. WELD HAS NUMEROUS NICKS. INJECTOR RISERS ARE CUT TOO SHORT FOR RE-USE. HEAT DISCOLORATION THROUGHOUT. RESIDUE ON THROAT INSERT ON DOWNSTREAM END. DELAMINATIONS OF ABLATIVE MATERIAL APPROX. 1/50 FROM END OF THROAT INSERT

7.1.8.2.3 Disassembly and Inspection (Reference Paragraph 7.1.8.1.3)

The TCA was sectioned along line C-D-E and visually inspected. The results of the inspection were as follows:

THERMAL DISCOLORATION THROUGHOUT THE ENTIRE COMBUSTION CHAMBER AREA, FOREIGN SUBSTANCE "BUILD UP" ON THE DOWNSTREAM SURFACE OF THE THROAT. DELAMINATIONS OF ABLATIVE, ASBESTOS, AND GLASS ROVING AT VARIOUS PLACES THROUGHOUT THEIR EXISITING AREAS.

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
7-16-64 T. Kniffin		RECEIVED R6-226 MAY 21 1965	WAIVED BY ERICKSON TO A. GRANIERE 4/26/65
			VERIFIED BY USAF: DATE J. Williams 6/22/65

FORM 608-B-43 NEW 6-63

REVISION B _____ Dated _____

SPACE ENGINES MANUFACTURING SERVICES

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208130-401 SHEET 133.1 OF 267

7.1.8.2.4 Disassembly of Propellant Valves (Reference Paragraphs 7.1.8.1.7 thru 7.1.8.1.13).

The propellant FUEL VALVE ~~valves~~ were disassembled and all parts called for were bagged and identified NO (~~yes or~~ no).

(1) VALVE HOUSING. - BURRS WERE FOUND IN BOTTOM OF FILTER PORT.

(2) FILTER - NO DEFECTS NOTED

(3) SPRING. - NO DEFECTS NOTED

(4) ARMATURE - OD IS SCRATCHED & PITTED. SLIGHT DISCOLORATION OR WEAR AT SPRING END.

(5) SEAT - SEAT IS PITTED ON CHAMFER ALSO SHOWS IND. OF BEING BURNT ON O.D.

(6) RETAINER, BALL - WEAR IS NOTED.

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PREPARED BY:	DATE	PERFORMED BY:	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL:	DATE
EC E. Cole	11-20-64	BURKS		[signature]	8/10/65	WAIVED BY R. FREE	8/10/65
						VERIFIED BY USAF: [signature]	8/10/65

FORM 608-B-43 NEW 6-63

Rev. C J.D. Marrazzini Date 11-20-64

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 208130-401 SHEET 134 OF 267

Reference: MAC SCD 52-52700, Revision G, Figure 10

7.2 Thrust Chamber Assembly Number Two

This subsection specifies those environment and service life tests which are to be performed on Thrust Chamber Assembly Number Two.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	1-31-64	R. Eide	1-31-64		
CHECKED BY:	DATE				
	1-31-64				

FORM 608-B-44 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PRE-TEST INSPECTION TEST NO. 208130-401 SHEET ~~102~~ OF ~~354~~

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.2.2.1

7.2.1 Pre-Test Inspection - TCA #2

7.2.1.1 Test Procedure

7.2.1.1.1 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 RA0220-350. Only those TCA's meeting the above requirements shall be accepted for DAT.

7.2.1.1.2 Braze propellant valve inlet adapters to the oxidizer and fuel propellant valves per RA0607-009.

7.2.1.1.3 Perform Weight Determination per paragraph 6.6.

369

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
C. G. Kniffin	4/30/64	R. Eide	1-31-64		
CHECKED BY:	DATE				
	1-31-64				

FORM 608-B-44 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PRE-TEST INSPECTION TEST NO. 208130-401 SHEET ~~100~~ OF 354

7.2.1.2 Test Data - TCA #2

7.2.1.2.1 Component Identification

Component Name	TCA	Oxidizer Valve	Fuel Valve
McDonnell Part No.	SCD-52-52700-217		
Rocketdyne Part No.	208130-61	9193194	9205846
Component Serial No.	4059276	(407557)	(407558) *

7.2.1.2.2 Inspection (reference paragraph 7.2.1.1)

7.2.1.2.2.1 The TCA was inspected to insure that it was of the proper configuration, 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 RA0220-350. YES (yes or no)

7.2.1.2.2.2 Propellant valve inlet adapters were installed on the propellant valves per paragraph 7.2.1.1.2. YES (yes or no)

7.2.1.2.2.3 Inspection Remarks

OXI. & FUEL VALVE P/N & S/N ARE REVERSED 6-4-64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T.C.Kniffin 4/30/64 1-31-64	6/5/64	6/4/64	VERIFIED BY USAF: DATE 6/4/64

FORM 608-B-43 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61 }

NAME OF TEST PRE-FLIGHT INSPECTION TEST NO. 208130-401 SHEET 1 OF 35

7.2.1.2.3 Weight Determination test (reference paragraph 6.6)

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

The TCA dry weight was 2.29 pounds.
(Record to the nearest one-hundredth pound)

Inspection Remarks NONE

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PREPARED BY:	DATE	PERFORMED BY:	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin		T. E. Page	6-5-64	M. J. Fogarty	6/5/64	VERIFIED BY USAF:	6/5/64

FORM 608-B-43 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST TEMPERATURE SHOCK TEST NO. 208130-401 SHEET ___ OF ___

IL 4388-5345

Deviation Request:

A deviation to DAT Specification 208130-401 is requested to perform a partial analysis on OFR #06856F. The tests to be conducted are;

1) Low Pressure Leak Check on Fuel Valve to establish if valve is closed.

2) Obtain opening and closing signature trace on Fuel and Oxidizer Valve without zener diode in circuit.

Recopied from original request dated 19, June 1964.

James D. Mavrogenis
Jim Mavrogenis
MAC Engineering

12-2-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

FORM 608-B-42 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST TEMPERATURE SHOCK TEST NO. 208130-401 SHEET ~~105~~ OF ~~221~~ 354

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.2.3.7

7.2.2 Temperature Shock - TCA #2

7.2.2.1 Test Procedure

7.2.2.1.1 Place the TCA unit in a temperature chamber maintained at a temperature of 185 ± 5F.

7.2.2.1.2 Expose the TCA to 185 ± 5F for a continuous period of four hours minimum.

7.2.2.1.3 Transfer the TCA unit to a temperature chamber maintained at a temperature of -40 ± 5F.
NOTE: Throughout the temperature shock testing the transfer of the TCA from one temperature chamber to another shall be accomplished within a maximum time limit of five minutes.

7.2.2.1.4 Expose the TCA unit to -40 ± 5F for a continuous period of four hours minimum.

7.2.2.1.5 Repeat paragraphs 7.2.2.1.1 through 7.2.2.1.4 two more times.

7.2.2.1.6 Allow the TCA unit to return to room ambient temperature.

7.2.2.1.7 Within one hour, following stabilization of the TCA's temperature, begin the first of the following procedures. The tests shall be carried through to completion without delay. In the event of a structural failure, see paragraph 3.6.

7.2.2.1.7.1 Perform Propellant Valve Proof Pressure and Leakage Test per paragraph 6.1

7.2.2.1.7.2 Perform Thrust Chamber Proof Pressure and Leakage Test per paragraph 6.2.

PREPARED BY: T.G.Kniffin	DATE 1-31-64	APPROVED FOR NAA:	DATE 1-31-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 1-31-64				

FORM 606-B-44 NEW 6-63

REVISION A dated 5 Jan 64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST TEMPERATURE SHOCK TEST NO 208130-401 SHEET 1-6 OF 35

7.2.2.1.7.3 Perform Propellant Valve Electrical Resistance Test per paragraph 6.3.

7.2.2.1.7.4 Perform Propellant Valve Dielectric Strength Test per paragraph 6.4.

7.2.2.1.7.5 Perform Propellant Valve Functional Test per paragraph 6.5.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.C. Griffin	1-31-64	R. Eichel	1-31-64		
CHECKED BY:	DATE				
	1-31-64				

FORM 608-B-44 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST TEMPERATURE SHOCK TEST NO. 208130-SHEET 401 OF 354

7.2.2.2 Test Data - TCA #2

7.2.2.2.1 Component Identification

Component Name TCA

McDonnell Part No. SCD-52-52700-217

Rocketdyne Part No. 208130-61

Component Serial No. 4059276

7.2.2.2.2 Temperature Shock test (reference paragraph 7.2.2.1)

7.2.2.2.2.1 The TCA was placed in a temperature chamber where it was exposed to a temperature of 185 F (185 ±5F) for a time period of 4 (4 minimum) hours. 6-16-64 @ 10:00 AM

7.2.2.2.2.2 The TCA was transfered to a temperature chamber where it was exposed to a temperature of -40 F (-40 ±5F) for a time period of 4 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No) 6-16-64 @ 2:00 PM.

7.2.2.2.2.3 The TCA was transfered to a temperature chamber where it was exposed to a temperature of 185 F (185 ±5F) for a time period of 4 HRS (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No) 6-16-64 6:00 P.M.

7.2.2.2.2.4 The TCA was transfered to a temperature chamber where it was exposed to a temperature of -40°F (-40 ±5F) for a time period of 4 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No) 10:00 P.M. 6-16-64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T.G. Kniffin	6-16-64	6/16/64	VERIFIED BY USAF: DATE 6/16/64

FORM 608-B-43 NEW 6-63

R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST TEMPERATURE SHOCK TEST NO 208130-401 SHEET ~~162~~ F ~~354~~

7.2.2.2.2.5 The TCA was transfered to a temperature chamber where it was exposed to a temperature of 183° F (185 ±5F) for a time period of 4 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No) IN AT 2:00 A.M. 6-17-64

7.2.2.2.2.6 The TCA was transfered to a temperature chamber where it was exposed to a temperature of -40 F (-40 ±5F) for a time period of 4 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No) IN AT 6:00 AM 6-17-64 OUT AT 10:00AM 6-17-64

7.2.2.2.2.7 Inspection Remarks

NONE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T.G. Kniffin 1-31-64	F. E. Pope 6-17-64	L. B. Johnson 6-17-64	WAIVE BY L. N. ALZOGFNS 12/7/64 VERIFIED BY USAF: 6-17-64 DATE

FORM 608-B-43 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST TEMPERATURE SHOCK TEST NO. 208130-401 SHEET ~~102~~ OF ~~351~~

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

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 ±10)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
Leakage		
Inlet Pressure (500 ±10)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate (2.23 maximum)	<.1 scc He/min	<.1 scc He/min

Inspection Remarks

THE BENDIX MS06-8-4S ELECTRICAL HARNESS WAS IMPROPERLY WIRED 6-17-64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T.G.Kniffin 4/30/64 1-31-64	F. E. Popa 6-17-64	[signature] 6/17/64	[signature] 12/9/64
			VERIFIED BY USAF: [signature] 6/17/64 DATE

FORM 608-D-43 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61 401

NAME OF TEST TEMPERATURE SHOCK TEST NO. 208130-401 SHEET 110 OF 354

7.2.2.2.4 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 ±0.25)	3 minutes	3 minutes

Inspection Remarks

NONE:

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 1-31-64	F.E. Pope 6-17-64	L.B. Johnson 6-17-64	CERTIFIED BY L. MACROGENIS 12/9/64
			VERIFIED BY USAF: DATE R.M. Ayres 6/17/64

FORM 608-B-43 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST TEMPERATURE SHOCK TEST NO 208130-401 SHEET 11 OF 35

7.2.2.2.5 Propellant Valve Electrical Resistance test (reference paragraph 6.3)

Environmental Temperature 70 °F (70 ±10°).

Resistance A - B

Oxidizer Valve 41.63 ohms (Acceptable per Figure 15, yes or no YES).

Fuel Valve 41.83 ohms (Acceptable per Figure 15, yes or no YES).

Resistance C - D (1.0 maximum)

Oxidizer Valve .02 ohms

Fuel Valve .04 ohms

Inspection Remarks

NONE

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T.G.Kniffin 1.[illegible].64	F.E. Pope 6-17-64	L.B. Johnson 6-17-64	REVIEWED BY [illegible] 12/9/66
			VERIFIED BY USAF 6/17/64 DATE R.M. Ayres

FORM 608-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-[illegible] / NAA 208130-61 }

NAME OF TEST TEMPERATURE SHOCK TEST NO. 208130-401 SHEET 2 OF

7.2.2.2.6 Propellant Valve Dielectric Strength test (reference paragraph [illegible])

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 +10 -0	Current Microamps 500 max.	Voltage Volts 500 +10 -0	Current Microamps 500 max.
COMPENSATION = A A to Ground	500	58 MIC AMPS	500	* 53 MIC AMPS
COMPENSATION = NONE C to Ground	500	58 MIC AMPS	500	* 56 MIC AMPS
COMPENSATION = NONE A to C	500	14 MIC AMPS	500	* 16 MIC AMPS

Inspection Remarks

* COMPENSATION WAS THE SAME AS LISTED ON THE OXIDIZER VALVE 6-17-64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.O.Kniffin 1-31-64	F. E. Pope 6-17-64	[signature] 6-17-64	WAIVED BY J. MALROGENIS 12/9/64 VERIFIED BY USAF: 6/[illegible]/64 DATE R.M. Cuyler

FORM 608-B-43 NEW 6-63

R-15019-2

DEVELOPMENT LABORATORY TEST REPORT

PAGE ____ OF ____

LAB TEST NO. ____

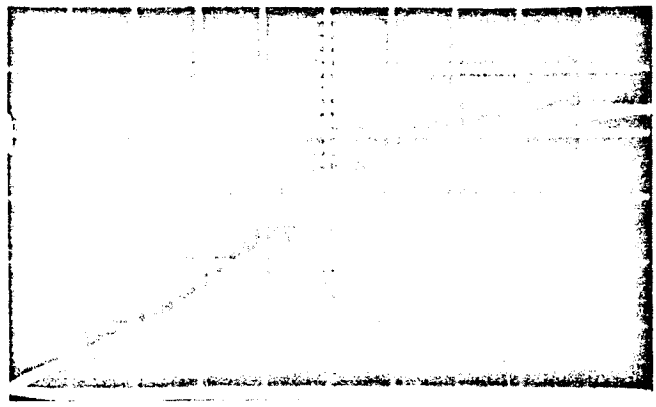
PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F. Pope	595399	ENV. LAB.	2061	6-17-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #2)	208130-61 S/N 4059276	POST TEMPERATURE SHOCK FUNCTIONAL (Response Time)

OXIDIZER VALVE

P/N 407557 S/N 9193194

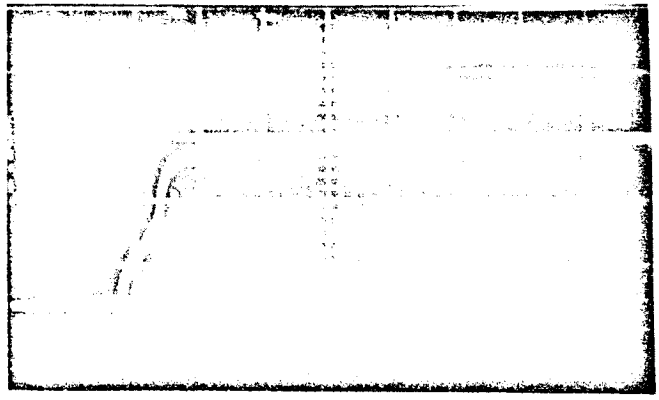
CURRENT TRACE
(Opening Time)



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

Requirement = 0.0065 sec
Actual = .0042 sec

VOLTAGE TRACE
(Closing Time)



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

Requirement = 0.002 sec.max.
Actual = 0.003 sec*

* Reference OFR 06856F

Form 600-V-67 Rev 10-63

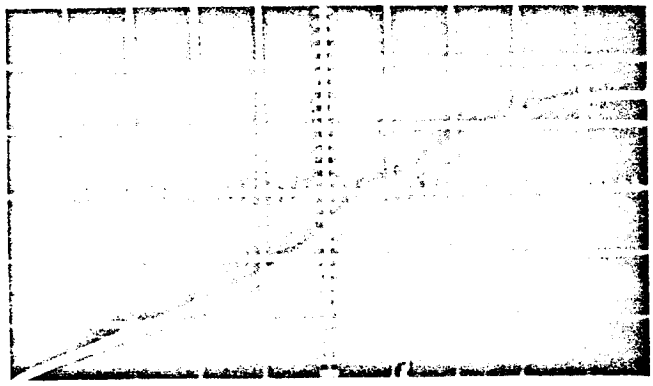
PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F. Pope	595399	ENV. TEST	2061	6-17-64

PART	PART NO.	TYPE OF TEST
25# RCS TCS (Unit #2)	208130-61 S/N 4059276	POST TEMPERATURE SHOCK FUNCTIONAL (Response Time)

FUEL VALVE

P/N 407558 S/N 9205846

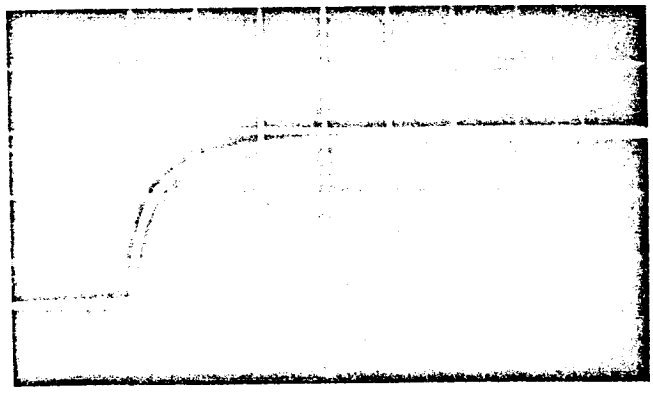
CURRENT TRACE
(Opening Time)



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

Requirement = 0.065 sec.max.
Actual = 0.062 sec.

VOLTAGE TRACE
(Closing Time)



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

Requirement = .002 sec.max.
Actual = *

* Reference Deviation

R-15019-2

Form 600-W-67 Rev 10-63

DEVELOPMENT LABORA

PAGE ____ OF ____

LAB TEST NO. ____

PREPARED BY	EWR NO.	PHONE	DATE
F. Pope	595399	2061	6-17-64

PART	PART NO.
25# RCS TCA (Unit #2)	208130-61 S/N 4059276

TEMPERATURE SHOCK (Response Time)

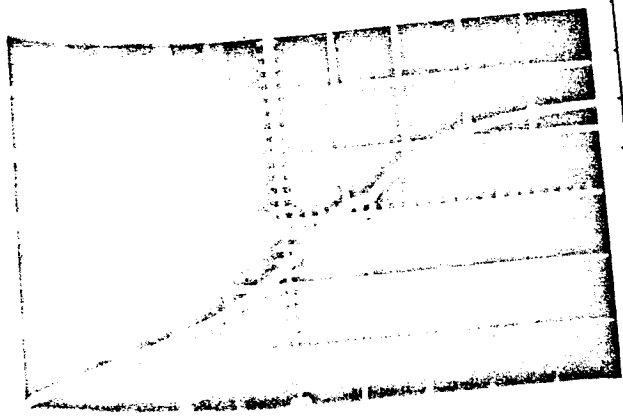
FUEL

P/N 407558

CURRENT TRACE
(Opening Time)
(Without Zener Diode)

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

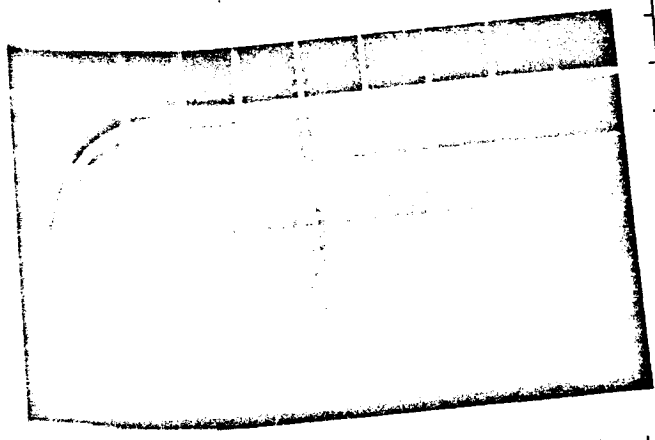
Requirement = .0065 sec.max.
Actual = .0064 sec



VOLTAGE TRACE
(Closing Time)
(Without Zener Diode)

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

Requirement = .002 sec.max.
Actual = *



* Reference Deviation

R-15019-2

Form 600-W-67 Rev 10-63

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F. Pope	595399	ENV. LAB.	2061	6-19-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #2)	208130-61 S/N 4059276	POST TEMPERATURE SHOCK FUNCTIONAL (Response Time)

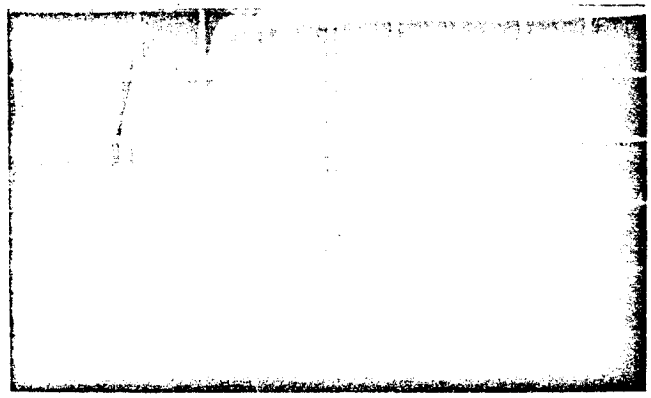
OXIDIZER VALVE

P/N 407557 S/N 9193194

VOLTAGE TRACE
Closing Time
(With Zener Diode)

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

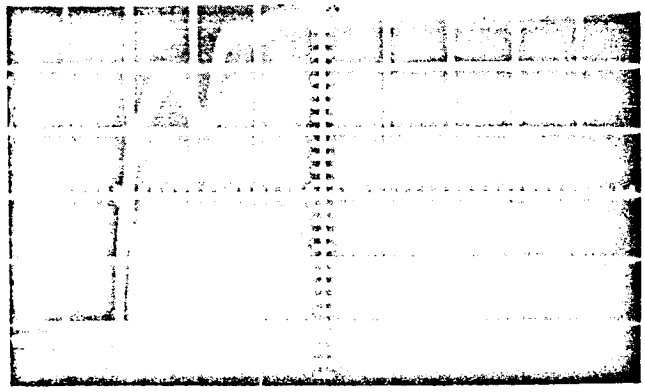
Requirements = .002 sec.max.
Actual = .003 sec.*



VOLTAGE TRACE
Closing Time
(With Zener Diode)

Horizontal = 1ms/cm
Vertical = 10v/cm

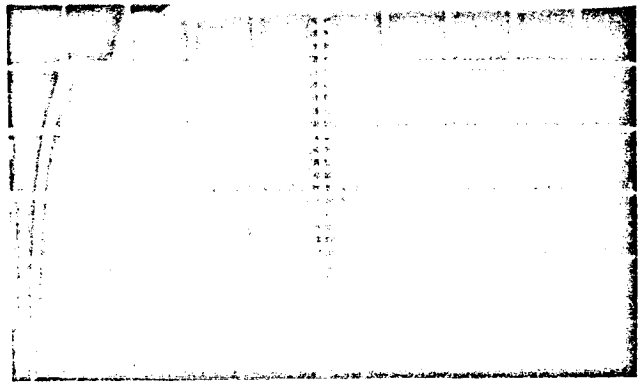
Requirements = .002 sec.max.
Actual = .0032 sec.*



VOLTAGE TRACE
Closing Time
(Without Zener Diode)

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

Requirements = .002 sec.max
Actual = .0017 sec.



* Reference Deviation
384

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DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	595399	ENV. TEST	2061	6-19-64

PART	PART NO	TYPE OF TEST
25# RCS TCA (Unit #2)	208130-61 S/N 4059276	POST TEMPERATURE SHOCK FUNCTIONAL (Response Time)

FUEL VALVE

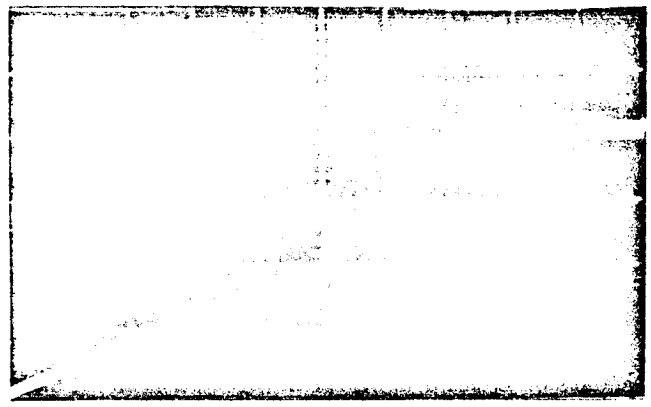
P/N 407558 S/N 9205846

CURRENT TRACE

Opening Time
(With Zener Diode)

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

Requirements = .0065 sec.max.
Actual = *

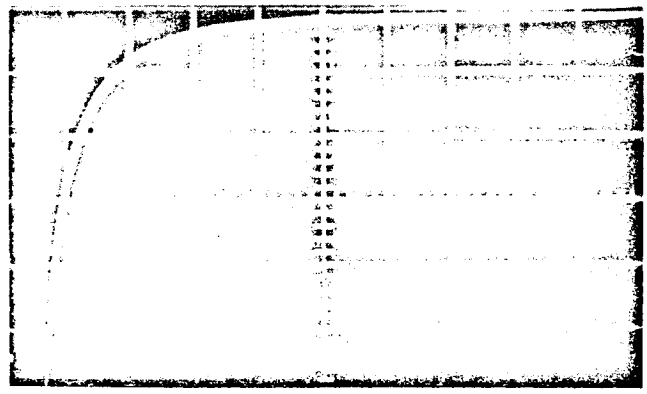


VOLTAGE TRACE

Closing Time
(Without Zener Diode)

Horizontal = 1ms/cm
Vertical = 10v/cm

Requirement = .002 max.
Actual = *

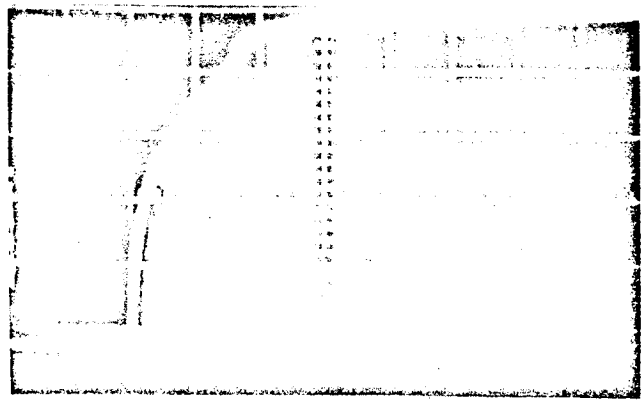


VOLTAGE TRACE

Closing Time
(With Zener Diode)

Horizontal = 1ms/cm
Vertical = 10v/cm

Requirement = .002 sex.max.
Actual = .0036 sec *



* Reference Deviation
R-15019-2

Form 600-W-67 Rev 10-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST TEMPERATURE SHOCK TEST NO. 208130-401 SHEET [illegible] OF [illegible]

7.2.2.2.7 Propellant Valve Functional test (reference paragraph 6.5).

	Oxidizer Valve.	Fuel Valve
Response Time		
Ambient Temperature (70 ±10)	70 F	70 F
Energizing Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Time (0.0065 maximum)	.0042 seconds	.0062 seconds
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Time (0.002 maximum) XX	* .0030 seconds	⊗ XX seconds
Low Voltage Operation		
Ambient Temperature (70 ±10)	70 F	70 F
Inlet Pressure (300 ±10 for "pull-in")	70 psig	70 psig
Opening Voltage (16 maximum)	VDC	VDC
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Voltage (1.0 minimum)	VDC	VDC

Inspection Remarks * FAILED CLOSING TIME S/B .002 SEC. MAX. 6-17-64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 6-13-64	L L Cracraft 6/17/64		VERIFIED BY USAF: DATE

FORM 608-B-43 NEW 6-63 R-15019-2

⊗ DURING FAILURE ANALYSIS OF OXIDIZER VALVE S/N 407557, THE PIN B OF THE FUEL VALVE S/N-407558, WAS BENT APPROX. 30° TO THE CENTER CAUSEING VALVE NOT TO ENERGIZE. THE PIN WAS STRAIGHTEN PER SPEC. RA0113-011 PARA 4.5

UNIT #2

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4054995

Dwg. No. 208130-61

Model SR-6

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
		Ctl #3 S/S			
1	11/2/64	PART NO. General: McDonald Rep J.D. Maverogenis Waived H/F test 11-2-64 Per tele-con at 2130 hrs Per Mel Moore			
		ACTION TAKEN: information only	11	2	64
2	11/2/64	PART NO. General: Slight NTO Flow Restriction indicated on 6th 1 sec. Cape cycle H/F.			
		ACTION TAKEN: TRANSFERRED TO SHORTAGE	11	3	64
3	11/2/64	PART NO. DAT TEST DUTY CYCLE POST RETRO - NTO Flow RESTRICTION NOTED -			
		ACTION TAKEN: TRANSFERRED TO SHORTAGE	11	3	64
4.	11/2/64	PART NO. DAT - TEST DUTY CYCLE - PRIOR TO 100 SEC MIN SKIN TEMPS EXCEEDED 550°F REF G/N 2 of TABLE II			
		ACTION TAKEN: TRANSFERRED TO SHORTAGE	11	3	64
5	11/2/64	PART NO. Facility Prop valve MMH MARROTA - failed To close completly and leakage of PRESSURE WAS NOTED DURING BURST PRESSURE TEST -			
		ACTION TAKEN: TRANSFERRED TO SHORTAGE	11	3	64

R-15019-2

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Form R 25-U Rev. 12-57

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PRE-TEST INSPECTION TEST NO. 208130-401 SHEET 135 OF 267

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.2.2.1

7.2.1 Pre-Test Inspection - TCA #2A

7.2.1.1 Test Procedure

7.2.1.1.1 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 RA0220-350. Only those TCA's meeting the above requirements shall be accepted for DAT.

7.2.1.1.2 Braze propellant valve inlet adapters to the oxidizer and fuel propellant valves per RA0607-009.

7.2.1.1.3 Perform Weight Determination per paragraph 6.6.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T. G. Kniffin	1-31-64	R. Eide	1-31-64		
CHECKED BY:	DATE				
H. Hollander	1-31-64				

FORM 608-B-44 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PRE-TEST INSPECTION TEST NO. 208130-401 SHEET 136 OF 267

7.2.1.2 Test Data - TCA #2A

7.2.1.2.1 Component Identification

Component Name	TCA	Oxidizer Valve	Fuel Valve
McDonnell Part No.	52-52700-217		
Rocketdyne Part No.	208130-61	407557	407558
Component Serial No.	4054995	9160557	9198083

7.2.1.2.2 Inspection (reference paragraph 7.2.1.1)

7.2.1.2.2.1 The TCA was inspected to insure that it was of the proper configuration, 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 RA0220-350. YES (yes or no)

7.2.1.2.2.2 Propellant valve inlet adapters were installed on the propellant valves per paragraph 7.2.1.1.2. YES (yes or no)

7.2.1.2.2.3 Inspection Remarks

NONE

PREPARED BY: DATE	RESPONSIBLE BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR DOUGLAS: DATE
T.G.Kniffin 4/30/64 1-31-64	8/28/64	Eugene Fiorini 8/28/64	VERIFIED BY: DATE

FORM 600-0-43 REV 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PRE-TEST INSPECTION TEST NO. 208130-401 SHEET 137 OF 267

[illegible].1.2.3 Weight Determination test (reference paragraph 6.6)

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

The TCA dry weight was 2.28 pounds.
(Record to the nearest one-hundredth pound)

Inspection Remarks NONE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T. C. Kniffin	F. E. Pope 8-23-64	[illegible] 8/21/64	J. D. Marrazzo 8/27/64
			VERIFIED BY USAF DATE 8/28/64 Earl F. [illegible]

FORM 608-D-43 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61 }

NAME OF TEST TEMPERATURE SHOCK TEST NO. 208130-401 SHEET 138 OF 267

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.2.3.7

7.2.2 Temperature Shock - TCA #2A

7.2.2.1 Test Procedure

7.2.2.1.1 Place the TCA unit in a temperature chamber maintained at a temperature of 185 ± 5F.

7.2.2.1.2 Expose the TCA to 185 ± 5F for a continuous period of four hours **minimum.** A

7.2.2.1.3 Transfer the TCA unit to a temperature chamber maintained at a temperature of -40 ± 5F.
NOTE: Throughout the temperature shock testing the transfer of the TCA from one temperature chamber to another shall be accomplished within a maximum time limit of five minutes.

7.2.2.1.4 Expose the TCA unit to -40 ± 5F for a continuous period of four hours minimum.

7.2.2.1.5 Repeat paragraphs 7.2.2.1.1 through 7.2.2.1.4 two more times.

7.2.2.1.6 Allow the TCA unit to return to room ambient temperature.

7.2.2.1.7 Within one hour, following stabilization of the TCA's temperature, begin the first of the following procedures. The tests shall be carried through to completion without delay. In the event of a structural failure, see paragraph 3.6.

7.2.2.1.7.1 Perform Propellant Valve Proof Pressure and Leakage Test per paragraph 6.1

7.2.2.1.7.2 Perform Thrust Chamber Proof Pressure and Leakage Test per paragraph 6.2.

PREPARED BY: T.G.Kniffin	DATE 1-31-64	APPROVED FOR NAA: R Eccle	DATE 1-31-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 1-31-64				

FORM 608-B-44 NEW 6-63

REVISION A R. J. Martin dated 5 Jun 64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST TEMPERATURE SHOCK TEST NO 208130-401 SHEET 139 OF 267

7.2.2.1.7.3 Perform Propellant Valve Electrical Resistance Test per paragraph 6.3.

7.2.2.1.7.4 Perform Propellant Valve Dielectric Strength Test per paragraph 6.4.

7.2.2.1.7.5 Perform Propellant Valve Functional Test per paragraph 6.5.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	1-31-64	L. Eidel by	1-31-64		
CHECKED BY:	DATE				
	1-31-64				

FORM 608-B-44 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST TEMPERATURE SHOCK TEST NO. 208130-401 SHEET 140 OF 267

7.2.2.2 Test Data - TCA #2A

7.2.2.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52700-217

Rocketdyne Part No. 208130-61

Component Serial No. 4054995

7.2.2.2.2 Temperature Shock test (reference paragraph 7.2.2.1)

7.2.2.2.2.1 The TCA was placed in a temperature chamber where it was exposed to a temperature of 185 F (185 ±5F) for a time period of 4 (4 minimum) hours. START @ 8:10 AM 8-29-64

START 12:10 PM 8-29-64

7.2.2.2.2.2 The TCA was transfered to a temperature chamber where it was exposed to a temperature of -40 F (-40 ±5F) for a time period of 4.30 minimum) hours. Transfer time was less than five minutes. YES (Yes or No)

7.2.2.2.2.3 The TCA was transfered to a temperature chamber where it was exposed to a temperature of 185 (185 ±5F) for a time period of 4 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No)

7.2.2.2.2.4 The TCA was transfered to a temperature chamber where it was exposed to a temperature of -40 F (-40 ±5F) for a time period of 4 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No)

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 1-31-64	H. Wallace 8-29-64	8-29-64 [signature]	J.D. Marrazzini 8/30/64
			VERIFIED BY USAF: DATE [signature] 8/30/64

FORM 608-B-43 NEW 6-63

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R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST TEMPERATURE SHOCK TEST NO 208130-401 SHEET 141 of 267

7.2.2.2.2.5 The TCA was transfered to a temperature chamber where it was exposed to a temperature of 185 (185 ±5F) for a time period of 4 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No)

7.2.2.2.2.6 The TCA was transfered to a temperature chamber where it was exposed to a temperature of -40 (-40 ±5F) for a time period of 4 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No)

7.2.2.2.2.7 Inspection Remarks

None

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR DOCUMENT DATE
T.G. Kniffin 1-31-64	F. S. Pope 8-30-64	8-30-64	8/30/64
			VERIFIED BY: DATE 8/30/64

FORM COJ-B-43 REV 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY — PART NO. { MAC 52-52700-217 / NAA 208130-61 }

NAME OF TEST: TEMPERATURE SHOCK — TEST NO. 208130-401 SHEET 142 OF 267

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

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 $^{+10}_{-0}$)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
Leakage Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (500 $^{+10}_{-0}$)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate (2.23 maximum)	Zero scc He/min	Zero scc He/min

Inspection Remarks

None

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	1-31-64	F.T. Vope	8-30-64	[illegible]	8/31/64	J.D. [illegible]	8/30/64
						BY NAA [illegible]	8/30/64

FORM CO-D-43 REV 6-63

REVISED BY J.D. [illegible] Dated 1/22/64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST TEMPERATURE SHOCK TEST NO. 208130-401 SHEET 243 OF 267

7.2.2.2.4 Thrust Chamber Proof Pressure and Leakage test (reference paragraph 6.2)

Proof Pressure

	1st Application	2nd Application
Pressure (392 ±10)	390 psig	390 psig
Time Duration (3 ±0.25)	3 minutes	3 minutes
Voltage (12 ±2)	12 VDC	12 VDC

Inspection Remarks

No Visible Leakage

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 6-22-64 1-31-64	F.E. Pope 8-30-64	J.F. [illegible]	J.D. Marrogenis 8/30/64
			VERIFIED BY: DATE E.E. Olson 8/30/64

FORM 608-B-43 NEW 6-63

REVISION A J.D. Marrogenis Dated 6/22/64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST TEMPERATURE SHOCK TEST NO. 208130-401 SHEET 344 OF 267

7.2.2.2.5 Propellant Valve Electrical Resistance test (reference paragraph 6.3)

Environmental Temperature 70 (70 ±10°).

