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GEMINI

DESIGN APPROVAL TEST PROGRAM

FINAL REPORT
THRUST CHAMBER ASSEMBLIES
VOLUME II

(UNCLASSIFIED TITLE)

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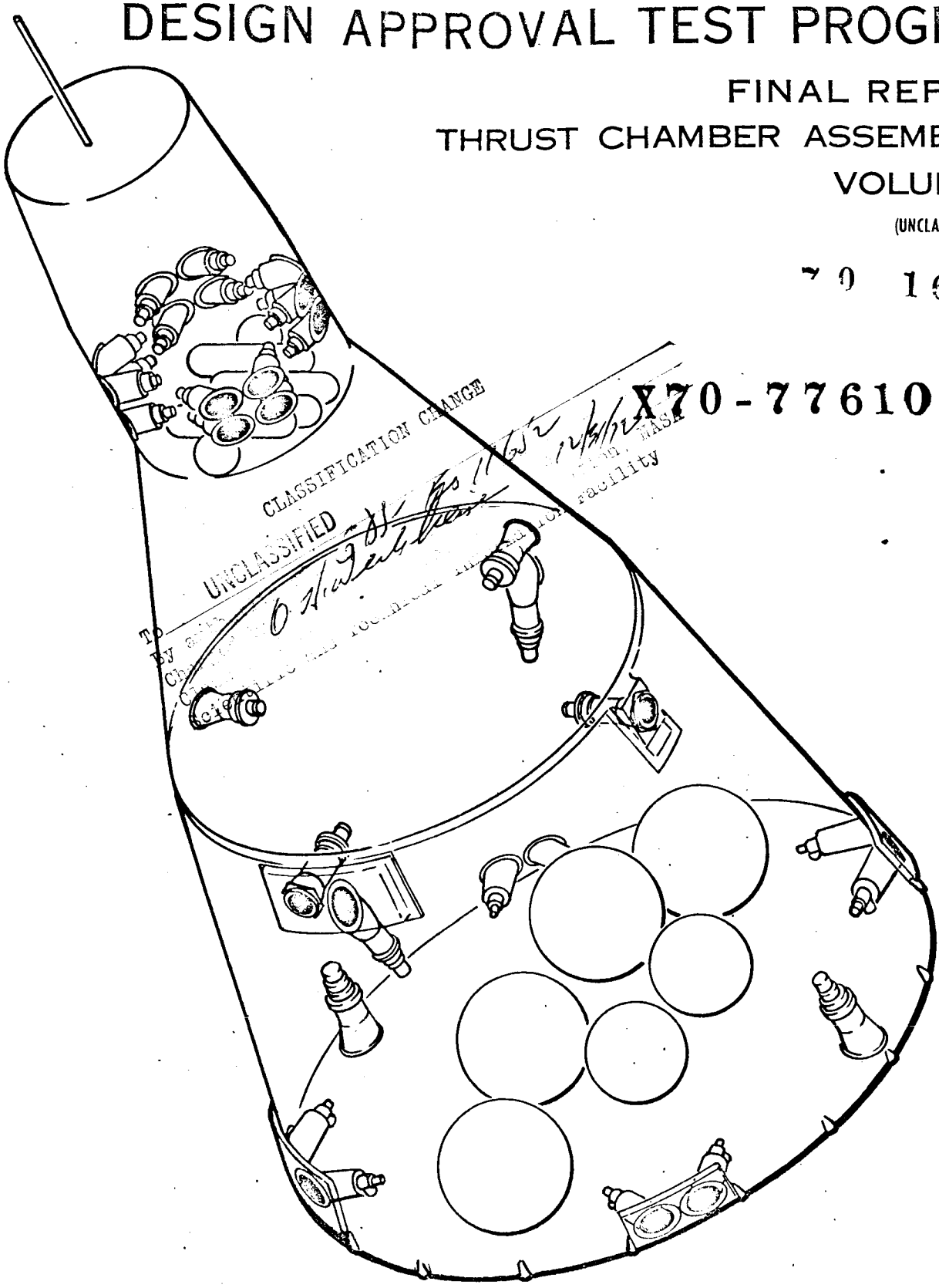

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GEMINI DESIGN APPROVAL TEST PROGRAM FINAL REPORT, THRUST CHAMBER ASSEMBLIES, VOLUME 2, BOOK 4, 100-POUND-THRUST OAMS TCA P/N 407540-21

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FOREWORD

This report on the Design Approval Testing of Gemini 100-pound-thrust OAMS 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 Gemini 100-pound-thrust OAMS Thrust Chamber Assembly is described. Test data, photographs of test equipment, and test summaries are included.

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INTRODUCTION AND SUMMARY

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

The objective of the Design Approval Test program was to demonstrate compliance of the 100-pound-thrust OAMS TCA with the requirements of McDonnell Aircraft Corporation Specification Control Drawing 52-52701 by conducting a planned series of environmental and operating tests on three Thrust Chamber Assemblies.

A total of four TCA's was required for the program because of the necessity of subjecting a TCA to a shock test without the McDonnell Aircraft Corporation (MAC)-added ablative-nozzle extension and propellant valve support bracket. The four TCA's were designated as Units 1, 1A, 2, and 3 for purposes of identification during the DAT program.

A failure occurred during the vibration testing of Unit 1. The random dwell in the Y-axis was terminated after approximately 3.5 minutes of the required 8.0 minutes because of a structural failure of the weld joint at the fuel valve inlet tube orifice housing. Although the simulated spacecraft propellant inlet tube was supported per MAC instructions, the support provisions were inadequate and the failure resulted. The failure was reported in OFR 07432R of Appendix B. Unit 1 was subsequently repaired and the vibration test was repeated using modified and adequately supported inlet tubes. The second vibration test on Unit 1 was successfully completed. Unit 1A was subjected to, and successfully completed the shock test originally scheduled to be conducted on Unit 1.

Compliance of the 100-pound-thrust OAMS Thrust Chamber Assembly with all specification requirements was demonstrated by the Design Approval Test program.

DESCRIPTION OF 100-POUND-THRUST OAMS
THRUST CHAMBER ASSEMBLY P/N 207540-21

The SE7 100-pound-thrust Orbit Attitude and Maneuver System (OAMS) Thrust Chamber Assembly (TCA) is a storable, liquid bipropellant, pressure fed, ablation cooled assembly (Fig. 1 through 3). It is used in the Orbit Attitude and Maneuver System for lateral, vertical, and forward translational maneuver control 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 chamber is fabricated from 90-degree oriented (perpendicular to the TCA centerline) resin-impregnated high-silica ablative material. The nozzle segment is fabricated from 0-degree oriented (parallel to the TCA centerline) resin impregnated high-silica ablative material. 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. In addition, the thrust chamber body is wrapped with a layer of phenolic impregnated asbestos fiber to provide additional heat barrier and sealing capabilities. Structural support for the thrust chamber body assembly is provided by alternate layers of high-temperature, high-strength glass cloth and filament-wound glass roving, bonded by phenolic resin. The thrust chamber body is encased in a stainless-steel shell to provide for 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 consists of 16 pairs of unlike doublets which impinge on a splash plate, providing propellant mixing for high combustion efficiency.

Thrust Chamber Assembly operation is controlled by two fast-acting, electrically operated, solenoid propellant valves. The valves are supported by 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 engages on a Teflon seat in the closed position. A metal stop below the Teflon seat is incorporated to limit the armature stroke. Closing is accomplished through the use of a spring, and sealing force is obtained from the spring and the pressure of the propellant acting on the ball. The P/N 207540-21 Thrust Chamber Assemblies tested are identical to those delivered for flight, with one exception. The -21 configuration of the P/N 207540 TCA is the same as the -61 production configuration, except the chamber-pressure sensing boss is not welded closed.

The physical and performance data for the 100-pound-thrust OAMS TCA P/N 207540-21 are presented in Table 1.

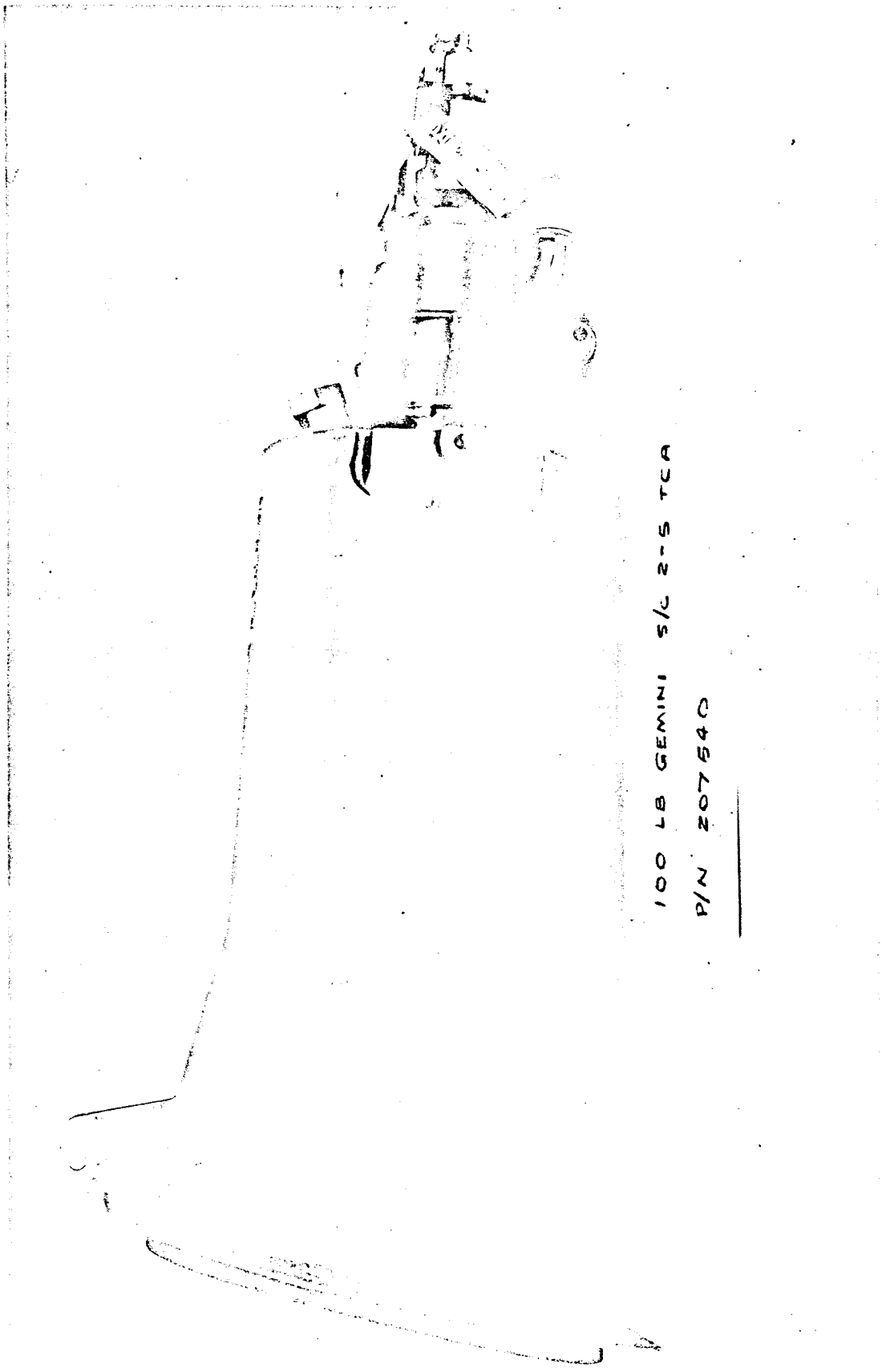

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Figure 1. Gemini 100-Pound-Thrust OAMS Thrust Chamber Assembly