Resistance A - B

Oxidizer Valve 41 ohms (Acceptable per Figure 15, yes or no Yes

Fuel Valve 41.5 ohms (Acceptable per Figure 15, yes or no Yes

Resistance C - D (1.0 maximum)

Oxidizer Valve .06 ohms

Fuel Valve .06 ohms

Inspection Remarks

None

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
T.G.Kniffin 1-31-64	F. T. Pope 8-30-64	[illegible] 8/30/64	J.D. [illegible] 8/30/64

FORM 603-D-39 REV 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST TEMPERATURE SHOCK TEST NO. 208130-401 SHEET 145 OF 267

7.2.2.2.6 Propellant Valve Dielectric Strength test (reference paragraph 6.4)

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 +10 -0	Current Microamps 500 max.	Voltage Volts 500 +10 -0	Current Microamps 500 max.
A to Ground	500	52	500	39
C to Ground	500	20	500	20
A to C	500	17	500	16

Inspection Remarks

None

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 1-31-64	F. E. Pope 8-30-64	J. P. Murchison 8/30/64	J. D. Marmenis 8/30/64
			VERIFIED BY USAF: DATE 8/30/64

FORM 608-B-43 REV 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE ____ OF ____

LAB TEST NO. ____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
J.Lally	595399	ENV.LAB.	2061	8-30-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #2A)	208230-61 S/N 4054995	POST TEMPERATURE SHOCK PROPELLANT VALVE FUNCTIONAL

OXIDIZER VALVE

P/N,407557 S/N 9160557

CURRENT TRACE

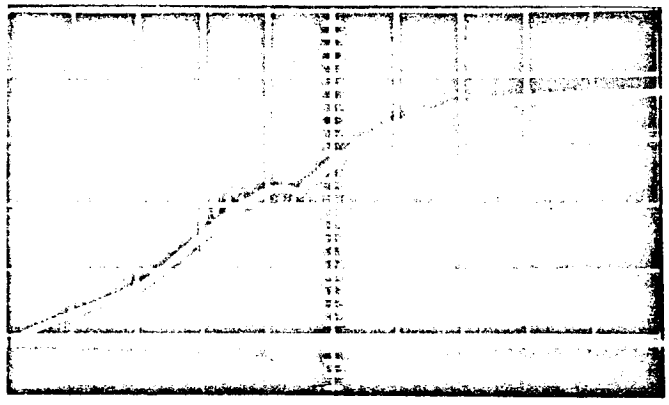
(Opening Time)

Horizontal = 1ms/cm

Vertical = 20mv/cm

Requirement = .0065 sec/max

Actual = .0045 sec.



VOLTAGE TRACE

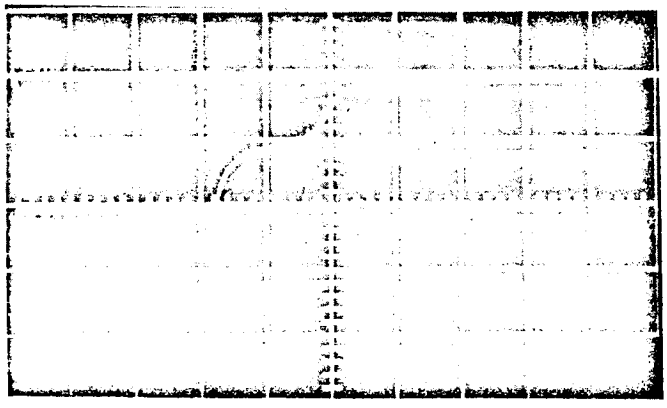
(Closing Time)

Horizontal = 0.5ms/cm

Vertical = 20v/cm

Requirement = .0035 sec/max

Actual = .0023 sec.



Form 600-W-67 Rev 10-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

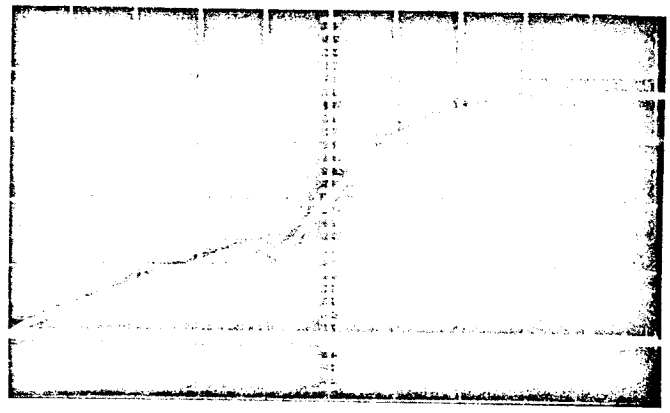
PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
J.Lally	595399	ENV.LAB	2061	8-30-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #2A) S/N 4054995	208130-61	POST TEMPERATURE SHOCK PROPELLANT VALVE FUNCTIONAL

FUEL VALVE

P/N 407558 S/N 9198083

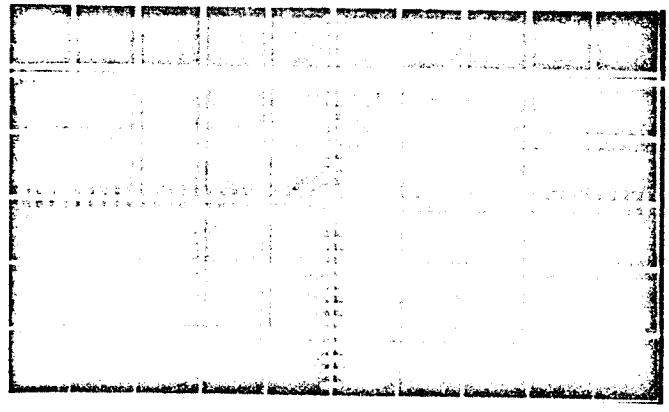
CURRENT TRACE
(Opening Time)



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

Requirement = .0065 sec/max
Actual = .0042 sec.

VOLTAGE TRACE
(Closing Time)



Horizontal = 0.5ms/cm
Vertical = 20v/cm

Requirement = .0035 sec/max
Actual = .0027 sec.

400

R-15019-2

Form 600-V-67 New 10-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST TEMPERATURE SHOCK TEST NO. 208130-401 SHEET 146 OF 267

7.2.2.2.7 Propellant Valve Functional test (reference paragraph 6.5)

	Oxidizer Valve	Fuel Valve
Response Time		
Ambient Temperature (70 ±10)	70 F	70 F
Energizing Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Time (0.0065 maximum)	.0045 seconds	.0042 seconds
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Time (0.0035maximum)	.0023 seconds	.0027 seconds
Low Voltage Operation		
Ambient Temperature (70 ±10)	70 F	70 F
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Voltage (16 maximum)	12.75 VDC	8 VDC
Inlet Pressure (zero for "drop-out")	0 psig	0 psig
Closing Voltage (1.0 minimum)	1.35 VDC	1.5 VDC

Inspection Remarks

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T.G.Kniffin 6-22-64 4/30/64 1-31-64	F. Z. Pope 8-30-64	[signature] 8/30/64	I. D. Mourozenis 8/30/64
			VERIFIED BY USAF DATE 8/30/64

FORM 608-D-43 NEW 6-63

REVISION A [signature] Dated 6/22/64

401

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 100 SECONDS TEST NO. 208130-401 SHEET 147 OF 267

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.3.1.3.2.2 B

7.2.3 DAT Duty Cycle to 100 Seconds - TCA #2A.

7.2.3.1 Test Procedure

7.2.3.1.1 Perform fuel and oxidizer propellant valve orifice removal per Paragraph 6.11.

7.2.3.1.2 Install fuel and oxidizer propellant valve orifice adapter (99-106167) in the facility propellant feed system (see Figure 6).

7.2.3.1.3 Install fuel and oxidizer valve metering orifice and retaining ring in the facility mounted orifice adapter.

7.2.3.1.4 Adjust instrumentation range per Table I and Note 4.

7.2.3.1.5 Perform Cape Cycle Firing Test per Paragraph 6.7.

7.2.3.1.5.1 Make a one-second firing followed by another one-second firing ten minutes later.

7.2.3.1.5.2 Wait sixty minutes and make a one-second firing followed by another one-second firing ten minutes later.

7.2.3.1.5.3 Repeat Paragraph 7.2.3.1.5.2.

7.2.3.1.5.4 Wait for TCA skin temperature to return to ambient temperature (70 ± 20 F).

7.2.3.1.6 Perform duty cycle firing test per Paragraph 6.7 and Table II. The total accumulated firing time shall be approximately 101.09 seconds or TCA catastrophic failure, whichever occurs first. Catastrophic failure is defined in Table II, Note 4. Following the termination of the firing, the TCA shall be B

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin		R.J. Eide	9-30-64		
CHECKED BY: R. C. Lo	9-30-64				

FORM 608-B-44 NEW 6-63

REVISION B J.D. Morrison Dated 10/26/64

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 100 SECONDS TEST NO. 208130-401 SHEET 147.1 OF 267

maintained at altitude conditions until the peak TCA exterior wall temperature is reached. Monitor and record temperature continuously during soakout period. The maximum acceptable TCA exterior wall temperature is defined in Table II, Note 4.

NOTE: Do not reduce altitude or remove the TCA from the test stand. Perform the procedures of paragraph 7.2.4.1.1 thru 7.2.4.1.3 during TCA temperature soakout period. Within 30 seconds after soakout period complete the procedures of paragraphs 7.2.4.1.4 thru 7.2.4.1.10. B

7.2.3.1.7 Reduce data per SEM 4388-4040.

7.2.3.1.7.1 The results of significant data shall include but not be limited to the following:

7.2.3.1.7.1.1 Graphical presentation of temperature versus time for all TCA thermocouple locations.

7.2.3.1.7.1.2 Graphical presentation of total impulse versus signal width:

7.2.3.1.7.1.3 Graphical presentation of mean specific impulse versus signal width:

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
E. Adams	10-15-64	[signature]	10-15-64		
CHECKED BY: [signature]	DATE 10-15-64				

FORM 608-B-44 NEW 6-63

REVISION B J. D. Marrogenis Dated 10-15-64

403

GEMINI [illegible] HARDWARE TEST RECORD

Date: 11-2-64 Cell 39 J Thrust Level 25# Inspector: KELLY

[illegible] IDENTIFICATION:
Test Objective:

Name	P/N	S/N	Verified
TCA	208130-61	4054995	
Injector	208530	7017869	
Ablative Liner	UNK	UNK	
Oxid. Valve	407557	9160557	
Fuel Valve	407558	9198083	

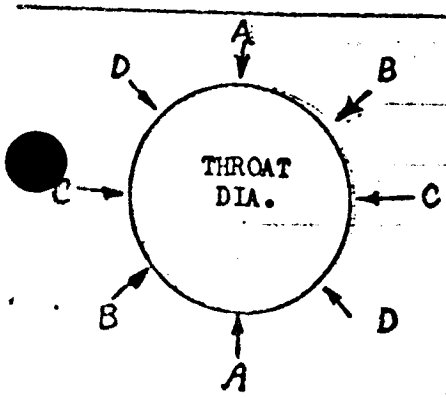
Test No.		Time	Duration	Altitude	Test Remarks
123	START	2040	6.0 sec	19 mb	CAPE cycle
	STOP	2305			
124	START	2354		140,000	RE-ENTRY SUB-CYCLES
	STOP	.0032	101.09 sec.		
	START	.0048		140,000	
	STOP	.0048		140,000	BURST PRESSURE: P/V FAILED TO OPEN
	START	.0052	3.6 SEC	140,000	BURST PRESSURE.
	STOP	.0052			

TCA Leak Check Performed (ANR 930) System Leak Check Performed (ANR 930).

Oxid. Valve Opening Verified (ANR 930) Fuel Valve Opening Verified (ANR 930)

Pre Test Injector Inspection. Remarks: OK

Pre Test Throat Insert Inspection. Remarks: GOOD



THROAT AND EXIT DIMENSIONS

Pre - Test		Post - Test	
A.A.	.3639	A.A.	.3630
B.B.	.3639	B.B.	.3634
C.C.	.3638	C.C.	.3632
D.D.	.3638	D.D.	.3630
Exit	1.608	Exit	1.579
Weight		Weight	

Cox NTO F/M S/N —— Cox MMH F/M S/N ——

Rampo NTO F/M S/N 847 Rampo MMH F/M S/N 691

[illegible] ORIFICE TAGS

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST DUTY CYCLE TO 100 SECONDS TEST NO 208130-401 SHEET 148 OF 267

7.2.3.2 Test Data - TCA # 2A

7.2.3.2.1 Component Identification

Component Name SE-6 25# TCA

McDonnell Part No. 52-52700-217

Rocketdyne Part No. 208130-61

Component Serial No. 4054995

Accumulated Acceptance Test Firing Time, seconds 12.0

	Pre-Test	Post-Test
Throat Diameter, inches (Average of four measurements)	.3639	.363
Nozzle Exit Diameter, inches	1.608	1.579

7.2.3.2.2 Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	10/26/64	10/26/64
Sample Batch Number	10-416	10-421
Sample Temperature, F	60°	62°
Sample Specific Gravity	1.465	0.878
Met Mil Spec. Requirements (Yes or No)	Yes	Yes

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 1-31-64	[signature] 11/2/64	[signature]	Waived per Telecon
			VERIFIED BY USAF: DATE Nov 2 1964

FORM 608-B-43 NEW 6-63

REVISION B J.D. [signature] Dated 10/26/64

405

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST DUTY CYCLE TO 100 SECONDS TEST NO. 208130-401 SHEET 149 OF 267

7.2.3.2.3 Duty Cycle Test (reference paragraph 7.2.3.1)

Test Cell Location CTL III

Test Cell Number 39J

Test Number 124

Test Date 11-2-64

The fuel and oxidizer propellant valve orifices were removed from the TCA per paragraph 6.11 (TCA) yes (yes or no) B

The fuel and oxidizer propellant valve orifice adapters were installed in the facility feed system. yes (TCA) (yes or no) B

The fuel and oxidizer propellant valve metering orifices were installed in the facility mounted orifice adapters. YES (ANB 930) yes or no) B

See Preceding Page for Duplicate Sheet

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
E.Adams	[signature]	Mel Moore 11/2/64	Waived per Telecon
			VERIFIED BY USAF: DATE Nov 2 1964

FORM 608-B-43 NEW 6-63

REVISION B J.D. Narrazenis Dated 10/26/64

406

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 203130-61 }

NAME OF TEST DUTY CYCLE TO 100 SECONDS TEST NO. 203130-401 SHEET 119 OF 267

7.2.3.2.3 Duty Cycle Test (reference paragraph 7.2.3.1)

Test Cell Location CTL43

Test Cell Number 34-J

Test Number 124

Test Date 11-2-64

The fuel and oxidizer propellant valve orifices were removed from the TCA per paragraph 6.11 YES (yes or no) B

The fuel and oxidizer propellant valve orifice adapters were installed in the facility feed system. YES (yes or no) B

The fuel and oxidizer propellant valve metering orifices were installed in the facility mounted orifice adapters. YES (yes or no) B

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
E. Adams	E. Adams	Mel Moore	Waived via tele-con
			VERIFIED BY USAF: DATE Nov 1 1964

FORM 608-B-43 NEW 6-63

REVISION B: _____ Dated _____

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DUTY CYCLE TO 100 SECONDS TEST NO. 208130-61 SHEET 150 OF 267

7.2.3.2.4 Cape Cycle test

Test Cell Location C.T.L. III

Test Cell Number 39 J

Test Number 123

Test Date 11-2-64

	Pulse Duration (sec) (1.000 ±.020 sec)	Time Between Pulses, (minutes)
1st Pulse	.985	10 (10)
2nd Pulse	.981	60 (60)
3rd Pulse	.980	10 (10)
4th Pulse	.980	60 (60)
5th Pulse	.980	10 (10)
6th Pulse	.980	
Accumulated Firing Time, seconds	5.89	

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T.G. Kniffin 1-31-64			VERIFIED BY USAF: DATE

FORM 608-B-43 NEW 6-63

REVISION B J.D. Marrogenis Dated 10/26/64

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 100 Seconds TEST NO. 208130-101 SHEET ___ OF ___

PRE-RETRO Phase (Effective firing time of .030 sec; time between pulses, 22 seconds)

Pulse Number, Pre-Retro Phase		13	14
Signal Width, msec		35.6	36.1
Start Time, msec (25 max)		13.9	14.6
Shutdown Impulse, lb-sec (.260 max) **		.1599	.1541
Environmental Pressure, psia		.022	.022
Environmental Temperature, °F (VAC chamber)		57	57
Oxidizer Temperature, °F		70	70
Fuel Temperature, °F		70	70
Oxidizer Inlet Pressure, psia		287	287
Fuel Inlet Pressure, psia		291	291
Total Oxidizer Flow, lbs		*	*
Total Fuel Flow, lbs		*	*
Mean Mixture Ratio, o/f		*	*
Pulse Total Impulse, lb-sec		.7512	.7572
Mean Specific Impulse, sec		*	*
Oxidizer Valve Voltage, volts		26	26
Fuel Valve Voltage, volts		26	26
Oxidizer Valve Current, amps		.637	.637
Fuel Valve Current, amps		.627	.627
Electrical Power, watts		32.86	32.86

* Flow Traces unreadable ** Ref: FAN NA-SEQ-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
W. Robinson	8/25/65		8/25/65		
CHECKED BY:	DATE				
	8/25/65				

FORM 608-B-44 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 100 Seconds TEST NO. 208130-401 SHEET ___ OF ___

RETRO Phase (Effective firing time of .070 seconds; time between pulses, .048 seconds)

Pulse Number, Retro Phase	2	92	183
Signal Width, msec	73.1	72.9	73.9
Start Time, msec (25 max)	9.6	8.6	8.6
Shutdown Impulse, lb-sec (.260 max) **	.1699	.1907	.2005
Environmental Pressure, psia	.022	.022	.022
Environmental Temperature, °F (VAC chamber)	60	60	60
Oxidizer Temperature, °F	70	70	70
Fuel Temperature, °F	70	70	70
Oxidizer Inlet Pressure, psia	287	287	287
Fuel Inlet Pressure, psia	291	291	291
Total Oxidizer Flow, lbs	*	*	*
Total Fuel Flow, lbs	*	*	*
Mean Mixture Ratio, o/f	*	*	*
Pulse Total Impulse, lb-sec	1.830	1.883	1.929
Mean Specific Impulse, sec	*	*	*
Oxidizer Valve Voltage, volts	26	26	26
Fuel Valve Voltage, volts	26	26	26
Oxidizer Valve Current, amps	.637	.637	.637
Fuel Valve Current, amps	.627	.627	.627
Electrical Power, watts	32.86	32.86	32.86

* Flow Traces unreadable ** Ref: E&N NA-SEL-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
[signature]	8/25/65	[signature]	8/25/65		
CHECKED BY: [signature]	8/25/65				

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 100 Seconds TEST NO. 208130-401 SHEET ___ OF ___

POST-RETRO Phase (Effective firing time of .030 seconds; time between pulses, 22 seconds)

Pulse Number, Post Retro Phase	1	21	67
Signal Width, msec	35.8	35.9	34.3
Start Time, msec (25 max)	9.1	9.7	9.6
Shutdown Impulse, lb-sec (.260 max) **	.2051	.2103	.2296
Environmental Pressure, psia	.022	.022	.022
Environmental Temperature, °F (vac chamber)	60	60	62
Oxidizer Temperature, °F	70	70	70
Fuel Temperature, °F	70	70	70
Oxidizer Inlet Pressure, psia	287	287	287
Fuel Inlet Pressure, psia	291	291	291
Total Oxidizer Flow, lbs	*	*	*
Total Fuel Flow, lbs	*	*	*
Mean Mixture Ratio, o/f	*	*	*
Pulse Total Impulse, lb-sec	.9345	.9287	.9068
Mean Specific Impulse, sec	*	*	*
Oxidizer Valve Voltage, volts	26	26	26
Fuel Valve Voltage, volts	26	26	26
Oxidizer Valve Current, amps	.637	.637	.637
Fuel Valve Current, amps	.627	.627	.627
Electrical Power, watts	32.86	32.86	32.86

* Flow Traces Unreadable ** Ref: ECN NA-SEL-28981

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
W. Robinson	8/25/65	[illegible]	8/25/65		
CHECKED BY: [illegible]	DATE 8/25/65				

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER PART NO. { MAC 52-52700-217 / NAA 208130-61 }

NAME OF TEST DAT DUTY CYCLE TO 100 Seconds TEST NO. 208130-1.01 SHEET ___ OF ___

RE-ENTRY Subcycle Phase No. 2, Pulse No. 1
(1 second on-time followed by .4 seconds off-time)

	Site Data	Standard Vacuum
Firing Duration, sec	1.0	
Time of Data Slice, sec	.8	
Environmental Pressure, psia	.021	0
Environmental Temperature, °F (vac chamber)	67	
Oxidizer Temperature, °F	68	70
Fuel Temperature, °F	65	70
Oxidizer Inlet Pressure, psia	279.4	287
Fuel Inlet Pressure, psia	289.9	291
Oxidizer Flowrate, lbs/sec	.04296	.04370
Fuel Flowrate, lbs/sec	.03416	.03406
Mixture Ratio, o/f (1.30 ± 3%)	1.26	1.28
Thrust, lbs (23.5 ± 5%)	22.0	22.2
Specific Impulse, sec (266 min)	285	285
Start Time, msec (25 max)	9	
Shutdown Impulse, lb-sec (.260 max) **	.1972	
Oxidizer Valve Voltage, volts	29.8	
Fuel Valve Voltage, volts	29.0	
Oxidizer Valve Current, amps	.680	
Fuel Valve Current, amps	.657	
Electrical Power, watts	39.3	

** Ref: ECN NA-SE6-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
[illegible]	8/25/65	[illegible]	8/25/65		
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[illegible]	8/25/65				

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 100 Seconds TEST NO. 208130-401 SHEET ___ OF ___

RE-ENTRY Sub-Cycle Phase No. 1
(one pulse with effective firing time of 1 second;
17 pulses with effective firing time of .020 seconds;
time between pulses, .4 seconds)

Pulse Number, Re-Entry Sub-Cycle Phase		2	17
Signal Width, msec		23.2	22.3
Start Time, msec (25 max)		10.1	9.6
Shutdown Impulse, lb-sec (.260 max) **		.2387	.1631
Environmental Pressure, psia		.022	.022
Environmental Temperature, °F (vac chamber)		62	62
Oxidizer Temperature, °F		70	70
Fuel Temperature, °F		70	70
Oxidizer Inlet Pressure, psia		287	287
Fuel Inlet Pressure, psia		291	291
Total Oxidizer Flow, lbs		*	*
Total Fuel Flow, lbs		*	*
Mean Mixture Ratio, o/f		*	*
Pulse Total Impulse, lb-sec		.5981	.5212
Mean Specific Impulse, sec		*	*
Oxidizer Valve Voltage, volts		26	26
Fuel Valve Voltage, volts		26	26
Oxidizer Valve Current, amps		.637	.637
Fuel Valve Current, amps		.627	.627
Electrical Power, watts		32.86	32.86

* Flow Tracers unreadable ** Ref: ECN NA-SEL-28981

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
[illegible]	8/25/65	[illegible]	8/25/65		
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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 100 Seconds TEST NO. 208130-1.01 SHEET ___ OF ___

E-ENTRY Subcycle Phase No. 26, Pulse No. 1
(1 second on-time followed by .4 seconds off-time)

	Site Data	Standard Vacuum
Firing Duration, sec	1.0	
Time of Data Slice, sec	.8	
Environmental Pressure, psia	.021	0
Environmental Temperature, °F (VAC chamber)	75	
Oxidizer Temperature, °F	68	70
Fuel Temperature, °F	65	70
Oxidizer Inlet Pressure, psia	289.9	287
Fuel Inlet Pressure, psia	279.5	291
Oxidizer Flowrate, lbs/sec	.04547	.04627
Fuel Flowrate, lbs/sec	.03416	.03406
Mixture Ratio, o/f (1.30 ± 3%)	1.33	1.36
Thrust, lbs (23.5 ± 5%)	22.8	23.1
Specific Impulse, sec (266 min)	286	287
Start Time, msec (25 max)	8.5	
Shutdown Impulse, lb-sec (.260 max) **	.16385	
Oxidizer Valve Voltage, volts	29.8	
Fuel Valve Voltage, volts	29.1	
Oxidizer Valve Current, amps	.703	
Fuel Valve Current, amps	.674	
Electrical Power, watts	40.5	

** Ref: ECN NA-SEL-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
W. Robinson	8/25/65	[illegible]	8/25/65		
CHECKED BY: [illegible]	DATE 8/25/65				

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 100 Seconds TEST NO. 208130-401 SHEET ___ OF ___

RE-ENTRY Sub-Cycle Phase No. 26
(Repeat of Re-Entry Sub-Cycle Phase No. 1)

Pulse Number, Re-Entry Sub-Cycle Phase		3	16
Signal Width, msec		22.1	22.3
Start Time, msec (25 max)		8.9	9.0
Shutdown Impulse, lb-sec (.260 max) **		.1954	.1965
Environmental Pressure, psia		.022	.022
Environmental Temperature, °F (vac chamber)		75	75
Oxidizer Temperature, °F		70	70
Fuel Temperature, °F		70	70
Oxidizer Inlet Pressure, psia		287	287
Fuel Inlet Pressure, psia		291	291
Total Oxidizer Flow, lbs		*	*
Total Fuel Flow, lbs		*	*
Mean Mixture Ratio, o/f		*	*
Pulse Total Impulse, lb-sec		.5787	.5810
Mean Specific Impulse, sec		*	*
Oxidizer Valve Voltage, volts		26	26
Fuel Valve Voltage, volts		26	26
Oxidizer Valve Current, amps		.637	.637
Fuel Valve Current, amps		.627	.627
Electrical Power, watts		32.86	32.86

* Flow Traces Unreadable ** Ref: ECN NA-SE 6-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
W. Robinson	8/25/65	[illegible]	8/27/65		
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[illegible]	8/27/65				

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 100 Seconds TEST NO. 208130-401 SHEET ___ OF ___

RE-ENTRY Subcycle Phase No. 52, Pulse No. 1
(1 second on-time followed by .4 seconds off-time)

	Site Data	Standard Minimum
Firing Duration, sec	1.0	
Time of Data Slice, sec	.8	
Environmental Pressure, psia	.021	0
Environmental Temperature, °F (vac chamber)	86	
Oxidizer Temperature, °F	68	70
Fuel Temperature, °F	65	70
Oxidizer Inlet Pressure, psia	279.5	287
Fuel Inlet Pressure, psia	289.9	291
Oxidizer Flowrate, lbs/sec	.04605	.04686
Fuel Flowrate, lbs/sec	.03428	.03419
Mixture Ratio, o/f (1.30 ± 3%)	1.34	1.37
Thrust, lbs (23.5 ± 5%)	22.6	22.9
Specific Impulse, sec (266 min)	281	282
Start Time, msec (25 max)	8.5	
Shutdown Impulse, lb-sec (.260 max) **	.17835	
Oxidizer Valve Voltage, volts	29.9	
Fuel Valve Voltage, volts	28.9	
Oxidizer Valve Current, amps	.709	
Fuel Valve Current, amps	.660	
Electrical Power, watts	40.3	

** Ref: ECN NA-SE6-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
[illegible]	8/25/65	[illegible]	8/27/65		
CHECKED BY: [illegible]	DATE 8/25				

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 100 Seconds TEST NO. 208130-401 SHEET ___ OF ___

RE-ENTRY Sub-Cycle Phase No. 52
(Repeat of Re-Entry Sub-Cycle Phase No. 1)

Pulse Number, Re-Entry Sub-Cycle Phase		4	17
Signal Width, msec		22.3	22.5
Start Time, msec (25 max)		8.9	9.6
Shutdown Impulse, lb-sec (.260 max) **		.2049	.1959
Environmental Pressure, psia		.022	.022
Environmental Temperature, °F (VAC chamber)		86	86
Oxidizer Temperature, °F		70	70
Fuel Temperature, °F		70	70
Oxidizer Inlet Pressure, psia		287	287
Fuel Inlet Pressure, psia		291	291
Total Oxidizer Flow, lbs		*	*
Total Fuel Flow, lbs		*	*
Mean Mixture Ratio, o/f		*	*
Pulse Total Impulse, lb-sec		.5853	.5551
Mean Specific Impulse, sec		*	*
Oxidizer Valve Voltage, volts		26	26
Fuel Valve Voltage, volts		26	26
Oxidizer Valve Current, amps		.637	.637
Fuel Valve Current, amps		.627	.627
Electrical Power, watts		32.86	32.86

* Flow Traces unreadable ** Ref: ECN NA-SE6-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
W. Robinson	8/25/65	[signature]	8/25/65		
CHECKED BY: [signature]	DATE 8/25/65				

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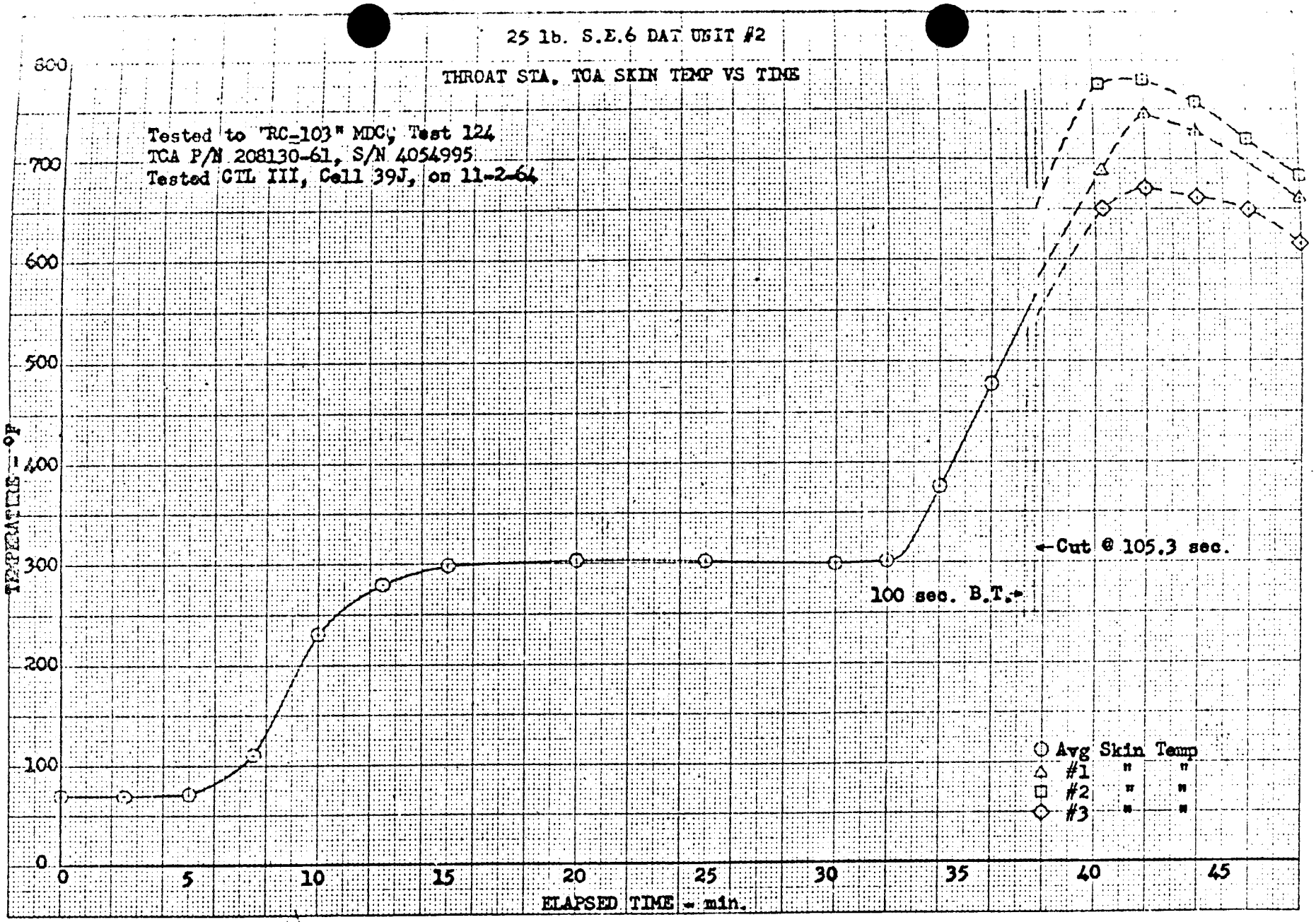
~~CONFIDENTIAL~~ 417

R-15019-2


25 lb. S.E.6 DAT UNIT #2
THROAT STA. TCA SKIN TEMP VS TIME
Tested to "RC-103" MDC; Test 124
TCA P/N 208130-61, S/N 4054995
Tested CTL III, Cell 39J, on 11-2-64
TEMPERATURE - °F
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
35
40
45
ELAPSED TIME - min.
←Cut @ 105.3 sec.
100 sec. B.T.→
Avg Skin Temp
#1 " "
#2 " "
#3 " "

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST BURST PRESSURE TEST NO. 208130-401 SHEET ___ OF ___

IL 4388-5347

Deviation Request:

The Burst Pressure Test data of paragraph 7.2.4.2 on page 165 will be completed when data is made available. Proceed with the Wt. Determination of paragraph 6.6 and 7.2.4.2.3.

Recopied from original request dated 12, November 1964.

James D. Mavrogenis
Jim Mavrogenis
MAC Engineering
12-2-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

419

FORM 608-B-42 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST BURST PRESSURE TEST NO. 208130-401 SHEET 164 OF 267

Reference: MAC SCD 52-52700, Revision G, paragraph 6.3.1.3.2.2

7.2.4 Burst Pressure - TCA #2 A B

7.2.4.1 Test Procedure

7.2.4.1.1 Open the oxidizer and fuel facility by-pass valves. See Figure 6.

7.2.4.1.2 Close the facility propellant valves. See Figure 6.

7.2.4.1.3 Adjust the test facility propellant tank pressures to 750 $^{+0}_{-20}$ psig. The parameters to be recorded during the firing test are combustion chamber exterior wall temperature, facility propellant tank pressures, TCA inlet pressures, and chamber pressure.

7.2.4.1.4 Activate instrumentation.

7.2.4.1.5 Open the TCA propellant valves.

7.2.4.1.6 Within one second after TCA propellant valve opening, open the facility propellant valves simultaneously.

7.2.4.1.7 Fire the TCA for three seconds following facility propellant valve opening. The firing test shall be terminated by closing the TCA propellant valves.

7.2.4.1.8 The TCA shall demonstrate operation without catastrophic chamber failure as defined in Table II, note 4.

7.2.4.1.9 Perform decontamination per paragraph 6.8.

7.2.4.1.10 Perform weight determination per paragraph 6.6.

PREPARED BY: T. Kniffin	DATE 8-3-64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE		8-12-64		

FORM 603-B-44 NEW 6-63

Revision B J.D.M. Dated 10/26/64

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST BURST PRESSURE TEST NO. 208130-401 SHEET 165 OF 267

7.2.4.2 Test Data - TCA #2A

7.2.4.2.1 Component Identification B

Component Name SE-6 25# TCA

McDonnell Part No. 52-52700 217

Rocketdyne Part No. 208130-61

Component Serial No. 4054995

7.2.4.2.2 Site Data

Facility oxidizer tank pressure (psig) 720 (750^{+0}_{-20})

Facility fuel tank pressure (psig) 745 (750^{+0}_{-20})

Oxidizer inlet pressure (psia) 689

Fuel inlet pressure (psia) 735

Main thrust (lbs) 45.1

Combustion chamber exterior wall temperature (F) 565 (650 F max)

Inspection Remarks

NONE

B

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
8-13-64 T.G. Kniffin			VERIFIED BY USAF: DATE

FORM 608-B-43 NEW 6-63

REVISION B J. D. Marrazzini Dated 10/26/64

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R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

166

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST BURST PRESSURE TEST NO. 208130-401 SHEET 166 OF 267

7.2.4.2.3 Weight Determination test (reference paragraph 6.6) B

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

The TCA dry weight was 2.19 pounds.
(Record to the nearest one-hundredth pound)

Inspection Remarks 11-13-64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
1/31/64 T. G. Kniffin	D. Fowler 11-13-64	T. S. Jones 11/13/64	Walter B. J. Mavrogenis 11-14-64
			VERIFIED BY USAF: DATE 11/13/64

FORM 608-B-43 NEW 6-63
Revision B J. D. Mavrogenis Dated 10/26/64

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208130-401 SHEET 167 OF 267

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.2.3.20

7.2.5 Disassembly and Inspection

7.2.5.1 Test Procedure

7.2.5.1.1 Prior to sectioning the TCA perform a visual inspection and record the post test condition of the TCA.

7.2.5.1.2 Cut the propellant valve mounting bracket and propellant valve feed tubes from the TCA injector face along line A, B as shown in Figure 7. All cutting shall be done by saw. C

7.2.5.1.3 Separate the propellant valves from the mounting bracket. C

7.2.5.1.4 Section the TCA by cutting along line C-D-E as depicted in Figure 16.

7.2.5.1.5 Perform visual inspection ofall detailed parts for evidence of damage, distortion, fluid incompatability, corrosion, broken parts and impending failure.

7.2.5.1.6 After test completion identify the sectioned TCA and detailed parts and package and store for reference (except for propellant valves). C

7.2.5.1.7 Machine, on the oxidizer propellant valve, the seat assembly to spacer weld to loosen the seat. Only the minimum amount of material to accomplish this shall be removed. The seat assembly P/N 407664 shall not be removed at this time.

7.2.5.1.8 Machine the filter assembly to solenoid weld to loosen the filter. Only the minimum amount of material to accomplish this shall be removed. The filter assembly P/N NA5-28097-T1 shall not be removed at this time. C

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole RC	11-20-64	[signature]	11-20-64		
CHECKED BY: [signature]	11-20				

FORM 608-B-44 NEW 6-63

Rev. C J.D. Mavrogenis Date 11-20-64

423

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208130-401 SHEET 167.1 OF 267

7.2.5.1.9	Remove, bag and identify the seat assembly.	C
7.2.5.1.10	Remove, bag and identify the armature P/N 407569.	
7.2.5.1.11	Remove, bag and identify the spring P/N 406806.	
7.2.5.1.12	Remove, bag and identify the filter assembly.	
7.2.5.1.13	Bag and identify the solenoid assembly.	
7.2.5.1.14	Repeat 7.2.5.1.7 thru 7.2.5.1.13 for the fuel propellant valve.	C

NOTE: Only authorized personnel shall have access to stored DAT hardware.

427

424

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
D. Cole DC.	11-20-64	[signature]	11-20-64		
CHECKED BY: [signature]	DATE 11-20				

FORM 608-B-44 NEW 6-63

Rev. C [signature] Date 11-20-64

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208130-401 SHEET 168 OF 267

7.2.5.2 Post Test Inspection Data - TCA #2A B

7.2.5.2.1 Component Identification

Component Name TCA

McDonnell Part No. SCD 52-52700-217

Rocketdyne Part No. 208130-61

Component Serial No. 4054995

7.2.5.2.2 Preliminary Inspection (Reference Paragraph 7.2.5.1.1)

The TCA was visually inspected prior to sectioning and the TCA condition was as follows: THROAT HAS 2 CRACKS. BOTH CRACKS RUN FROM UPSTREAM EDGE TO DOWNSTREAM EDGE. ONE IS AT 3:00 O'CLOCK THE OTHER IS AT 8:00 O'CLOCK. ABLATIVE ON EXIT EDGE IS CHIPPED FROM 10:00 TO 12:00. ABLATIVE SEPERATION APPROX 1" FROM DOWNSTREAM EDGE OF THROAT ALSO ON OUTER SIDE OF ABLATIVE A SEPERATION OCCURS FROM 2:30 TO 4:00. ALL LINERS APPEAR TO BE BONDED. INSERTER APPEARS INTACT.

7.2.5.2.3 Disassembly and Inspection (Reference Paragraph 7.2.5.1.3)

The TCA was sectioned along line C-D-E and visually inspected. The results of the inspection were as follows:

(a) 100% DEPTH IN CHAR.

(b) CRACK IN THROAT BOTH VERICAL & HORIZONTAL.

(c) SEPERATION IN ASBESTOS WRAP. CHAMBER & NOZZLE

(d) BUILD UP OF FOREIGN MATTER ON LINNER & THROAT. OWOR

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
7-16-64 T. Kniffin	7.2.5.2.1 & 7.2.5.2.2.	Gary L Dugdale 5/19/65	C Mehrli 6/2/65
			VERIFIED BY USAF: DATE L.P. Byrom 6/7/65

FORM 608-B-43 NEW 6-63

Revision B _____ Dated _____

R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208130-401 SHEET 168.1 OF 267

7.2.5.2.4 Disassembly of Propellant Valves (Reference Paragraphs 7.2.5.1.7 thru 7.2.5.1.13). C

The propellant valves were disassembled and all parts called for were bagged and identified YES (yes or no).

407557 OXID. VALVE S/N 9160557 FILTER HOUSING FOUND CONTAMINATED WHEN DISASSEMBLED.

NO COMMENTS ON FUEL VALVE

PREPARED BY:	DATE	PERFORMED BY:	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL:	DATE
E. Cole	11-20-64	R. F. Burks	6/9/65	J. R. Sutherland	6/9/65	Waived by J. Erickson	6/9/65
						VERIFIED BY USAF:	DATE
						J. J. Murillo	6/9/65

FORM 608-B-43 NEW 6-63

Rev. C J. D. Marrogeries Date 11-20-64

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61 }

NAME OF TEST REVISED DAT PROGRAM TEST NO. 208130-401 SHEET ___ OF ___

IL 4388-5353

TCA Unit No.4 of the original SE6 DAT program, which completed salt spray, shall be reidentified as Unit No.3 in the revised DAT program. The next test sequence for Unit No.3 shall be Humidity.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-3-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

427

FORM 608-B-42 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO 208130-401 SHEET 169 OF 267

Reference: MAC SCD 52-52700, Revision G, Figure 10

7.3 Thrust Chamber Assembly Number Three

This subsection specifies those environment and service life tests which are to be performed on Thrust Chamber Assembly Number Three.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	1-31-64	R Eide	1-31-64		
CHECKED BY:	DATE				
	1-31-64				

FORM 608-B-44 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 208130-401 SHEET ~~214~~ OF ~~224~~

Reference: MAC SCD 52-52700, Revision G, Figure 10

7.4 Thrust Chamber Assembly Number Four

This subsection specifies those environment and service life tests which are to be performed on Thrust Chamber Assembly number Four.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	1-31-64	R. Eide	1-31-64		
CHECKED BY:	DATE				
	1-31-64				

FORM 608-B-44 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY — PART NO. { MAC 52-52700-217 / NAA 22-8130-61

NAME OF TEST: PRE-TEST INSPECTION — TEST NO. 22-8130-401 SHEET ~~215~~ OF ~~254~~

Reference: MAC SCD 52-52700, Revision C, Paragraph 6.2.2.1

7.4.1 Pre-Test Inspection - TCA #4

7.4.1.1 Test Procedure

7.4.1.1.1 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 RA0220-350. Only those TCA's meeting the above requirements shall be accepted for DAT.

7.4.1.1.2 Braze propellant valve inlet adapters to the oxidizer and fuel propellant valves per RA0607-009.

7.4.1.1.3 Perform Weight Determination per paragraph 6.6.

PREPARED BY: T.G. Kniffin	DATE 1-31-64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 1-31-64		1-31-64		

FORM 608-B-44 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PRE-TEST INSPECTION TEST NO. 208130-401 SHEET 216 OF 319

7.4.1.2 Test Data - TCA #4

7.4.1.2.1 Component Identification

Component Name	TCA	Oxidizer Valve	Fuel Valve
McDonnell Part No.	SCD 52-52700-217		
Rocketdyne Part No.	208130-61	407557	407558
Component Serial No.	4055298	9237909	9202598

7.4.1.2.2 Inspection (reference paragraph 7.4.1.1)

7.4.1.2.2.1 The TCA was inspected to insure that it was of the proper configuration, 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 RA0220-350. YES (yes or no)

7.4.1.2.2.2 Propellant valve inlet adapters were installed on the propellant valves per paragraph 7.4.1.1.2. YES (yes or no)

7.4.1.2.2.3 Inspection Remarks

NONE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T.G. Kniffin 4/30/CA 1-31-64	6/5/64	6/4/64	VERIFIED BY USAF: DATE 6/4/64

FORM 608-B-43 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PRE-TEST INSPECTION TEST NO. 208130-401 SHEET 21 OF 35

7.4.1.2.3 Weight Determination test (reference paragraph 6.6)

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

The TCA dry weight was 2.29 pounds.
(Record to the nearest one-hundredth pound)

Inspection Remarks NONE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T. G. Kniffin	T. E. Pope 6/5/64	M. J. Fogarty 6/5/64	VERIFIED BY USAF: DATE HE Moore 6/6/64

FORM 608-B-43 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST SALT SPRAY TEST NO. 208130-401 SHEET ~~21~~ OF ~~354~~

Reference:	MAC SCD 52-52700, Revision G, Paragraph 6.2.3.8
7.4.2	Salt Spray - TCA #4
7.4.2.1	Test Procedure
7.4.2.1.1	This test shall be run in accordance with Federal Test Method Standard 151a, Method 811.1.
7.4.2.1.2	Remove the TCA nozzle cover.
7.4.2.1.3	Insure that the fuel and oxidizer inlet ports are properly capped.
7.4.2.1.4	Install moisture proof closures on the propellant valve electrical connectors.
7.4.2.1.5	Orient the TCA in the salt spray chamber (paragraph 5.2.6) so that the X Axis and the Y Axis (Figure 7) each make angles of 45 degrees with the horizontal and then positive directions are pointed upward, and that the Z Axis is horizontal and parallel to the principal direction of horizontal flow of fog through the chamber.
7.4.2.1.6	The concentration of salt in the salt spray solution shall be 5 per cent.
7.4.2.1.7	Record on the data sheet the dates and times of start and completion of the salt spray test. The duration of exposure to the salt atmosphere shall be 50 hours.
7.4.2.1.8	Within one hour after the TCA has been removed from the salt spray chamber, begin the first of the following tests. The tests shall be carried through to completion without delay. NOTE: Failure at the electrical connector interface is not Rocketdyne's responsibility.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	1-31-64	R. Eide	1-31-64		
CHECKED BY:	DATE				
	1-31-64				

FORM 608-B-44 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 203130-61

NAME OF TEST SALT SPRAY TEST NO. 203130-SHEET 210 OF 354 401

7.4.2.1.9 Perform Propellant Valve Proof Pressure and Leakage per paragraph 6.1.

7.4.2.1.10 Perform Propellant Valve Electrical Resistance per paragraph 6.3.

7.4.2.1.11 Perform Propellant Valve Dielectric Strength per paragraph 6.4.

7.4.2.1.12 Perform Propellant Valve Functional per paragraph 6.5.

7.4.2.1.13 Repeat paragraphs 7.4.2.1.9 through 7.4.2.1.12 after 48 hours has elapsed since the removal of the TCA from the salt spray chamber. A

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	1-31-64		1-31-64		
CHECKED BY:	DATE				
	1-31-64				

FORM 608-B-44 NEW 6-63

REVISION A J.D. Mangum DATED 6/24/64

PAGE 220A

ROCKETDYNE

MATERIALS LABORATORIES

TEST REPORT

UNIT #4

REPORT NO. PTR 4-253-039N

DATE 6-17-64 G.O. S-1214

REFERENCE EWR 595399 (6-127)

QUANTITY

PART NAME

PART NO.

MATERIAL Salt used for salt spray test D/596-146

SPECIFICATION

SUBMITTED BY Environmental test DEPT. 596-146 LOCATION PHONE 2061

PURPOSE OF TEST To determine whether the submitted salt solution and solid meets the requirements of Federal Test Method Standard 151A Method 811.1.

LABORATORY TESTS AND RESULTS

TENSILE TESTS

SAMPLE NO.	YIELD STRENGTH KSI	ULTIMATE LOAD LBS.	ULTIMATE STRENGTH KSI	ELONGATION %	REDUCTION OF AREA %	HARDNESS	REMARKS
REQ'D.							

OTHER TESTS

	Required	Actual
1. Appearance	Flakes	Pellets*
2. Chemical Analysis		
Nickel	Free (less than 0.1%)	Not detected less than .001%
Copper	Free (less than 0.1%)	0.0026%
Sodium iodide	Less than 0.1%	0.095%

*not considered disqualifying since used in solution.

D. [illegible] (2) D/596-146
D. [illegible] D/596-146
J. L. Hunter D/596-146
R-15019-2

Signed 6-18-64 Date

Approved 6-18-64 Date

UNIT #4

ROCKETDYNE

MATERIALS LABORATORIES

TEST REPORT

REPORT NO. PTR 4-253-041[illegible]

DATE 6-26-64 G.O. 5246

REFERENCE EWR 595399 (6-217)

QUANTITY 75 ml per day

PART NAME

PART NO.

MATERIAL Salt solution for salt spray test

SPECIFICATION

SUBMITTED BY John Senter DEPT. 596-146 LOCATION Canoga PHONE 2061

PURPOSE OF TEST To determine specific gravity of salt solution for compliance with [illegible]uirements of Federal Test Method Standard 151A Method 811.1.

LABORATORY TESTS AND RESULTS

TENSILE TESTS

SAMPLE NO.	YIELD STRENGTH KSI	ULTIMATE LOAD LBS.	ULTIMATE STRENGTH KSI	ELONGATION %	REDUCTION OF AREA %	HARDNESS	REMARKS
REQ'D.							

OTHER TESTS

Date Sample Submitted	Sampled Location	Required	Result
6-23-64	Far End	1.0268 - 1.0413	1.0567
6-23-64	Nozzle End	1.0268 - 1.0413	1.0475
6-25-64	Far End	1.0268 - 1.0413	1.0547
6-25-64	Nozzle End	1.0268 - 1.0413	1.0462

Dist.
D. A. Neilson 596-146
R. R. Oestman " "
J. L. Senter " "
436

R-15019-2

Signed [signature] Date 6-26-64 Approved [signature] Date 6-26-64

FORM 870-U-1 REV. 5-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST SALT SPRAY TEST NO 208130-401 SHEET 22 OF 354

7.4.2.2 Test Data - TCA #4

7.4.2.2.1 Component Identification

Component Name TCA

McDonnell Part No. SCD52-52700-217

Rocketdyne Part No. 208130-61

Component Serial No. 4055298

7.4.2.2.2 Salt Spray test (reference paragraph 7.4.2.1)

7.4.2.2.2.1 Salt spray exposure was begun on 6-22-64 11:20AM (date and time)

7.4.2.2.2.2 The type of salt and water used in preparing salt water solution was GRANULAR IODINE FREE - DISTILLED WATER (ATTACHED CHEMICAL ANALYSIS)

NOTE: SEE ATTACHED PAGE 220A

7.4.2.2.2.3 The solution concentration was 5% (5 ±1) per cent.

7.4.2.2.2.4 Salt spray exposure was ended on 6-24-64 1:20PM (date and time)

7.4.2.2.2.5 The following data was taken daily during the exposure period.

Volume of salt solution collected in milliliters per hour per 80 square centimeters of horizontal collecting area (0.5 to 3.0 ml per hour per 80 sq. cm.)

	First Day	Second Day
Nozzle end receptacle	1.54	1.58
Far end receptacle	2.0	1.87

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 1-31-64	F.E. Page 6-24-64	G. Kaye 6-24-64	VERIFIED BY USAF: 6/24/64 DATE R.M. Ayres

FORM 608-B-43 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST SALT SPRAY TEST NO. 208130-401 SHEET 221 OF 354

7.4.2.2.2.5 (Cont'd) Specific gravity of collected solution (1.0268 to 1.0413 at 95 ±2F)

	First Day	Second Day
Nozzle end receptacle	* 1.0475	* 1.0462
Far end receptacle	* 1.0567	* 1.0547

pH of collected solution (6.5 to 7.2 at 95 ±2F)

	First Day	Second Day
Nozzle end receptacle	* 7.4	6.8
Far end receptacle	* 7.4	7.15

* NOTE: SEE ATTACHED DISCREPANCY SHEET.

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 1-21-64	F. E. Pope 6-25-64	G. Kaye 6-25-64	J. D. Morrisons 7/1/64 VERIFIED BY USAF 7/1/64 DATE Robert M. Ayres

FORM 608-B-43 NEW 6-63

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DEVIATION RECORD

~~STRUCTURAL APPROVAL & MATERIALS REVIEW~~

UNIT, SERIAL OR SHIP NO. 4055298 ASSEMBLY NO. 208130-61
(CIRCLE ONE)

INSP. AUTH.	MAT. REV. ENG.	PART NO.	TYPE OF REPAIR	MECH. NO.	INSP. ACCEPT.	CUST.
	DATE 6/27/64	208130-61	NONE	DATE		

Discrepancy 1. AT THE END OF SALT SPRAY TEST (50 HOURS) THE FOLLOWING WAS NOTICED:
a. RUST FORMED AT WELD (P/N 407557 AND P/N 407553 VALVE ASSY'S) BETWEEN P/N NAS-2869771 FILTER ASSY AND P/N 407670-2 SOLENOID ASSY. RUST FROM WELDS DISCOLORED VALVE ASSY'S AND P/N 208140 BRACKETS.
b. SALT FORMATION WAS NOTICED ON BOTH ELECTRICAL RECEPTICALS, SALT FORMATION NOTICED INSIDE OF BOTH ELECTRICAL RECEPTICALS DOWN TO C'PINES.

Disposition

This is not an acceptable discrepancy. MAC requests that this discrepancy be fully investigated & a report on this to accompany the report on this TCA. Testing is to be continued.

James D. Mavrogenis
MAC Engrg
7/1/64

HOLE CK. / MAT. CK.

INSP. AUTH.	MAT. REV. ENG.	PART NO.	TYPE OF REPAIR	MECH. NO.	INSP. ACCEPT.	CUST.
	DATE			DATE		

Discrepancy 2. SPECIFIC GRAVITY OF COLLECTED 5-PER CENT SOLUTION AT NOZZLE END RECEPTICAL WAS .0062 OVER 1.0413 MAX ON THE FIRST DAY. SECOND DAY THE READING WAS .0049 OVER 1.0413 MAX.
FAR END RECEPTICAL FIRST DAY READING WAS .0154 OVER 1.0413 MAX. SECOND DAY THE READING WAS .0134 OVER 1.0413 MAX.

Disposition

Acceptable as is

HOLE CK. / MAT. CK.

INSP. AUTH.	MAT. REV. ENG.	PART NO.	TYPE OF REPAIR	MECH. NO.	INSP. ACCEPT.	CUST.
	DATE			DATE		

Discrepancy 3. pH OF COLLECTED 5-PER CENT SOLUTION AT NOZZLE END RECEPTICAL THE READING WAS .2 OVER 7.2 MAX ON THE FIRST DAY. pH OF COLLECTED 5-PER CENT SOLUTION AT FAR END RECEPTICAL THE READING WAS .2 OVER 7.2 MAX ON THE FIRST DAY.

Disposition

Acceptable as is

HOLE CK. / MAT. CK.

FORM R 60-W

Void If Not Written in Ink

439

MSE 4-21

INTERNAL LETTER
NORTH AMERICAN AVIATION, INC.

DATE 17 August 1964

TO E. Adams
ADDRESS 896-[illegible] - Zone 16
Van Nuys #2

FROM Space Engines Materials
ADDRESS 596-178 - Zone 16
Van Nuys #2

PHONE 6324

SUBJECT Rusting of DAT Thrust Chamber Assembly

Distri:
Zone 6
Badger 596-174
Zone 16
[illegible]ler 596-178
Rosengard 596-178
Kleint 596-178

A 25Lb. RCS thrust chamber assembly (P/N 208130-61, S/N 4055290), which had undergone hot firing and 50 hour salt spray tests, was examined by Materials and Processes. Loosely adherent rust was observed in weld areas, a condition typical of many stainless steel weld joints following salt spray tests. There was no evidence of attack which would destroy or reduce the structural integrity of the part. It is the opinion of Materials and Processes that the part is acceptable to continue with the remaining humidity and subsequent hot fire tests as outlined for the DAT program.

G. E. Williams
Space Engines Materials

C. E. Moeller, Supervisor
Space Engines Materials
Materials and Processes

GEW:CEM/nr

440

R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST SALT SPRAY TEST NO. 208130-401 SHEET 222 OF 354

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

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 $\pm^{10}_{0}$)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
Leakage		
Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (500 $\pm^{10}_{0}$)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate (2.23 maximum)	<0.1 scc He/min	<0.1 scc He/min

Inspection Remarks

NONE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 4/30/64 1-31-64	T. E. Pope 6-24-64	G. Kaye 6-24-64	VERIFIED BY USAF: 6/24/64 DATE R. M. Ayers

FORM 608-D-43 NEW 6-63

REVISION A J. D. Morgan Dated 6/20/64

441

R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST SALT SPRAY TEST NO 208130-401 SHEET 222 OF 354

7.4.2.2.4. Propellant Valve Electrical Resistance test (reference paragraph 6.3)

Environmental Temperature 70 (70 ±10F).

Resistance A - B

Oxidizer Valve 41.84 ohms (Acceptable per Figure 15, yes or no YES).

Fuel Valve 41.84 ohms (Acceptable per Figure 15, yes or no YES).

Resistance C - D (1.0 maximum)

Oxidizer Valve .065 ohms

Fuel Valve .080 ohms

Inspection Remarks

NONE

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
T.G.Kniffin 1-31-64	F.B. Pope 6-24-64	G Kaye 6/24/64	VERIFIED BY USAF 6/24/64 DATE R.M. Ayers

FORM 608-B-39 NEW 6-63

442

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST SALT SPRAY TEST NO. 208130-401 SHEET 224 OF 354

7.4.2.2.5 Propellant Valve Dielectric Strength test (reference paragraph 6.4)

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 +10 -0	Current Microamps 500 max.	Voltage Volts 500 +10 -0	Current Microamps 500 max.
A to Ground	500	5 μa	500	5 μa
C to Ground	500	3 μa	500	4 μa
A to C	500	4 μa	500	1 μa

Inspection Remarks

NONE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 1-31-64	F. E. Pope 6-24-64	D Kaye 6-24-64	T. [illegible] 6/24/64
			VERIFIED BY USAF: 6/24/64 DATE

FORM 608-B-43 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	595399	ENV.TEST	2061	6-24-64

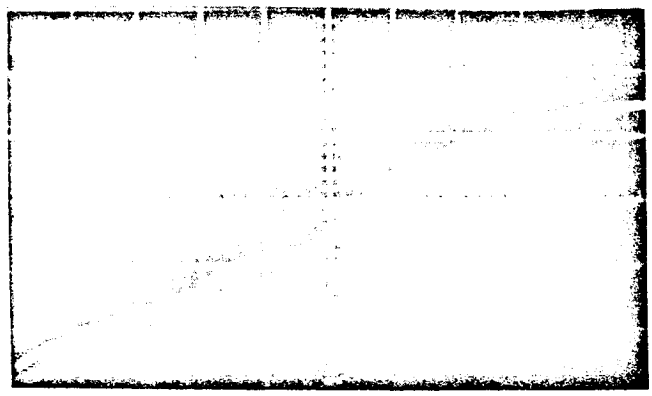
PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #4)	208130-61 S/N 4055298	POST SALT SPRAY PROPELLANT VALVE FUNCTIONAL

OXIDIZER VALVE

P/N 407557 S/N 9237909

CURRENT TRACE

(Opening Time)



Horizontal = 1mc/cm

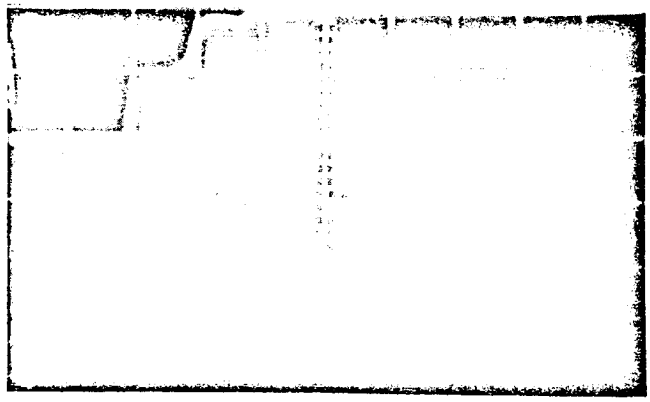
Vertical = 20mv/cm

Requirement = .0065 sec/max

Vertical = .0044 sec.

VOLTAGE TRACE

(Closing Time)



Horizontal = 1ms/cm

Vertical = 20v/cm

Requirement = .0035 sec/max

Actual = .0025 sec

R-15019-2

Form 600-W-67 New 10-63

DEVELOPMENT LABORATORY TEST REPORT

PAGE ____ OF ____

LAB TEST NO. ____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	595399	ENV. TEST	2061	6-24-64

PART	PART NO	TYPE OF TEST
25# RCS TCA (Unit #4)	208130-61 S/N 4055298	POST SALT SPRAY PROPELLANT VALVE FUNCTIONAL

FUEL VALVE

P/N 407558 S/N 9202598

CURRENT TRACE
(Opening Time)

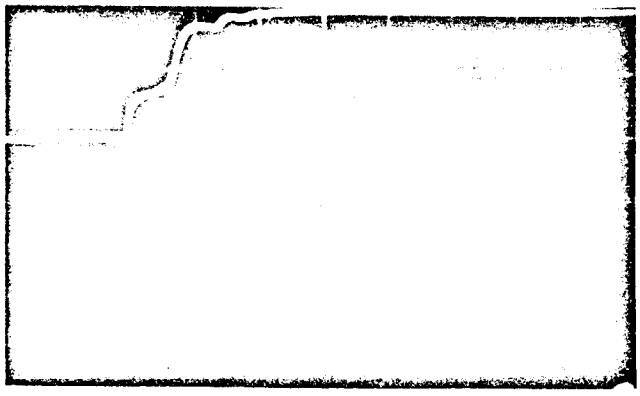
Horizontal = 1ms/cm
Vertical = 20mv/cm

Requirement = .0065 sec.max.
Actual = .0040 sec.

VOLTAGE TRACE
(Closing Time)

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

Requirement = .0035 sec.max.
Actual = .0025 sec.



Form 600-W-67 New 10-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST SALT SPRAY TEST NO. 208130-401 SHEET 225 OF 354

7.4.2.2.6 Propellant Valve Functional test (reference paragraph 6.5)

	Oxidizer Valve	Fuel Valve
Response Time		
Ambient Temperature (70 ±10)	70 F (ANR 321)	70 F
Energizing Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig A
Opening Time (0.0065 maximum)	.0044 seconds	.004 seconds
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Time (0.002 maximum) * (ANR 321) EA	.0025 seconds	.0025 seconds
Low Voltage Operation		
Ambient Temperature (70 ±10)	73 F	72 F
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig A
Opening Voltage (16 maximum)	8.6 VDC	6.6 VDC
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Voltage (1.0 minimum)	1.13 VDC	1.2 VDC

Inspection Remarks

* SEE CHANGE DATED 6-23-64 PARA 6.5.7. EA

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 6-20-64 4/30/64 1-31-64	L Cracraft 596- 6-24-64	6/24/64	6/24/64
			VERIFIED BY USAF: DATE 6/24/64

FORM 608-B-43 NEW 6-63

REVISION A Dated 6/20/64

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST SALT SPRAY TEST NO. 208130-401 SHEET 226 OF 354

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

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 $\pm^{10}_{0}$)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
Leakage Voltage (26 $\pm$0.5)	26 VDC	26 VDC
Inlet Pressure (500 $\pm^{10}_{0}$)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate (2.23 maximum)	<0.1 scc He/min	<0.1 scc He/min

Inspection Remarks

NONE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 1-22-64 4/3/64 1-31-64	F.E. Page 6-26-64	G. Kaye 6-26-64	VERIFIED BY USAF: 6/26/64 DATE R M Myers

FORM 608-B-43 NEW 6-63

REVISION A J.D. Morrogan Dated 6/22/64

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R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST SALT SPRAY TEST NO. 208130-401 SHEET 227 OF 354

7.4.2.2.8 Propellant Valve Electrical Resistance test (reference paragraph 6.3)

Environmental Temperature 70 (70 ±10F).

Resistance A - B

Oxidizer Valve 41.615 ohms (Acceptable per Figure 15, yes or no YES).

Fuel Valve 41.815 ohms (Acceptable per Figure 15, yes or no YES).

Resistance C - D (1.0 maximum)

Oxidizer Valve .038 ohms

Fuel Valve .045 ohms

Inspection Remarks

NONE

~~453~~
~~448~~

448

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T.G.Kniffin 1-31-64	F. E. Pope 6-26-64	G. Kaye 6-26-64	VERIFIED BY USAF 6/26/64 DATE R M [illegible]

FORM 608-B-39 NEW 6-63

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST SALT SPRAY TEST NO. 208130-401 SHEET 228 OF 354

7.4.2.2.9 Propellant Valve Dielectric Strength test (reference paragraph 6.4)

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 +10 -0	Current Microamps 500 max.	Voltage Volts 500 +10 -0	Current Microamps 500 max.
A to Ground	500	72 Ma	500	113 ma
C to Ground	500	58 ma	500	55 ma
A to C	500	18 ma	500	18 ma

Inspection Remarks

NONE.

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 1-31-64	F.Z. Pope 6-26-64	G Kaye 6-26-64	VERIFIED BY USAF: 6/26/64 DATE R. M. Hyne

FORM 608-B-43 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	595399	ENV. TEST	2061	6-26-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #4)	208130-61 S/N 4055298	POST SALT SPRAY PROPELLANT VALVE FUNCTIONAL

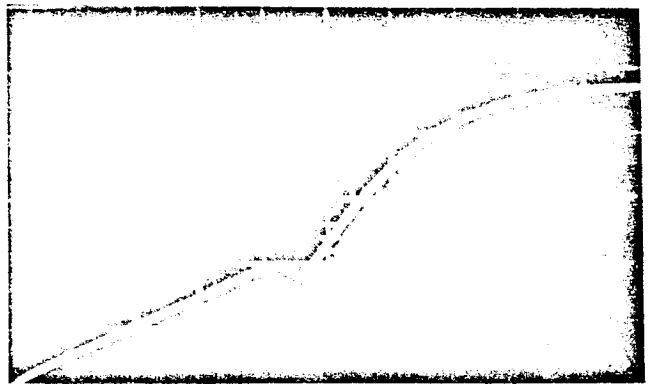
OXIDIZER VALVE

P/N407557 S/N 9237909

CURRENT TRACE
(Opening Time)

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

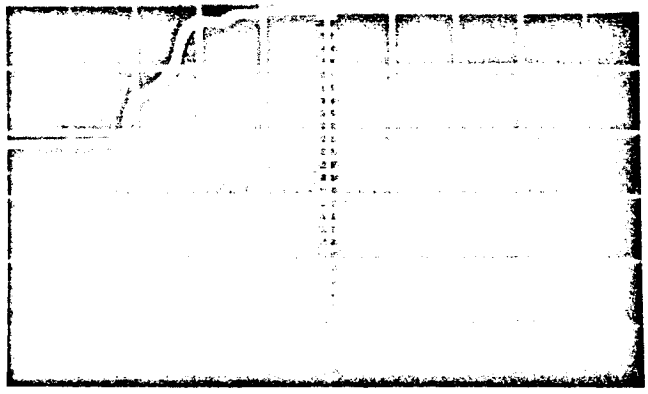
Requirement = .0065 sec.max.
Actual = .0046 sec.



VOLTAGE TRACE
(Closing Time)

Horizontal = 1ms/cm
Vertical = v/cm

Requirement = .0035 sec.max
Actual = .0024 sec.



R-15019-2

Form 600-W-67 New 10-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE ____ OF ____

LAB TEST NO. ____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	595399	ENV.TEST	2061	6-26-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #4)	208130-61 S/N 4055298	POST SALT SPRAY PROPELLANT VALVE FUNCTIONAL

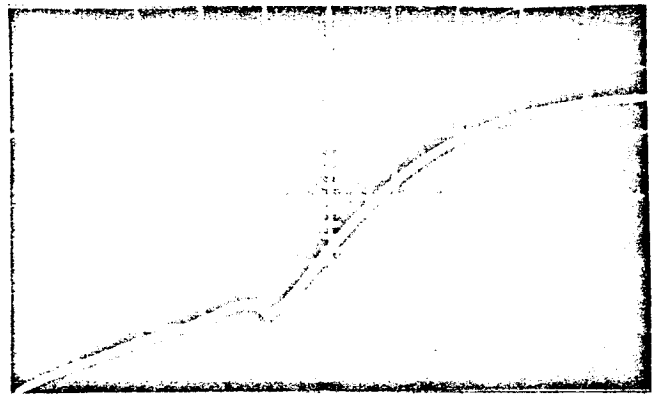
FUEL VALVE

P/N 407558 S/N 9202598

CURRENT TRACE
(Opening Time)

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

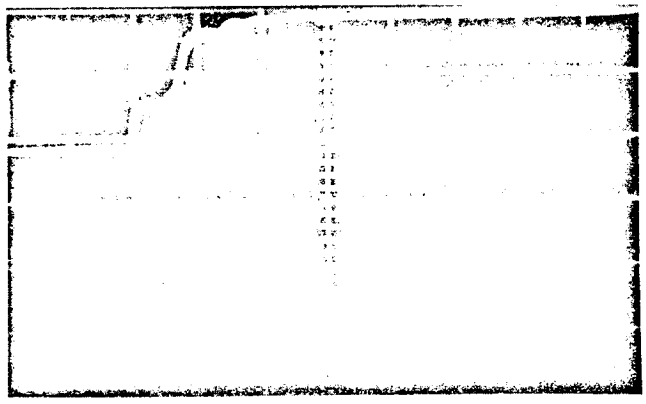
Requirement = .0065 sec.max.
Actual = .0041 sec.



VOLTAGE TRACE
(Closing Time)

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

Requirement = .0035 sec.max.
Actual = .0025 sec.



ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST SALT SPRAY TEST NO. 208130-401 SHEET 227 OF 354

7.4.2.2.10 Propellant Valve Functional test (reference paragraph 6.5)

	Oxidizer Valve	Fuel Valve	
Response Time			
Ambient Temperature (70 ±10)	70 F (ANR 921)	70 F (ANR 224)	
Energizing Voltage (26 ±0.5)	26 VDC (ANR 921)	26 VDC	
Inlet Pressure (300 ±10 for "pull-in")	300 psig (ANR 921)	300 psig	A
Opening Time (0.0065 maximum)	.0046 seconds (ANR 921)	.0041 seconds	
Inlet Pressure (zero for "drop-out")	ZERO psig (ANR 921)	ZERO psig	
Closing Time (0.0[illegible] maximum)	.0024 seconds (ANR 921)	.0025 seconds	A
Low Voltage Operation			
Ambient Temperature (70 ±10)	70 F (ANR 921)	70 F	
Inlet Pressure (300 ±10 for "pull-in")	300 psig (ANR 921)	300 psig	A
Opening Voltage (16 maximum)	8.65 VDC (ANR 921)	6.4 VDC	
Inlet Pressure (zero for "drop-out")	ZERO psig (ANR 921)	ZERO psig	
Closing Voltage (1.0 minimum)	1.20 VDC (ANR 921)	1.25 VDC	

Inspection Remarks

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 4/30/64 1-31-64	L.L. Cracraft 6-26-64	[signature] 6/26/64 (ANR 921)	VERIFIED BY USAF: [signature] DATE 6/26/64

FORM 608-B-43 NEW 6-63

452 REVISION A [signature] Dated 6/22/64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST HUMIDITY TEST NO. 208130-401 SHEET 185 OF 267

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.2.3.10

7.3.3 Humidity - TCA #3

7.3.3.1 Test Procedure

7.3.3.1.1 Install the TCA in the humidity exposure chamber so that, with the fuel propellant valve positioned on top, the longitudinal axis of the thrust chamber assembly is horizontal.

7.3.3.1.2 Insure that the fuel and oxidizer inlet ports are properly capped.

7.3.3.1.3 Install moisture proof closures on TCA fuel and oxidizer electrical connectors.

7.3.3.1.4 Remove the protective closure at the thrust chamber exit nozzle.

7.3.3.1.5 Instrumentation shall be provided for a continuous record of the temperature chamber wet and dry bulb temperatures.

7.3.3.1.6 The test shall start with the thrust chamber subjected to local ambient conditions of temperature (68F to 100F) and humidity for a period of at least one hour.

7.3.3.1.7 Provide a relative humidity within the test chamber of 95 to 100%. Record the data and the time on the data sheet.

7.3.3.1.8 During the next two hours of the test, gradually raise the temperature of the test chamber to 160 ±5F.
CAUTION: Assure that the test chamber is vented to atmosphere.

7.3.3.1.9 Maintain for a period of six hours, the test chamber temperature and humidity per paragraph 7.3.3.1.7 and 7.3.3.1.8.

PREPARED BY: T.G. Kniffin	DATE 1-31-69	APPROVED FOR NAA:	DATE 1-31-69	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 1-31-69				

7-10-64

FORM 608-B-44 NEW 6-63

REVISION B _____ Dated _____

186

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST HUMIDITY TEST NO. 208130-401 SHEET 186 OF 267

7.3.3.1.10	During next sixteen hours of test reduce chamber temperature to a value between 68 and 100F.
7.3.3.1.11	Repeat paragraph 7.3.3.1.8 through 7.3.3.1.10 nine consecutive times. At the end of the testing record the date and time. NOTE: Total test time shall be 240 hours (10 cycles).
7.3.3.1.12	Allow the TCA to return to local ambient conditions of temperature and humidity.
7.3.3.1.13	Within one hour after the TCA reaches the conditions of paragraph 7.3.3.1.12 begin the first of the following tests. The tests shall be carried through to completion without delay. NOTE: Failure at the electrical plug interface is not Rocketdyne's responsibility. It is permissable to blow the electrical connector dry with GN_2.
7.3.3.1.13.1	Propellant Valve Electricl Resistance per paragraph 6.3.
7.3.3.1.13.2	Propellant Valve Dielectric Strength per paragraph 6.4.
7.3.3.1.13.3	Propellant Valve Functional per paragraph 6.5.
7.3.3.1.14	Energize the propellant valves with 12 ±2 VDC.
7.3.3.1.15	Supply 120 ±10 psig GN_2 purge to the two propellant valve inlet ports for a period of three minutes.
7.3.3.1.16	Close the purge supply valve.
7.3.3.1.17	De-energize the TCA propellant valves.
7.3.3.1.18	Remove all test equipment, pressurant and electrical connections to the TCA, and assure that the TCA is dry.
7.3.3.1.19	Replace all protective closures.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G.Kniffin	1-31-64	R. Eide	1-31-64		
CHECKED BY:	DATE				
	1-31-64				

FORM 608-B-44 NEW 6-63

REVISION B. _____ Dated _____

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST HUMIDITY TEST NO. 208130-401 SHEET ___ OF ___

IL 4388-5352

Deviation Request:

Delete wet bulb temperature from humidity test as test facility maintains 100% humidity and ambient pressure.