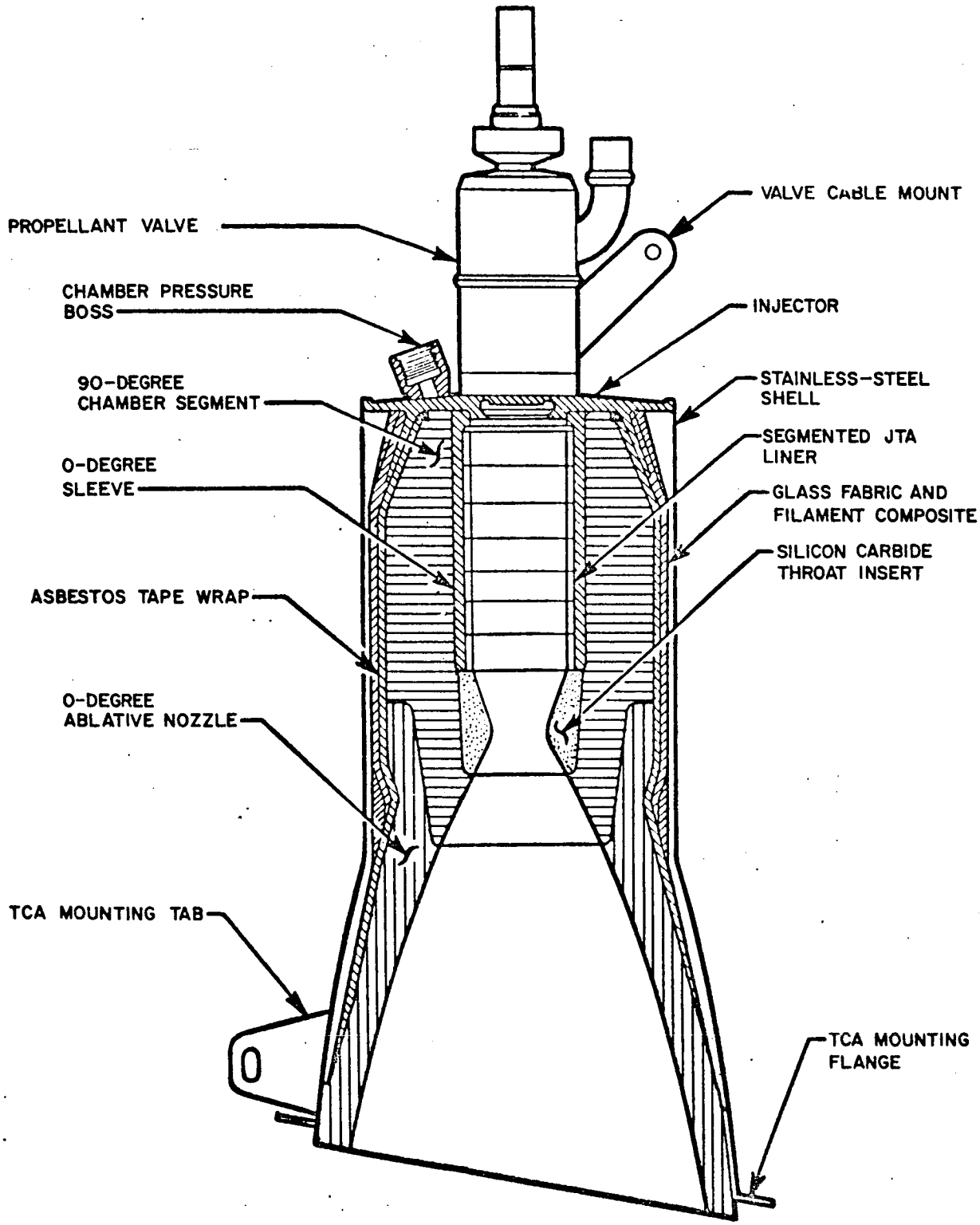

Figure 2. Gemini 100-Pound-Thrust OAMS Thrust Chamber Assembly Schematic

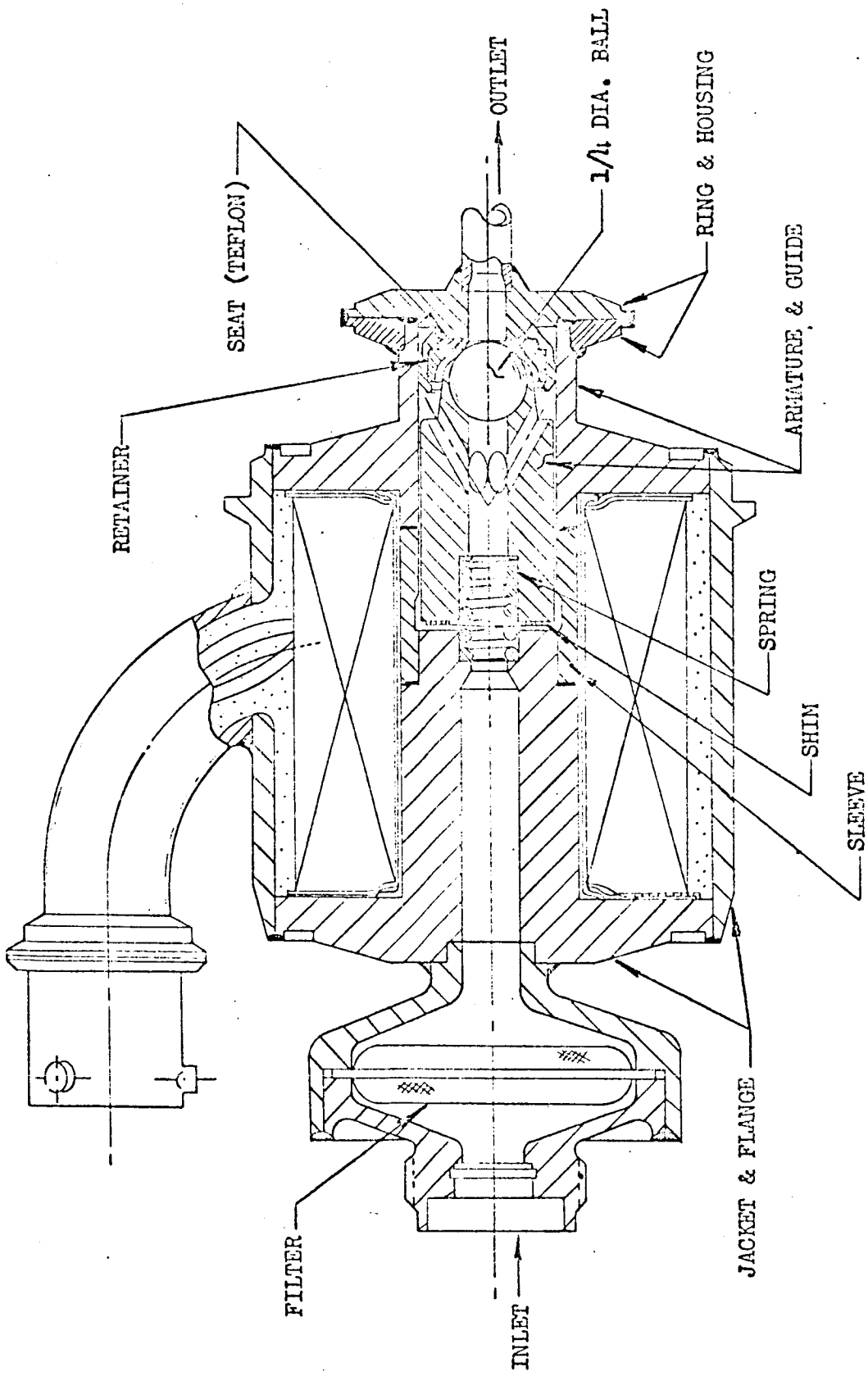

Figure 3. Gemini OAMS Propellant Valve (P/N 407662)

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TABLE 1

100-POUND-THRUST OAMS TCA 207540-21
PHYSICAL AND PERFORMANCE DATA

Compliance of the Gemini 100-pound-thrust OAMS TCA P/N 207540-21 with the following physical and performance requirements has been verified by design approval tests.

Physical	
Envelope	overall dimensions are: length 15.5 inches, forward OD 4.0 inches, and aft OD 5.5 inches
Weight	8.63 pounds
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	
Propellants	nitrogen tetroxide and monomethylhydrazine
Thrust, Vacuum, Nominal, pounds	94.5
Chamber Pressure, Mean, psia	133.0
Mixture Ratio, Nominal, o/f	1.6

TABLE 1
(Continued)

Performance (continued)

Specific Impulse	classified (see page)
Oxidizer Inlet Pressure, Nominal, psia	283.0
Fuel Inlet Pressure, Nominal, psia	286.0
Life, Specification Performance, MAC Mission Duty Cycle OCM 218, seconds	220
Life, Guaranteed, MAC Mission Duty Cycle OCM 218, seconds	300
Propellant Valve Service Life,[1] 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, maximum	50
Shutdown Time (with spacecraft electrical circuit; off signal to 2 percent of thrust), milliseconds, maximum	125
Shutdown Impulse (without spacecraft electrical circuit), lb-sec	1.5
Environmental Temperature Range, Operating, F	+15 to +200

[1]This requirement was verified on 85-pound-thrust DAT TCA S/N 4053579. (Book 3, Volume 2 Report R-15019-2)

TABLE 1*

(Continued)

Performance

Specific Impulse, Mean, seconds	298

*Classified parameter

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TABLE 1

(Concluded)

Performance

Environmental Temperature Shock Range, Nonoperating, F	-40 to +185
Vibration Level Random (rms), g	9.6
Shock Level (in shipping container), g/11 milliseconds	15
Proof Pressure, psig	480 at 68 F

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TEST PROGRAM

TEST OUTLINE

Four thrust chamber assemblies, designated Units 1, 1A, 2, and 3, were subjected to the following tests.

Unit I

1. Visual Inspection
    a. Weight determination
    b. Component modification
2. Vibration Test
    a. Propellant valve proof pressure and leakage
    b. Thrust chamber proof pressure and leakage
    c. Propellant valve electrical resistance
    d. Propellant valve dielectric strength
    e. Propellant valve functional
    f. Visual inspection
3. Temperature Shock Test
    a. Propellant valve proof pressure and leakage
    b. Thrust chamber proof pressure and leakage
    c. Propellant valve electrical resistance
    d. Propellant valve dielectric strength
    e. Propellant valve functional

4. Mission Duty Cycle to Failure
5. Disassembly and Inspection

Unit 1A

1. Visual Inspection
2. Mechanical Shock Test
   a. Propellant valve proof pressure and leakage
   b. Thrust chamber proof pressure and leakage
   c. Propellant valve electrical resistance
   d. Propellant valve dielectric strength
   e. Propellant valve functional
   f. Visual inspection

Unit 2

1. Visual Inspection
   a. Weight determination
2. Propellant Valve Continuous Duty Test
   a. Propellant valve proof pressure and leakage
   b. Propellant valve electrical resistance
   c. Propellant valve dielectric strength
   d. Propellant valve functional

3. Mission Duty Cycle to Minimum Duration and Burst Pressure Test

4. Disassembly and Inspection

Unit 3

1. Visual Inspection
   a. Weight determination
2. Mission Duty Cycle to Guaranteed Life
3. Explosive Atmosphere Test (Propellant Valves Only)
   a. Propellant valve proof pressure and leakage
   b. Propellant valve electrical resistance
   c. Propellant valve dielectric strength
   d. Propellant valve functional
4. Fuel and Oxidizer Resistance Test (Propellant Valves Only)
   a. Propellant valve electrical resistance
   b. Propellant valve functional
   c. Propellant valve dielectric strength
   d. Propellant valve proof pressure and leakage
   e. Propellant valve load analysis
5. Disassembly and Inspection

TEST UNIT IDENTIFICATION

The test units subjected to testing were identified as Rocketdyne P/N 207540-21, and the Serial Numbers were as follows:

Unit 1	S/N 4058958
Unit 1A	S/N 4058965
Unit 2	S/N 4054757
Unit 3	S/N 4054759

TEST DESCRIPTION AND RESULTS, UNIT 1

VISUAL INSPECTION

Description

Unit 1 was inspected to ensure that it was of the proper configuration, undamaged, and had been subjected to and passed an acceptance test per Rocketdyne Specification RA0220-349.

The Unit was then shipped to McDonnell Aircraft Corporation for installation of a propellant valve support bracket and a nozzle extension per MAC Drawing 52-52067. This modification was necessitated by earlier vibration tests conducted by both Rocketdyne and MAC. Following the return of the unit to Rocketdyne, simulated spacecraft system tube extensions (P/N 99-106715 and P/N 99-106716) were attached to the TCA inlet tube stubs. Installation of the simulated spacecraft system tube extension was accomplished per Rocketdyne Specification RA0607-009, "In-Place Brazing of Tubes and Fittings for Space Engines."

Results

The visual inspection was successfully completed.

VIBRATION TEST

Description

Unit 1 was to be subjected to random vibration testing along each of three mutually perpendicular axes. The random vibration time for each axis was to be 8 minutes, less the equalization time required to verify spectrum shape and tolerance. The equalization time was not to exceed 20 percent of the vibration time for each axis.

Prior to the start of the vibration testing in each axis, a sine-wave survey (1 g maximum peak, logarithmic sweep from 5 to 2000 cps in 5 minutes) was to be conducted to calibrate the input and output accelerometers. A functional test was to be conducted following the completion of the vibration test. During the vibration test, the TCA was mounted in MAC-supplied spacecraft bracketry, which in turn was mounted to a rigid test fixture.

Results

Unit 1 was first subjected to vibration in the X axis. As a result of difficulties encountered during the equalization phase of the test, the maximum allowable equalization time was exceeded. Testing was continued

as authorized by Rocketdyne Internal Letter 4388-5351(page 233 of Appendix D). During the subsequent random phase of the test, excessive g levels were recorded by the response accelerometers mounted on the MAC nozzle extension. Visual inspection of the TCA and dye-penetrant inspection of the TCA nozzle welds revealed no abnormalities. However, the MAC nozzle extension mounting bolts were found to be below the specified torque value. The bolts were retorqued, and three additional accelerometers were installed at the TCA nozzle exit to record vibration levels. The TCA was reinstalled and another equalization run was conducted as authorized by Rocketdyne Internal Letter 4388-5354(page 236 Appendix D). The X-axis vibration was then successfully completed.

Unit 1 was reoriented for vibration in the Y-axis. The equalization run was successfully completed within the allotted time. At 2.55 minutes of the random-vibration dwell phase, a facility malfunction resulted in an interruption of the test. During this down time, visual inspection of the TCA revealed a structural failure of the fuel inlet tube at the weld to the orifice housing body. This failure was reported in OFR 07432R of Appendix B, and the analysis of the failure was reported in FAR 07432R of Appendix B.

HARDWARE DISPOSITION

After completion of the failure analysis, Unit 1 was reworked by the installation of a new fuel inlet tube and returned to the DAT program. The visual inspection and vibration tests were then repeated.

VISUAL INSPECTION

Description

Unit 1 was inspected following rework of the fuel inlet tube to verify that the rework was satisfactory and that no damage had occurred during the rework and associated handling.

Results

The visual inspection was successfully completed.

VIBRATION TEST

Description

Unit 1 was installed in the vibration test fixture, the inlet tubes were secured per revised MAC directions, and the unit was subjected to a revised random vibration test as outlined by MAC Engineering in Internal Letter 1064/RIM-23 (page 255 of Appendix D). The primary revisions made by the Internal Letter were to change the order of testing from X-axis, Y-axis, Z-axis to Y-axis, Z-axis, X-axis and to delete the 1-g sine-wave survey in the Y-axis. The DAT failure criterion was also removed from the last X-axis test, as it was considered overstress. Leak tests were performed following the Y-axis and the Z-axis tests, and a complete functional test was performed following the X-axis test. Nine accelerometers were mounted on the TCA to record vibration data. In addition, two strain gages were mounted on the fuel inlet tube and one strain gage was mounted on the oxidizer inlet tube to record the amplitude during the tests.

Results

The Y-axis vibration test and the subsequent leak test were completed successfully. However, visual inspection following the test disclosed that the aft-mounting tab bolt had loosened; this bolt was retorqued.

During the Z-axis phase of the test, difficulties were encountered in equalization of the TCA because of the vibration fixture design and the TCA nozzle extension. As a result, the allowable equalization time was exceeded and a portion of the spectrum was still out of tolerance. Testing was continued as authorized by Rocketdyne Internal Letter 4388-5356 and 5358 (pages 246 and 248 of Appendix D). During the random dwell phase of the test 3.66 minutes of vibration were accumulated at a 5-g rms level, instead of at a 9.6-g rms level, because of an instrumentation readout error. Testing was continued as authorized by Rocketdyne Internal Letter 4388-5356 (page 246 Appendix D) adding 3 minutes of vibration time at the required 9.6-g level to compensate for the low level during the previous test. The vibration test in the Z-axis and the subsequent leak test were then successfully completed. Vibration in the X-axis was the last phase of the test to be conducted. Because of the accumulation of excess vibration time on the TCA, the 1-g sine-wave survey was deleted as authorized by Rocketdyne Internal Letter 4388-5379 (page 249 Appendix D). The equalization test was completed within the allowable time. The random vibration test was terminated after 3 minutes and 53 seconds when the TCA trunnion bolts loosened. These bolts were retorqued and the test was resumed.

Testing was again terminated after an accumulated time of 4 minutes and 46 seconds as a result of insufficient clearance between the spacecraft

mounting bracket and the TCA. The mounting bracket was realigned and the test was resumed. The X-axis vibration test was then successfully completed. The postvibration functional test was also successfully completed; however, two deviations were made to expedite the tests, Rocketdyne Internal Letter 4388-5360 (page 251 Appendix D) and IL 4388-5362 (page 253 Appendix D). The first deviation deleted inspection of the welds hidden by the MAC propellant-valves bracket and the nozzle extension. The second deviation allowed the propellant-valve closing time to be taken without the MAC spacecraft control circuit.

TEMPERATURE SHOCK TEST

Description

Unit 1 was placed in a 185 F temperature chamber and exposed to this environment 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 to be subjected to a functional test.

Results

The temperature exposure portion of the test was successfully completed; however, the functional test was delayed because the late arrival of an item of test equipment. Testing was continued as authorized by Rocketdyne Internal Letter 4388-5367 (page 301 Appendix D). The temperature shock test was then successfully completed.

MISSION DUTY CYCLE-TO-FAILURE TEST

Description

Prior to mission duty cycle (MDC) testing of Unit 1, the simulated spacecraft system tube extensions were replaced by short tube stub connectors (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." Unit 1 was then installed in the hot-fire test facility and was subjected to a mission duty cycle-to-failure test. The first portion of the mission duty cycle 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 mission duty cycle consisted of the pulses as described in Table II, page 450 of Appendix D. This portion of the MDC was conducted at a simulated altitude in excess of 100,000 feet and at local ambient temperature. Immediately following the pulse portion of the MDC, the third portion, a steady-state test to failure, was conducted.

Results

The DAT mission duty cycle-to-failure test was successfully completed. Failure occurred after 331 seconds of burn time when the nozzle section of the TCA was expelled. Failure was defined as skin temperature in excess of 700 F.

DISSAMBLY AND INSPECTION

Description

Unit 1 was visually inspected for any defects, damage, or abnormal wear. A record was made of pertinent items of condition visible prior to disassembly. The disassembly consisted of (1) removal of the MAC propellant-valve support bracket, (2) removal of the propellant valves, (3) sectioning of the propellant valves at the fabrication welds, (4) disassembly of the propellant valve internal parts, and (5) 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 revealed the following: (1) the nozzle section, including the throat, had separated from the remainder of the thrust chamber just above the throat; (2) A 5/8-inch-diameter hole was burned in the stainless-steel shell 3 inches forward of the exit flange; (3) five JTA chamber-liner segments were missing and the remaining two were eroded and broken; (4) the injector splash plate was eroded at all impingement points; (5) the combustion chamber ablative sleeve was eroded in all areas where the JTA liner segments were missing; and (6) the stainless-steel shell was damaged because of high temperature just downstream of the nozzle failure point.

The postdisassembly inspection revealed, in addition to verification of the predisassembly items, the following: (1) there were no propellant

valve discrepancies, (2) there was deterioration of the MAC-added potting compound between the stainless-steel shell and the thrust chamber body, and (3) the combustion chamber area was charred through to the asbestos insulation.

TEST DESCRIPTION AND RESULTS, UNIT 1A

The mechanical shock test that was originally scheduled to be conducted on TCA Unit 1, was conducted on Unit 1A, since Unit 1 had been modified by MAC for the vibration test. Unit 1 did not represent the "as shipped from Rocketdyne" configuration, and the objective of this test was to verify the ability of the TCA to withstand shock in the shipping container.

VISUAL INSPECTION

Description

Unit 1A was inspected to ensure that it was of the proper configuration, undamaged, and had been subjected to and passed an acceptance test per Rocketdyne Specification RA0220-349.