Recopied from original request dated 19, August 1964.

James D. Mavrogenis
Jim Mavrogenis
MAC Engineering
12-2-64

R. A. Cole
R. A. Cole
Gemini DAT-RAT Unit

J55

FORM 608-B-42 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61 }

NAME OF TEST HUMIDITY TEST NO. 208130-401 SHEET 187 OF 267

7.3.3.2 Test Data - TCA #3

7.3.3.2.1 Component Identification

Component Name TCA

McDonnell Part No. SCD-52-52700-217

Rocketdyne Part No. 208130-61

Component Serial No. 4055298

7.3.3.2.2 Humidity test (reference paragraph 7.3.3.1)

7.3.3.2.2.1 Humidity testing was begun on 8/19/64 ~~11:00 A.M.~~ 3:10 PM (give date and time)

7.3.3.2.2.2 During the testing the relative humidity was maintained at or above 95 per cent. YES (Yes or No)

7.3.3.2.2.3 Humidity testing was ended on 8-29-64 3:10 PM (give date and time)

7.3.3.2.2.4 Inspection Remarks

NOTED EXTRA AMOUNT OF RUST AND CORROSION ON RECEPTLEL * AN929-3C CAPS ON THE FUEL & OXIDIZER PORTS HAS A LARGE AMOUNT OF CORROSION INSIDE ALSO CORROSION WAS NOTED ON THE INSIDE OF INLET ADAPTERS 8-29-64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 7-10-64 1-31-64	F. T. Pope 8-29-64	Z. Johnson 8-29-64	R. L. Jue 8-29-64
			VERIFIED BY USAF: 8-31-64

FORM 608-B-43 NEW 6-63

REVISION B _____ Dated _____

188

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST HUMIDITY TEST NO. 208130-401 SHEET 188 OF 267

7.3.3.2.3 Propellant Valve Electrical Resistance test (reference paragraph 6.3) B

Environmental Temperature 70 (70 ±10F).

Resistance A - B

Oxidizer Valve 41.5 ohms (Acceptable per Figure 15, yes or no yes).

Fuel Valve 41.8 ohms (Acceptable per Figure 15, yes or no yes).

Resistance C - D (1.0 maximum)

Oxidizer Valve .06 ohms

Fuel Valve .1 ohms

Inspection Remarks

None

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PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	7-10-64	F. E. Pope	8-29-64	[signature]	8/29/64	R. L. Free	8-29-64
	1-31-64					VERIFIED BY USAF	DATE
						[signature]	8-31-64

FORM 608-B-39 NEW 6-63

REVISION B _____ Dated _____

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST HUMIDITY TEST NO. 208130-401 SHEET 189 OF 267

7.3.3.2.4 Propellant Valve Dielectric Strength test (reference paragraph 6.4) B

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 +10 -0	Current Microamps 500 max.	Voltage Volts 500 +10 -0	Current Microamps 500 max.
A to Ground	500	8	500	38
C to Ground	500	34	500	20
A to C	500	20	500	15

Inspection Remarks

NONE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 7-10-64 1-31-64	F. E. Pope 8-29-64	L. Johnson 8-29-64	R. L. Free 8-29-64
			VERIFIED BY USAF: DATE
			R. K. Cowell 8-31-64

FORM 608-B-43 NEW 6-63

REVISION B Dated

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE ____ OF ____

LAB TEST NO. ____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
J.Lally	595399	ENV.TEST	2061	8-29-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #3)	208130-61 S/N 4055298	POST HUMIDITY PROPELLANT VALVE FUNCTIONAL

OXIDIZER VALVE

P/N 407557 S/N 9237909

CURRENT TRACE

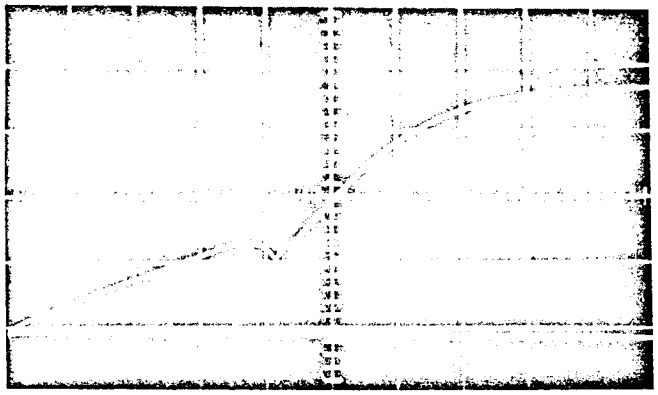
(Opening Time)

Horizontal = 1ms/cm

Vertical = 20mc/cm

Requirement = .0065 sec/max

Actual = .0042 sec



VOLTAGE TRACE

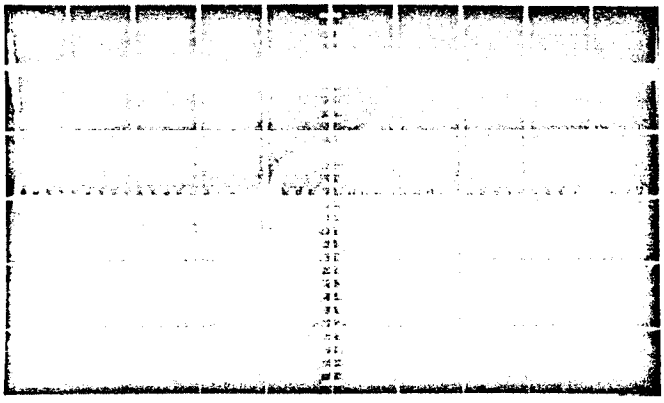
(Closing Time)

Horizontal = 0.5ms/cm

Vertical = 20v/cm

Requirement = .0035 sec/max

Actual = .0025 sec



Form 600-V-67 New 10-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
J.Lally	595399	ENV.LAB.	2061	8-29-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #3)	208130-61 S/N 4055298	POST HUMIDITY PROPELLANT VALVE FUNCTIONAL

FUEL VALVE

P/N 407558 S/N 9202598

CURRENT TRACE

(Opening Time)

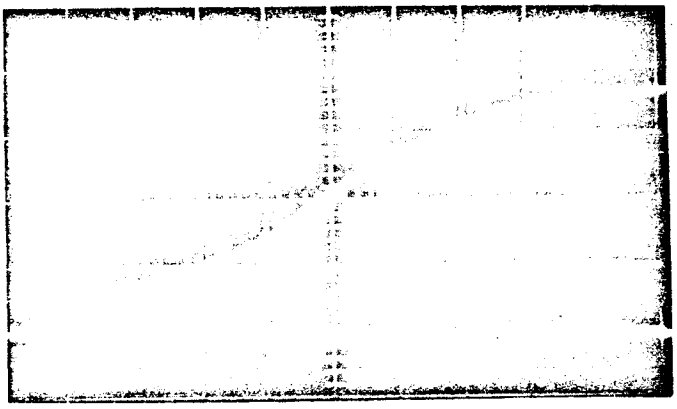
Horizontal = 1ms/cm

Vertical = 20mv/cm

Requirement = .0065 sec/max

Actual = *

* Reference OFR 12909



R-15019-2

Form 600-W-67 New 10-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST HUMIDITY TEST NO. 208130-101 SHEET 190 OF 267

7.3.3.2.5 Propellant Valve Functional test (reference paragraph 6.5) B

		Oxidizer Valve	Fuel Valve	
Response Time				
Ambient Temperature (70 ±10)	ANR	71° F	71° F	
Energizing Voltage (26 ±0.5)	ANR	26 VDC	26 VDC	
Inlet Pressure (300 ±10 for "pull-in")	ANR	300 psig	300 psig	A
Opening Time (0.0065 maximum)	ANR	.0042 seconds	* seconds	
Inlet Pressure (zero for "drop-out")	ANR	ZERO psig	psig	
Closing Time (0.0035 maximum)	ANR	.0025 seconds	seconds	A
Low Voltage Operation				
Ambient Temperature (70 ±10)	ANR	71° F	F	
Inlet Pressure (300 ±10 for "pull-in")	ANR	300 psig	psig	A
Opening Voltage (16 maximum)	ANR	8.0 VDC	VDC	
Inlet Pressure (zero for "drop-out")	ANR	ZERO psig	psig	
Closing Voltage (1.0 minimum)	ANR	1.25 VDC	VDC	

Inspection Remarks * SEE OFR #12909R AND 25U FORM

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 6-22-64 4/30/64 1-31-64	F. T. Pope 8-29-64		VERIFIED BY USAF: DATE

7-10-64

FORM 608-B-43 NEW 6-63

REVISION A J. D. Mangum Dated 6/22/64

REVISION B Dated

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UNIT #3

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4060450

Dwg. No. 208130-61

Model SE-6

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
		ENVIRONMENTAL TEST LAB D/596/146 C/P			
1	INA 9/22/64	PART NO. 208130-61 S/N 4060450 COMPLETED PARA 7.3.3 HUMIDITY TEST. UNIT SHIPPED TO V/N 2 ENG. STORES ATTN: ED. BRELLAND			
ACTION TAKEN		INFO ONLY NO ACTION REQ		INA 9-22-64	INA
I	11/6/64 AK	PART NO. 208130-61 S/N 4060450, Ablative material in Throat of T/C Seperated causing Leakage during cycling Procedure of Para. 7.3.5.2.6			
ACTION TAKEN		Ref. I.L. Dated 6 Nov., 1964		AK 11-7-64	AK
3	11/6/64 AK	PART NO. Water Leaking excessively during cycling Procedure of Para 7.3.5.2.6			
ACTION TAKEN		Ref. IL Dated 6 Nov., 1964		AK 11-7-64	AK
		PART NO.			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					

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Form R 25-u Rev. 12-57

R-15019-2

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PRE-TEST INSPECTION TEST NO. 208130-401 SHEET 120 OF 267

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.2.2.1

7.3.1 Pre-Test Inspection - TCA #3A

7.3.1.1 Test Procedure

7.3.1.1.1 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 RA0220-350. Only those TCA's meeting the above requirements shall be accepted for DAT.

7.3.1.1.2 Braze propellant valve inlet adapters to the oxidizer and fuel propellant valves per RA0607-009.

7.3.1.1.3 Perform Weight Determination per paragraph 6.6.

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PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	1-31-64	R Eutel	1-31-64		
CHECKED BY:	DATE				
	1-31-69				

FORM 608-B-44 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST PRE-TEST INSPECTION TEST NO. 208130-401 SHEET 171 OF 267

7.3.1.2 Test Data - TCA #3A

7.3.1.2.1 Component Identification

Component Name	TCA	Oxidizer Valve	Fuel Valve
McDonnell Part No.	52-52700-217		
Rocketdyne Part No.	208130-61	407557	407558
Component Serial No.	4060450	9294000	8759958

7.3.1.2.2 Inspection (reference paragraph 7.3.1.1)

7.3.1.2.2.1 The TCA was inspected to insure that it was of the proper configuration, 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 RA0220-350. YES (yes or no)

7.3.1.2.2.2 Propellant valve inlet adapters were installed on the propellant valves per paragraph 7.3.1.1.2. YES (yes or no)

7.3.1.2.2.3 Inspection Remarks

NONE

PREPARED BY:	PERFORMED BY:	WITNESSED FOR NAA	CERTIFIED FOR McDONNELL:	VERIFIED BY USAF:
T.G.Kniffin 4/30/64 1-31-64	M.D. Dehnick 9/11/64	[signature] 9/11/64	Waived by J.D. Mavrogenis by EA	Waived by Jr. O'Hara REF AVG DTD 9-11-64 9/11/64

FORM 603-B-43 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PRE-TEST INSPECTION TEST NO. 208130-401 SHEET 172 OF 267

7.3.1.2.3 Weight Determination test (reference paragraph 6.6)

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

The TCA dry weight was 2.31 pounds.
(Record to the nearest one-hundredth pound)

Inspection Remarks None

465

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T. G. Kniffin	F. E. Pafe 9-12-64	J. F. Murchison 9/12/64	Waived by J D Mavrogan Ex
			VERIFIED BY USAF: DATE H. E. Noel 9-12-64

FORM 608-B-43 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST HUMIDITY TEST NO. 208130-401 SHEET 185 OF 267

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.2.3.10

7.3.3 Humidity - TCA #3A

7.3.3.1 Test Procedure

7.3.3.1.1 Install the TCA in the humidity exposure chamber so that, with the fuel propellant valve positioned on top, the longitudinal axis of the thrust chamber assembly is horizontal.

7.3.3.1.2 Insure that the fuel and oxidizer inlet ports are properly capped.

7.3.3.1.3 Install moisture proof closures on TCA fuel and oxidizer electrical connectors.

7.3.3.1.4 Remove the protective closure at the thrust chamber exit nozzle.

7.3.3.1.5 Instrumentation shall be provided for a continuous record of the temperature chamber wet and dry bulb temperatures.

7.3.3.1.6 The test shall start with the thrust chamber subjected to local ambient conditions of temperature (68F to 100F) and humidity for a period of at least one hour.

7.3.3.1.7 Provide a relative humidity within the test chamber of 95 to 100%. Record the data and the time on the data sheet.

7.3.3.1.8 During the next two hours of the test, gradually raise the temperature of the test chamber to 160 ±5F.
CAUTION: Assure that the test chamber is vented to atmosphere.

7.3.3.1.9 Maintain for a period of six hours, the test chamber temperature and humidity per paragraph 7.3.3.1.7 and 7.3.3.1.8.

PREPARED BY: T.G. Kniffin	DATE 1-31-69	APPROVED FOR NAA: R. Eagle by TDK	DATE 1-31-69	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 1-31-69				

7-10-64

FORM 608-B-44 NEW 6-63

REVISION B _____ Dated _____

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DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST HUMIDITY TEST NO. 208130-401 SHEET 186 OF 267

7.3.3.1.10	During next sixteen hours of test reduce chamber temperature to a value between 68 and 100F.
7.3.3.1.11	Repeat paragraph 7.3.3.1.8 through 7.3.3.1.10 nine consecutive times. At the end of the testing record the date and time. NOTE: Total test time shall be 240 hours (10 cycles).
7.3.3.1.12	Allow the TCA to return to local ambient conditions of temperature and humidity.
7.3.3.1.13	Within one hour after the TCA reaches the conditions of paragraph 7.3.3.1.12 begin the first of the following tests. The tests shall be carried through to completion without delay. NOTE: Failure at the electrical plug interface is not Rocketdyne's responsibility. It is permissable to blow the electrical connector dry with GN_2.
7.3.3.1.13.1	Propellant Valve Electricl Resistance per paragraph 6.3.
7.3.3.1.13.2	Propellant Valve Dielectric Strength per paragraph 6.4.
7.3.3.1.13.3	Propellant Valve Functional per paragraph 6.5.
7.3.3.1.14.	Energize the propellant valves with 12 ±2 VDC.
7.3.3.1.15	Supply 120 ±10 psig GN_2 purge to the two propellant valve inlet ports for a period of three minutes.
7.3.3.1.16	Close the purge supply valve.
7.3.3.1.17	De-energize the TCA propellant valves.
7.3.3.1.18	Remove all test equipment, pressurant and electrical connections to the TCA, and assure that the TCA is dry.
7.3.3.1.19	Replace all protective closures.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G.Kniffin	1-31-64	R. Eide	1-31-64		
CHECKED BY:	DATE				
	1-31-64				

7-10-64

FORM 608-B-44 NEW 6-63

REVISION B. _____ Dated _____

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST HUMIDITY TEST NO. 208130-401 SHEET ___ OF ___

IL 4388-5351

Deviation Request:

Wet bulb temperature (reference paragraph 7.3.3.1.5) will not be continuously recorded as environmental chamber maintains 100% relative humidity at local ambient pressure.

Recopied from original request dated 12, September 1964.

James D. Mavrogenis
Jim Mavrogenis
MAC Engineering
12-2-64

R. Cole
R. Cole
Gemini DAT-RAT Unit

FORM 608-B-42 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST HUMIDITY TEST NO. 208130-401 SHEET 187 OF 267

7.3.3.2 Test Data - TCA #3A

7.3.3.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52700-217

Rocketdyne Part No. 208130-61

Component Serial No. 4060450

7.3.3.2.2 Humidity test (reference paragraph 7.3.3.1)

7.3.3.2.2.1 Humidity testing was begun on 9:AM 9-12-64 (give date and time)

7.3.3.2.2.2 During the testing the relative humidity was maintained at or above 95 per cent. * (Yes or No)

7.3.3.2.2.3 Humidity testing was ended on 9-22-64 9:00 AM (give date and time)

7.3.3.2.2.4 Inspection Remarks

* REF IL DTD SEPT 12, 64

SALT DEPOSITS ON BOTH ELECTRICAL PLUG INTERFACE

SLIGHT RUST BETWEEN UNION AND FUEL INLET TUBE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 7-10-64 1-31-64	F. E. Pope 9-22-64	G. Kaye 9-22-64	Waived by R.L. Free 9-22-64
			VERIFIED BY USAF: DATE 9/22/64

FORM 608-B-43 NEW 6-63

REVISION B Dated

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R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST HUMIDITY TEST NO. 208130-401 SHEET 183 OF 267

7.3.3.2.3 Propellant Valve Electrical Resistance test (reference paragraph 6.3) B

Environmental Temperature 70 (70 ±10F).

Resistance A - B

Oxidizer Valve 40.8 ohms (Acceptable per Figure 15, yes or no YES).

Fuel Valve 41 ohms (Acceptable per Figure 15, yes or no YES).

Resistance C - D (1.0 maximum)

Oxidizer Valve .06 ohms

Fuel Valve .30 ohms

Inspection Remarks

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	7-10-64	Free Moeller	9/21/64	S. Kaye	9-22-64	waived by R.J. Free	9-22-64
	1-31-64					VERIFIED BY USAF	9/22/64

FORM 608-B-39 NEW 6-63

REVISION B _____ Dated _____

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST HUMIDITY TEST NO. 208130-401 SHEET 189 OF 267

7.3.3.2.4 Propellant Valve Dielectric Strength test (reference paragraph 6.4) B

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 +10 -0	Current Microamps 500 max.	Voltage Volts 500 +10 -0	Current Microamps 500 max.
A to Ground	500	36.8	500	35
C to Ground	500	38	500	22
A to C	500	18	500	18

Inspection Remarks

None

PREPARED BY:	DATE	PERFORMED BY:	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL:	DATE
T.G.Kniffin	7-10-64 1-31-64	Fred Moeller	9/21/64	G. Kaye	9-22-64	Waived by R.J. Frei 9-22-64	
						VERIFIED BY USAF:	DATE 9/22/64

FORM 608-B-43 NEW 6-63

REVISION B Dated

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	595399	ENV.LAB.	2061	9-22-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #3A	208130-61 S/N 4060450	POST HUMIDITY FUNCTIONAL (Response Time)

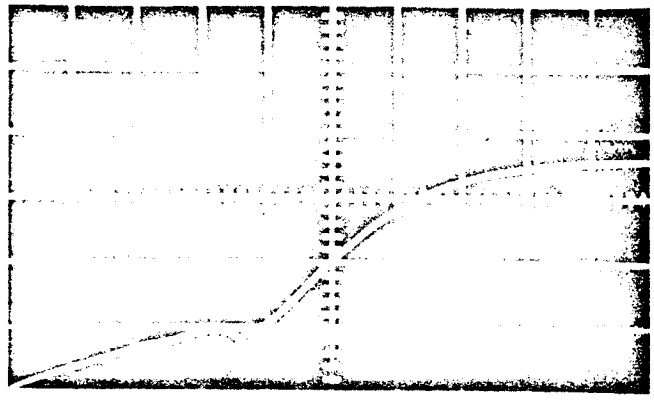
OXIDIZER VALVE

P/N 407557 S/N 9294000

CURRENT TRACE
(Opening Time)

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

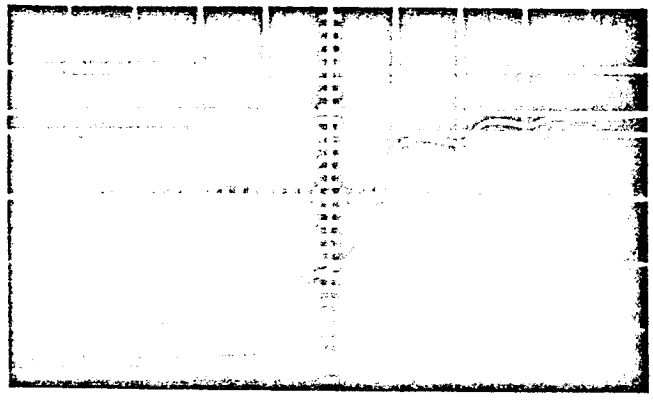
Requirement = .0065 sec.max.
Actual = .0036 sec.



VOLTAGE TRACE
(Closing Time)

Horizontal = .5ms/cm
Vertical = 10v/cm

Requirement = .0035 sec.max.
Actual = .0028sec.



R-15019-2

Form 600-W-67 Rev 10-63

DEVELOPMENT LABORATORY TEST REPORT

PAGE ____ OF ____

LAB TEST NO. ____

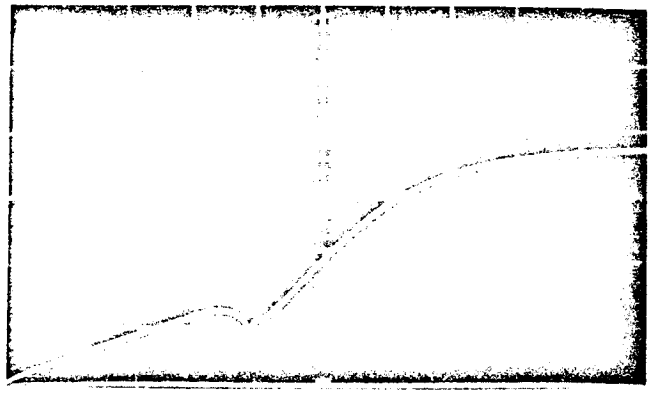
PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	595399	ENV.LAB.	2061	9-22-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #3A	208130-61 S/N 4060450	POST HUMIDITY FUNCTIONAL 9Response Time)

FUEL VALVE

P/N 407558 S/N 8759958

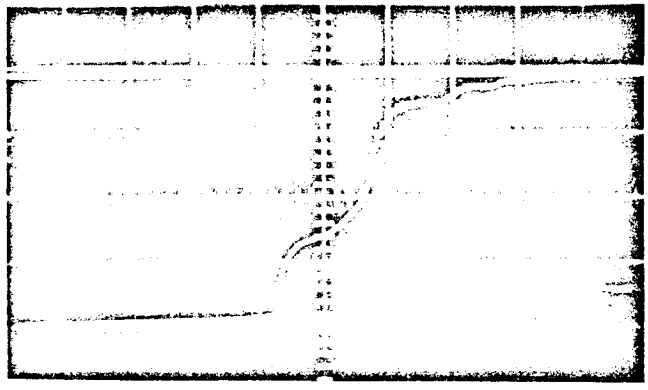
CURRENT TRACE
(Opening Time)



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

Requirement = .0065 sec.max.
Actual = .0039 sec.

VOLTAGE TRACE
(Closing Time)



Horizontal = .5ms/cm
Vertical = 10v/cm

Requirement = .0035 sec.max
Actual = .0028 sec.

R-15019-2

Form 600-V-67 New 10-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST HUMIDITY TEST NO. 208130-401 SHEET 190 OF 267

7.3.3.2.5 Propellant Valve Functional test (reference paragraph 6.5) B

	Oxidizer Valve	Fuel Valve
Response Time		
Ambient Temperature (70 ±10)	70 F	70 F
Energizing Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Time (0.0065 maximum)	.0036 seconds	.0039 seconds
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Time (0.0035 maximum)	.0028 seconds	.0028 seconds
Low Voltage Operation		
Ambient Temperature (70 ±10)	70 F	70 F
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Voltage (16 maximum)	6 VDC	7.2 VDC
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Voltage (1.0 minimum)	1.2 VDC	1.2 VDC

A

Inspection Remarks

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 6-22-64 4/30/64 1-31-64	L L Cracraft 9-22-64	G Kaye 9-22-64	Waived by R. L. Fries EA 9-22-64
			VERIFIED BY USAF: DATE 9/22/64

FORM 608-B-43 NEW 6-63

REVISION A J. D. Mavrogan Dated 6/22/64

474 REVISION B _____ Dated _____

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 136 SECONDS TEST NO. 208130-401 SHEET 191 OF 267

Reference: MAC SCD 52-52700, Revision G, paragraph 6.3.1.3.2.2

7.3.4 DAT Duty Cycle to 136 Seconds - TCA #3A.

7.3.4.1 Test Procedure

7.3.4.1.1 Perform Cape Cycle Firing Test per paragraph 6.7. B

7.3.4.1.1.1 Make a one second firing followed by another one second firing ten minutes later.

7.3.4.1.1.2 Wait sixty minutes and make a one second firing followed by another one second firing ten minutes later.

7.3.4.1.1.3 Repeat paragraph 7.3.4.1.1.2.

7.3.4.1.2 Wait for TCA skin temperature to return to ambient temperature (70 ±20F) and perform the DAT duty cycle Firing Test per paragraph 6.7 and Table II. The Firing Test shall be terminated upon completion of 136 seconds Firing Time as defined in Table II.

7.3.4.1.2.1 The TCA shall not exceed a maximum skin temperature of 550F at the end of the 100 seconds total burn time ("in spec" performance).

7.3.4.1.2.2 The TCA shall not exceed a maximum skin temperature of 650F at 136 seconds total burn time. (guaranteed life).

7.3.4.1.3 Perform decontamination per paragraph 6.8.

7.3.4.1.4 Reduce data per SEM 4388-4040.

7.3.4.1.4.1 The results of significant data shall include but not be limited to the following:

7.3.4.1.4.1.1 Graphical presentation of temperature versus time for all TCA thermocouple locations.

7.3.4.1.4.1.2 Graphical presentation of total impulse versus signal width.

7.3.4.1.4.1.3 Graphical presentation of mean specific impulse versus signal width.

7.3.4.1.4.1.4. Failure Analysis.

7.3.4.1.5 Perform weight determination per Paragraph 6.6. B

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
J. A. Gangor	9/29/64	[signature]	9-30-64		
CHECKED BY:	DATE				
R W Dennis	Rc				

FORM 608-B-44 NEW 6-63

REVISION B J. D. [signature] Dated 9/30/64

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R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DUTY CYCLE TO 136 SECONDS TEST NO 208130-401 SHEET 192 OF 267

7.3.4.2 Test Data - TCA #3A

7.3.4.2.1 Component Identification

Component Name T.C.A. SE-6

McDonnell Part No. 52-52700-217

Rocketdyne Part No. 208130-61

Component Serial No. 4060450

Accumulated Acceptance Test Firing Time, seconds 30 sec

	Pre-Test	Post-Test
Throat Diameter, inches (Average of four measurements)	3635	3636
Nozzle Exit Diameter, inches	1.635	1.638

7.3.4.2.2 Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	9-30-64	9-30-64
Sample Batch Number	9-456	9-457
Sample Temperature, F	69°	82°
Sample Specific Gravity	1.460	.870
Met Mil Spec. Requirements (Yes or No)	Yes	Yes

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED BY NAA DATE	CERTIFIED FOR McDONNELL DATE
T.G. Kniffin 7-10-64 1-31-64	K. I. Allen 10-5-64	Mel Moore 10/5/64	Walter Ref Dept #1 10/4/64
			VERIFIED BY USAF: DATE 10-27-64

FORM 608-B-43 NEW 6-63

REVISION B J.D. [illegible] Dated 9/25/64

R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DUTY CYCLE TO 136 SECONDS TEST NO. 208130-401 SHEET 193 OF 267

7.3.4.2.3. Cape Cycle test (Reference paragraph 7.3.4.1)

Test Cell Location C.T.L. III SS 10/5/64

Test Cell Number 39 J

Test Number 091

Test Date 10/5/64 10/5/64

	Pulse Duration (sec) (1.000 ±.020 sec)	Time Between Pulses, (minutes)
1st Pulse	.985	10 (10)
2nd Pulse	.984	60 (60)
3rd Pulse	.989	10 (10)
4th Pulse	.988	60 (60)
5th Pulse	.989	10 (10)
6th Pulse	.989	
Accumulated Firing Time, seconds	5.92	

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T.G. Kniffin 7-10-64			VERIFIED BY USAF: DATE

FORM 608-B-43 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST DUTY CYCLE TO 136 SECONDS TEST NO. 208130-401 SHEET 194 OF 267

7.3.4.2.4 Duty Cycle test (Reference paragraph 7.3.4.1) B

Test Cell Location C.T.L III SS

Test Cell Number 39 J

Test Number 092

Test Date 10/5/64

NOTE: All data corrected to Standard Vacuum conditions.

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
J. A. Ganger 9/29/64	R. I. Allen 10-5-64	Mel Moore 10/5/64	Waived Ref Dep#1 10/5/64
			VERIFIED BY USAF: DATE 10/5/64

FORM 608-B-43 NEW 6-63

REVISION B J.D. Tarrogenis Dated 9/30/64

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R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 136 Seconds TEST NO. 208130-401 SHEET ___ OF ___

PRE-RETRO Phase (Effective firing time of .030 sec; time between pulses, 22 seconds)

Pulse Number, Pre-Retro Phase	2	4	14
Signal Width, msec	22.0	26.5	26.6
Start Time, msec (25 max)	15.6	16.0	15.3
Shutdown Impulse, lb-sec (.260 max) **	*	*	*
Environmental Pressure, psia	.016	.016	.016
Environmental Temperature, °F (vac chamber)	78	78	78
Oxidizer Temperature, °F	79	79	79
Fuel Temperature, °F	80	80	80
Oxidizer Inlet Pressure, psia	280	280	280
Fuel Inlet Pressure, psia	294	294	294
Total Oxidizer Flow, lbs	.00130	.00147	.00150
Total Fuel Flow, lbs	.00093	.00107	.00108
Mean Mixture Ratio, o/f	1.398	1.374	1.389
Pulse Total Impulse, lb-sec	*	*	*
Mean Specific Impulse, sec	*	*	*
Oxidizer Valve Voltage, volts	27.8	27.8	27.8
Fuel Valve Voltage, volts	27.5	27.5	27.5
Oxidizer Valve Current, amps	.687	.687	.687
Fuel Valve Current, amps	.677	.677	.677
Electrical Power, watts	37.72	37.72	37.72

* Electrical interference in F Trace ** Ref: ECN NA-3E6-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
H. Robinson	8/25/65	[illegible]	8/25/65		
CHECKED BY: [illegible]	8/25/65				

FORM 608-B-44 NEW 6-63

R-15019-2

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 136 Seconds TEST NO. 208130-401 SHEET ___ OF ___

RETRO Phase (Effective firing time of .070 seconds; time between pulses, .048 seconds)

Pulse Number, Retro Phase	1	90	185
Signal Width, msec	68.2	67.1	67.6
Start Time, msec (25 max)	16.3	13.9	13.0
Shutdown Impulse, lb-sec (.260 max) **	*	*	*
Environmental Pressure, psia	.016	.016	.016
Environmental Temperature, °F (Vac chamber)	78	82	83
Oxidizer Temperature, °F	79	79	79
Fuel Temperature, °F	80	80	80
Oxidizer Inlet Pressure, psia	280	280	280
Fuel Inlet Pressure, psia	294	294	294
Total Oxidizer Flow, lbs	.00350	.00330	.00329
Total Fuel Flow, lbs	.00255	.00247	.00252
Mean Mixture Ratio, o/f	1.373	1.336	1.306
Pulse Total Impulse, lb-sec	*	*	*
Mean Specific Impulse, sec	*	*	*
Oxidizer Valve Voltage, volts	27.8	27.8	27.8
Fuel Valve Voltage, volts	27.5	27.5	27.5
Oxidizer Valve Current, amps	.687	.663	.651
Fuel Valve Current, amps	.677	.660	.643
Electrical Power, watts	37.72	36.58	35.78

* Electrical interference in F Trace ** Ref: FCN NA-56-289R1

PREPARED BY: DATE	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
E.L. Robinson 8/25/65	8/25/65	
CHECKED BY: DATE		
8/25/65		

FORM 608-8-44 NEW 6-63

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A DIVISION OF NORTH AMERICAN AVIATION INC

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 136 Seconds TEST NO. 208130-401 SHEET ___ OF ___

POST-RETRO Phase (Effective firing time of .030 seconds; time between pulses, 22 seconds)

Pulse Number, Post Retro Phase	1	21	68
Signal Width, msec	28.7	29.5	29.5
Start Time, msec (25 max)	12.5	17.5	17.3
Shutdown Impulse, lb-sec (.260 max) **	*	*	*
Environmental Pressure, psia	.016	.016	.016
Environmental Temperature, °F	82	80	80
Oxidizer Temperature, °F	79	79	79
Fuel Temperature, °F	80	80	80
Oxidizer Inlet Pressure, psia	280	280	280
Fuel Inlet Pressure, psia	294	294	294
Total Oxidizer Flow, lbs	.00149	.00161	.00161
Total Fuel Flow, lbs	.00113	.00120	.00121
Mean Mixture Ratio, o/f	1.319	1.342	1.331
Pulse Total Impulse, lb-sec	*	*	*
Mean Specific Impulse, sec	*	*	*
Oxidizer Valve Voltage, volts	27.8	27.8	27.8
Fuel Valve Voltage, volts	27.5	27.5	27.5
Oxidizer Valve Current, amps	.651	.663	.639
Fuel Valve Current, amps	.643	.660	.627
Electrical Power, watts	35.78	36.58	35.01

* Electrical interference in F Trace ** Ref ECN NA-SEL6-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
N. Robinson	8/25/65	[illegible]	8/24/65		
CHECKED BY: [illegible]	DATE 8/25/65				

FORM 608-B-44 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER PART NO. MAC 52-52709-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 136 Seconds TEST NO. 208130-401 SHEET ___ OF ___

RE-ENTRY Subcycle Phase No. 1, Pulse No. 1
(1 second on-time followed by .4 seconds off-time)

	Site Data	Standard Vacuum
Firing Duration, sec	1.0	
Time of Data Slice, sec	.8	
Environmental Pressure, psia	.014	0
Environmental Temperature, °F (VAC chamber)	80	
Oxidizer Temperature, °F	78	70
Fuel Temperature, °F	79	70
Oxidizer Inlet Pressure, psia	284.3	287
Fuel Inlet Pressure, psia	296.4	291
Oxidizer Flowrate, lbs/sec	.04813	*
Fuel Flowrate, lbs/sec	.03614	*
Mixture Ratio, o/f (1.30 ± 3%)	1.33	*
Thrust, lbs (23.5 ± 5%)	*	*
Specific Impulse, sec (266 min)	*	*
Start Time, msec (25 max)	18.5	
Shutdown Impulse, lb-sec (.260 max) **	*	
Oxidizer Valve Voltage, volts	27.5	
Fuel Valve Voltage, volts	27.8	
Oxidizer Valve Current, amps	.632	
Fuel Valve Current, amps	.628	
Electrical Power, watts	34.9	

*Electrical interference in Trace
**Ref: ECN NA-SE6-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
W. Robinson	8/25/65	[illegible]	8/25/65		
CHECKED BY: [illegible]	DATE 8/25/65				

FORM 600-B-44 NEW 6-63

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R-15019-2

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 136 Seconds TEST NO. 208130-401 SHEET ___ OF ___

RE-ENTRY Sub-Cycle Phase No. 1
(one pulse with effective firing time of 1 second;
17 pulses with effective firing time of .020 seconds;
time between pulses, .4 seconds)

Pulse Number, Re-Entry Sub-Cycle Phase		4	17
Signal Width, msec		18.1	17.5
Start Time, msec (25 max)		9.5	9.5
Shutdown Impulse, lb-sec (.260 max) **		*	*
Environmental Pressure, psia		.016	.016
Environmental Temperature, °F (VHC chamber)		80	80
Oxidizer Temperature, °F		79	79
Fuel Temperature, °F		80	80
Oxidizer Inlet Pressure, psia		280	280
Fuel Inlet Pressure, psia		294	294
Total Oxidizer Flow, lbs		.00105	.00102
Total Fuel Flow, lbs		.00076	.00073
Mean Mixture Ratio, o/f		1.382	1.397
Pulse Total Impulse, lb-sec		*	*
Mean Specific Impulse, sec		*	*
Oxidizer Valve Voltage, volts		27.8	27.8
Fuel Valve Voltage, volts		27.5	27.5
Oxidizer Valve Current, amps		.639	.639
Fuel Valve Current, amps		.627	.627
Electrical Power, watts		35.01	35.01

* Electrical interference in F Trace ** Ref: FCN NA-SRB-289R1

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
W. Robinson	8/25/65	[illegible]	8/25/65		
CHECKED BY:	DATE				
[illegible]	8/25/65				

FORM 608-B-44 NEW 6-63

R-15019-2

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER PART NO. MAC 52-52709-217 / NAA 208130-A1

NAME OF TEST DAT DUTY CYCLE TO 136 Seconds TEST NO. 208130-101 SHEET ___ OF ___

RE-ENTRY Subcycle Phase No. 26, Pulse No. 1
(1 second on-time followed by .4 seconds off-time)

	Site Data	Standard Vacuum
Firing Duration, sec	1.0	
Time of Data Slice, sec	.8	
Environmental Pressure, psia	.015	0
Environmental Temperature, °F (vac chamber)	84	
Oxidizer Temperature, °F	80	70
Fuel Temperature, °F	79	70
Oxidizer Inlet Pressure, psia	285.3	287
Fuel Inlet Pressure, psia	296.4	291
Oxidizer Flowrate, lbs/sec	.04878	*
Fuel Flowrate, lbs/sec	.03614	*
Mixture Ratio, o/f (1.30 ± 3%)	1.35	*
Thrust, lbs (23.5 ± 5%)	*	*
Specific Impulse, sec (266 min)	*	*
Start Time, msec (25 max)	14	
Shutdown Impulse, lb-sec (.260 max) **	*	
Oxidizer Valve Voltage, volts	27.5	
Fuel Valve Voltage, volts	27.9	
Oxidizer Valve Current, amps	.652	
Fuel Valve Current, amps	.640	
Electrical Power, watts	35.8	

*Electrical interference in F Trace
**Ref: ECN NA-SEB-28971

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
W. Robinson	8/25/65	[illegible]	8/25/65		
CHECKED BY: [illegible]	DATE 8/25/65				

FORM 606-B-44 NEW 6-63

R-15019-2

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A DIVISION OF NORTH AMERICAN AVIATION INC

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 136 Seconds TEST NO. 208130-401 SHEET ___ OF ___

RE-ENTRY Sub-Cycle Phase No. 26
(Repeat of Re-Entry Sub-Cycle Phase No. 1)

Pulse Number, Re-Entry Sub-Cycle Phase		2	18
Signal Width, msec		16.2	16.2
Start Time, msec (25 max)		9.7	9.3
Shutdown Impulse, lb-sec (.260 max) **		*	*
Environmental Pressure, psia		.016	.016
Environmental Temperature, °F (VAC chamber)		84	84
Oxidizer Temperature, °F		79	79
Fuel Temperature, °F		80	80
Oxidizer Inlet Pressure, psia		280	280
Fuel Inlet Pressure, psia		294	294
Total Oxidizer Flow, lbs		.00100	.00096
Total Fuel Flow, lbs		.00074	.00071
Mean Mixture Ratio, o/f		1.351	1.352
Pulse Total Impulse, lb-sec		*	*
Mean Specific Impulse, sec		*	*
Oxidizer Valve Voltage, volts		27.8	27.8
Fuel Valve Voltage, volts		27.5	27.5
Oxidizer Valve Current, amps		.651	.651
Fuel Valve Current, amps		.643	.643
Electrical Power, watts		35.78	35.78

* Electrical interference in F Trace ** Ref: FCN NA-SEL-289RR

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
[illegible]	8/25/65	[illegible]	8/25/65		
CHECKED BY: [illegible]	DATE 8/25/65				

FORM 608-8-44 NEW 6-63

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ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER PART NO. { MAC 52-52700-217 / NAA 208130-61 }

NAME OF TEST DAT DUTY CYCLE TO 136 Seconds TEST NO. 208130-1.02 SHEET ___ OF ___

RE-ENTRY Subcycle Phase No. 52, Pulse No. 1
(1 second on-time followed by .4 seconds off-time)

	Site Data	Standard Facility
Firing Duration, sec	1.0	
Time of Data Slice, sec	.8	
Environmental Pressure, psia	.015	0
Environmental Temperature, °F (vac chamber	85	
Oxidizer Temperature, °F	81	70
Fuel Temperature, °F	80	70
Oxidizer Inlet Pressure, psia	284.3	287
Fuel Inlet Pressure, psia	296.4	291
Oxidizer Flowrate, lbs/sec	.04836	*
Fuel Flowrate, lbs/sec	.03625	*
Mixture Ratio, o/f (1.30 ± 3%)	1.33	*
Thrust, lbs (23.5 ± 5%)	*	*
Specific Impulse, sec (266 min)	*	*
Start Time, msec (25 max)	14.5	
Shutdown Impulse, lb-sec (.260 max) **	*	
Oxidizer Valve Voltage, volts	27.5	
Fuel Valve Voltage, volts	27.8	
Oxidizer Valve Current, amps	.643	
Fuel Valve Current, amps	.640	
Electrical Power, watts	35.5	

*Electrical interference in F Trace
**Ref: ECN NA-SE6-28981

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
W. Robinson	8/25/65	[illegible]	8/24/65		
CHECKED BY:	DATE				
[illegible]	4/29/64				

FORM 608-B-44 NEW 6-63

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~~CONFIDENTIAL~~ E-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 136 Seconds TEST NO. 208130-101 SHEET ___ OF ___

RE-ENTRY Sub-Cycle Phase No. 52
(Repeat of Re-Entry Sub-Cycle Phase No. 1)

Pulse Number, Re-Entry Sub-Cycle Phase		3	18
Signal Width, msec		17.8	15.7
Start Time, msec (25 max)		9.7	9.4
Shutdown Impulse, lb-sec (.260 max) **		*	*
Environmental Pressure, psia		.016	.016
Environmental Temperature, °F (vac chamber)		85	85
Oxidizer Temperature, °F		79	79
Fuel Temperature, °F		80	80
Oxidizer Inlet Pressure, psia		280	280
Fuel Inlet Pressure, psia		294	294
Total Oxidizer Flow, lbs		.00106	.00099
Total Fuel Flow, lbs		.00078	.00067
Mean Mixture Ratio, o/f		1.359	1.478
Pulse Total Impulse, lb-sec		*	*
Mean Specific Impulse, sec		*	*
Oxidizer Valve Voltage, volts		27.8	27.8
Fuel Valve Voltage, volts		27.5	27.5
Oxidizer Valve Current, amps		.651	.651
Fuel Valve Current, amps		.643	.643
Electrical Power, watts		35.78	35.78

* Electrical interference in F Trace ** Ref: ECN NA-3E6-28978I

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Robinson	8/5/65	[illegible]	8/24/65		
CHECKED BY:	DATE				
[illegible]	8/24/65				

FORM 608-U-44 NEW 6-63

R-15019-2

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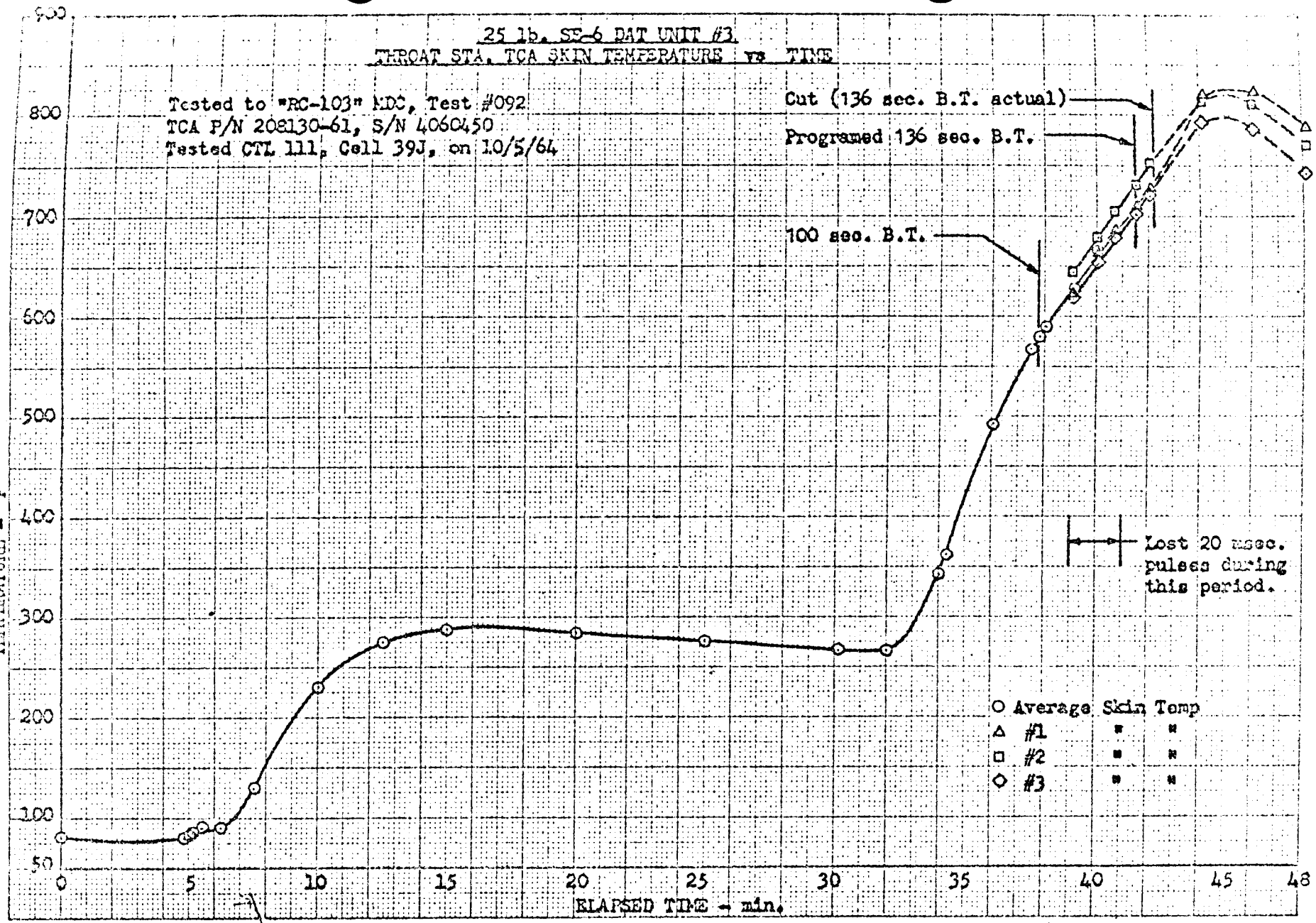
25 lb. SE-6 DAT UNIT #3
THROAT STA. TCA SKIN TEMPERATURE vs TIME
Tested to "RC-103" MDC, Test #092
TCA P/N 208130-61, S/N 4060450
Tested CTL 111, Cell 39J, on 10/5/64
Cut (136 sec. B.T. actual)
Programed 136 sec. B.T.
100 sec. B.T.
Lost 20 msec. pulses during this period.
Average Skin Temp
#1
#2
#3
TEMPERATURE - °F
ELAPSED TIME - min.
900
800
700
600
500
400
300
200
100
50
0
5
10
15
20
25
30
35
40
45
48

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 136 SECONDS TEST NO. 208130-401 SHEET 214 OF 267

7.3.4.2.5 Weight Determination test (reference paragraph 6.6) B

All protective closures were removed from the TCA.
YES (Yes or No) (ANR 921)

The TCA dry weight was 2.22 pounds.
(Record to the nearest one-hundredth pound)

Inspection Remarks NONE (ANR 921)

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
7-10-64 T. G. Kniffin	F. E. Pope 10-29-64	[signature] 10-29-64 (ANR 921)	WAIVED BY RL FREE 10-29-64 (ANR 921) VERIFIED BY USAF: DATE 10-29-64

FORM 608-B-43 NEW 6-63
REVISION B J. D. Narrogens Dated 9/30/64

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UNIT #3A

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4060450

Dwg. No. 208130-61

Model SE6

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
		Customer			
#1	10/6/64	PART NO. 208130-61 T/C/A Firing Procedures Para. 6.7 Thru 6.8.37, 7.3.4 Thru - 7.3.4.1.22 Waived By AFQC. Per Telecon Mr Hal Mize AFQC Super - 2nd Shift.			
ACTION TAKEN		Info. Only.			10-6-64
		PART NO.			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					

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R-15019-2

Form R 25-U Rev. 12-57

Unit #34

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4060450

Dwg. No. 208130-61

Model SE-6

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
		CTL #-III			
1	10/5/64 ANR 930	PART NO. General: HIF Test 091 & 092 Waived By Eng. J.D. Maurogenis via Telecon 10/5/64 2100.			
		ACTION TAKEN: information only	10/5/64 ANR 930	10/5/64 ANR 930	10/5/64 ANR 930
2	10/5/64 ANR 930	PART NO. General: HIF test 091 After second 1st Firing of Cape cycle, Recieved NTO Flow Zero shift. ARC21 checked & Remained Constant.			
		ACTION TAKEN: information only	ANR 930	ANR 930	ANR 930
3	10/5/64 ANR 930	PART NO. 208130-61 S/N 4060450 TCA Failed to Reach 100 sec. Accumulated Firing Time Prior to Reaching 550°. Ref Table II item #2			
		ACTION TAKEN: TRANSFERED TO SHORTAGE	10-6-64 ANR 930	ANR 930	ANR 930
4	10/5/64 ANR 930	PART NO. 208130-61 S/N 4060450 T.C.A. Failed to Reach 136 sec. Accumulated Firing Time Prior to Reaching 650°. Ref Table #II item 3			
		ACTION TAKEN: TRANSFERED TO SHORTAGE	10-6-64 ANR 930	ANR 930	
5	10/5/64 ANR 930	PART NO. 208130-61 S/N 4060450 T.C.A. Decontaminated up to Para 6.8.30			
		ACTION TAKEN: Decontamination complete thru 6.8.31	10/6/64 ANR 930	10/6/64 ANR 930	10/6/64 ANR 491

R-15019-2

Form R 25-U Rev. 12-57

UNIT #3A

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4060450

Dwg. No. 208130-61

Model S.E-6

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
6	10/6/64 (ANR 930)	PART NO. 208130-61 S/N 4060450 TCA COMPLETED PAR. 6.7 & 6.8 TCA FIRING & DECONTAMINATION			
ACTION TAKEN		INFORMATION ONLY NO ACTION REQUIRED	10-6-64	(ANR 930)	(ANR 930)
		PART NO. Insp. Complete at C.T.L. 3 (ANR 939) 10/6/64			
ACTION TAKEN					
7	10/29/64 (ANR 921)	PART NO. 208130-61 DAT DUTY CYCLE DATA WILL BE ENTERED AFTER REDUCTION. TESTING SHOULD CONTINUE. TRANSFERED TO SHORTAGE			
ACTION TAKEN		INFORMATION ONLY	10/29/64 (ANR 921)		(ANR 921)
8	(ANR 324) 11/17/64	PART NO. 208130-61 S/N 4060450 COMPLETED PARA 7.3.5.2.19 AT D596/146 CP, UNIT TRANSFERED TO OER CRLB V/N II ATTN: ED BRELLAND.			
ACTION TAKEN		INFO ONLY NO ACTION REQ.		(ANR 324) 11-17-64	(ANR 324)
		PART NO.			
ACTION TAKEN					

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R-15019-2

Form R 25-U Rev. 12-57

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

IL 4388-5155

INTERNAL LETTER
North American Aviation, Inc.

DATE 26 October 1964

TO MAC Engineering
Address

FROM Gemini DAT-RAT Unit
Address D/896-388

PHONE 6107

SUBJECT DAT 25 lb RCS TCA Unit #3A(P/N 208130-61, S/N 4060450)

REFERENCE (a) Operation and Failure Analysis Report No. 12918R, dated 15 October 1964

It is requested that remedial action on the above reference be deferred on the subject TCA to permit completion of the remaining test requirement of propellant valve service life test.

E. Adams
E. Adams
Gemini DAT-RAT Unit

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

R L Mantler
R. Mantler
Resident Engineer
McDonnell

493

R-15019-2

FORM R 18-D-4

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 215 OF 267

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.3.1.3.2.2

7.3.5 Propellant Valve Service Life - TCA #3A

7.3.5.1 Test Procedure

7.3.5.1.1 Perform Propellant Valve Proof Pressure and Leakage per paragraph 6.1.

7.3.5.1.2 Perform Propellant Valve Electrical Resistance per paragraph 6.3.

7.3.5.1.3 Perform Propellant Valve Dielectric Strength per paragraph 6.4.

7.3.5.1.4 Perform Propellant Valve Functional per paragraph 6.5.

7.3.5.1.5 Install the TCA in a test setup as shown in Figure 10. Close all test valves. The environmental temperature shall be room temperature.

7.3.5.1.6 Adjust the regulated GN_2 supply pressure so that 200 ±10 psig is indicated on G_1.

7.3.5.1.7 Open V_1. Adjust the DC power supply to 26 ±1 VDC.

7.3.5.1.8 Activate the cycler. The propellant valves shall each be cycled 3300 times. The 3300 cycles shall consist of 660 cycles at each of 1, 2, 3, 4 and 5 cycles per second.
NOTE: Prior to beginning propellant valve service life each propellant valve has already accumulated in excess of 1700 cycles.
Following the above 3300 cycles of operation and each successive five thousand cycles of operation thereafter the propellant valves shall be energized continuously and observation made of G_1 and G_2. The filter elements shall be replaced with clean elements if a difference of 90 psi or greater exists between G_1 and G_2. Energize time shall not exceed one minute.

B

B

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	1-31-64	R. Eide	1-31-64		
CHECKED BY:	DATE				
	1-31-64				

7-10-64

FORM 608-B-44 NEW 6-63

REVISION B _____ Dated _____

216

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 216 OF 267

7.3.5.1.9	Reduce the regulated GN_2 supply pressure to zero. Then close V_1. Reduce the DC power supply voltage to zero.
7.3.5.1.10	Remove the TCA from the test setup.
7.3.5.1.11	Repeat paragraph 7.3.5.1.1 and paragraph 7.3.5.1.4.
7.3.5.1.12	Reinstall the TCA in the test setup.
7.3.5.1.13	Fill the reservoir with water leaving a small amount of ullage for expansion due to temperature effects. Open V_1.
7.3.5.1.14	Adjust the reservoir temperature to 200 ±5F. Adjust the TCA environmental temperature to 250 ±5F.
7.3.5.1.15	Adjust the regulated GN_2 supply pressure so that 200 ±10 psig is indicated on G_1. Adjust the DC power supply to 26 ±1VDC.
7.3.5.1.16	Activate the cycler. The propellant valves shall each be cycled 5000 times. The 5000 cycles shall consist of 1000 cycles at each of 1, 2, 3, 4, and 5 cycles per second.
7.3.5.1.17	Repeat paragraphs 7.3.5.1.9 through 7.3.5.1.13.
7.3.5.1.18	Adjust the reservoir temperature and the TCA environmental temperature to 160 ±5F.
7.3.5.1.19	Adjust the regulated GN_2 supply pressure so that 200 ±10 psig is indicated on G_2. Adjust the DC power supply to 26 ±1 VDC.
7.3.5.1.20	Repeat paragraph 7.3.5.1.16 four times.
7.3.5.1.21	Repeat paragraphs 7.3.5.1.9 through 7.3.5.1.12.

B

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	1-31-64	R. Eidel by WK	1-31-64		
CHECKED BY:	DATE				
W H Marsden	1-31-64				

7-10-64

FORM 608-B-44 NEW 6-63

REVISION B _____ Dated _____

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217

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 217 OF 267

7.3.5.1.22	Remove the water from the reservoir and fill the reservoir with a fifty per cent solution of alcohol and water.
7.3.5.1.23	Adjust the regulated GN_2 supply pressure so that 200 ±10 psig is indicated at G_2. Open V_1.
7.3.5.1.24	Energize the propellant valves with 26 ±1 VDC. When the alcohol and water solution appears at the vent de-energize the propellant valves.
7.3.5.1.25	Adjust the reservoir temperature and the TCA environmental temperature to 15 ±5F.
7.3.5.1.26	Repeat paragraph 7.3.5.1.16 four times.
7.3.5.1.27	Repeat paragraphs 7.3.5.1.9 and 7.3.5.1.10.
7.3.5.1.28	Repeat paragraphs 7.3.5.1.1 through 7.3.5.1.4.

B

B

496

7-10-64

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	1-31-64	R. Eide	1-31-64		
CHECKED BY:	DATE				
	1-31-64				

FORM 608-B-44 NEW 6-63

REVISION B _____ Dated _____

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET ___ OF ___

IL 4388-5348

Deviation Request:

The Propellant Valve Electrical Resistance Test of paragraph 7.3.5.2.17 will be performed following the Low Temperature Functional Tests of paragraphs 7.3.5.2.16, 7.3.5.1.18 and 7.3.5.2.19. This out of sequence testing will permit earlier completion of Service Life Tests on the 25# RCS Valves.

Recopied from original request dated 9, November 1964.

James D. Mavrogenis
Jim Mavrogenis
MAC Engineering

E. Adams
E. Adams
Gemini DAT-RAT Unit

12-2-64

R-15019-2

FORM 608-B-42 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET ___ OF ___

Deviation Request: IL 4388-5349

Due to the extreme environmental temperatures encountered in the propellant valve service tests these deviations are hereby authorized. (Reference paragraph 7.3.5).

1. For paragraph 6.1 both propellant valves will be run simultaneously. If the leakage rate is over 2.23 scc He/min the valves will then be run separately.

2. For paragraph 6.5 the response times for both propellant valves will be run prior to the low voltage operations.

Recopied from original request dated 28, October 1964.

James D Mavrogenis
Jim Mavrogenis
MAC Engineering
12-2-64

R Cole
R. Cole
Gemini DAT-RAT Unit

498

R-15019-2

FORM 608-B-42 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. { MAC 52-52700-217 / NAA 208130-61 }

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET ___ OF ___

IL 4388-5350

Deviation Request:

Sealing Compound will be applied to SE6 TCA Unit #3A around Nozzle Exit Ablative and Shell Interface and Interior of Nozzle Segment to prevent leakage during Propellant Valve Service Life Test.

Recopied from original request dated 6, November 1964.

James D. Mavrogenis
Jim Mavrogenis
MAC Engineering

E. Adams
E. Adams
Gemini DAT-RAT Unit

12-2-64

R-15019-2

FORM 608-B-42 NEW 6-63

218

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 218 OF 267

7.3.5.2 Test Data - TCA #3A

7.3.5.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52700-217

Rocketdyne Part No. 208130-61

Component Serial No. 4060450 (ANR 921)

NOTE: All data corrected to Standard Vacuum conditions.

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 7-10-64 1-31-64	F. E. Pape 10-29-64	[signature] 10-29/64 (ANR 921)	[signature] R L [illegible] 10-29-64 (ANR 921)
			VERIFIED BY USAF: DATE 29 OCT. 64

FORM 608-B-43 NEW 6-63

REVISION B. _____ Dated _____

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

219

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 219 OF 267

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

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 ±10)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
Leakage Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (500 ±10)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate (2.23 maximum)	ZERO scc He/min	ZERO scc He/min

A

Inspection Remarks

NONE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 7-10-64 6-22-64 4/30/64 1-31-64	F. E. Bope 10-29-64	[signature] 10-29-64	WAIVED R.L. FREE 10-29-64
			VERIFIED BY USAF: DATE 29 OCT 64

FORM 608-B-43 NEW 6-63

REVISION A [signature] Dated 6/22/64

REVISION B _____ Dated _____

501

R-15029-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 220 OF 267

7.3.5.2.3 Propellant Valve Electrical Resistance test (reference paragraph 6.3)

Environmental Temperature 70 (70 ±10F).

Resistance A - B

Oxidizer Valve 40.21 ohms (acceptable per Figure 15, yes or no YES).

Fuel Valve 41.21 ohms (Acceptable per Figure 15, yes or no YES).

Resistance C - D (1.0 maximum)

Oxidizer Valve .29 ohms

Fuel Valve .21 ohms

Inspection Remarks

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G.Kniffin	7-10-64	F. E. Pope	10-29-64	C. T. Sank	10-29-64	R L FREE	
						VERIFIED BY USAF	DATE
							29 OCT 64

FORM 608-B-39 NEW 6-63

REVISION B _____ Dated _____

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 221 OF 267

7.3.5.2.4 Propellant Valve Dielectric Strength test (reference paragraph 6.4) B

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 +10 -0	Current Microamps 500 max.	Voltage Volts 500 +10 -0	Current Microamps 500 max.
A to Ground	500	75	500	71
C to Ground	500	54	500	54
A to C	500	[illegible]	500	13

Inspection Remarks

NONE

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 7-10-64 1-31-64	F. I. Pope 10-29-64	C T Rand 10-29-64	10/29/64
			VERIFIED BY USAF: DATE 29 OCT 64

FORM 608-B-43 NEW 6-63

REVISION B ——— Dated ———

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F. Pope	595399	ENV.LAB	2061	10-29-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #3A)	208130-61 S/N 4060450	PRE-PROPELLANT VALVE SERVICE LIFE FUNCTIONAL

OXIDIZER VALVE

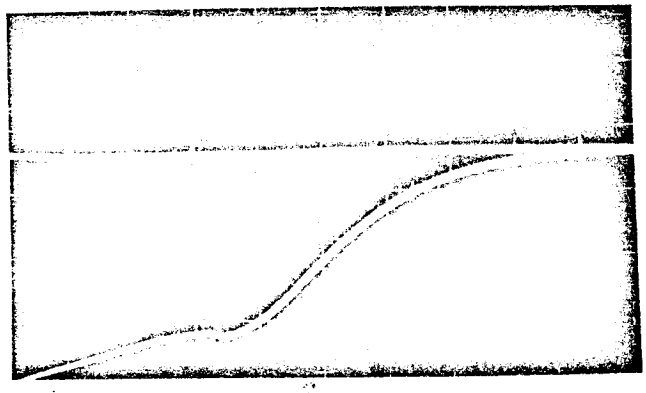
P/N 407557 S/N 9294000

ENVIRONMENTAL TEMPERATURE 70F

CURRENT TRACE
(Opening Time)

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

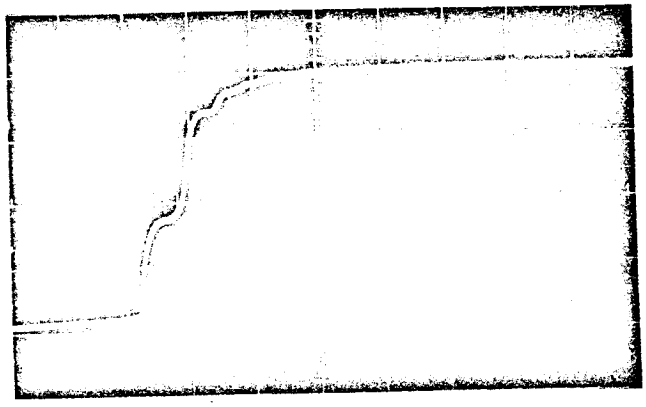
Requirement = .0065 sec/max
Actual = .0035 sec.



VOLTAGE TRACE
(Closing Time)

Horizontal = 1ms/cm
Vertical = 10v/cm

Requirement = .0035 sec/max
Actual = .0025 sec.



Form 600-W-67 New 10-63 R-15019-2

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	595399	ENV. LAB	2061	10-29-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit # 3A) S/N 4060450	208130-61	PRE PROPELLANT VALVE SERVICE LIFE FUNCTIONAL

FUEL VALVE

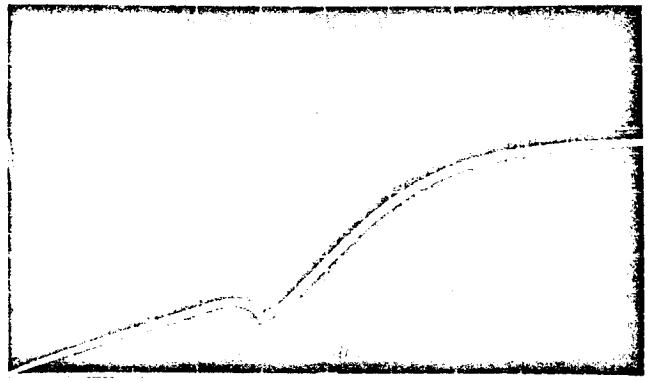
P/N 407558 S/N 8759958

ENVIRONMENTAL TEMPERATURE 70F

CURRENT TRACE
(Opening Time)

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

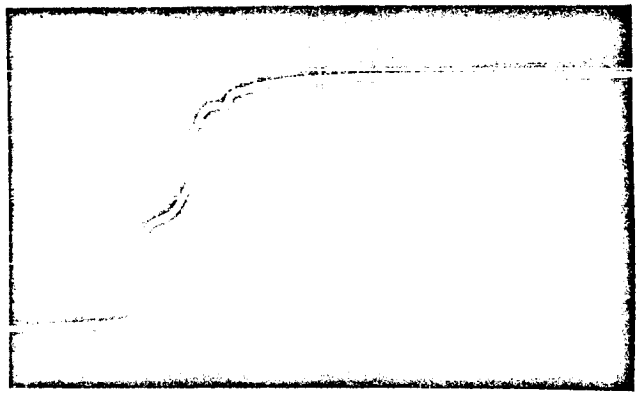
Requirement = .0065 sec.max.
Actual = .0040 sec.



VOLTAGE TRACE
(Closing Time)

Horizontal = 1ms/cm
Vertical = 10v/cm

Requirement = .0035 sec.max.
Actual = .0026 sec.



DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 222 OF 267

7.3.5.2.5 Propellant Valve Functional test (reference paragraph 6.5) B

	Oxidizer Valve	Fuel Valve
Response Time		
Ambient Temperature (70 ±10)	70 F (ANR 941)	70 F (ANR 921)
Energizing Voltage (26 ±0.5)	26 VDC (ANR 941)	26 VDC (ANR 921)
Inlet Pressure (300 ±10 for "pull-in")	300 psig (ANR 941)	300 psig (ANR 921)
Opening Time (0.0065 maximum)	.0035 seconds (ANR 941)	* .0040 ~~.0025~~ seconds (ANR 921)
Inlet Pressure (zero for "drop-out")	ZERO psig (ANR 941)	ZERO psig (ANR 921)
Closing Time (0.0035 maximum)	.0025 seconds (ANR 941)	.0026 seconds (ANR 921)
		* VOID (ANR 921) 10-29-64
Low Voltage Operation		
Ambient Temperature (70 ±10)	70° F (ANR 921)	70° F (ANR 921)
Inlet Pressure (300 ±10 for "pull-in")	300 psig (ANR 921)	300 psig (ANR 921)
Opening Voltage (16 maximum)	6.75 VDC (ANR 921)	7.5 VDC (ANR 921)
Inlet Pressure (zero for "drop-out")	ZERO psig (ANR 921)	ZERO psig (ANR 921)
Closing Voltage (1.0 minimum)	1.2 VDC (ANR 921)	1.15 VDC (ANR 921)

Inspection Remarks

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 1-22-64 4/30/64 1-31-64	F. E. Pope 10-29-64	[signature] 10-29-64 (ANR 921)	[signature] 10-29-64
			VERIFIED BY USAF: DATE 29 OCT 64

1-16-64

FORM 608-B-43 NEW 6-63
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R-15019-2

REVISION A [signature] Dated 6/22/64

REVISION B _____ Dated _____

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 223 OF 267

7.3.5.2.6 Propellant Valve Service Life test (reference paragraph 7.3.5.1) B

7.3.5.2.6.1 B

	Oxidizer Valve	Fuel Valve
Environmental Temp. (Room temp.)	70 F	70 F
GN_2 supply pressure (200 ±10)	200 psig	200 psig
Number of cycles (3300)	3300 cycles	3300 cycles
Total service life cycles (3300)	3300 cycles	3300 cycles

Inspection Remarks

~~None 11-6-64~~ *

Water Leaking excessively From Throat during All 3300 Cycles

11-6-64

* Ref Sgk #2 + #3

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 7-10-64 1-31-64	H.E. Wallace 11-6-64	J.F. Murchison 11-12-64	[signature] 11-12-64 [signature]
			VERIFIED BY USAF: [signature] 11/12/64

FORM 608-B-43 NEW 6-63

REVISION B _____ Dated _____

B-15019-2

* Entered in Error

507

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

224

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 224 OF 267

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

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 ±10)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
Leakage Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (500 ±10)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate (2.23 maximum)	ZERO scc He/min	ZERO scc He/min

Inspection Remarks

None 11-6-64

PREPARED BY:	DATE	PERFORMED BY:	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL:	DATE
T.G.Kniffin	6-22-64 4/30/64 1-31-64	H E Wallace	11-6-64	J F Murchison	11-6-64	Approved by J. Mavrogan	11-6-64
						VERIFIED BY USAF:	DATE
						[illegible]	11/6/64

FORM 608-B-43 NEW 6-63

REVISION A J.D. Mavrogan Dated 6/22/64

REVISION B _____ Dated _____

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R-15019-2

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F. Pope	595399	ENV.LAB	2061	11-6-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #3A) S/N 4060450	208130-61	PROPELLANT VALVE SERVICE LIFE FUNCTIONAL (3300 Cycles)

OXIDIZER VALVE

P/N 407557 S/N 9294000

ENVIRONMENTAL TEMPERATURE 70F

CURRENT TRACE

(Opening Time)

Horizontal = 1ms/cm

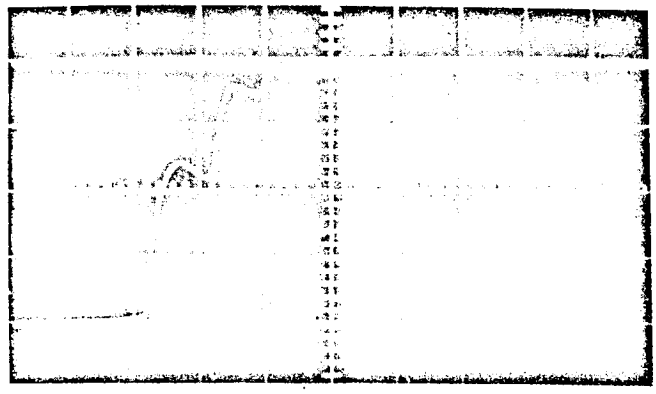
Vertical = 20mv/cm

Requirement = .0065 sec.max.

Actual = .0035 sec.

VOLTAGE TRACE

(Closing Time)



Horizontal = 1ms/cm

Vertical = 10v/cm

Requirement = .0035 sec.max.

Actual = .0031 sec.

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE ____ OF ____

LAB TEST NO. ____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	595399	ENV.LAB.	2061	11-6-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #3A) S/N 4060450	208130-61	PROPELLANT VALVE SERVICE LIFE FUNCTIONAL (3300 Cycles)

FUEL VALVE

P/N 407558 S/N 8759958

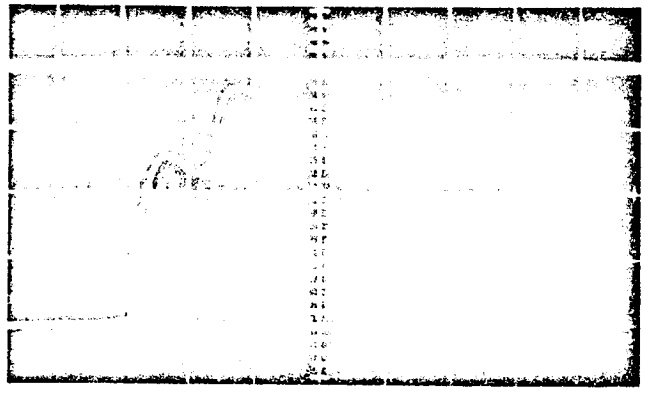
ENVIRONMENTAL TEMPERATURE 70F

CURRENT TRACE
(Opening Time)

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

Requirement = .0065 sec.max.
Actuation = .0043 sec.