Unit 1A had previously been subjected to a visual inspection; however, because of damage of the fuel inlet tube during handling, it had been removed from the program. Prior to submittal for inspection as Unit 1A, the oxidizer inlet tube adapter, which had been installed during the original visual inspection, was removed and the fuel inlet tube stub was replaced to bring the TCA to the configuration required for the mechanical shock test.

Results

The visual inspection was successfully completed.

MECHANICAL SHOCK TEST

Description

Unit 1A was placed in the standard Rocketdyne shipping container 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. A functional test was conducted after completion of the mechanical shock test.

Results

The mechanical shock test was successfully completed.

TEST DESCRIPTION AND RESULTS, UNIT 2

VISUAL INSPECTION

Description

Unit 2 was inspected to ensure that it was of the proper configuration, undamaged, and had been subjected to and passed an acceptance test per Rocketdyne Specification RA0220-349. The unit was then modified by the addition of special tube stub connectors (P/N 99-106126)

to the existing propellant valve inlet tube stubs. Installation of the connectors was accomplished per Rocketdyne Specification RA0607-009, "In-Place Brazing of Tubes and Fittings for Space Engines."

Results

The visual inspection was successfully completed.

OXIDIZER PROPELLANT VALVE CONTINUOUS DUTY TEST

Description

Unit 2 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 a functional test.

Results

The propellant valve continuous duty test was successfully completed.

MISSION DUTY CYCLE-TO-IN-SPECIFICATION LIFE
AND HOT-FIRE BURST TEST

Description

Prior to the mission duty cycle test, Unit 2 was reworked by removing the propellant metering orifices. The unit was then installed in the hot-fire

test facility, and the propellant metering orifices were installed in special orifice adapters (P/N 99-106726 and 99-106727). These 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 test and, later, bypass the orifices during the high-chamber-pressure burst test.

The first portion of the mission duty cycle was a "cape firing cycle" conducted at local ambient pressure and temperature conditions. After this firing cycle, the TCA was allowed to return to ambient temperature.

The second portion of the mission duty cycle consisted of pulses, as described in Table II, page 450 of Appendix D, up to the specification life duration. Following the MDC, the TCA shell temperature was allowed to reach the maximum value resulting from thermal soak out.

During the temperature soak out period following the MDC, the propellant tank pressures were raised to 750 psig and the orifice adapter bypass valves were opened. After all thermocouples had peaked and dropped 5 F, a 3-second steady-state burst-pressure firing was conducted at a chamber pressure of 222 psia. This was 78 psi lower than the 300 psia chamber pressure expected; however, it was more than adequate to verify structural integrity of the TCA.

Results

The DAT mission duty cycle-to-in-specification life and hot-fire burst test was successfully completed.

DISASSEMBLY AND INSPECTION

Description

Unit 2 was visually inspected for any defects, damage, or abnormal wear. 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 2 revealed the following: (1) the throat insert had hairline cracks in addition to those present prior to DAT testing, and (2) there were slight ablative delaminations in the nozzle.

Difficulty was experienced during sectioning, which resulted in shattering of the throat insert and the JTA combustion chamber liner segments and ragged edges on the ablative material.

In addition to verification of the predisassembly items, the postdisassembly inspection revealed the following: (1) there were no propellant valve discrepancies, (2) there were slight separations of the 90-degree ablative material immediately upstream of the throat and (3) the char immediately upstream of the throat extended out to the asbestos layer.

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 RA0220-349. The unit was then modified by the addition of special tube stub connectors (P/N 99-106126) to the existing propellant valve inlet tube stubs. The installation of the connectors was accomplished per Rocketdyne Specification RA0607-009, "In-Place Brazing of Tubes and Fittings for Space Engines."

Results

The visual inspection was successfully completed.

MISSION DUTY CYCLE-TO-GUARANTEED LIFE TEST

Description

Unit 3 was installed in the hot-fire test facility and subjected to a mission duty cycle-to-guaranteed life test. The first portion of the mission duty cycle 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 mission duty cycle consisted of the pulses as described in Table II, page 450 of Appendix D, up to the guaranteed life duration.

Results

The mission duty cycle-to-guaranteed life test was successfully completed.

EXPLOSIVE ATMOSPHERE TEST

Description

The propellant valves were to have been removed from Unit 3 prior to the start of the test. Unit 3 was placed in an explosive-atmosphere test chamber and conditioned to a temperature of 160 F. A potentially explosive atmosphere was created in the test chamber by the introduction of butane gas. The TCA was then tested for ignition of the atmosphere by actuating the propellant valves at several pressure altitudes between sea level and 50,000 feet. For each required pressure altitude, the valves were actuated as follows: ten actuations at a pressure altitude 5000 feet above the target level, then one actuation at each of 10 equally spaced levels down to 5000 feet below target pressure altitude, except at sea level. No tests were conducted at levels below sea level. The valves were energized with 26 vdc for 10 seconds during each actuation to demonstrate actuation without generating an explosion. Prior to the first actuation and after the final actuation, a sample of the gas in the chamber was removed and spark ignited to demonstrate combustibility.

Propellant valve functional tests were conducted prior to and following the explosive atmosphere exposure.

Results

To expedite testing, the valves were not removed from Unit 3 prior to the start of the test. Testing proceeded as authorized by Rocketdyne Internal Letter 4388-5371 (page 399 Appendix D). The explosive atmosphere test was successfully completed.

FUEL AND OXIDIZER RESISTANCE TEST

Description

The propellant valves were removed from the TCA, installed in the test facility, filled with propellants, and temperature conditioned to 160 F. The valves were then actuated three times during each 24-hour period at equally spaced intervals. Oscillograph recordings were made during each valve actuation to verify proper valve operation. The total exposure period was to be 2 weeks (336 hours). Functional tests were conducted on the valves following the propellant exposure period.

Results

The fuel and oxidizer resistance test was successfully completed. The following deviations were made to the original test schedule: the exposure time on the fuel valve was extended by 8 hours, and the exposure time on the oxidizer valve was extended by 16 hours. These extensions were necessary to make up for lost actuation and/or temperature records caused by facility malfunctions (reference Rocketdyne Internal Letter 4388-5375 page 420 and Internal Letter 4388-5376 page 421 Appendix D).

DISASSEMBLY AND INSPECTION

Description

Unit 3 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 propellant valves at the fabrication welds, (2) disassembly of the propellant 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

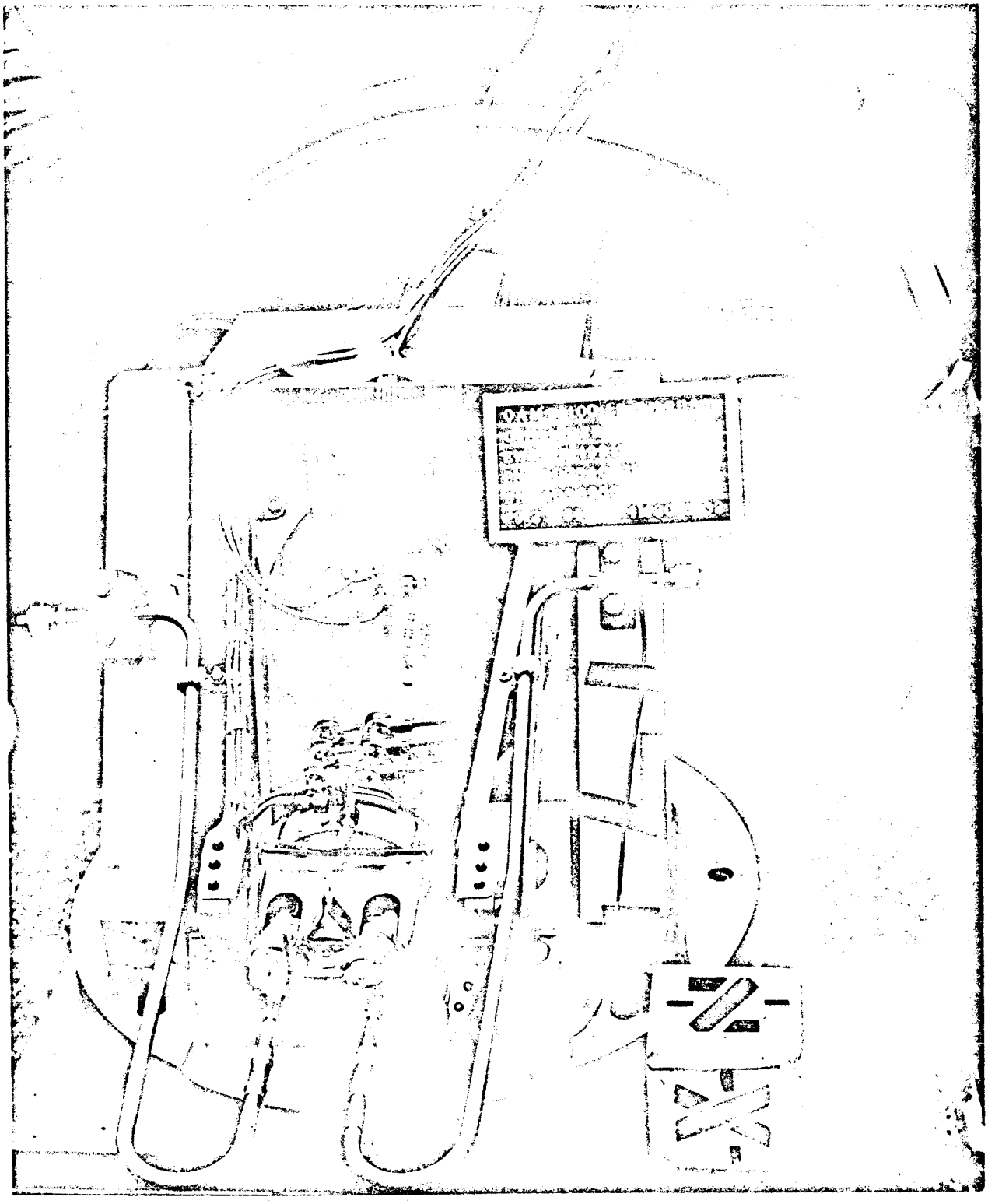
The predisassembly inspection of Unit 3 revealed the following: (1) there were slight delaminations of the ablative material in the nozzle area, (2) the throat insert contained hairline cracks, and (3) a JTA combustion-zone liner segment was missing immediately upstream of the throat, and the ablative combustion-zone sleeve was eroded at this point.

Difficulty was encountered in the chamber sectioning, which resulted in shattering of the throat insert and several JTA combustion-zone liner segments. The postdisassembly inspection of Unit 3 revealed the following: (1) the erosion where the JTA segment was missing continued between the throat insert and the body; (2) there were delaminations of the ablative material, particularly immediately upstream of the throat; (3) the char immediately upstream of the throat extended out to the asbestos; and (4) no propellant valve discrepancies were found.

APPENDIX A

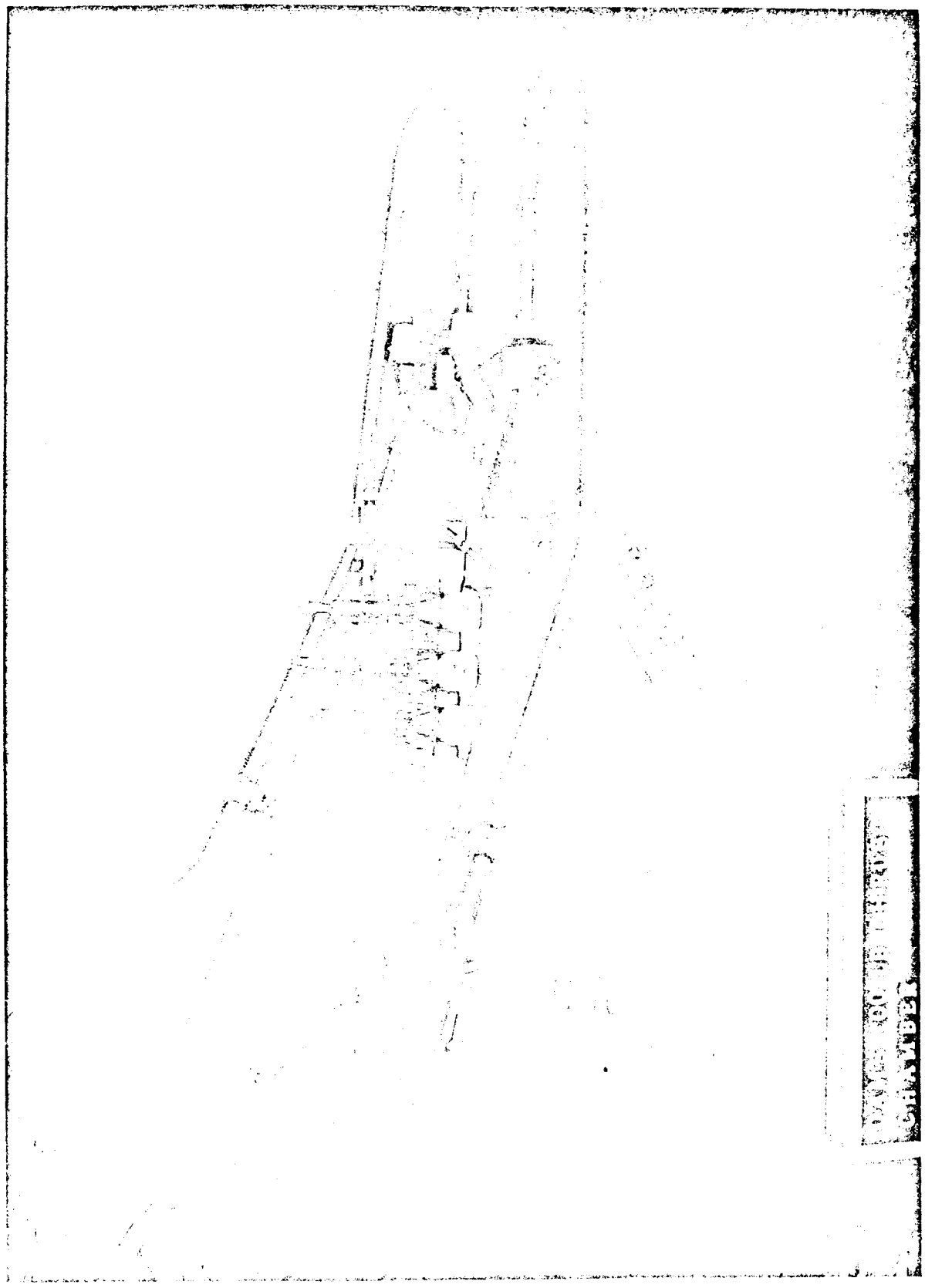
APPENDIX A

PHOTOGRAPHS OF TESTS AND TEST EQUIPMENT



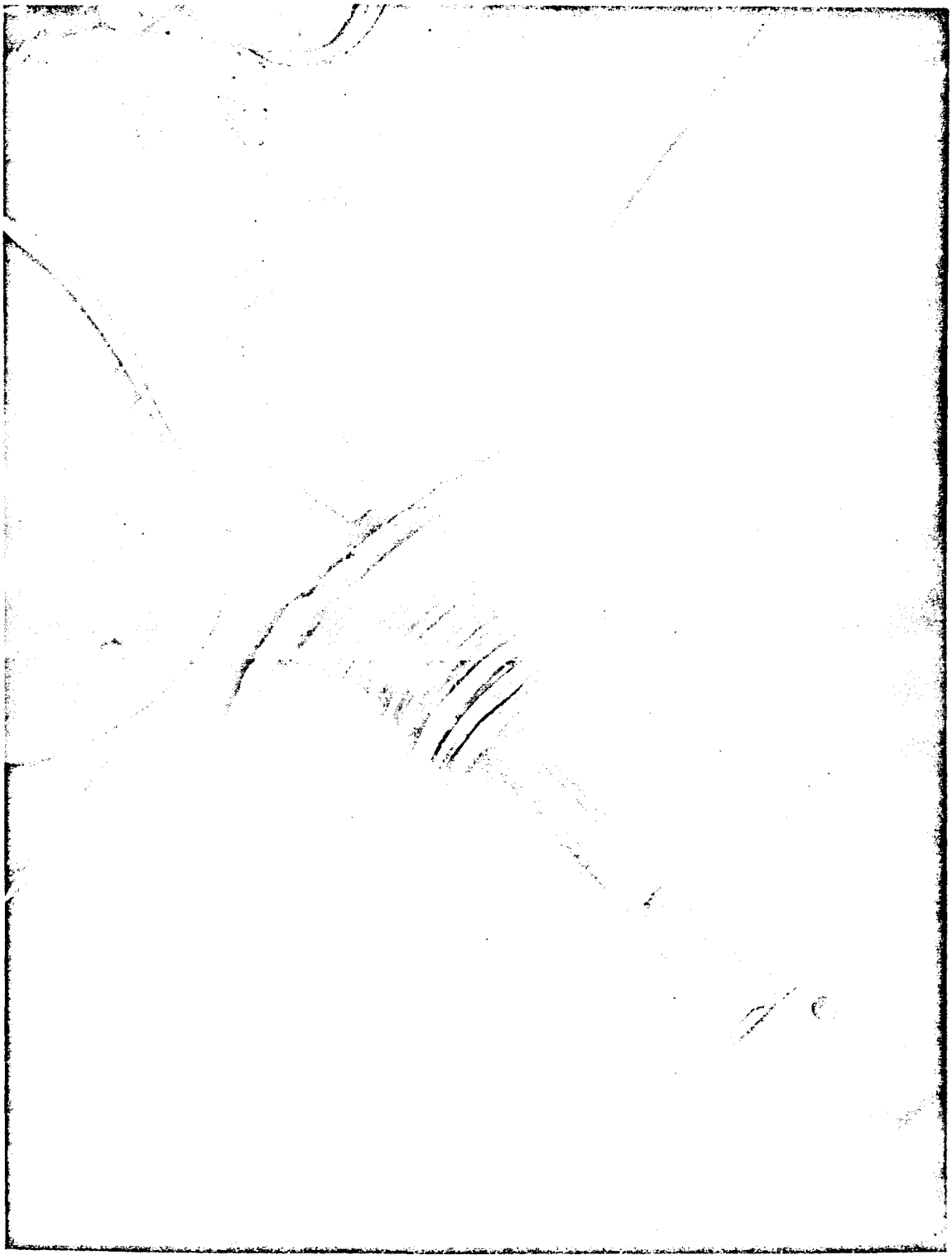
1HE33-9/23/64-C1

Figure 4 . 100-Pound-Thrust OAMS TCA Unit No. 1, Vibration Test



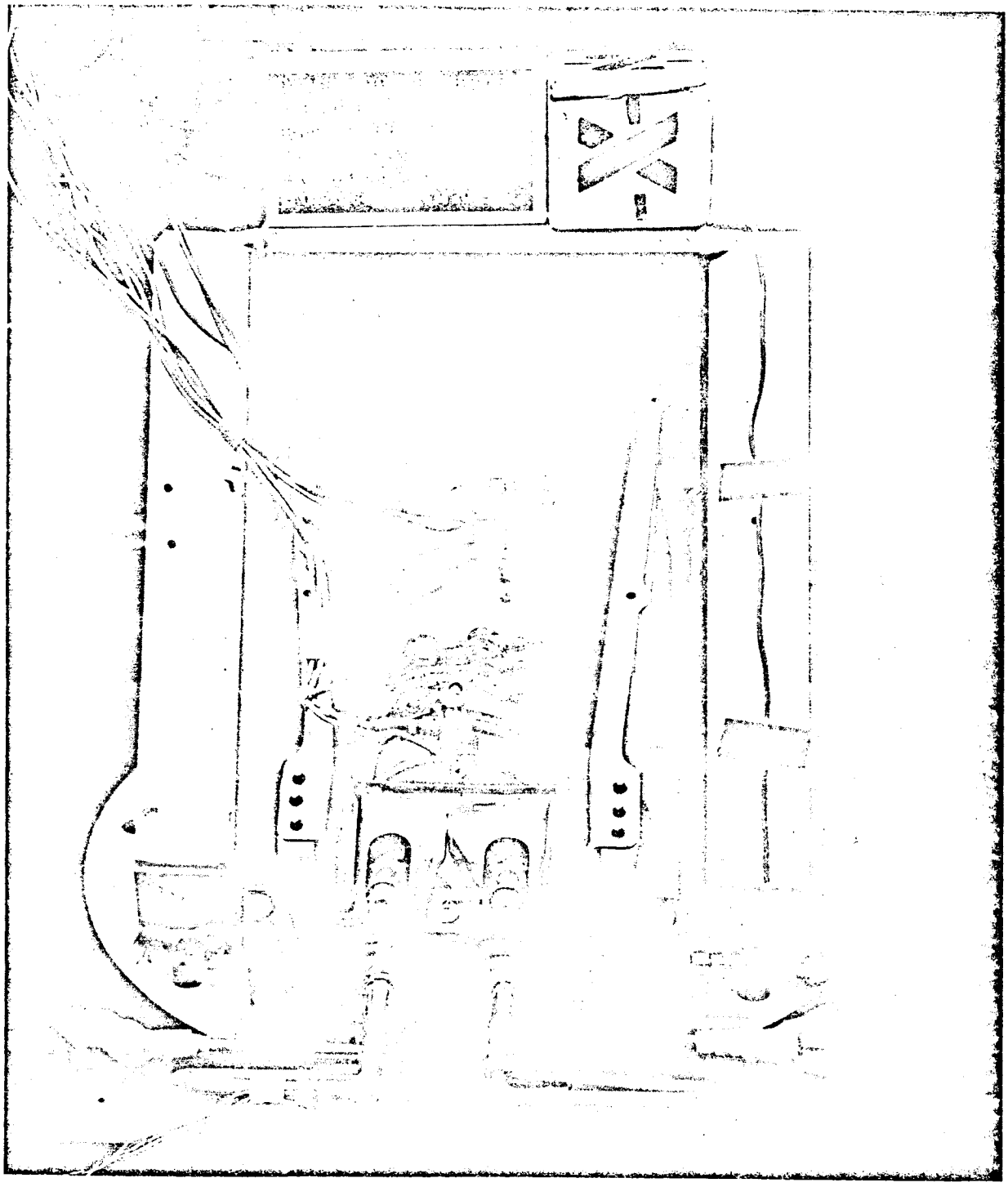
1HE35-9/23/64-C1C

Figure 5. 100-Pound-Thrust OAMS TCA Unit No. 1, Vibration Test



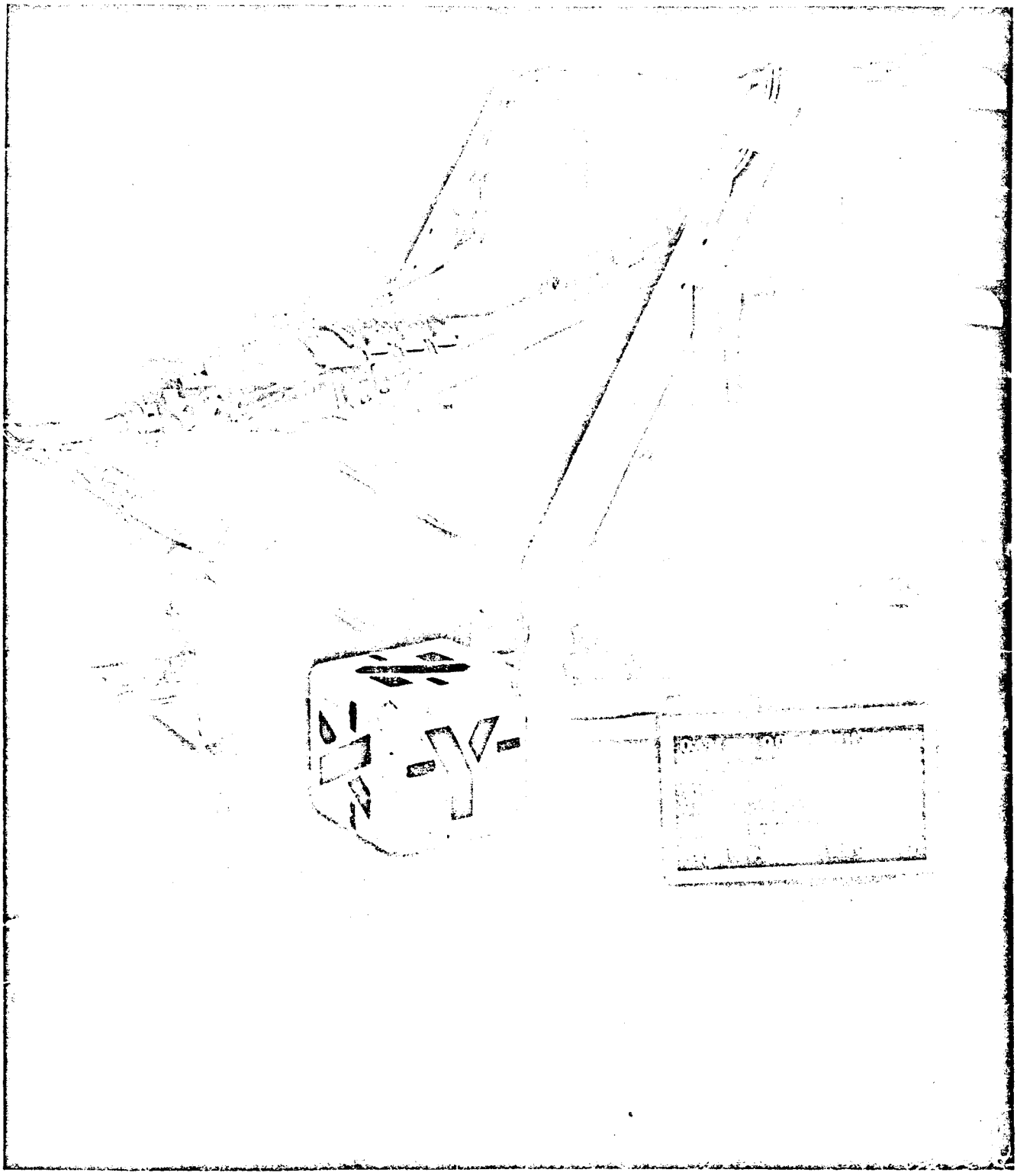
1HE35-9/23/64-C1A

Figure 6. 100-Pound-Thrust OAMS TCA Unit No. 1, Fuel Inlet Tube Failure Vibration Test



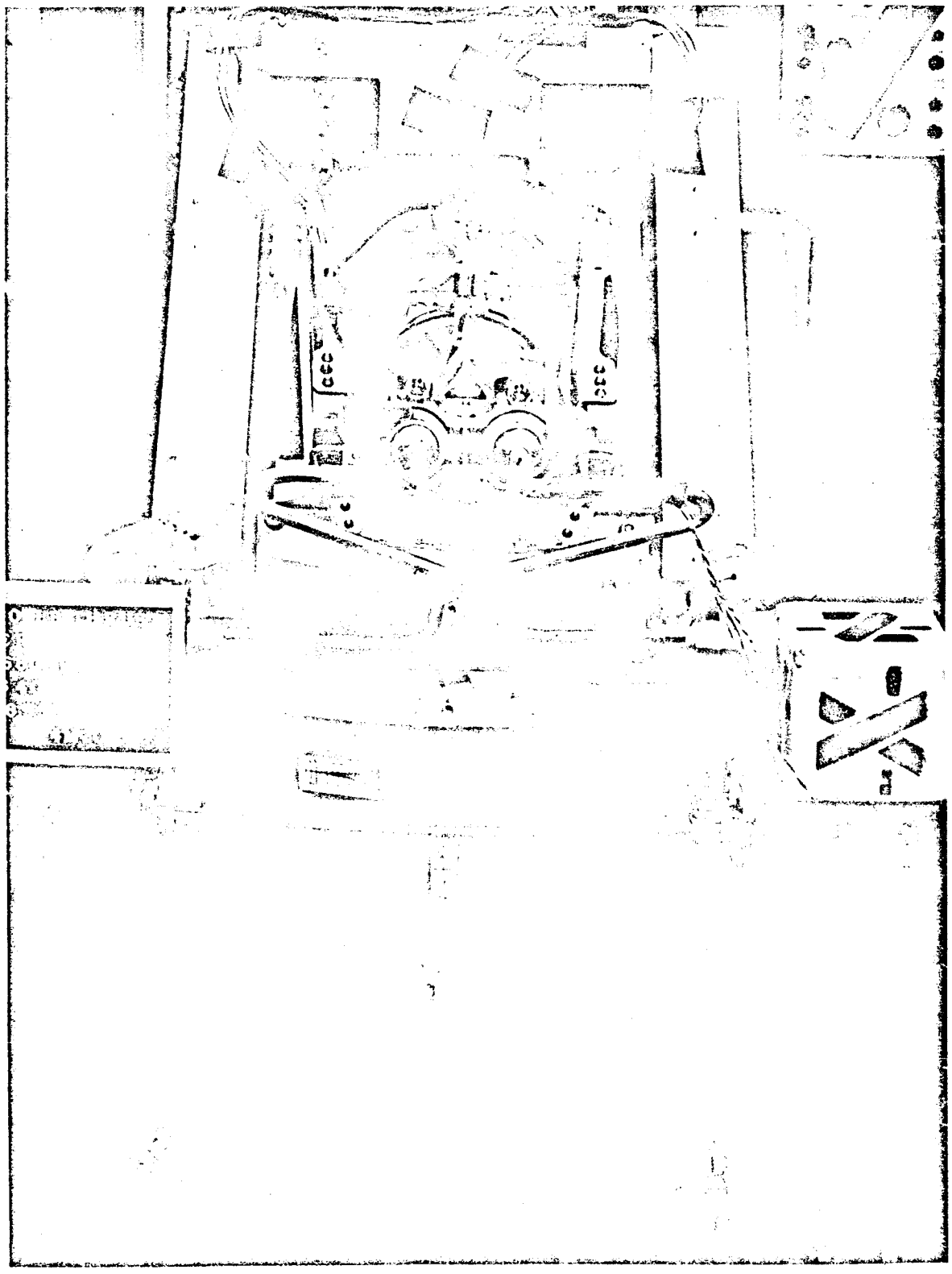
1ED34-10/23/64-C1

Figure 7. 100-Pound-Thrust OAMS TCA Unit No. 1, Vibration Test (Rerun)



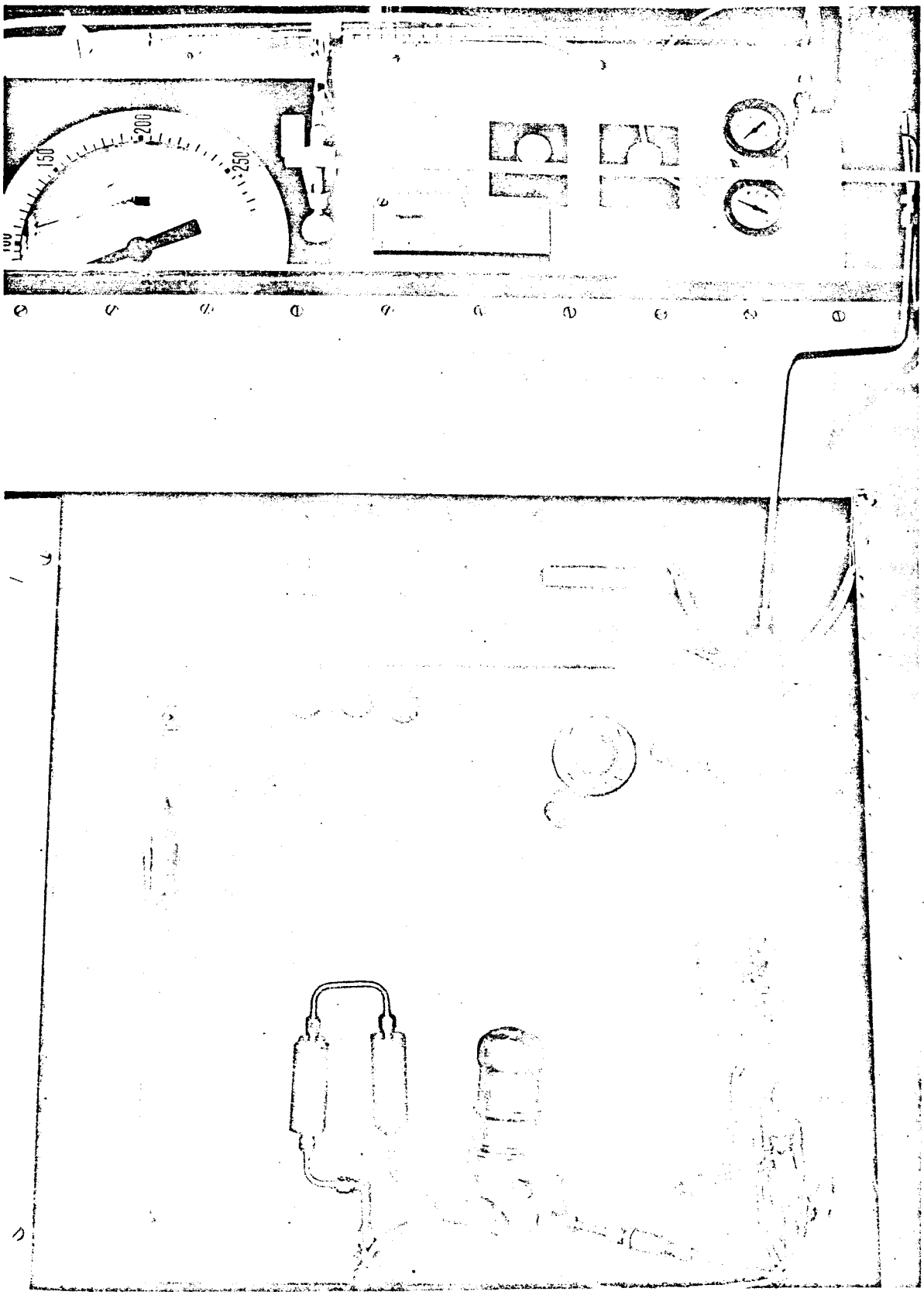
1HD34-10/26/64-C1A

Figure 8. 100-Pound-Thrust OAMS TCA Unit No. 1, Vibration Test (Rerun)