VOLTAGE TRACE
(Closing Time)



Horizontal = 1ms/cm
Vertical = 10v/cm

Requirement = .0035 sec.max.
Actuation = .0032 sec

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 225 OF 267

7.3.5.2.8 Propellant Valve Functional test (reference paragraph 6.5) B

	Oxidizer Valve	Fuel Valve
Response Time		
Ambient Temperature (70 ±10)	70 F	70 F
Energizing Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Time (0.0065 maximum)	.0035 seconds	.0043 seconds
Inlet Pressure (zero for "drop-out")	Zero psig	Zero psig
Closing Time (0.0035 maximum)	.0031 seconds	.0032 seconds
Low Voltage Operation		
Ambient Temperature (70 ±10)	70 F	70 F
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Voltage (16 maximum)	6.3 VDC	7.7 VDC
Inlet Pressure (zero for "drop-out")	Zero psig	Zero psig
Closing Voltage (1.0 minimum)	1.4 VDC	1.4 VDC

A

Inspection Remarks

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 7-10-64 6-22-64 4/30/64 1-31-64	J.E. Wallace 11-6-64	J.F. Murchison 11-6-64	Waived By J. Marrogonis 11-6-64
			VERIFIED BY USAF: DATE

FORM 608-B-43 NEW 6-63

REVISION A J.D. Marrogonis Dated 6/22/64

REVISION B _____ Dated _____

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ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 226 OF 267

7.3.5.2.9 Propellant Valve Service Life test (reference paragraph 7.3.5.1) B

7.3.5.2.9.1 B

	Oxidizer Valve	Fuel Valve
Environmental temp. (250 ±5)	250 F	250 F
Water Temp. (200 ±5)	200 F	200 F
GN_2 supply pressure (200 ±10)	200 psig	200 psig
Number of cycles (5000)	5000 cycles	5000 cycles
Total service life cycles (8300)	8300 cycles	8300 cycles

Inspection Remarks

None 11-7-64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 1-31-64	M.E. Frey 11-7-64	11-7-64	Waived By J. Marrocquin 11/7/64
			VERIFIED BY USAF: DATE 11/7/64

7-10-64

FORM 608-B-43 NEW 6-63

REVISION B _____ Dated _____

512

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 227 OF 267

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

	Oxidizer Valve	Fuel Valve	
Proof Pressure Env. Temp (250 ±5)	250 F	250 F	B
Pressure (500 ±10)	500 psig	500 psig	
Time Duration (3 minimum)	3 minutes	3 minutes	
Leakage Voltage (26 ±0.5)	26 VDC	26 VDC	A
Inlet Pressure (500 ±10)	500 psig	500 psig	
Time Duration (5 minimum)	5 minutes	5 minutes	
Leakage Rate (2.23 maximum)	ZERO scc He/min	ZERO scc He/min	

Inspection Remarks

None 11-7-64

PREPARED BY:	DATE	PERFORMED BY:	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL:	DATE
T.G.Kniffin	6-22-64 4/30/64 1-31-64	M.E. Frey	11/7/64	J.F. Murchison	11-7-64	Warned By J. Mavrogani 11-7-64	
						VERIFIED BY USAF:	DATE

7-10-64

FORM 608-B-43 NEW 6-63

REVISION A T.D. Mavrogani Dated 6/22/64

REVISION B Dated

R-15019-2

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE ____ OF ____

LAB TEST NO. ____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	595399	ENV. LAB.	2061	11-7-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #3 A) S/N 4060450	208130-61	PROPELLANT VALVE SERVICE LIFE FUNCTIONAL (8300 Cycles)

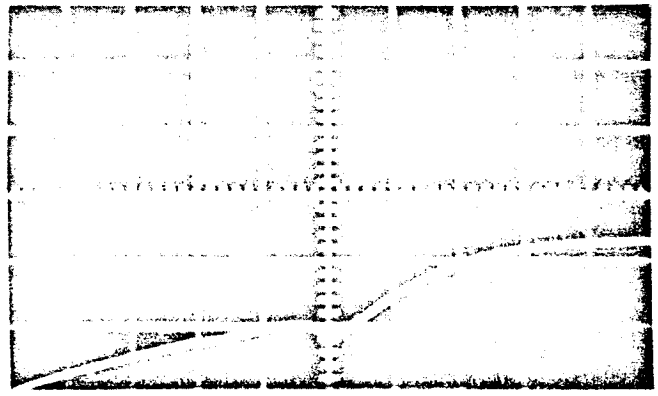
OXIDIZER VALVE

P/N 407557 S/N 9294000

ENVIRONMENTAL TEMPERATURE 250F

CURRENT TRACE

(Opening Time)



Horizontal = 1ms/cm

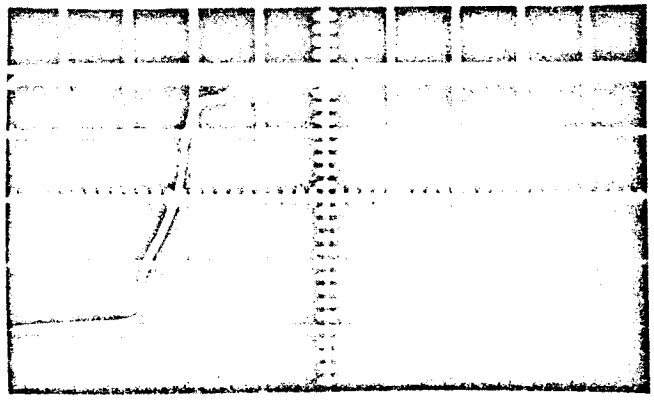
Vertical = 20mv/cm

Requirement = .0065 sec.max.

Actual = .0049 sec.

VOLTAGE TRACE

(Closing Time)



Horizontal = 1ms/cm

Vertical = 10v/cm

Requirement = .0035 sec.max.

Actual = .0026 sec.

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	595399	ENV.LAB.	2061	11-7-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #3A)	2081-30-61 S/N 4060450	PROPELLANT VALVE SERVICE LIFE FUNCTIONAL (8300 Cycles)

FUEL VALVE

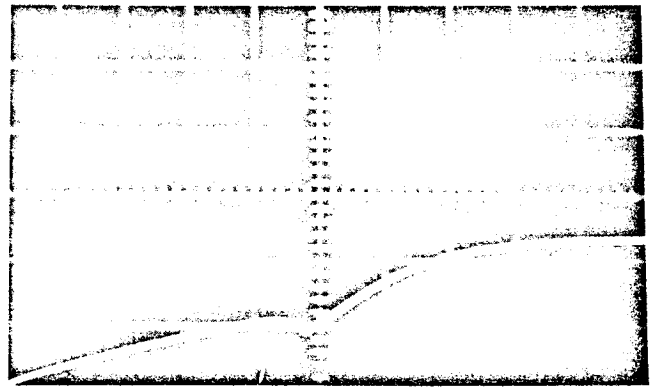
P/N 407558 S/N 8759958

ENVIRONMENTAL TEMPERATURE 250F

CURRENT TRACE
(Opening Time)

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

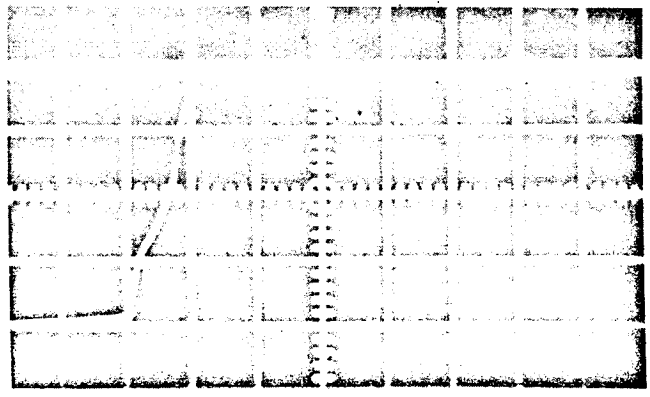
Requirement = .0065 Sec.max.
Actual = .0048 sec.



VOLTAGE TRACE
(Closing Time)

Horizontal = 1ms/cm
Vertical = 10v/cm

Requirement = .0035 sec.max.
Actual = .0025 sec.



DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY — PART NO. { MAC 52-52700-217 / NAA 208130-61 }

NAME OF TEST: PROPELLANT VALVE SERVICE LIFE — TEST NO. 208130-401 SHEET 228 OF 267

7.3.5.2.11 Propellant Valve Functional test (reference paragraph 6.5) B

	Oxidizer Valve	Fuel Valve	
Response Time			
Env. Temperature (250 ±5F)	250° F	250° F	B
Energizing Voltage (26 ±0.5)	26 VDC	26 VDC	
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig	A
Opening Time (0.0065 maximum)	.0049 seconds	.0048 seconds	
Inlet Pressure (zero for "drop-out")	Zero psig	Zero psig	
Closing Time (0.0035 maximum)	.0026 seconds	.0025 seconds	A
Low Voltage Operation			
Ambient Temperature (70 ±10)	70° F	70 F	
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig	A
Opening Voltage (16 maximum)	7.7 VDC	7.7 VDC	
Inlet Pressure (zero for "drop-out")	Zero psig	Zero psig	
Closing Voltage (1.0 minimum)	1.3 VDC	1.2 VDC	

Inspection Remarks

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 6-22-64 4/30/64 1-31-64	M. E. Frey 11/7/64	J. F. Marchiano 11-7-64	Waived J. Mavrogenis 11-7-64
			VERIFIED BY USAF: DATE 11/17/64

1-10-64

FORM 608-B-43 NEW 6-63

REVISION A J. D. Mavrogenis Dated 6/22/64
REVISION B. Dated

227

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 203130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 203130-401 SHEET 229 OF 267

7.3.5.2.12 Propellant Valve Service Life test (reference paragraph 7.3.5.1) B

7.3.5.2.12.1 B

	Oxidizer Valve	Fuel Valve
Environmental Temp. (160 ±5)	160 F	160 F
Water temp. (160 ±5)	160 F	160 F
GN_2 supply pressure (200 ±10)	200 psig	200 psig
Number of cycles (5000)	5000 cycles	5000 cycles
Total service life cycles (13,300)	13,300 cycles	13,300 cycles

Inspection Remarks ΔP ON FILTER 10 PSIG.

None 11-9-64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 1-31-64	11-9-64	11-9-64	11-9-64
			VERIFIED BY USAF: DATE

7-10-64

FORM 608-B-43 NEW 6-63

REVISION B _____ Dated _____

R-15019-2

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 230 OF 267

7.3.5.2.12.2

	Oxidizer Valve	Fuel Valve
Environmental temp. (160 ±5)	160 F	160 F
Water temp. (160 ±5)	160 F	160 F
GN_2 supply pressure (200 ±10)	200 psig	200 psig
Number of cycles (5000)	5000 cycles	5000 cycles
Total service life cycles (18,300)	18,300 cycles	18,300 cycles

Inspection Remarks ΔP on Filter 10 psig

None 11-9-64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 7-10-64 1-31-64	H E Wallace 11-9-64	J. F. Murdison 11-9-64	Waived by J. Marrogenis 11-9-64
			VERIFIED BY USAF: DATE H E Moore 11-9-64

FORM 608-B-43 NEW 6-63

REVISION B _____ Dated _____

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 231 OF 267

7.3.5.2.12.3

	Oxidizer Valve	Fuel Valve
Environmental temp. (160 ±5)	160 F	160 F
Water temp. (160 ±5)	160 F	160 F
GN_2 supply pressure (200 ±10)	200 psig	200 psig
Number of cycles (5000)	5000 cycles	5000 cycles
Total service life cycles (23,300)	23,300 cycles	23,300 cycles

Inspection Remarks ΔP on Filters 10 PSIG.

None 11-9-64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 7-10-64 1-31-64	11-9-64	11-9-64	Received By 11-9-64
			VERIFIED BY USAF: DATE 9 Nov 64

FORM 608-B-43 NEW 6-63

REVISION B _____ Dated _____

519

232

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 232 OF 267

7.3.5.2.12.4

B

	Oxidizer Valve	Fuel Valve
Environmental temp. (160 ±5)	160 F	160 F
Water temperature (160 ±5)	160 F	160 F
GN_2 supply pressure (200 ±10)	200 psig	200 psig
Number of cycles (5000)	5000 cycles	5000 cycles
Total service life cycles (28,300)	28,300 cycles	28,300 cycles

Inspection Remarks ΔP on Filters 10 PSIG

None 11-9-64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 7-10-64 1-31-64	11-9-64	11-9-64	Waived by 11-9-64
			VERIFIED BY USAF: DATE 9 Nov 64

FORM 608-B-43 NEW 6-63

REVISION B _____ Dated _____

233

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 233 OF 267

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

	Oxidizer Valve	Fuel Valve
Proof Pressure Env. Temp. (160 ±5F)	160 F	160 F
Pressure (500 ±10)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
Leakage Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (500 ±10)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate (2.23 maximum)	1.0 scc He/min	1.0 scc He/min

B

A

Inspection Remarks

None 11-9-64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T.G.Kniffin 6-22-64 4/30/64 1-31-64	11-9-64 V. Davis	J.F. Murchison 11-9-64	Waived by J. Marrogianis 11-9-64
			VERIFIED BY USAF: DATE 9 Nov 64

7-10-64

FORM 608-B-43 NEW 6-63

REVISION A J.D. Marrogianis Dated 6/22/64

REVISION B _____ Dated _____

R-15019-2

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	595399	ENV.LAB	2061	11-10-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #3A) S/N 4060450	208130-61	PROPELLANT VALVE SERVICE LIFE FUNCTIONAL (28,300 Cycles)

OXIDIZER VALVE

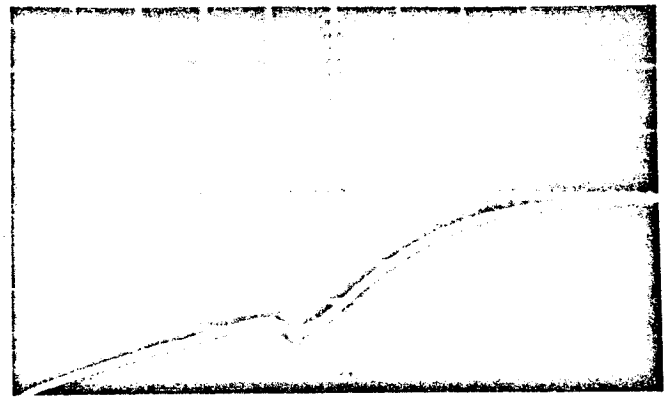
P/N 407557 S/N 9294000

ENVIRONMENTAL TEMPERATURE 160F

CURRENT TRACE
(Opening Time)

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

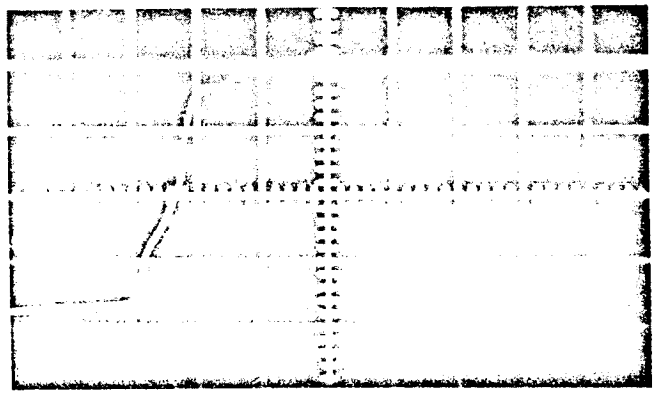
Requirement = .0065 sec/max
Actual = .0044 sec.



VOLTAGE TRACE
(Closing Time)

Horizontal = 1ms/cm
Vertical = 10v/cm

Requirement = .0035 Sec/max.
Actual = .0026 sec.



ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE ____ OF ____

LAB TEST NO. ____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	595399	ENV.LAB	2061	11-10-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #3)	208130-61 S/N 4060450	PROPELLANT VALVE SERVICE LIFE FUNCTIONAL (28,300 Cycles)

FUEL VALVE

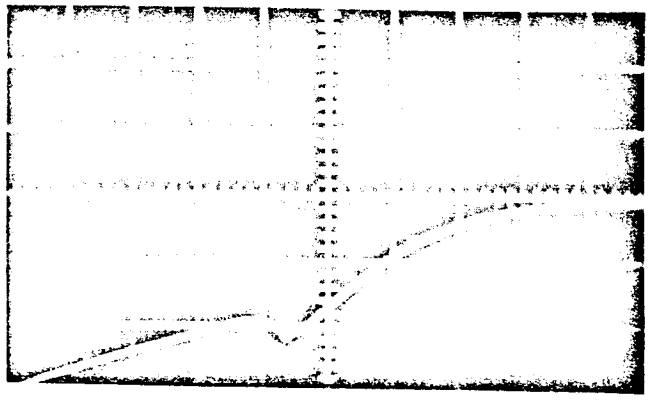
P/N 407558 S/N 8759958

ENVIRONMENTAL TEMPERATURE 160F

CURRENT TRACE
(Opening Time)

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

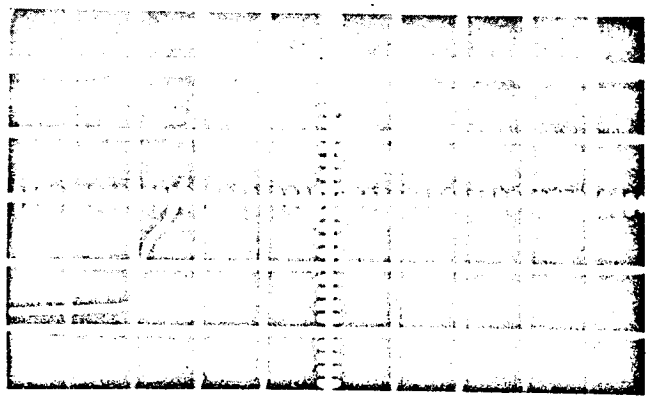
Requirement = .0065 sec/max
Actual = .0044 sec.



VOLTAGE TRACE
(Closing Time)

Horizontal = 1ms/cm
Vertical = 10v/cm

Requirement = .0035 sec/max
Actual = .0028 sec.



Form 600-V-67 New 10-63 R-15019-2

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 203130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 203130-401 SHEET 234 OF 267

7.3.5.2.14 Propellant Valve Functional test (reference paragraph 6.5) B

	Oxidizer Valve	Fuel Valve	
Response Time			
Env. Temperature (160 ±5F)	160 F	160 F	B
Energizing Voltage (26 ±0.5)	26 VDC	26 VDC	
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig	A
Opening Time (0.0065 maximum)	.0044 seconds	.0044 seconds	
Inlet Pressure (zero for "drop-out")	Zero psig	Zero psig	
Closing Time (0.0035 maximum)	.0026 seconds	.0028 seconds	
Low Voltage Operation			
Ambient Temperature (70 ±10)	70 F	70 F	
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig	A
Opening Voltage (16 maximum)	7.5 VDC	7.4 VDC	
Inlet Pressure (zero for "drop-out")	Zero psig	Zero psig	
Closing Voltage (1.0 minimum)	1.3 VDC	1.3 VDC	

Inspection Remarks

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 6-22-64 4/30/64 1-31-64	11-10-64 V. Dan	J.F. Murchison 11-10-64	Waived By 11-10-64 J. Mavrogenis
			VERIFIED BY USAF: DATE 9 NOV 64

1-10-64

FORM 608-B-43 NEW 6-63

REVISION A J.D. Mavrogenis Dated 6/22/64

REVISION B _____ Dated _____

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 235 OF 267

7.3.5.2.15 Propellant Valve Service Life test (reference paragraph 7.3.5.1) B

7.3.5.2.15.1

	Oxidizer Valve	Fuel Valve
Environmental temp. (15 ±5)	15 F	15 F
Alcohol and water temp. (15 ±5)	15 F	15 F
CN_2 supply pressure (200 ±10)	200 psig	200 psig
Number of cycles (5000)	5000 cycles	5000 cycles
Total service life cycles (33,300)	33300 cycles	33300 cycles

Inspection Remarks

ΔP of Filters 23 PSIG

PREPARED BY:	DATE	PERFORMED BY:	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL:	DATE
T.G. Kniffin	1-31-64	V Davis	11-10-64	J.J. Murchison	11-10-64	Waived By J. Mavrogonis	11-10-64
						VERIFIED BY USAF:	DATE
						[illegible] McNamee	11/10/64

7-10-64

FORM 608-B-43 NEW 6-63

REVISION B ——— Dated ———

525

R-15019-2

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 236 OF 267

7.3.5.2.15.2

B

	Oxidizer Valve	Fuel Valve
Environmental temp. (15 ±5)	15 F	15 F
Alcohol and water temp. (15 ±5)	15 F	15 F
GN_2 supply pressure (200 ±10)	200 psig	200 psig
Number of cycles (5000)	5000 cycles	5000 cycles
Total service life cycles (38,300)	38,300 cycles	38,300 cycles

Inspection Remarks

ΔP OF FILTERS 23 PSIG

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 7-10-64 1-31-64	11-10-64	11-10-64	Received By 11-10-64
			VERIFIED BY USAF: DATE 11/10/64

FORM 608-B-43 NEW 6-63

REVISION B _____ Dated _____

237

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 203130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 203130-401 SHEET 237 OF 267

7.3.5.2.15.3

	Oxidizer Valve	Fuel Valve
Environmental temp. (15 ±5)	15 F	15 F
Alcohol and water temp. (15 ±5)	15 F	15 F
GN_2 supply pressure (200 ±10)	200 psig	200 psig
Number of cycles (5000)	5000 cycles	5000 cycles
Total service life cycles (43,300)	43,300 cycles	43,300 cycles

Inspection Remarks

ΔP of Filters is 22 PSIG

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 7-10-64 1-31-64	11-10-64	11-10-64	11-10-64
			VERIFIED BY USAF: DATE 10 NOV 64

FORM 608-B-43 NEW 6-63

REVISION B _____ Dated _____

527

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 238 OF 267

7.3.5.2.15.4 B

	Oxidizer Valve	Fuel Valve
Environmental test (15 ±5)	15 F	15 F
Alcohol and water temp. (15 ±5)	15 F	15 F
GN_2 supply pressure (200 ±10)	200 psig	200 psig
Number of cycles (5000)	5000 cycles	5000 cycles
Total service life cycles (48,300)	48300 cycles	48300 cycles

Inspection Remarks

ΔP OF FILTERS IS 22 PSIG

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 7-10-64 1-31-64	11-10-64	11-10-64	Waived by 11-10-64 J. Marchegiani
			VERIFIED BY USAF: DATE 10 NOV 64

FORM 608-B-43 NEW 6-63

REVISION B ——— Dated ———

239

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-527000-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 239 OF 267

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

	Oxidizer Valve	Fuel Valve
Proof Pressure Env. Temp. (15 ±5)	15 F	15 F
Pressure (500 +10 -0)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
Leakage Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (500 +10 -0)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate (2.23 maximum)	< .1 scc He min	< .1 scc He min

B

A

Inspection Remarks

None 11-10-64

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G. Kniffin 1-22-64 4/3-4/64 1-21-64	11-10-64	11-10-64	11/10/64
			VERIFIED BY USAF: DATE 10 Nov 64

7-10-64

FORM 608-B-43 NEW 6-63

REVISION A J.D. Manogue Dated 6/22/64

REVISION B Dated

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 240 OF 267

7.3.5.2.17 Propellant Valve Electrical Resistance test (reference paragraph 6.3) B

Environmental Temperature 70 (70 ±10°F).

Resistance A - B

Oxidizer Valve 40.3 ohms (Acceptable per Figure 15, yes or no Yes

Fuel Valve 40.1 ohms (Acceptable per Figure 15, yes or no Yes

Resistance C - D (1.0 maximum)

Oxidizer Valve .26 ohms

Fuel Valve .46 ohms

Inspection Remarks

None 11-11-64

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T.G.Kniffin 7-10-64 1-31-64	H. E. Wallace 11-11-64	11-11-64	11-11-64
			VERIFIED BY USAF DATE 11/11/64

FORM 608-B-39 NEW 6-63

REVISION B _____ Dated _____

241

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 241 OF 267

7.3.5.2.18 Propellant Valve Dielectric Strength test (reference paragraph 6.4) B

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 +10 -0	Current Microamps 500 max.	Voltage Volts 500 +10 -0	Current Microamps 500 max.
A to Ground	500 (ANR 70)	100 (ANR 70)	500 (ANR 70)	78 (ANR 70)
C to Ground	500 (ANR 70)	80 (ANR 70)	500 (ANR 70)	62 (ANR 70)
A to C	500 (ANR 70)	47 (ANR 70)	500 (ANR 70)	20 (ANR 70)
Env. Temp 15 ±5F	(ANR 70) 15° F		(ANR 70) 15° F	

B

Inspection Remarks

None 11-10-64 (ANR 70)

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 8-3-64 7-10-64 1-31-64	H E Wallace 11-10-64	J. F. Murchison 11-10-64 (ANR 70)	Waived By J. Marrogani 11-10-64 (ANR 70)
			VERIFIED BY USAF: DATE 10 Nov 64

FORM 608-B-43 NEW 6-63

REVISION B _____ Dated _____

DEVELOPMENT LABORATORY TEST REPORT

PAGE ____ OF ____

LAB TEST NO. ____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	595399	ENV.LAB.	2061	11-11-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #3A)	208130-61 S/N 4060450	PROPELLANT VALVE SERVICE LIFE FUNCTIONAL (48,300 Cycles)

OXIDIZER VALVE

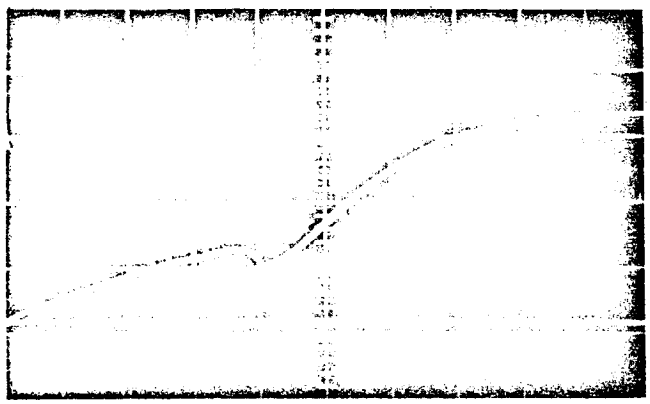
P/N 407557 S/N 9294000

ENVIRONMENTAL TEMPERATURE 15F

CURRENT TRACE
(Opening Time)

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

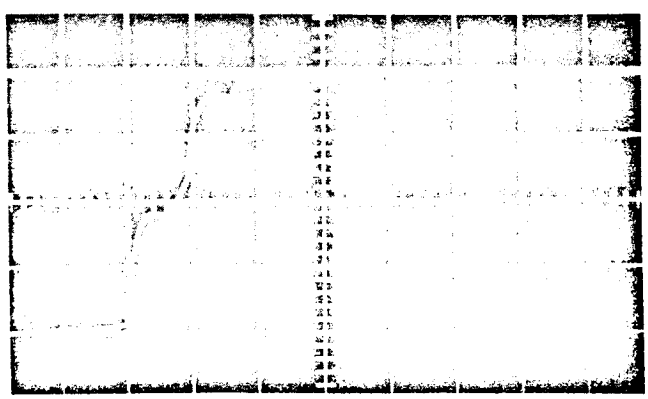
Requirement = .0065 sec.max.
Actual = .0041 sec.



VOLTAGE TRACE
(Closing Time)

Horizontal = 1ms/cm
Vertical = 10v/cm

Requirement = .0035 sec.max.
Actual = .0026 sec.



ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	595399	ENV.LAB.	2061	11-11-64

PART	PART NO.	TYPE OF TEST
25# RCS TCA (Unit #3 A) S/N 4060450	208130-61	PROPELLANT VALVE SERVICE LIFE FUNCTIONAL (48,300 Cycles)

FUEL VALVE

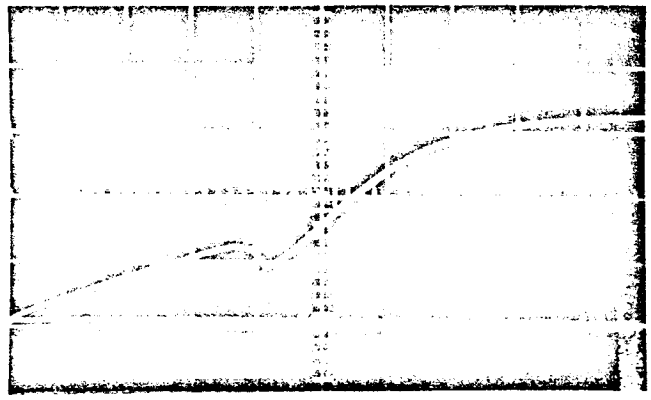
P/N 407558 S/N 8759958

ENVIRONMENTAL TEMPERATURE 15F

CURRENT TRACE
(Opening Time)

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

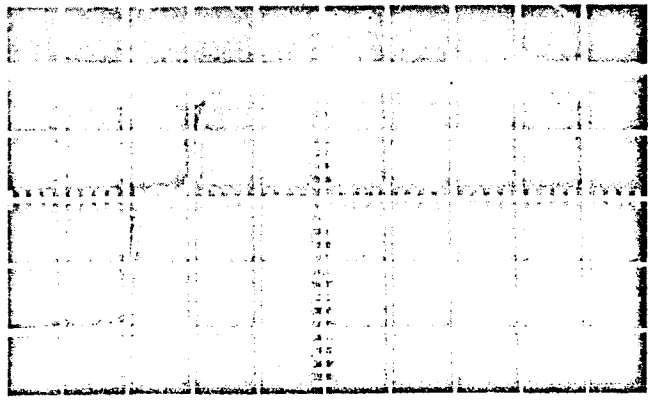
Requirement = .0065 sec.max.
Actual = .0041 sec.



VOLTAGE TRACE
(Closing Time)

Horizontal = 1ms/cm
Vertical = 10v/cm

Requirement = .0035 sec.max.
Actual = .0027 sec.



DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 242 OF 267

7.3.5.2.19 Propellant Valve Functional test (reference paragraph 6.5) B

	Oxidizer Valve	Fuel Valve	
Response Time			
Env. Temperature (15± 5F)	15 F	15 F	B
Energizing Voltage (26 ±0.5)	26 VDC	26 VDC	
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig	A
Opening Time (0.0065 maximum)	.0041 seconds	.0041 seconds	
Inlet Pressure (zero for "drop-out")	zero psig	zero psig	
Closing Time (0.0035 maximum)	~~.0034~~ 0026 seconds	~~.0034~~ 0027 seconds	A
Low Voltage Operation			
Ambient Temperature (70 ±10)	70 F	70 F	
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig	A
Opening Voltage (16 maximum)	7.6 VDC	7.5 VDC	
Inlet Pressure (zero for "drop-out")	zero psig	zero psig	
Closing Voltage (1.0 minimum)	1.3 VDC	1.2 VDC	

Inspection Remarks

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
T.G.Kniffin 6-22-64 4/30/64 1-31-64	H. E. Wallace 11-11-64	11-11-64	11-11-64
			VERIFIED BY USAF: DATE 11/11/64

FORM 608-B-43 NEW 6-63

REVISION A J. D. Montgomery Dated 6/22/64

REVISION B Dated

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208130-401 SHEET 243 OF 267

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.2.3.20

7.3.6 Disassembly and Inspection

7.3.6.1 Test Procedure

7.3.6.1.1 Prior to sectioning the TCA perform a visual inspection and record the post test condition of the TCA.

7.3.6.1.2 Cut the propellant valve mounting bracket and propellant valve feed tubes from the TCA injector face along line A, B as shown in Figure 7 . All cutting shall be done by saw. C

7.3.6.1.3 Separate the propellant valves from the mounting bracket. C

7.3.6.1.4 Section the TCA by cutting along line C-D-E as depicted in Figure 16.

7.3.6.1.5 Perform visual inspection ofall detailed parts for evidence of damage, distortion, fluid incompatability, corrosion, broken parts and impending failure.

7.3.6.1.6 After test completion identify the sectioned TCA and detailed parts and package and store for reference (except for propellant valves). C

7.3.6.1.7 Machine, on the oxidizer propellant valve, the seat assembly to spacer weld to loosen the seat. Only the minimum amount of material to accomplish this shall be removed. The seat assembly P/N 407664 shall not be removed at this time.

7.3.6.1.8 Machine the filter assembly to solenoid weld to loosen the filter. Only the minimum amount of material to accomplish this shall be removed. The filter assembly P/N NA5-28097-T1 shall not be removed at this time. C

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole	11-20-64				
CHECKED BY:	DATE				
E. Adam	11-20		11-20-64		

FORM 608-B-44 NEW 6-63

Rev. C J.D. Margerum Date 11-20-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208130-401 243.1 SHEET ___ OF 267

7.3.6.1.9 Remove, bag and identify the seat assembly.

7.3.6.1.10 Remove, bag and identify the armature P/N 407569.

7.3.6.1.11 Remove, bag and identify the spring P/N 406806.

7.3.6.1.12 Remove, bag and identify the filter assembly.

7.3.6.1.13 Bag and identify the solenoid assembly.

7.3.6.1.14 Repeat 7.3.6.1.7 thru 7.3.6.1.13 for the fuel propellant valve.

NOTE: Only authorized personnel shall have access to stored DAT hardware.

C

C

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
D. Cole DC	11-20-64				
CHECKED BY: E Adams	DATE 11-20		11-20-64		

FORM 608-B-44 NEW 6-63

Rev. C J.D. Montgomery Date 11-20-64

244

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208130-401 SHEET 244 OF 267

7.3.6.2 Post Test Inspection Data - TCA #3A B

7.3.6.2.1 Component Identification

Component Name TCA

McDonnell Part No. SCD 52-52700-217

Rocketdyne Part No. 208130-61

Component Serial No. 4060450

7.3.6.2.2 Preliminary Inspection (Reference Paragraph 7.3.6.1.1)

The TCA was visually inspected prior to sectioning and the TCA condition was as follows:

NO DETRIMENTAL DISCREPANCY NOTED.

7.3.6.2.3 Disassembly and Inspection (Reference Paragraph 7.3.6.1.3)

The TCA was sectioned along line C-D-E and visually inspected. The results of the inspection were as follows:

T.C.A. HAS A MINOR SEPERATION OF THE ABLATIVE AND ASBESTOS ALSO MINOR INNER LAMINAR DELAMINATIONS IN THE ABLATIVE.

PREPARED BY: DATE	PERFORMED BY: DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL: DATE
7-16-64 T. Kniffin		PARA 7.3.6.2.2 5/4/5 PARA 7.3.6.2.3 [illegible]	WAIVED BY SCOTT TO [illegible] 7/24/5
			VERIFIED BY USAF: DATE 1-JUNE 65

FORM 608-B-43 NEW 6-63

Revision B ——— Dated ———

537

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208130-401 SHEET 244.1 OF 267

7.3.6.2.4 Disassembly of Propellant Valves (Reference Paragraphs 7.3.6.1.7 thru 7.3.6.1.13). C

The propellant valves were disassembled and all parts called for were bagged and identified YES (yes or no).

BOTH FUEL & OXID. ARMATURES WERE OBSERVED TO HAVE SCRATCHES AND DISCOLORATION

PREPARED BY:	DATE	PERFORMED BY:	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL:	DATE
E. Cole E.C.	11-20-64	[signature]	6/9/65	[signature]	6/9/65	[signature]	6/9/65
						VERIFIED BY USAF: [signature]	DATE 6/9/65

FORM 608-B-43 NEW 6-63

Rev. C J. D. Marrogenis Date 11-20-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY — PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST: MINIMUM INSTRUMENTATION REQUIREMENTS HOT FIRE TESTS — TEST NO. 208130-401 SHEET 245 OF 267

TABLE I

MEASUREMENT	RANGE	(3) PRECISION	(1) RESPONSE (SEC)	RECORDER
Main Thrust (4) (5) (6)	0-30 lb	B(±0.5%)	1 ±.25	Null Balance
Main Thrust (2) (5) (6)	0-30 lb	Y**	0.001	Oscillograph
Oxidizer Inlet Pressure (4)	0-500 psig	C(±1.0%)	1 ±.25	Null Balance
Oxidizer Inlet Pressure (4)	0-500 psig	Y**	0.001	Oscillograph
Fuel Inlet Pressure (4)	0-500 psig	C(±1.0%)	1 ±.25	Null Balance
Fuel Inlet Pressure (4)	0-500 psig	Y**	0.001	Oscillograph
Oxidizer Flowmeter Temperature (5)	0-300 F	D(±5.0F)		Null Balance
Oxidizer Inlet Temperature (5)	0-300 F	D(±5.0F)		Null Balance
Fuel Flowmeter Temperature (5)	0-300F	D(±5.0F)		Null Balance
Fuel Inlet Temperature (5)	0-300 F	D(±5.0F)		Null Balance
Oxidizer Flowrate (5)	0.15-0.50 gpm	B(±0.5%)*	1 ±.25	Null Balance
Oxidizer Flowrate (5)	0-0.5 gpm	B(±0.5%)*	0.001	Oscillograph
Fuel Flowrate (5)	0.15-0.65 gpm	B(±0.5%)*	1 ±.25	Null Balance
Fuel Flowrate (5)	0-0.65 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)	0.02-0.20 psia	C(±1.0%)	1 ±.25	Null Balance
Environmental Pressure (Fine)	0.02-0.20 psia	C(±1.0%)	1 ±.25	Null Balance
Environmental Pressure (Coarse)	0.02-15.0 psia	C(±1.0%)	1 ±.25	Null Balance
Environmental Temperature	0-300 F	D(±5.0F)		Null Balance
Combustion Chamber Exterior Wall Temperature (3 Places)	0-1000 F	D(±20 F)		Null Balance

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
J. Ganger	7/15/64	R. Eide	4-30-64		
CHECKED BY:	DATE				
[illegible]	4/1/64				

FORM 608-B-44 NEW 6-63

REVISION D [illegible] Dated 10/26/64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST MINIMUM INSTRUMENTATION REQUIREMENTS - HOT FIRE TESTS TEST NO. 208130-401 SHEET 246 OF 267

TABLE I
(cont'd)

MEASUREMENT	(1) RESPONSE (SEC)	RECORDER
Start and Cutoff, Pip	0.001 1.0 Max	Oscillograph and Time Sequence
Oscillograph Drive, Pip	1.0 Max	Time Sequence
DIGR Drive, 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) Trace full scale deflection shall be 3.0 inch minimum.

(3) Letters designate instrumentation precision category per RA0201-050.

(4) Ranges shall be increased 100 per cent for DAT Duty Cycle to minimum duration (including Cape Cycle) and Burst Pressure Firing Tests.

(5) A single measuring transducer may be utilized to satisfy the requirements of more than one "bit" of information under the following circumstances:
   A) Signal of one parameter is split to satisfy the requirements for more than one type of recorder.
   B) Transducer is physically located to satisfy the requirements of more than one parameter.

(6) May be deleted for Cape Cycle Tests only.

PREPARED BY: J. Ganger	DATE 9/29/64	APPROVED FOR NAA: B. H. Eide	DATE 9-30-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY: R. W. Dimmick	DATE R.C.				