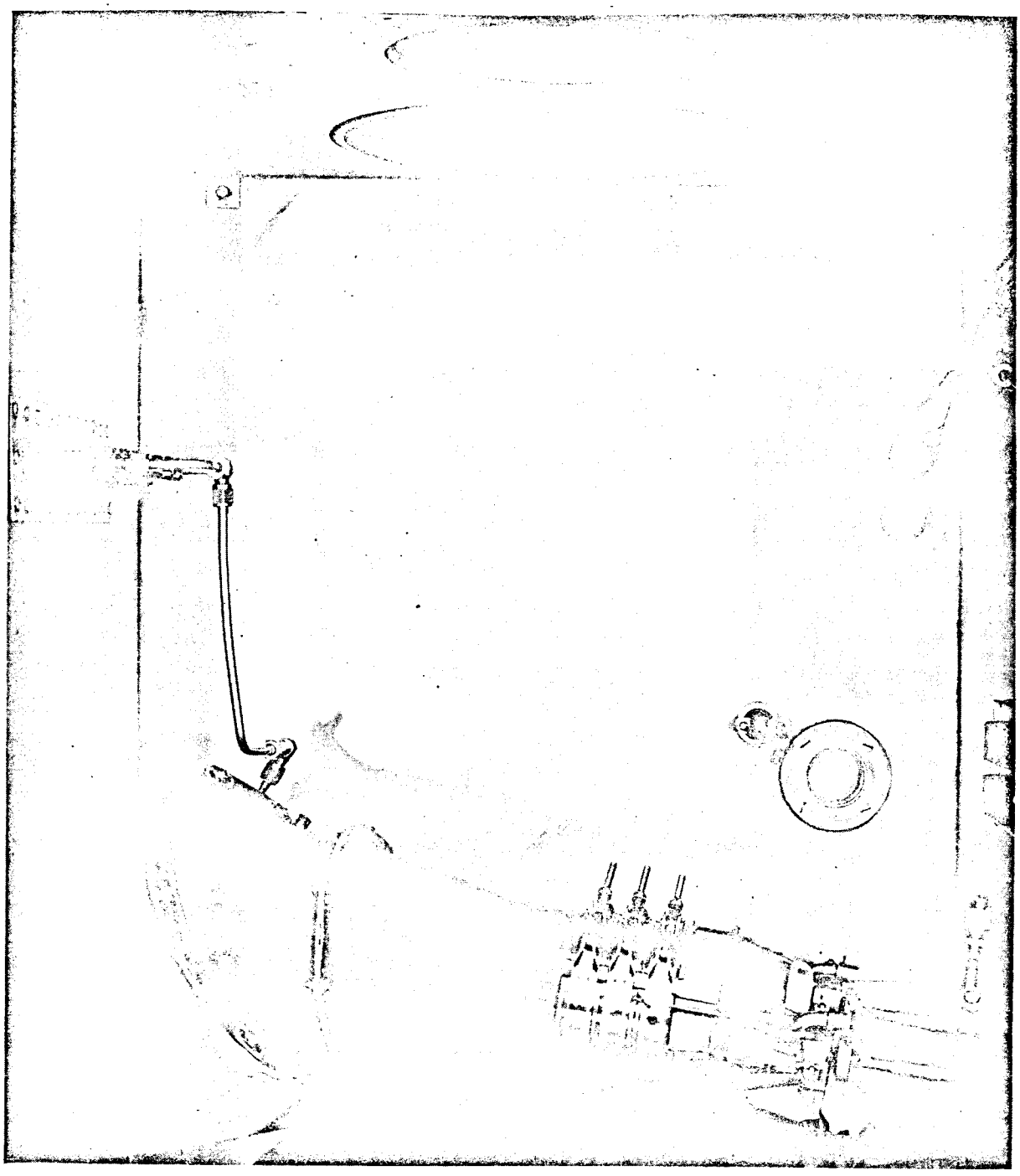
1HD34-10/26/64-C1B

Figure 9. 100-Pound-Thrust OAMS TCA Unit No. 1, Vibration Test (Rerun)



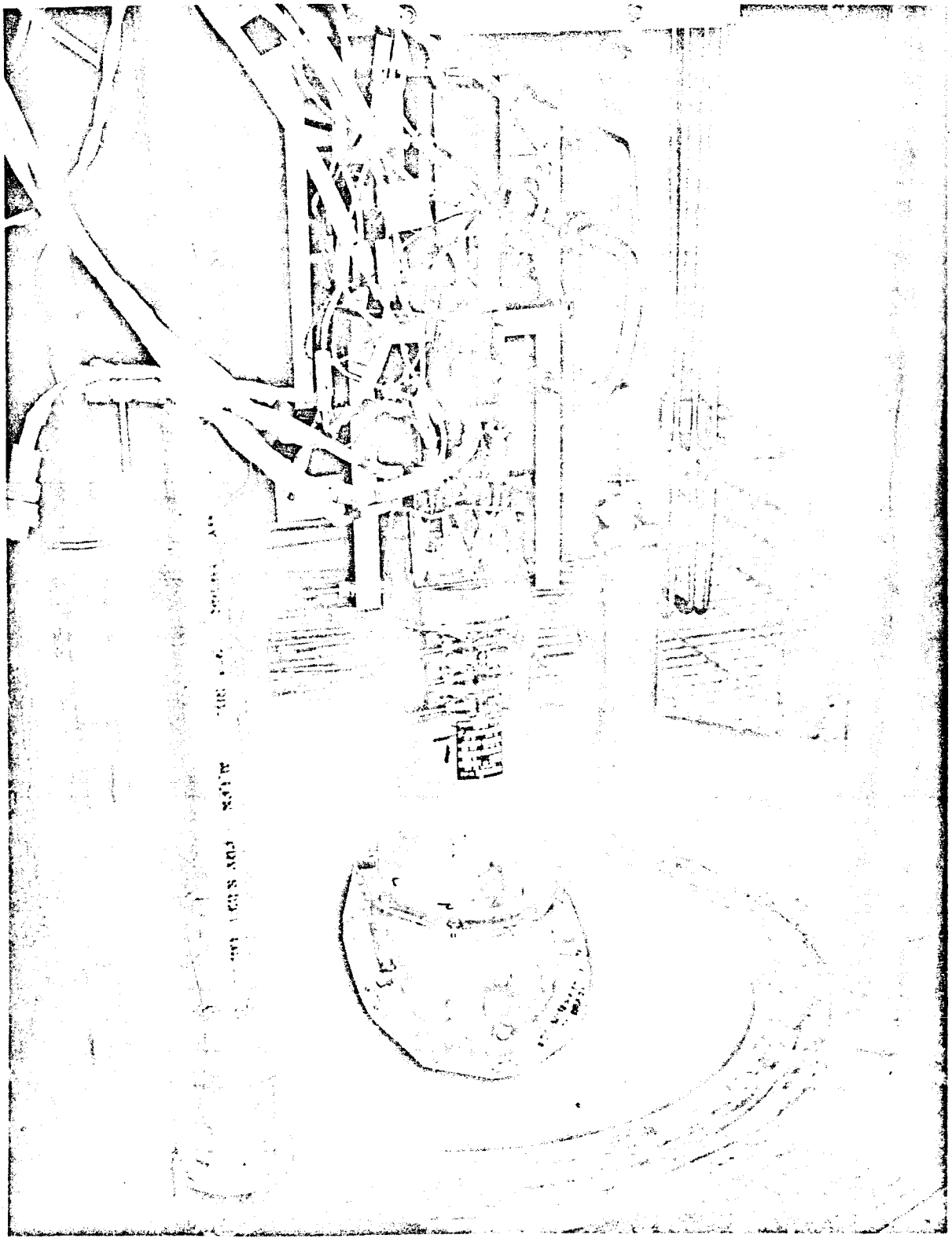
1HD64-12/4/64-C1

Figure 10. 100-Pound-Thrust OAMS TCA Unit No. 1, Proof Pressure and Leakage Test



1HD34-12/4/64-C1B

Figure 11 . 100-Pound-Thrust OAMS TCA Unit No. 1, Temperature Shock Test

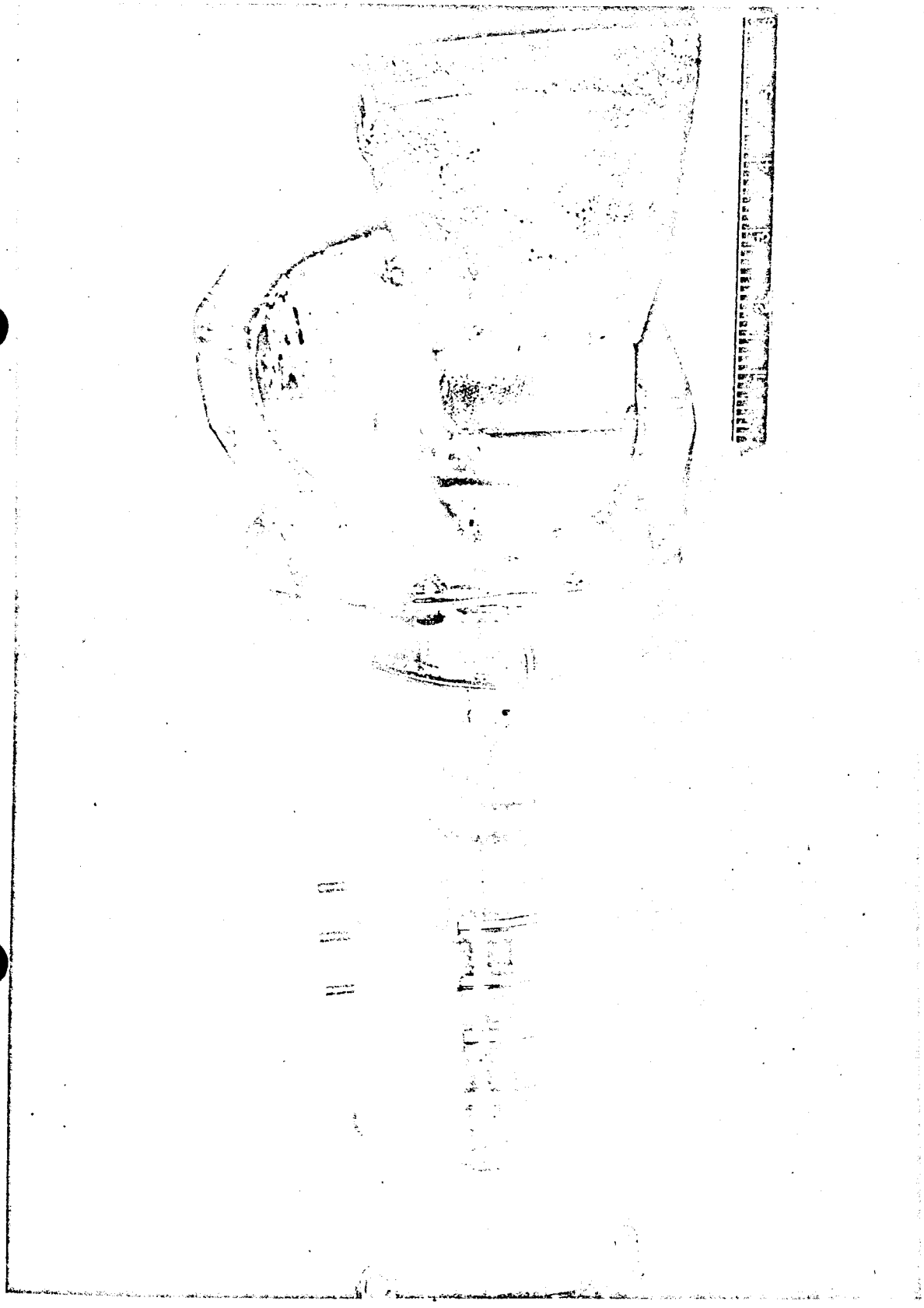


1HE32-11/10/64-S1A

Figure 12. 100-Pound-Thrust OAMS TCA Unit No. 1, Hot-Fire Test Setup, Cell 39K

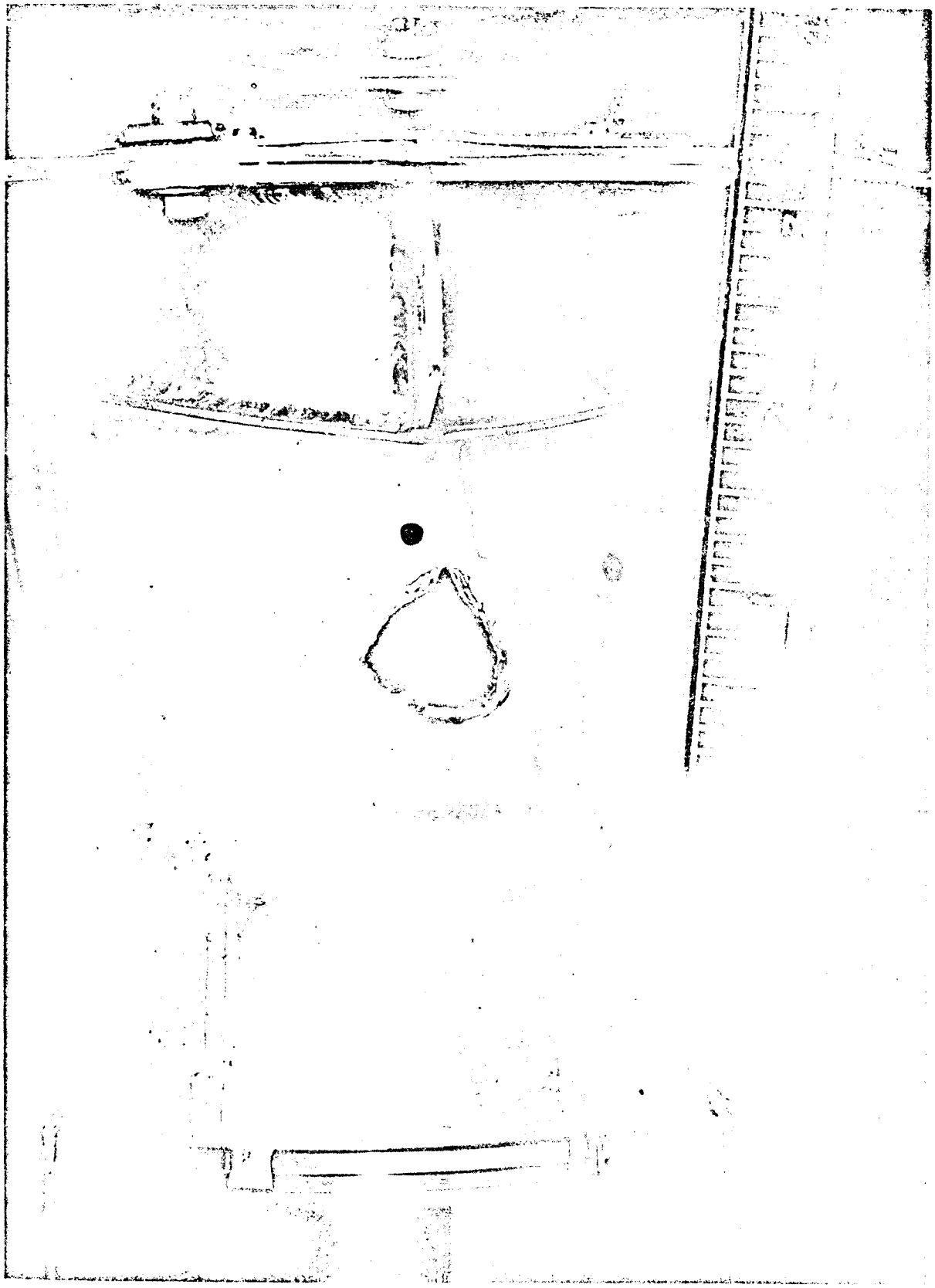
1HE32-11/10/64-S1B

Figure 13. 100-Pound-Thrust OAMS TCA Unit No. 1, Hot-Fire Test Setup, Cell 39K



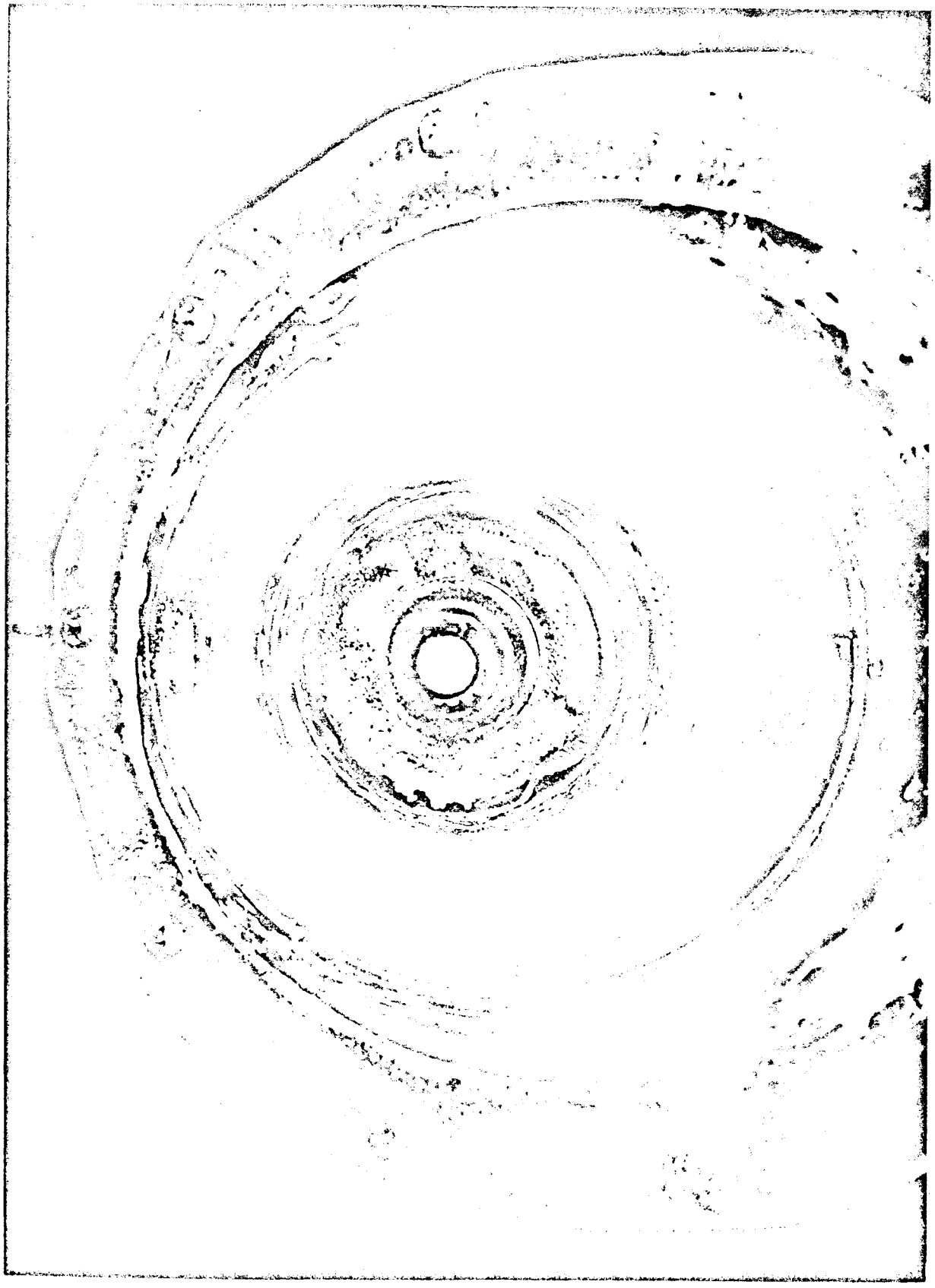
1HE22-11/16/64-S1A

Figure 14. 100-Pound-Thrust OAMS TCA Unit No. 1, Post Hot-Fire MDC to Failure



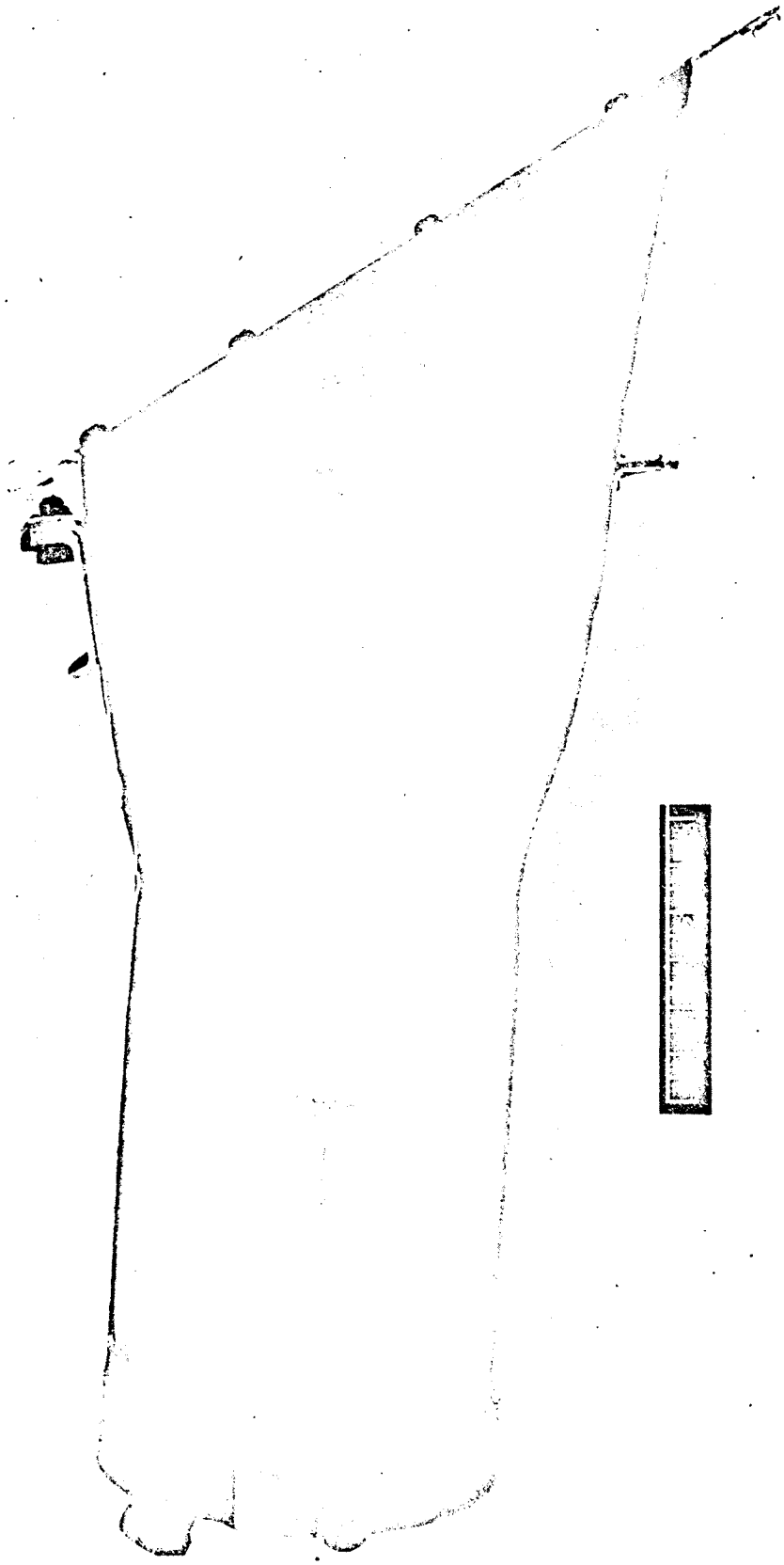
1HE22-11/16/64-S1B

Figure 15. 100-Pound-Thrust OAMS TCA Unit No. 1, Post Hot-Fire MDC to Failure



1HE22-11/16/64-S1D

Figure 16. 100-Pound-Thrust OAMS TCA Unit No. 1, Post Hot-Fire MDC to Failure



1HE35-4/23/65-C1B

Figure 17. 100-Pound-Thrust OAMS TCA Unit No. 1, MDC to Failure, Disassembly and Inspection

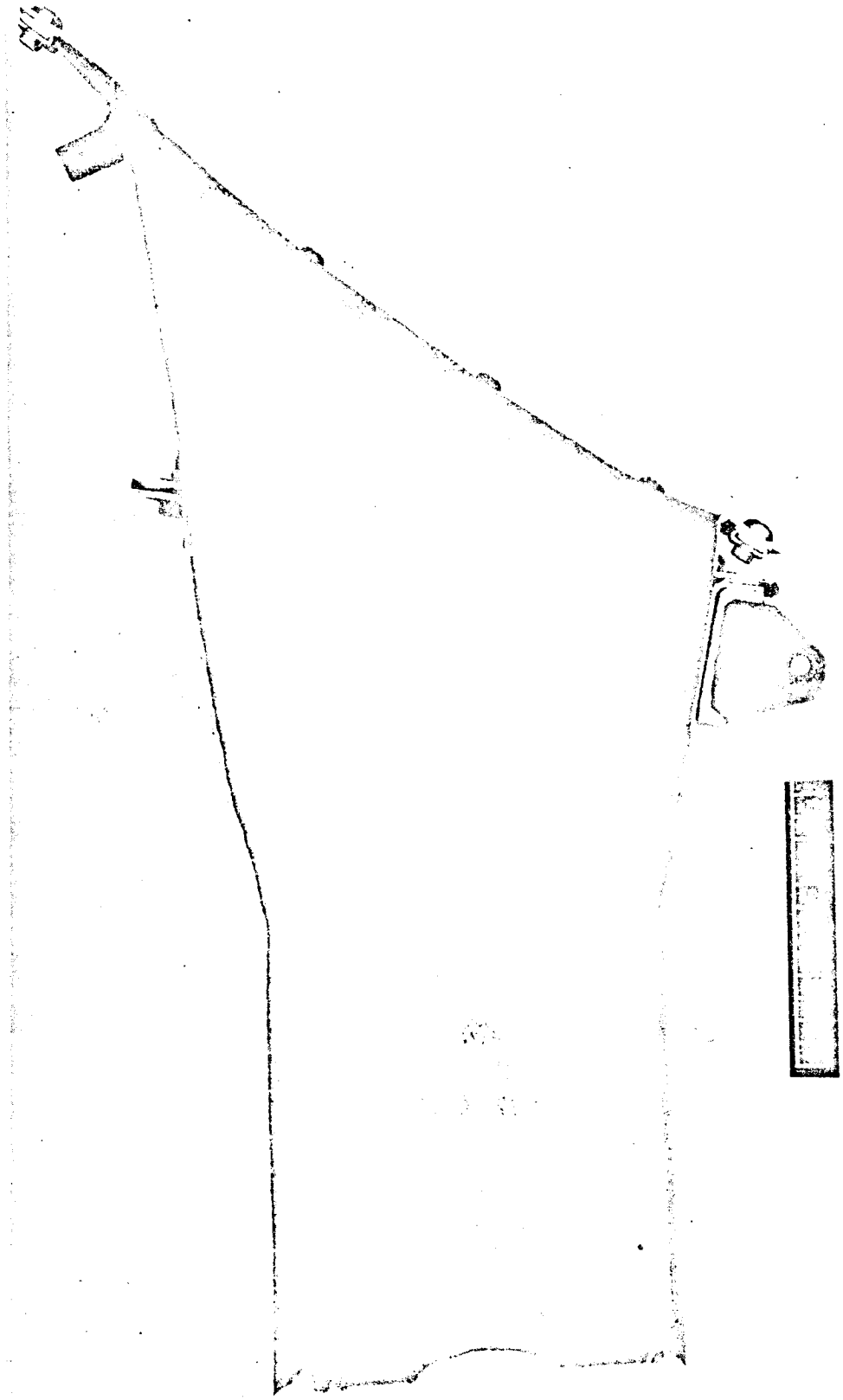
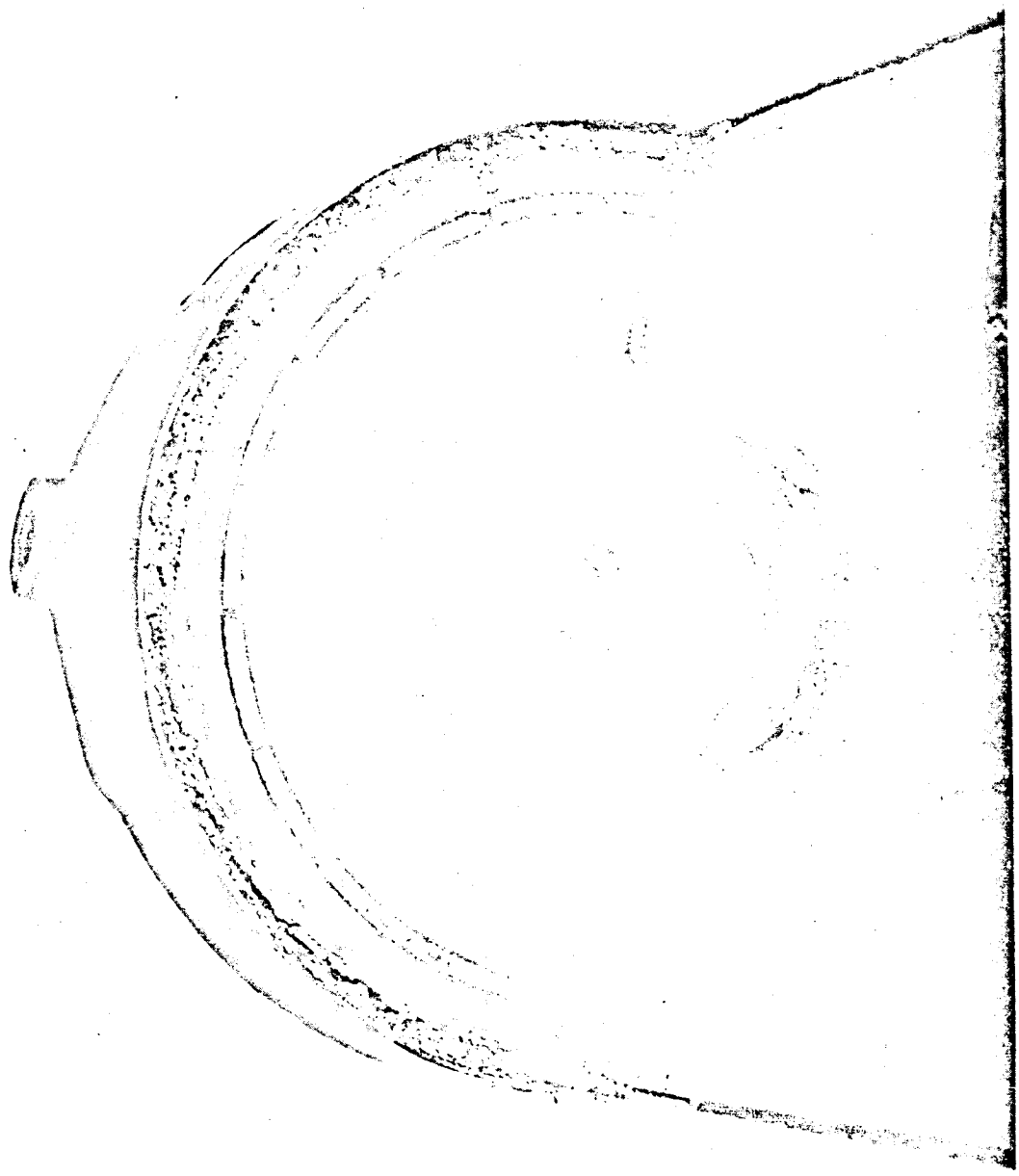
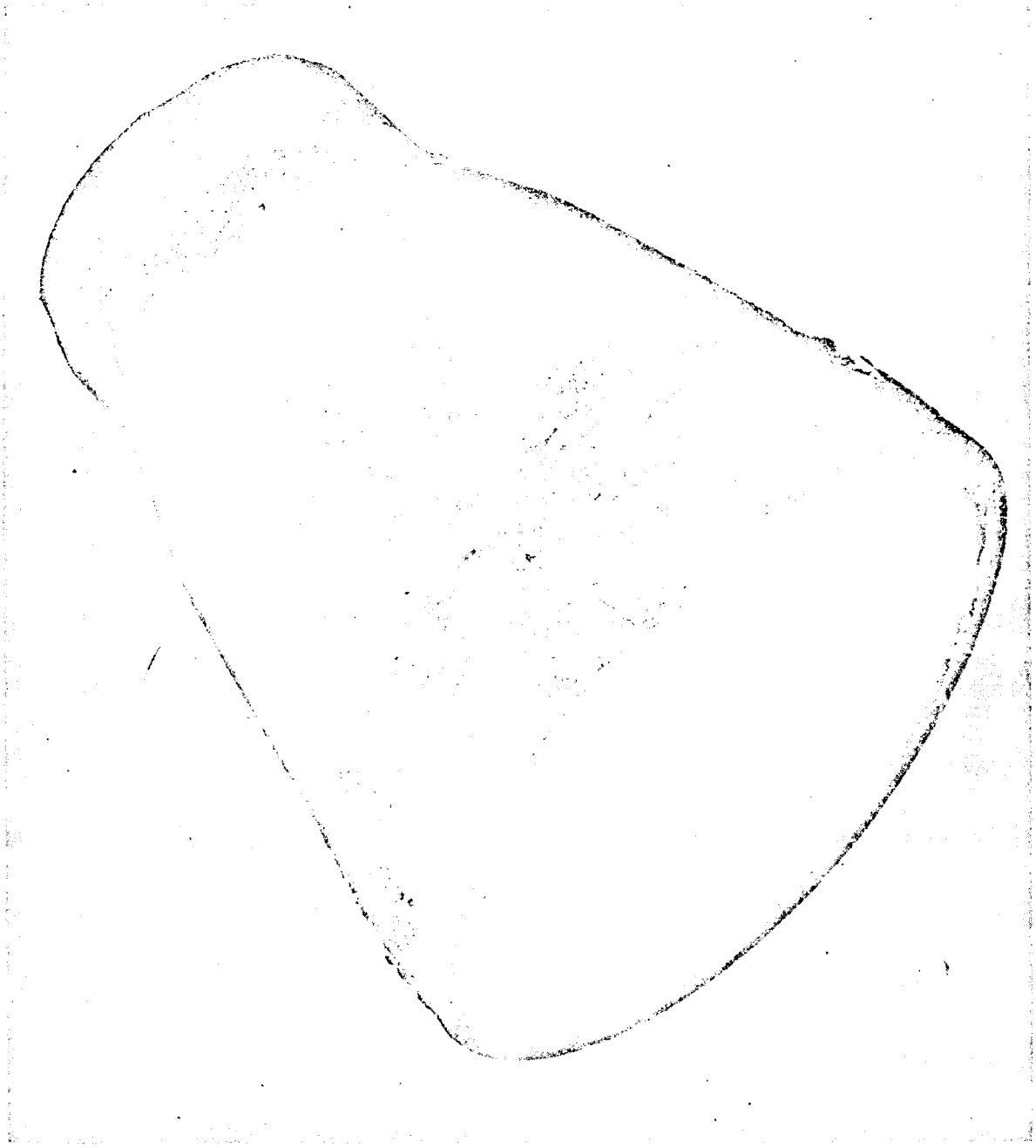