FORM 608-B-44 NEW 6-63

REVISION D J. D. Marrazzini Dated 10/26/64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST MINIMUM INSTRUMENTATION REQUIREMENTS - HOT FIRE TESTS TEST NO. 208130-401 SHEET 246.1 OF 267

TABLE I
(cont'd)

NOTES: (cont'd)

* "B" precision is required only: 1) on the OSC. when turbine type flowmeters are used ; 2) on the DIGR when drag body type flowmeters are used. For drag body type flowmeters, a three-step transfer calibration shall be recorded on the oscillograph and DIGR at the following pre and post test bleed flowrates; 0.032, 0.043 and 0.053 lb/sec. The Osc. deflections at nominal test flowrates shall be 2.5 inches minimum. For turbine type flowmeters, the DIGR precision shall be "C(±1.0%)".

** Thrust:
Perform a pre test multi-step calibration and record on the oscillograph at the following simulated thrusts; 0, 1.5, 3, 6, 15, 24, 27, 30, 27, 24, 15, 6, 1, 1.5 and 0. This shall be followed by a pre and post test one-step calibration (verification).

** Inlet Pressures:
Perform a multi-step transfer calibration (referenced to the DIGR) and record on the oscillograph 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.

** Valve Voltages:
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.

*** Perform a pre and post test Chamber Pressure standardization and record on the oscillograph.

PREPARED BY: J. Ganger	DATE 9/29/64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: K.W. Dinius	DATE Rg	R F Eide	9-30-64		

FORM 608-B-44 NEW 6-63

REVISION C J.D. Morgan Dated 9-17-64

541

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST RCS TCA DESIGN APPROVAL TEST DUTY CYCLE TEST NO. 208130-401 SHEET 247 OF 267

TABLE II

Phase	Approximate Mission Time Elapsed (sec)	Number of Pulses	Time Between Pulses (sec)	Effective Firing Time (sec)	TCA Firing Time (sec)	(1) Accumulative Firing Time (sec)
Pre-Retro	0-308	14	22.000	0.030	0.42	16.42
Retro	308-330	185	0.048	0.070	12.95	29.37
Post-Retro	330-1828	68	22.000	0.030	2.04	31.41
Re-Entry	1828-1830	1	0.400	1.000	1.00	
Sub-Cycle	1830-1837	17	0.400	0.020	0.34	32.75
Re-Entry (2)	1837-2272	51	0.400	1.000	51.00	
Sub-Cycles		867	0.400	0.020	17.34	101.09
Test Cycles (3)	2272-2503	27	0.400	1.000	27.00	
Sub-Cycles		459	0.400	0.020	9.18	137.27
Test Cycles (4)	2503-TCA Failure					

(1) Includes 10 seconds of calibration firing and 6 seconds of simulated Cape Canaveral firing time.

(2) The RE-ENTRY SUB-CYCLE is repeated 51 times (52 SUB-CYCLES total) to demonstrate TCA specification performance for an accumulative firing time, including calibration and simulated Cape Canaveral firing time, of 100 seconds minimum. TCA skin temperatures shall not exceed 550 °F. C

(3) The RE-ENTRY SUB-CYCLE is repeated 27 times (79 SUB-CYCLES total) to demonstrate TCA operation without catastrophic failure for an accumulative firing time of 136 seconds minimum.

PREPARED BY: DATE	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
T.G. Kniffin 1-31-64	R. Eide 1-31-64	J.D. Mavrogenis 9-17-64
CHECKED BY: DATE		
1-31-64		

FORM 608-B-44 NEW 6-63

REVISION C J.D. Mavrogenis Dated 10/26/64

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST RCS TCA DESIGN APPROVAL TEST DUTY CYCLE TEST NO. 208130-401 SHEET 248 OF 267

TABLE II
(cont'd)

(4) The RE-ENTRY SUB-CYCLE is repeated until catastrophic chamber failure which is defined as a condition in which further operation of the TCA 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 650 F at any point on TCA exterior wall.

NOTE: Three temperature sensors shall be mounted on the exterior wall as shown in Figure 6. The average temperature is to be used only when 650 F is not exceeded by the TCA.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T. G. Kniffin	4/30/64	R. G. Eide	4-30-64	J. D. Mangeris	9/17/64
CHECKED BY:	DATE				
[illegible]	4-2-64				

FORM 608-B-44 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE ELECTRICAL SCHEMATIC TEST NO. 208130-101 SHEET 251 OF 267

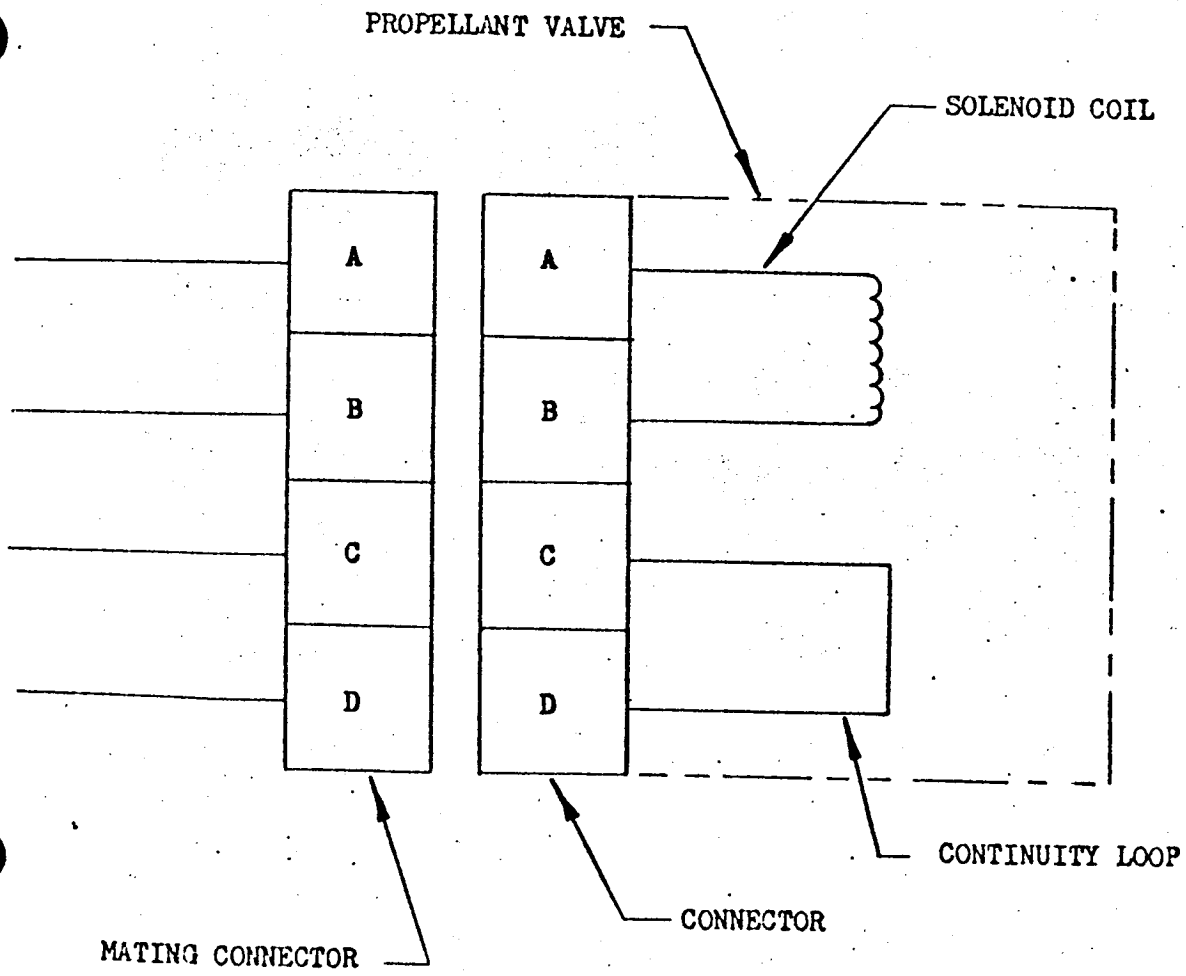

FIGURE 1

FORM 608-B-42 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE PROOF PRESSURE AND LEAKAGE TEST NO. 208130-401 SHEET 252 OF 267

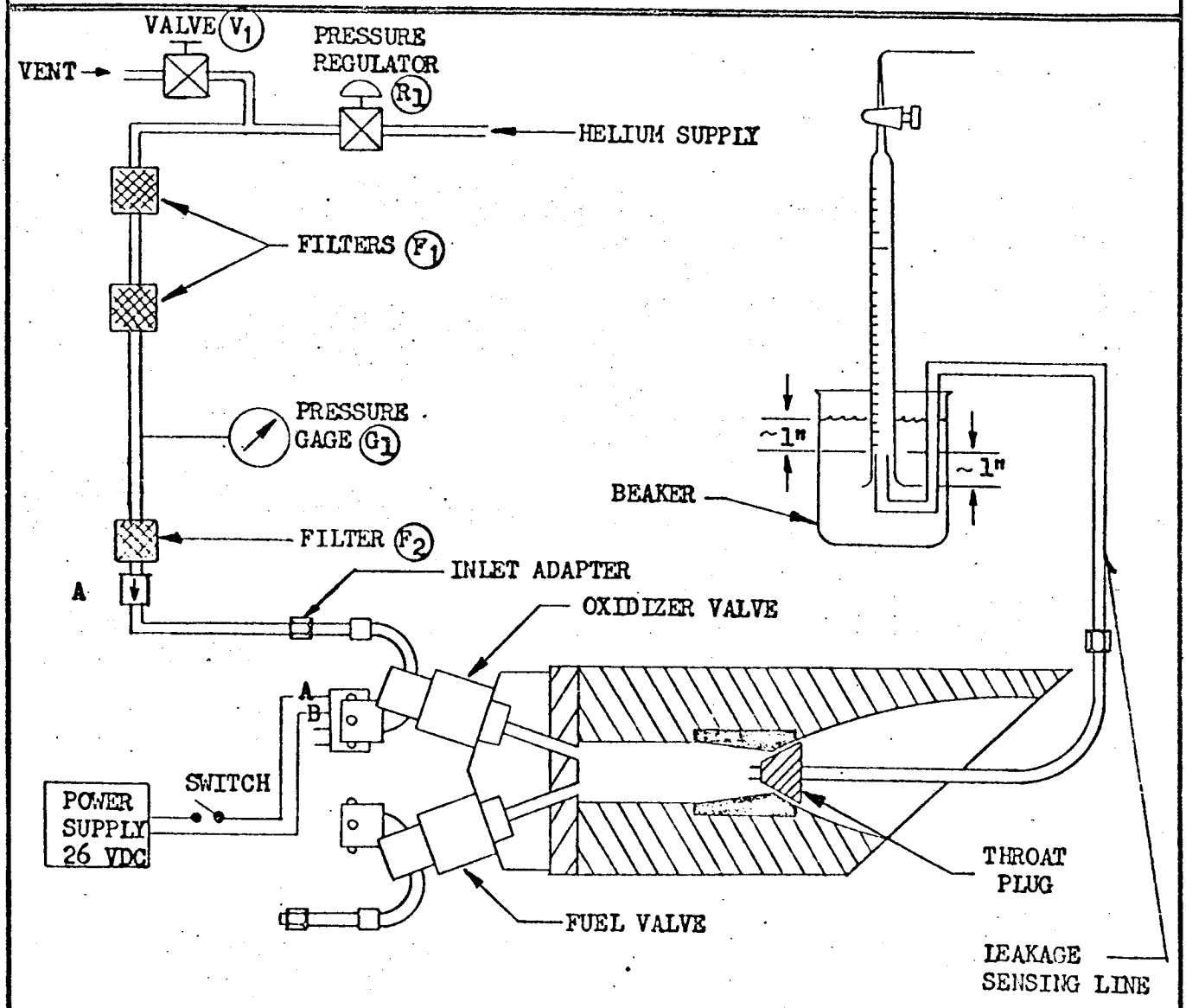


FIGURE 2

FORM 608-B-42 NEW 6-63

REVISION A Dated 6/12/64

545

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST THRUST CHAMBER PROOF PRESSURE AND LEAKAGE TEST NO. 208130-401 SHEET 253 OF 267

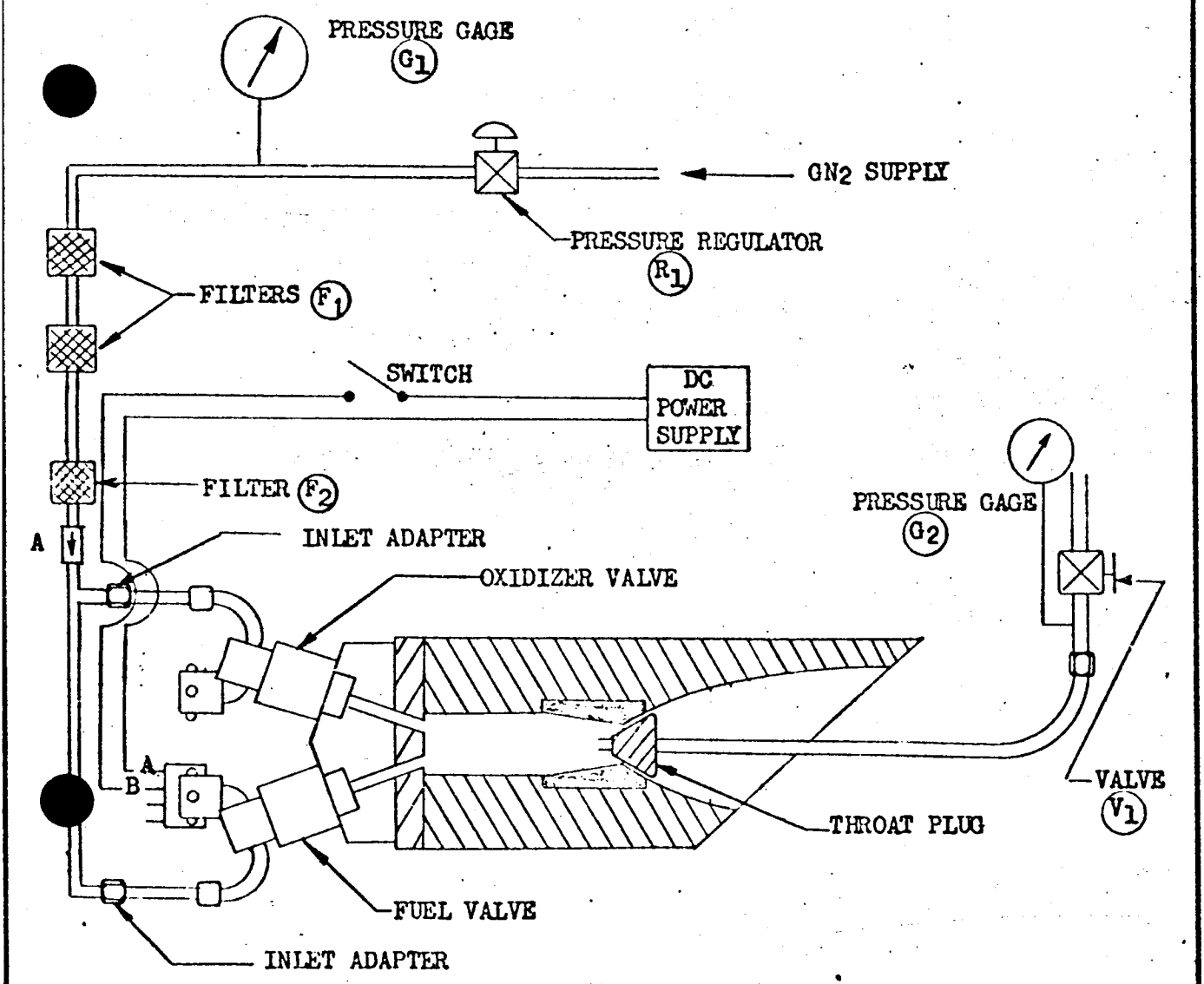


FIGURE 3

FORM 608-B-42 NEW 6-63

REVISION A [signature] Dated 6/12/64

254

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST PROPELLANT VALVE FUNCTIONAL TEST NO. 208130-401 SHEET 254 OF 267

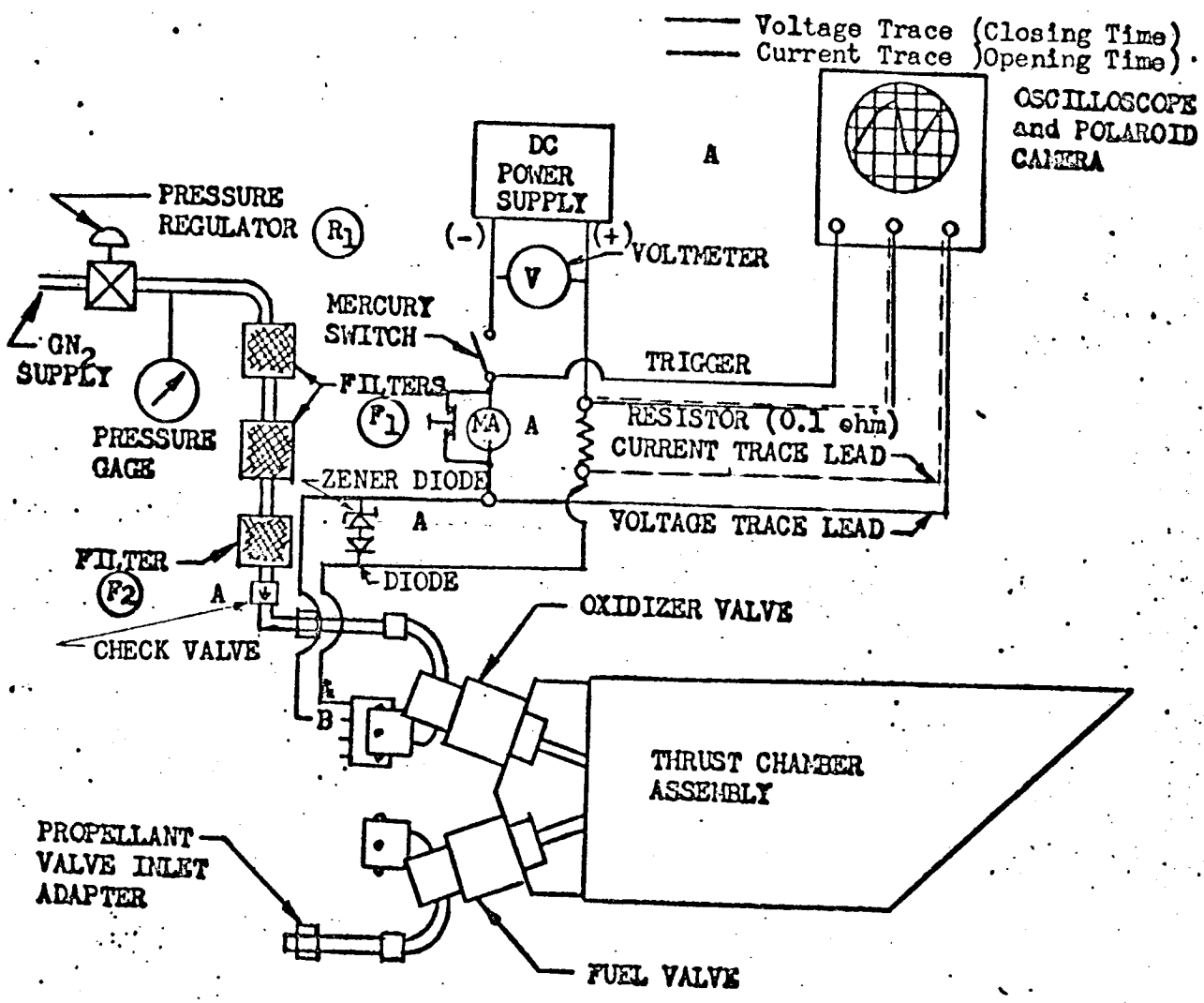


FIGURE 4

547

FORM 608-B-37 NEW 6-63

REVISION A [signature] Dated 6/16/64

255

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE VOLTAGE AND CURRENT TRACES TEST NO. 208130-101 SHEET 255 OF 267

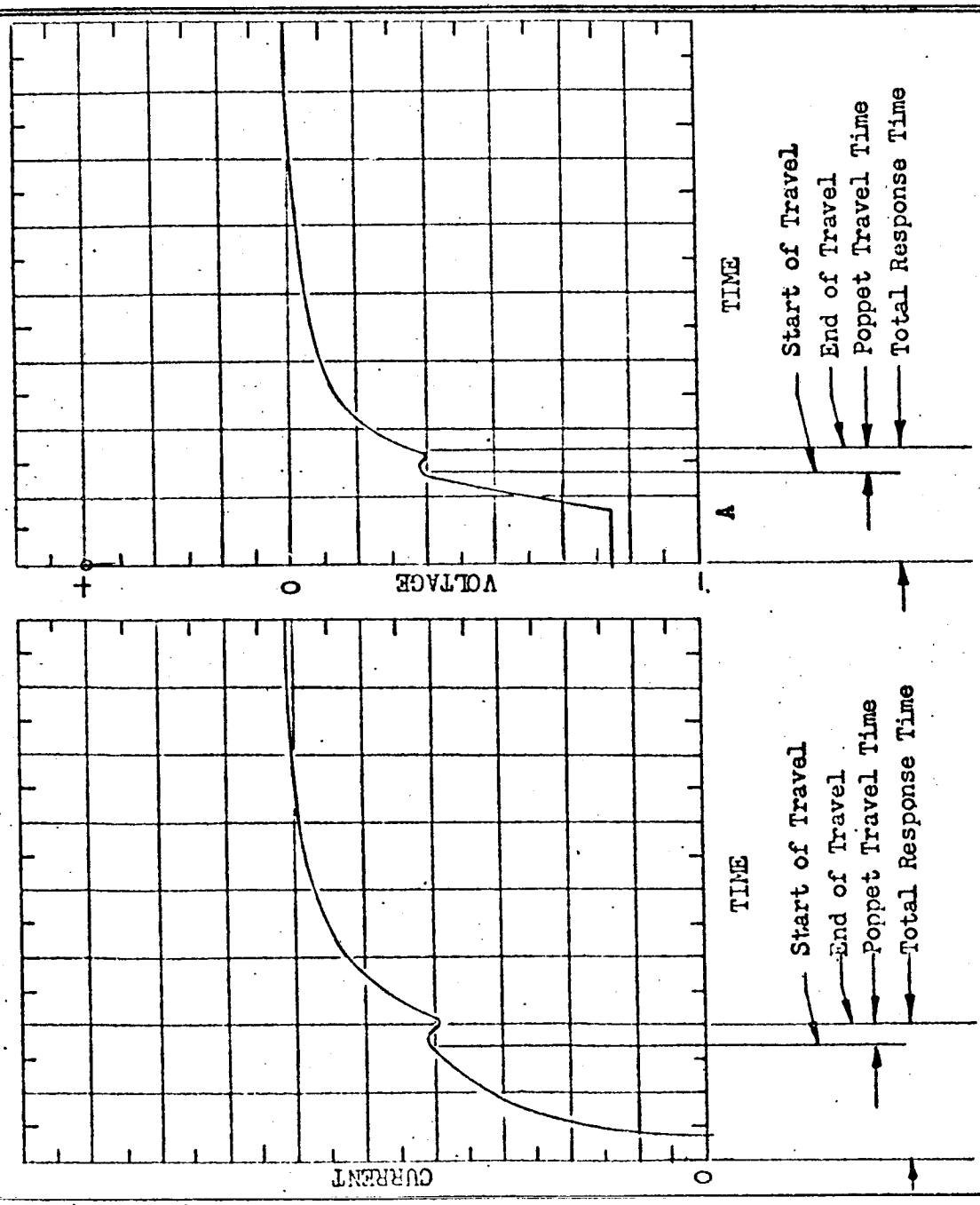


FIGURE 5

A

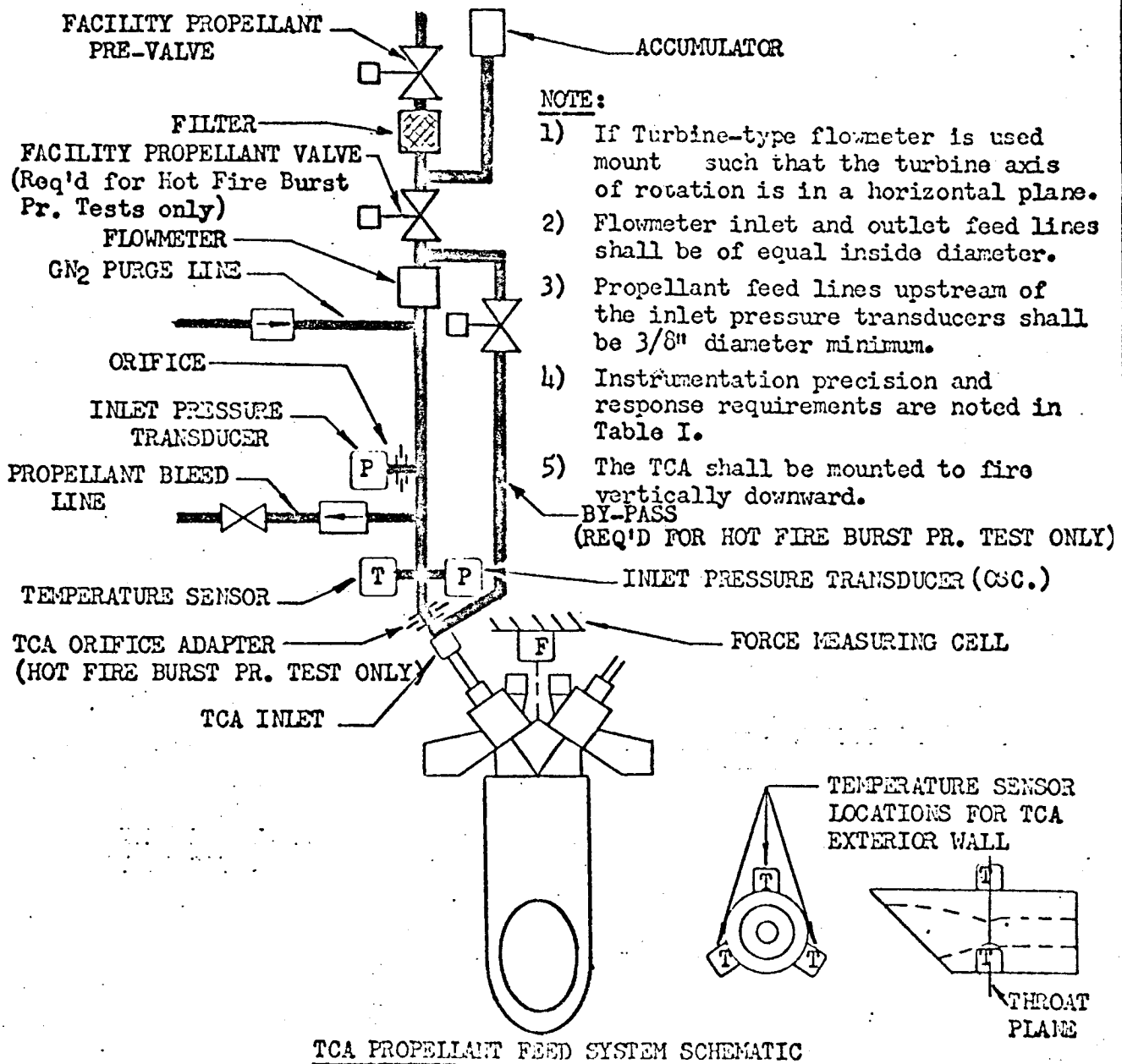
FORM 608-B-42 NEW 6-63

REVISION A J. D. Mangan Dated 6/22/64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT FEED SYSTEM TEST NO. 208130-401 SHEET 256 OF 267



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 inside diameter.
3) Propellant feed lines upstream of the inlet pressure transducers shall be 3/8" diameter minimum.
4) Instrumentation precision and response requirements are noted in Table I.
5) The TCA shall be mounted to fire vertically downward.

TCA PROPELLANT FEED SYSTEM SCHEMATIC

FIGURE 6

FORM 608-B-42 NEW 6-63

REVISION D J.D. Marzzanis Dated 10/26/64

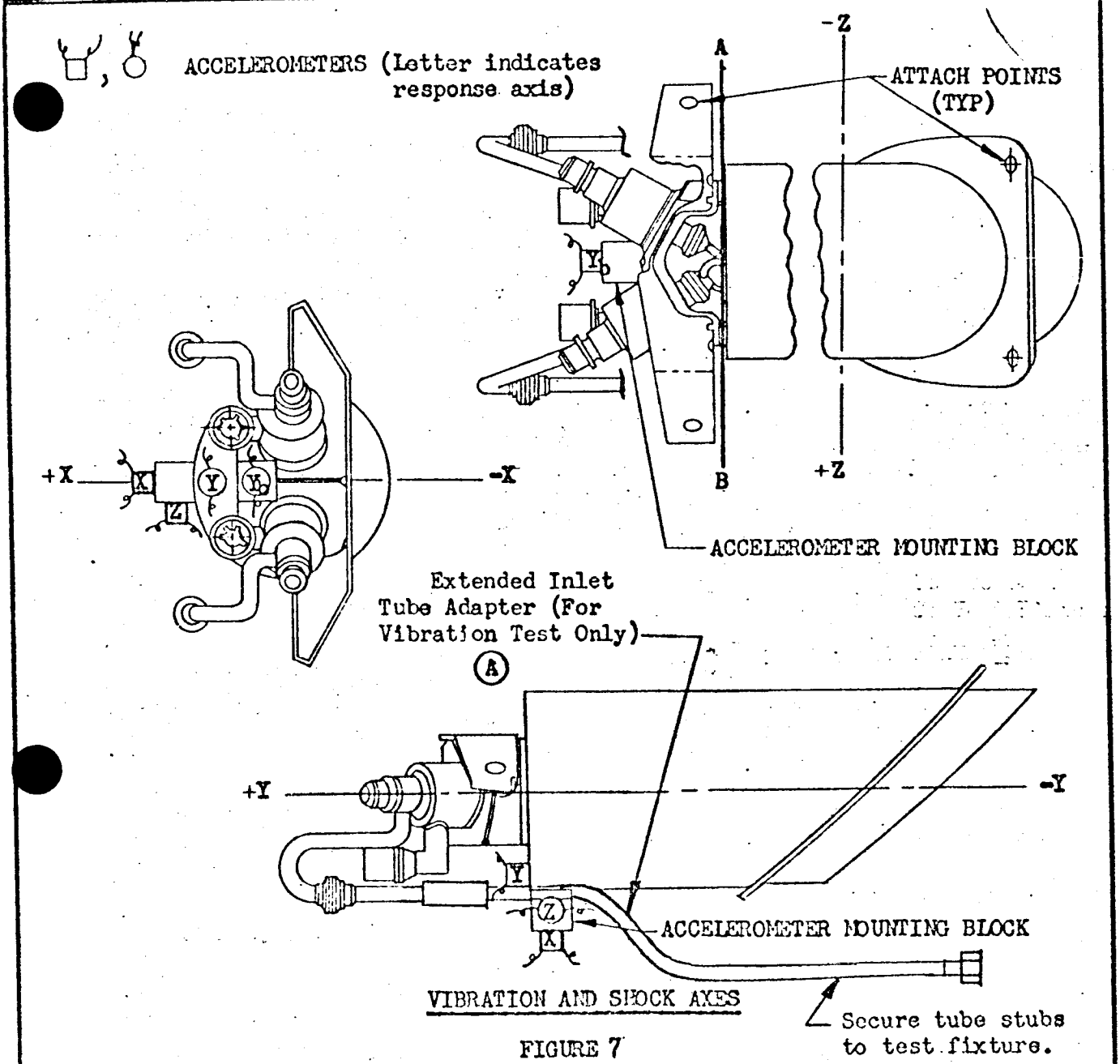
549

258

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION AND SHOCK TEST NO. 208130-401 SHEET 258 OF 267



VIBRATION AND SHOCK AXES

FIGURE 7

FORM 608-B-42 NEW 6-63

REVISION A J.D. Mangano DATED 26 May 64

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST VIBRATION AMPLITUDE TEST NO. 208130-101 SHEET 347 OF 354

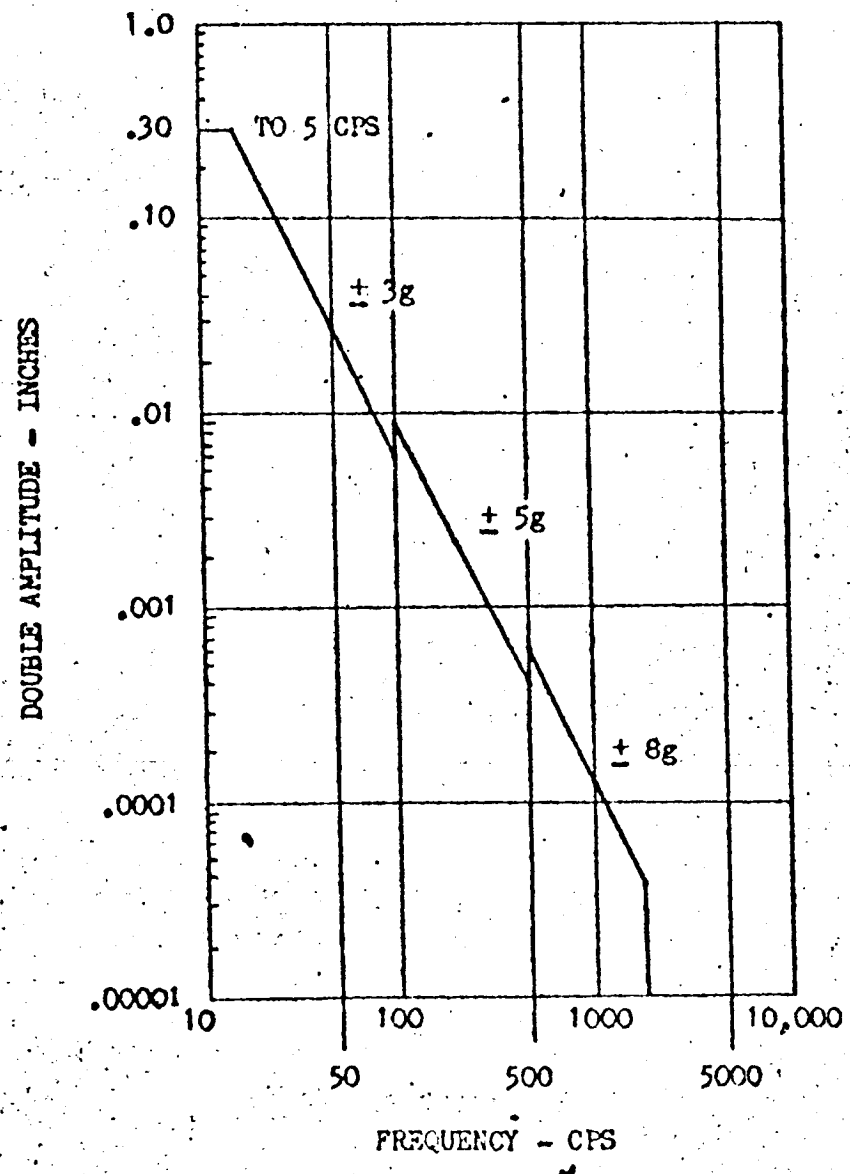


FIGURE 8

FORM 608-B-42 NEW 6-63

259

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST RANDOM VIBRATION TEST NO. 208130-401 SHEET 259 OF 267

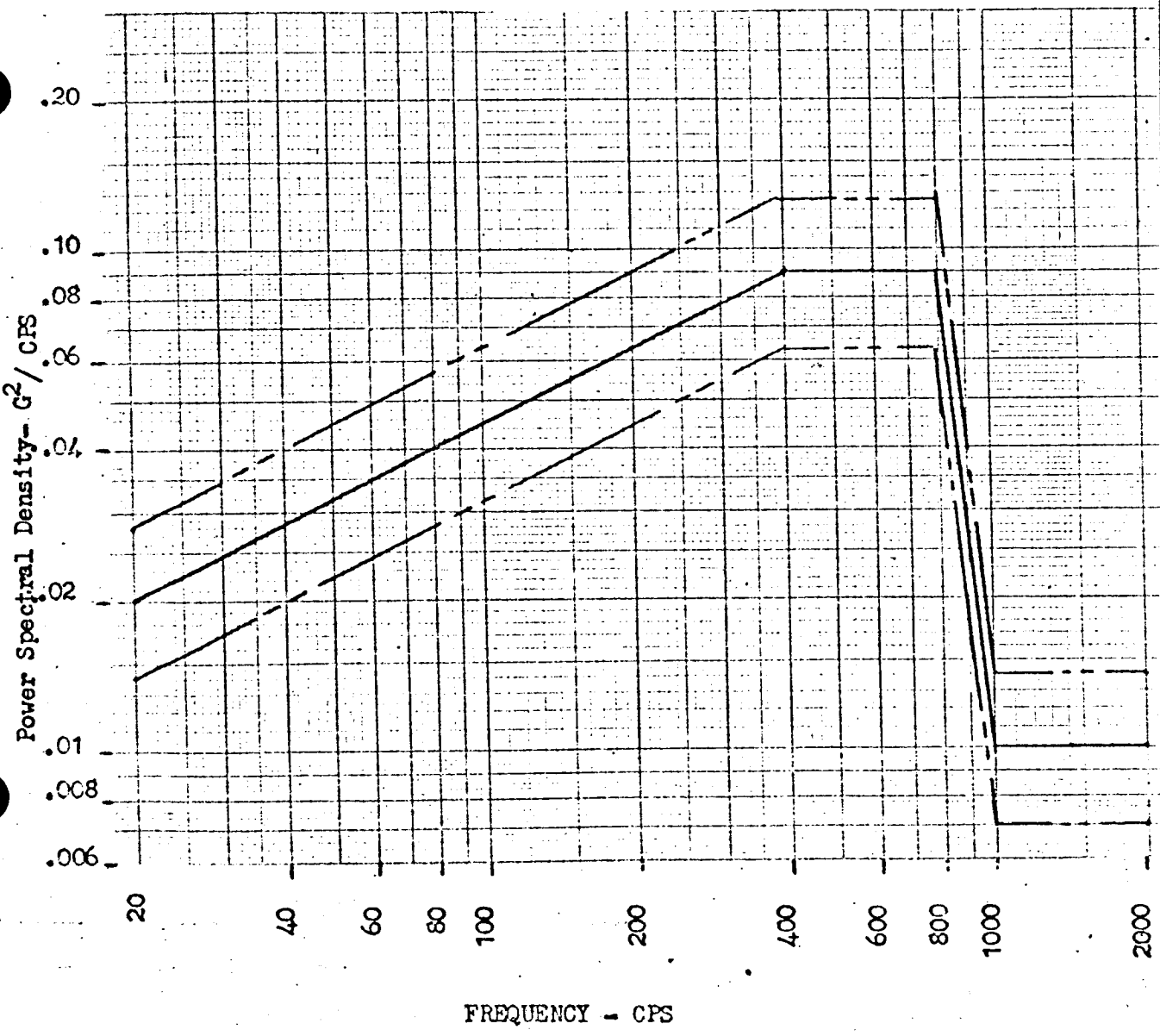


FIGURE 8 (Continued)

FORM 608-B-42 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST EXPLOSIVE ATMOSPERE TEST NO. 208130-401 SHEET 260 OF 267

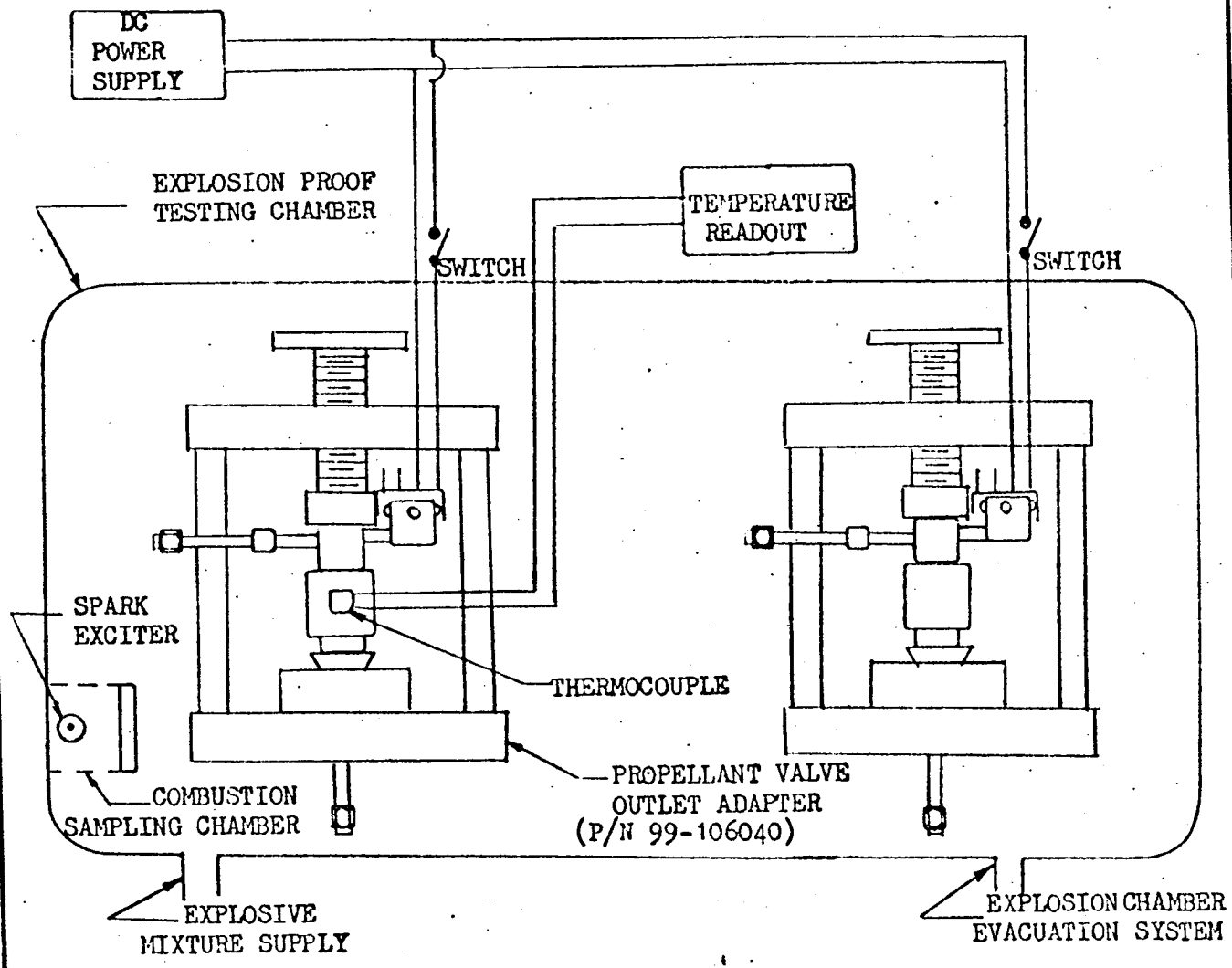


FIGURE 9

FORM 608-B-42 NEW 6-63

261

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61 }

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 208130-401 SHEET 261 OF 267

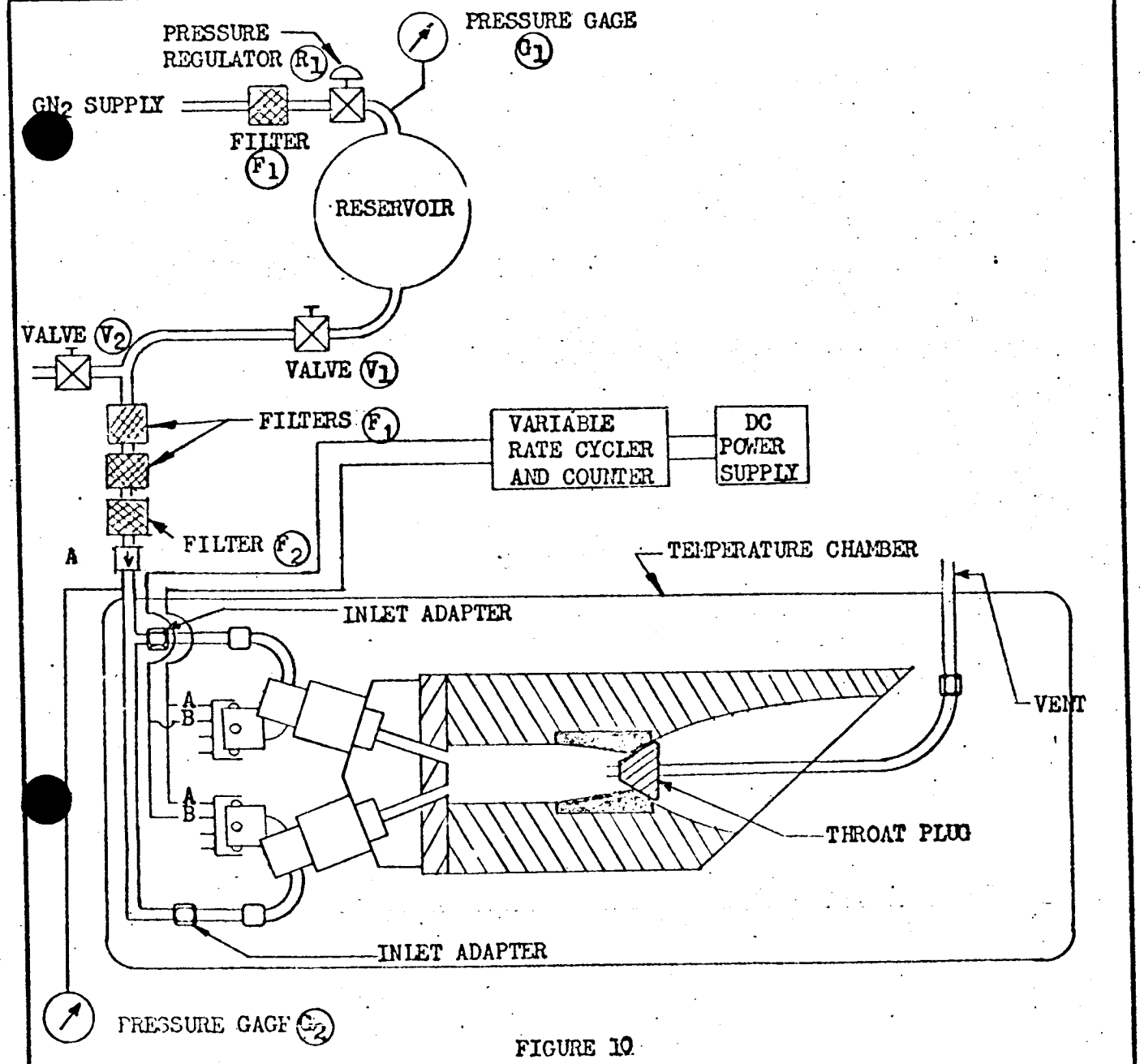


FIGURE 10

FORM 608-B-42 NEW 6-63

REVISION A [illegible] dated 6/12/64

262

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 / NAA 208130-61

NAME OF TEST THRUST PULSE PARAMETERS TEST NO. 208130-401 SHEET 262 OF 267

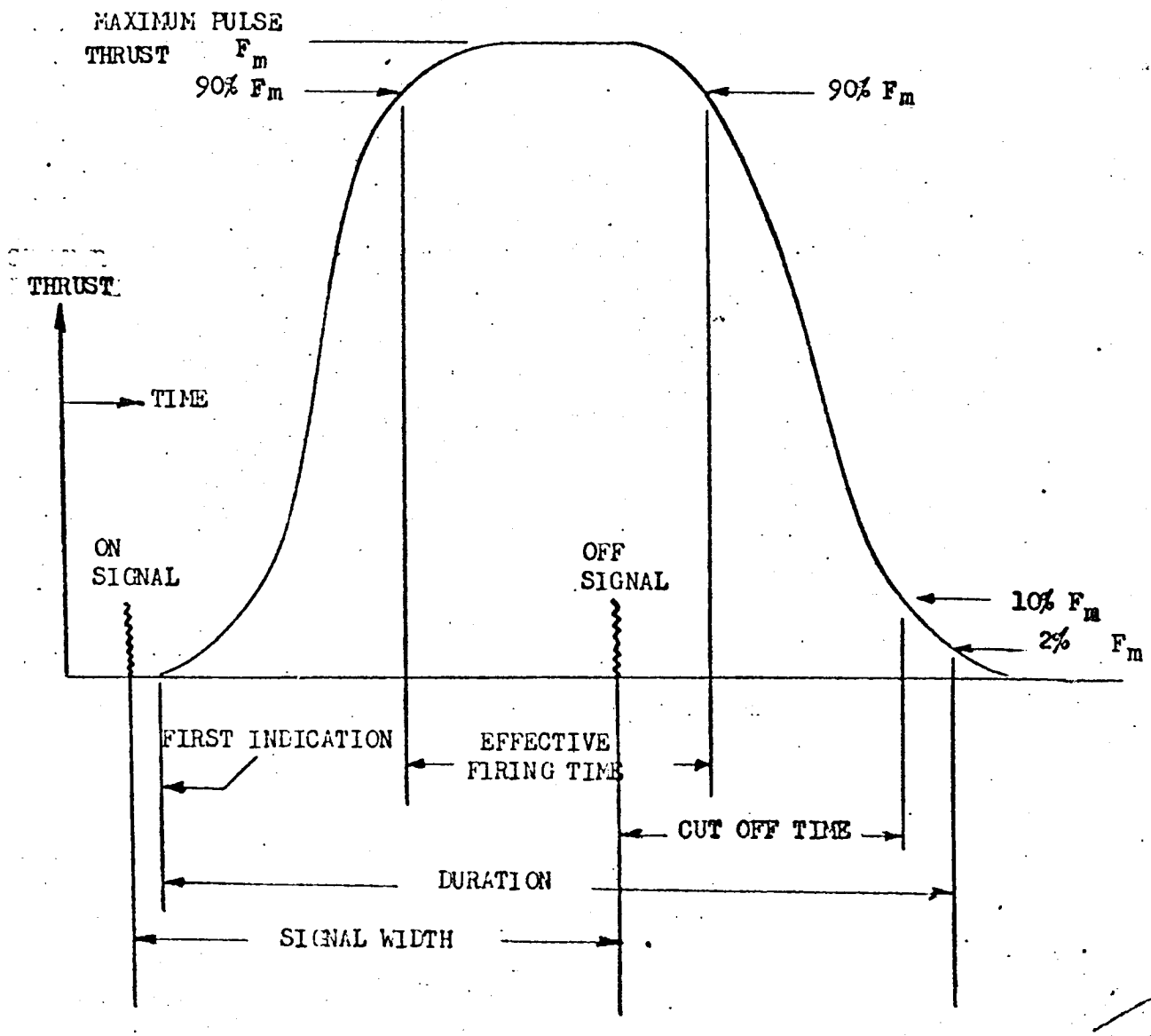


FIGURE 11

FORM 608-B-42 NEW 6-63

REVISION C / D. Thompson Dated 9-17-64

263

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208130-401 SHEET 263 OF 267

C

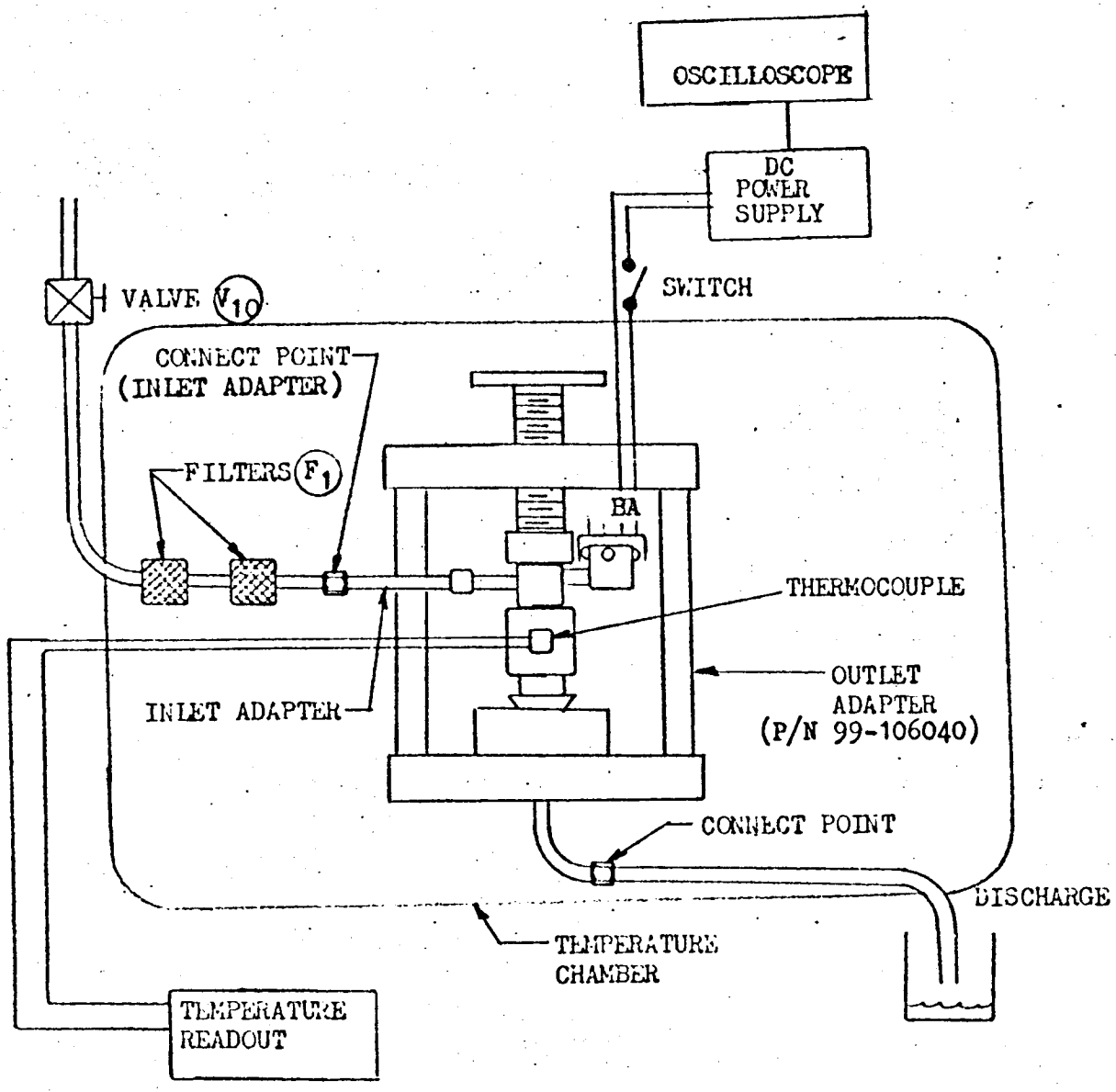


FIGURE 12

FORM 608-B-42 NEW 6-63

Rev. C J. D. Mavrogenis dated 10-6-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52700-217 NAA 208130-61

NAME OF TEST PROPELLANT VALVE LOAD ANALYSIS TEST NO. 208130-401 SHEET 264 OF 267

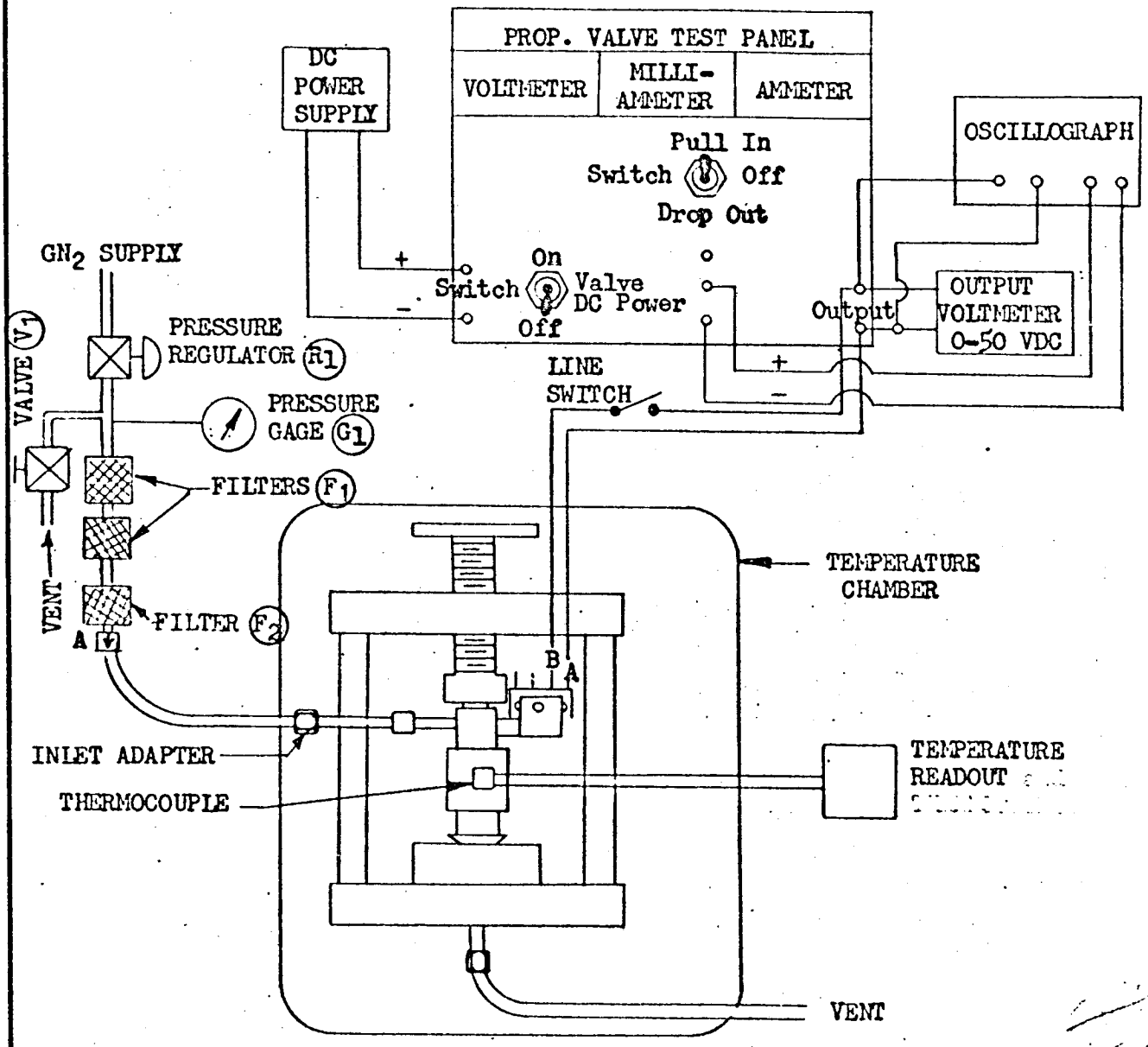


FIGURE 13

FORM 608-B-42 NEW 6-63

REVISION A J.D. [illegible] Dated 6/12/64

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 208130-101 SHEET 265 OF 267

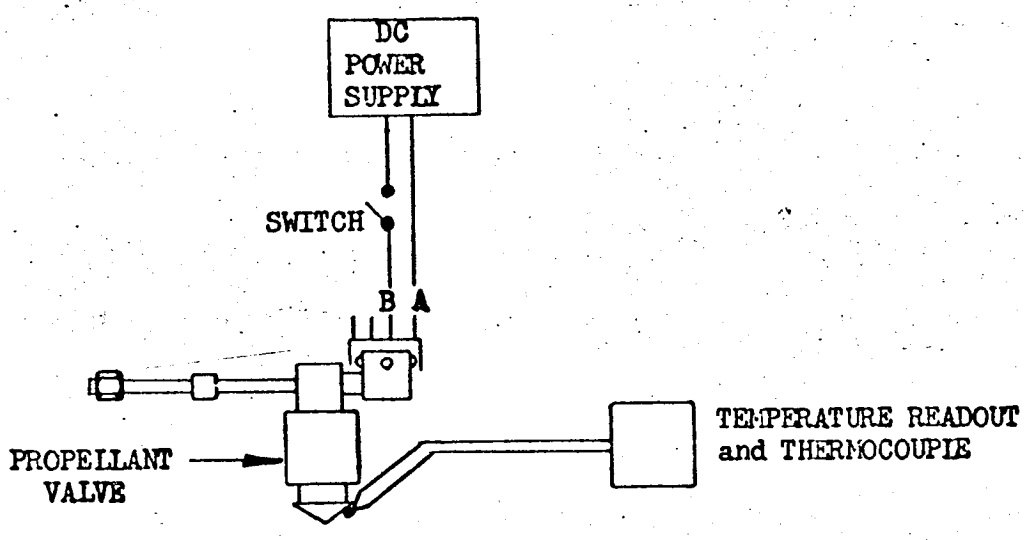


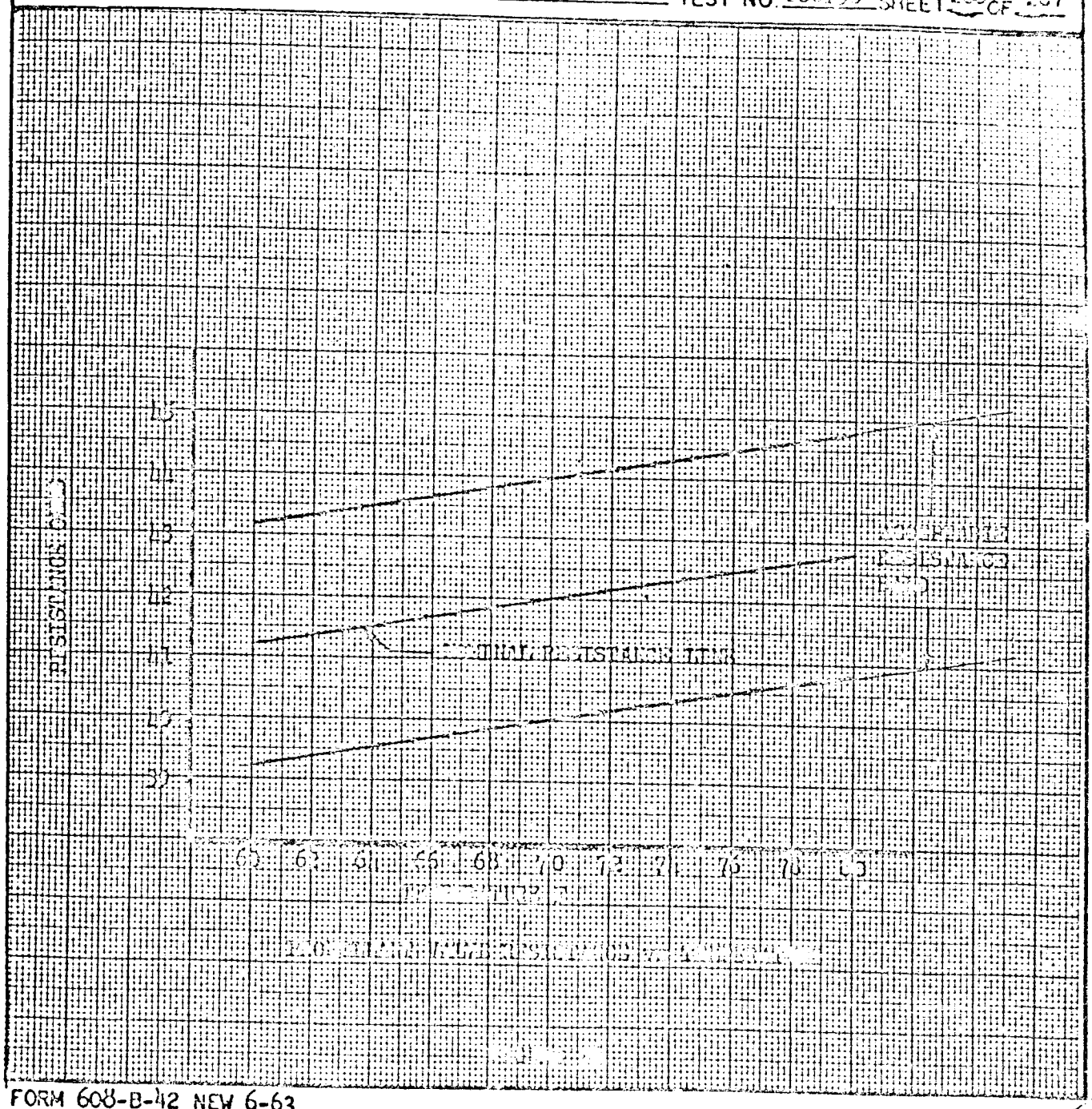
FIGURE 14

FORM 608-B-42 REV 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST PROPELLANT VALVE ELECTRICAL RESISTANCE TEST NO. 208130-101 SHEET 266 OF 267

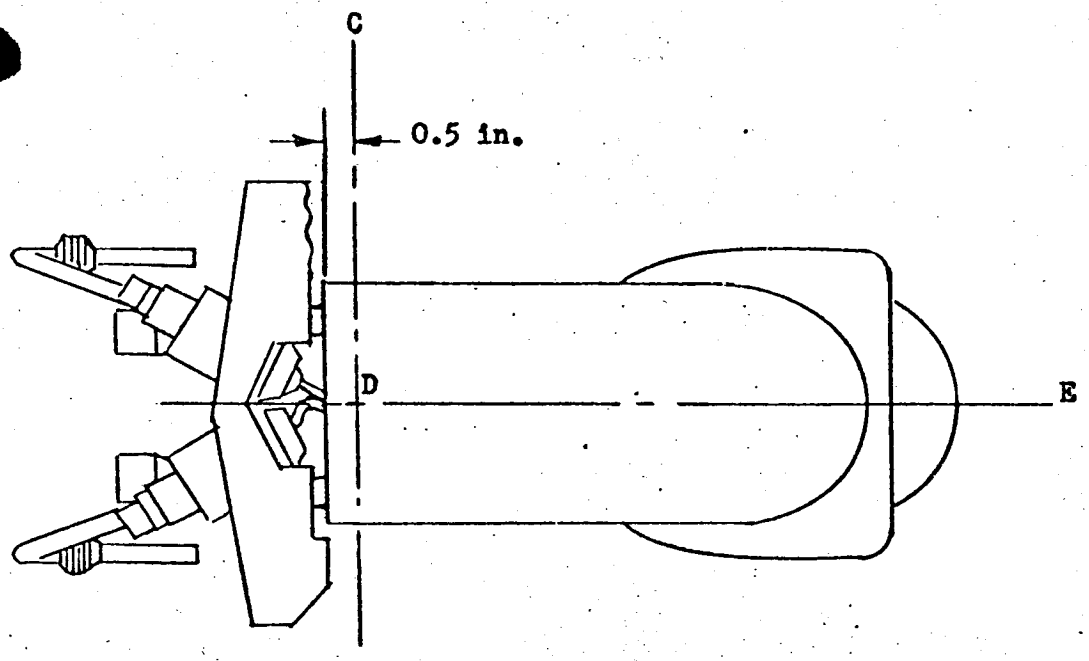


FORM 608-B-42 NEW 6-63

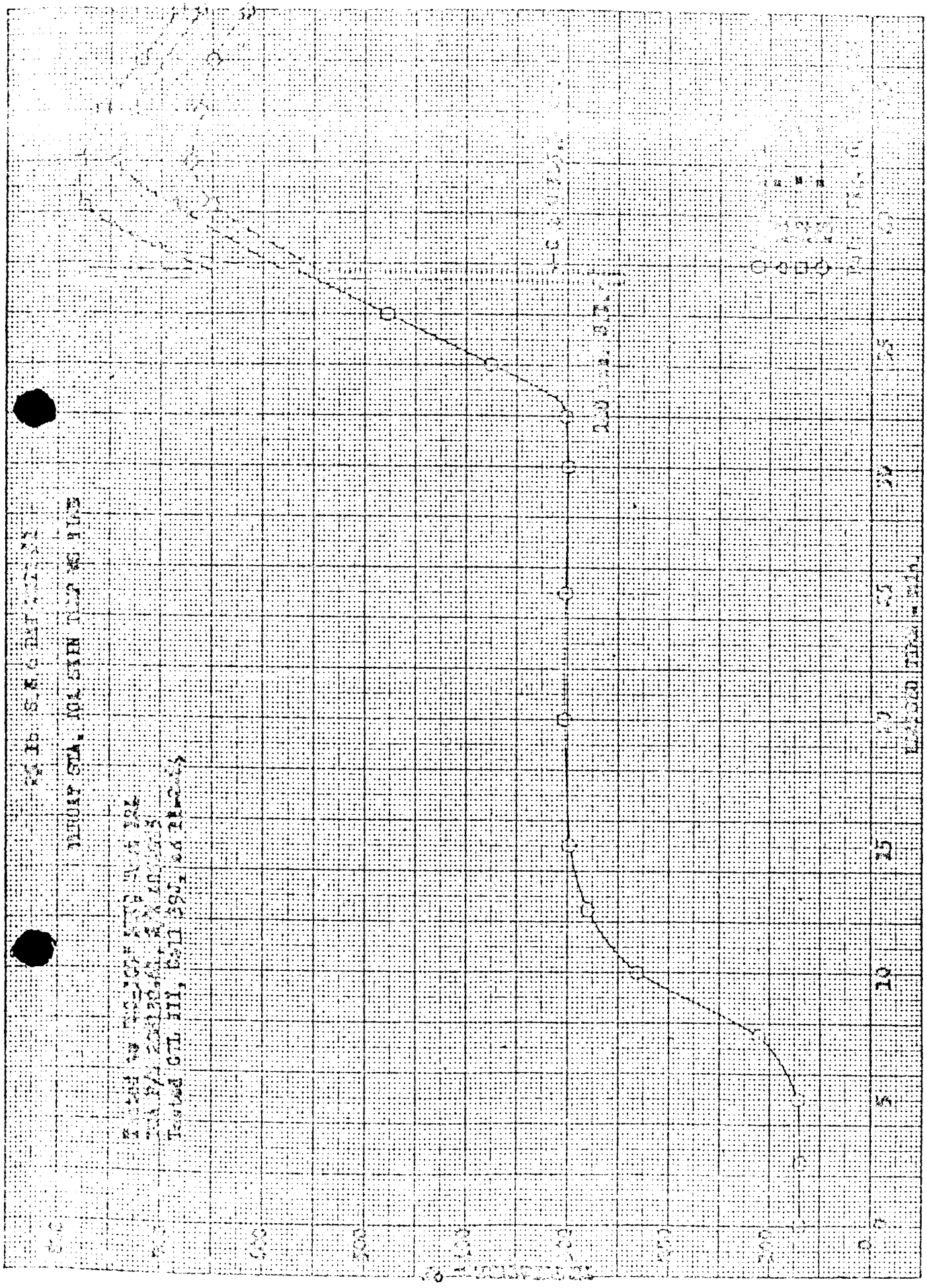
DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208130-401 SHEET 267 OF 267



SECTIONING DIAGRAM
FIGURE 16

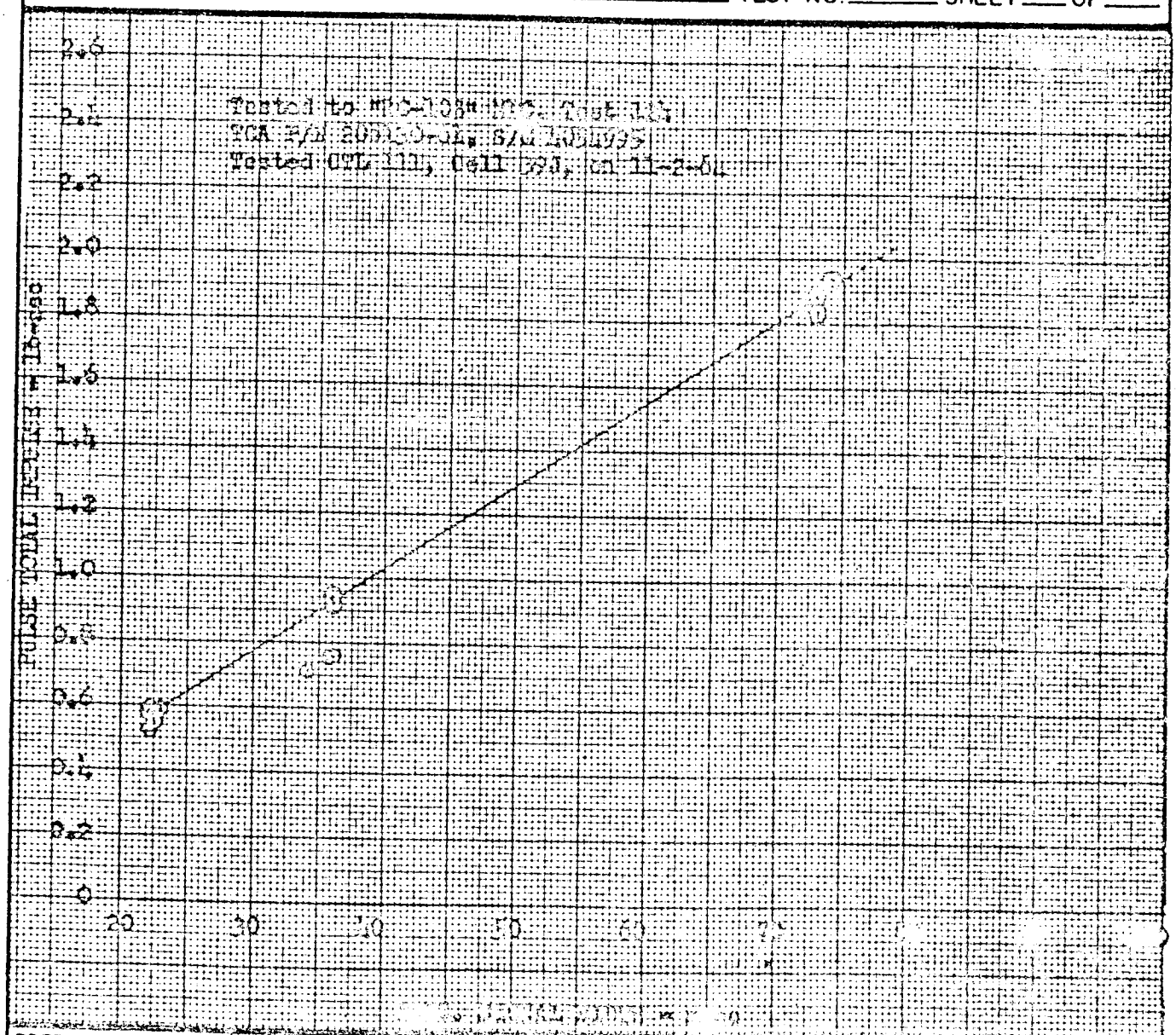


ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE REENTRY CONTROL SYSTEM

COMPONENT NAME 25lb THRUST RCS TCA DAT UNIT 2A PART NO. { MAC 52-52700-217 / NAA 208130-61

NAME OF TEST DAT DUTY CYCLE TO 100 sec TEST NO. 208130-401 SHEET ___ OF ___



PREPARED BY: [signature] DATE	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
CHECKED BY: [signature] DATE	[signature] 11/15/65	

FORM 608-B-44 NEW 6-63