Figure 18. 100-Pound-Thrust OAMS TCA Unit No. 1, MDC to Failure, Disassembly and Inspection



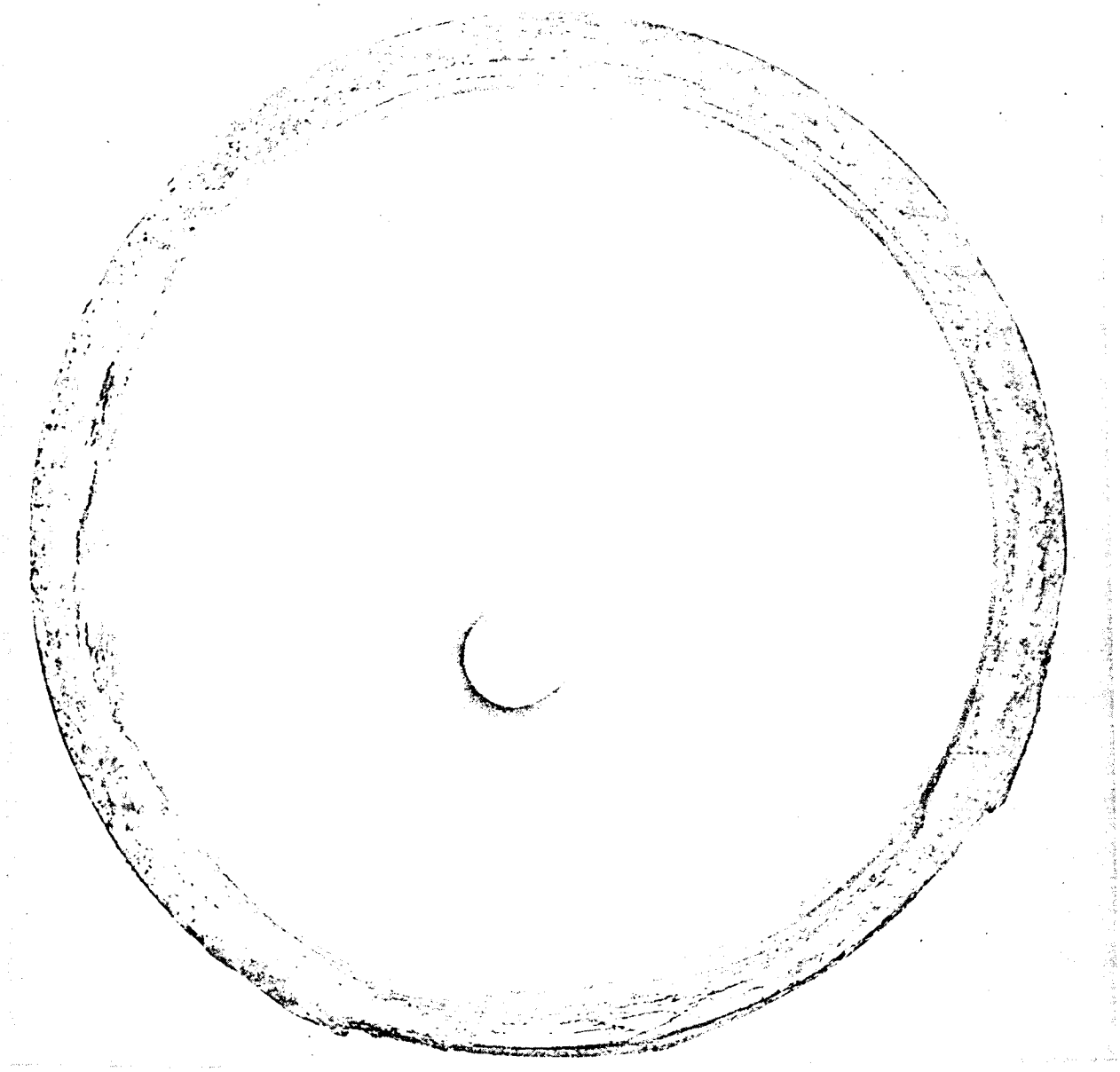
1HE35-4/23/65-C1C

Figure 19. 100-Pound-Thrust QAMS TCA Unit No. 1, MDC to Failure, Disassembly and Inspection



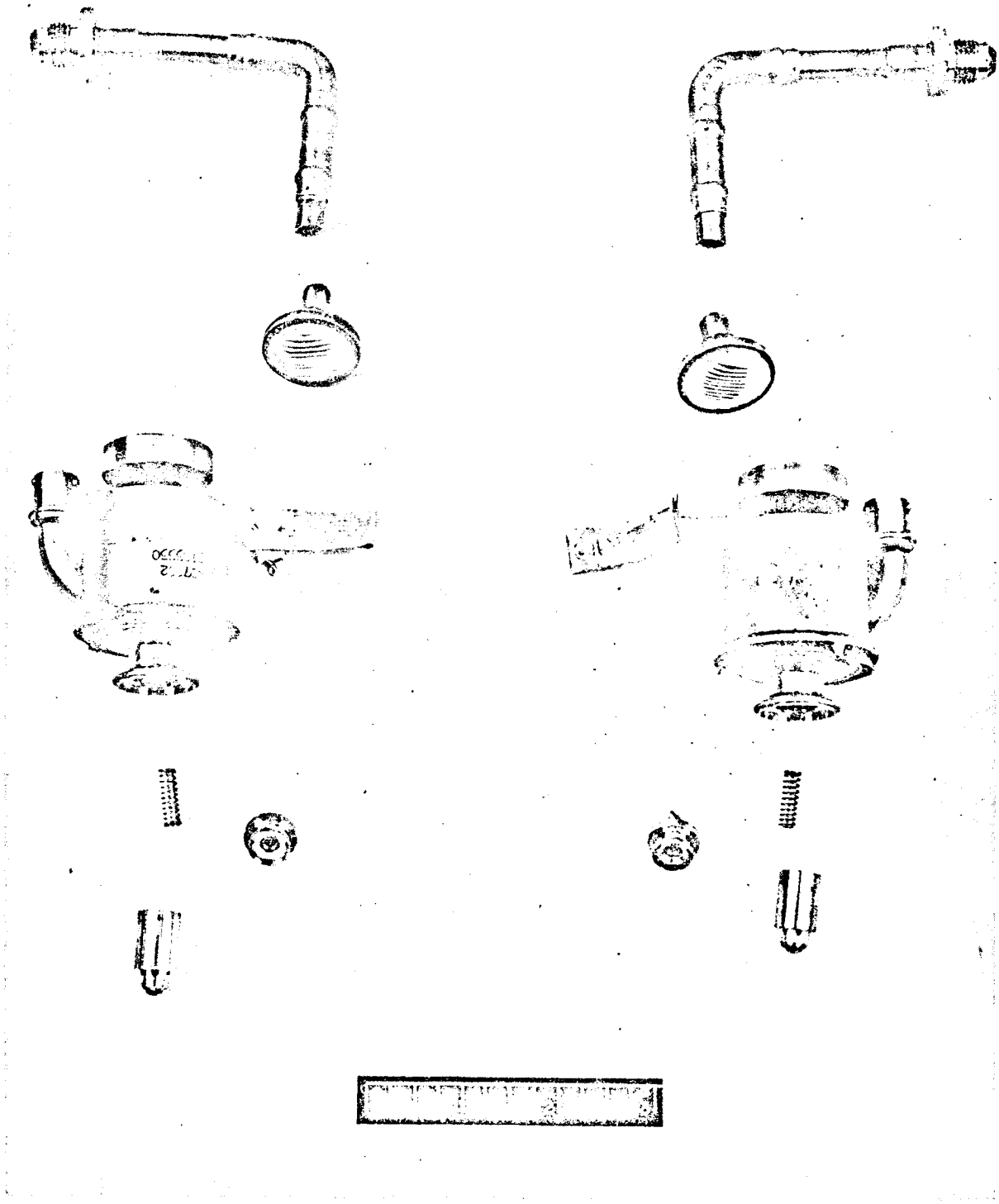
1HE35-4/23/65-C1D

Figure 20. Nozzle From 100-Pound-Thrust OAMS TCA Unit No. 1, MDC to Failure, Disassembly and Inspection



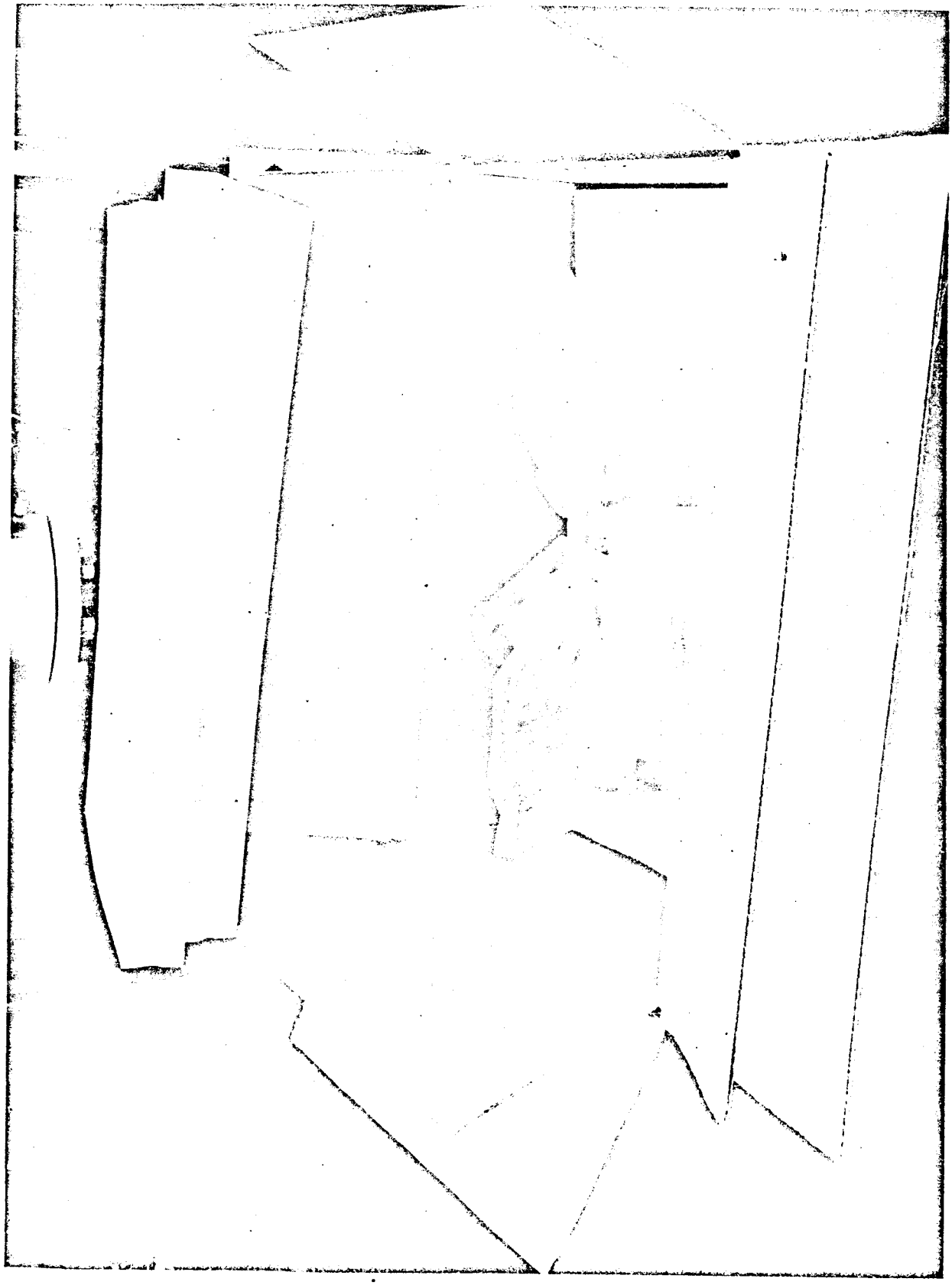
1HE35-4/23/65-C1E

Figure 21. Nozzle From 100-Pound-Thrust OAMS TCA Unit No. 1, MDC to Failure, Disassembly and Inspection



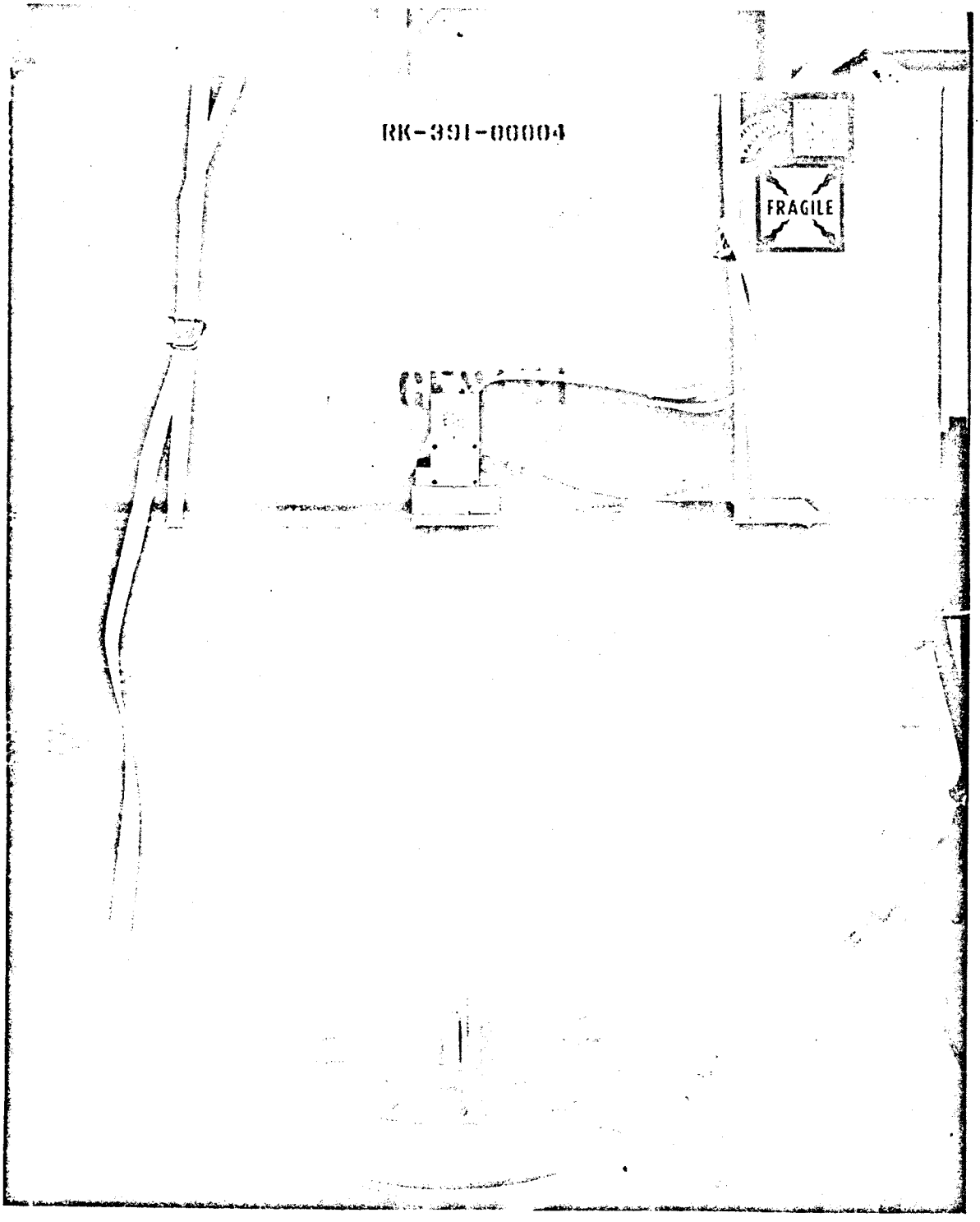
1HE35-4/19/65-C2

Figure 22. Propellant Valves From 100-Pound-Thrust OAMS TCA Unit No. 1, MDC to Failure, Disassembly and Inspection



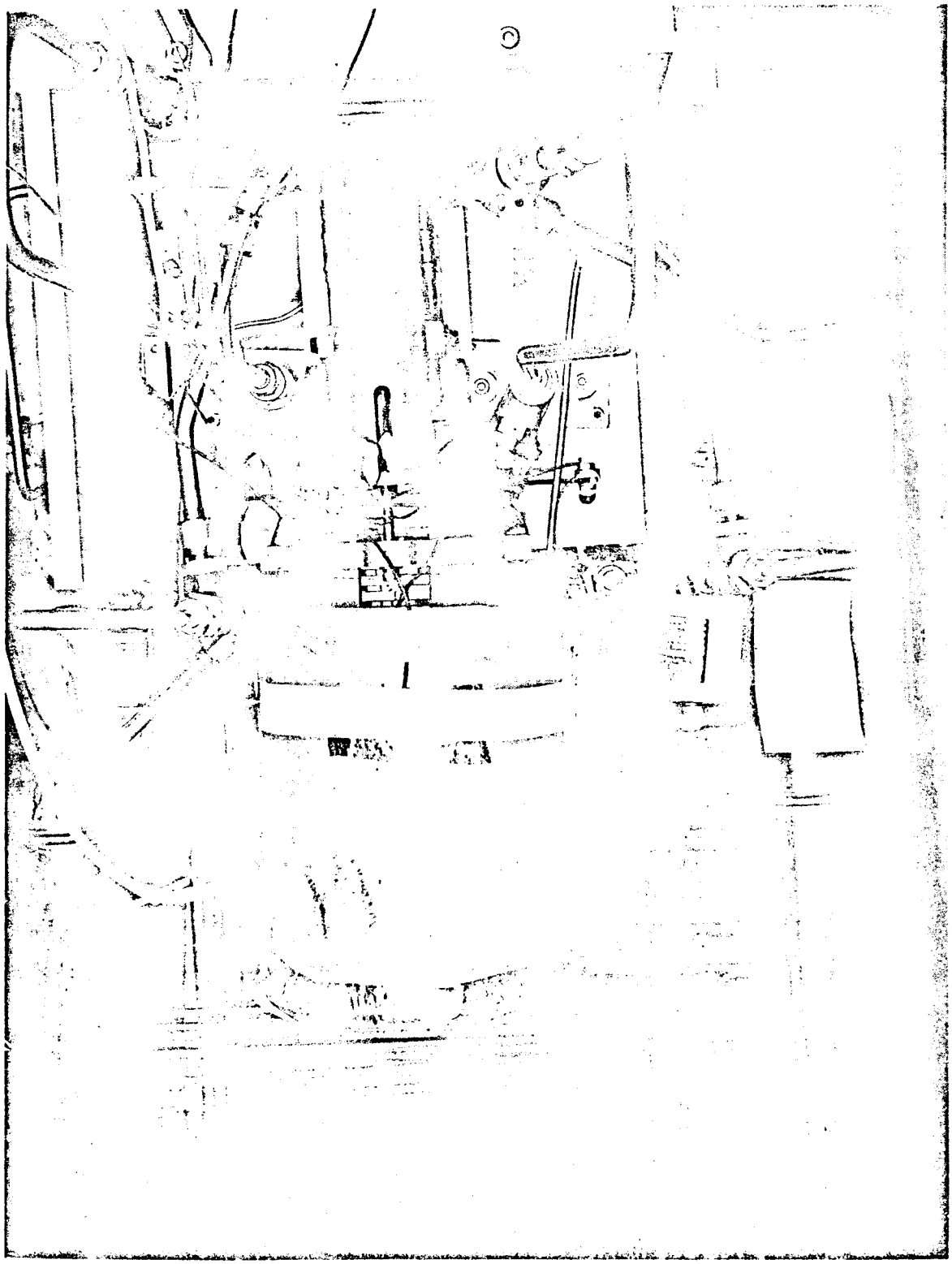
1HD33-11/13/64-C1A

Figure 23. 100-Pound-Thrust OAMS TCA Unit No. 1A, Mechanical Shock Test



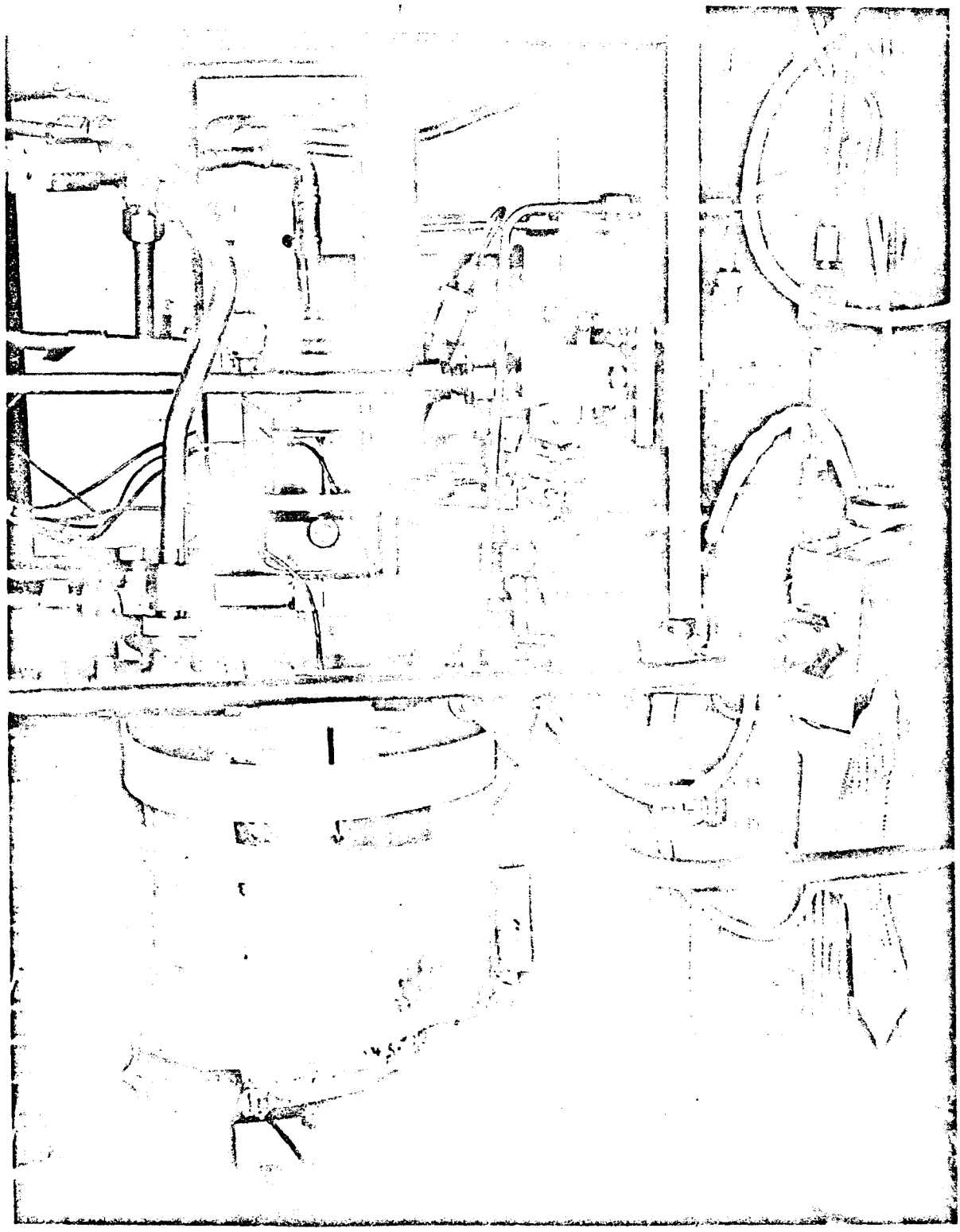
1HD33-11/13/64-C1B

Figure 24. 100-Pound-Thrust OAMS TCA Unit No. 1A, Mechanical Shock Test



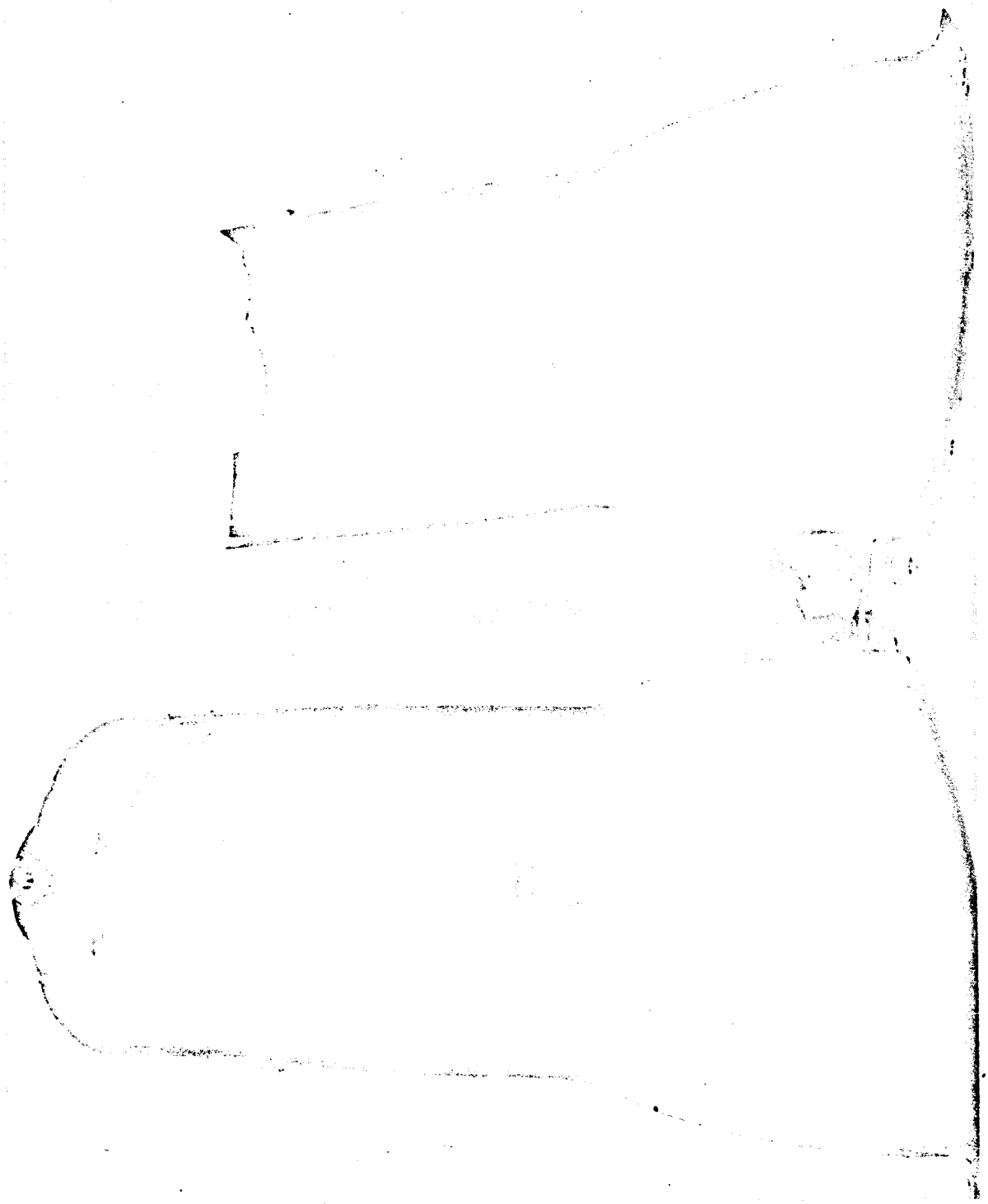
1HE27-10/21/64-S1A

Figure 25. 100-Pound-Thrust OAMS TCA Unit No. 2, Hot-Fire Test Setup, Cell 39K



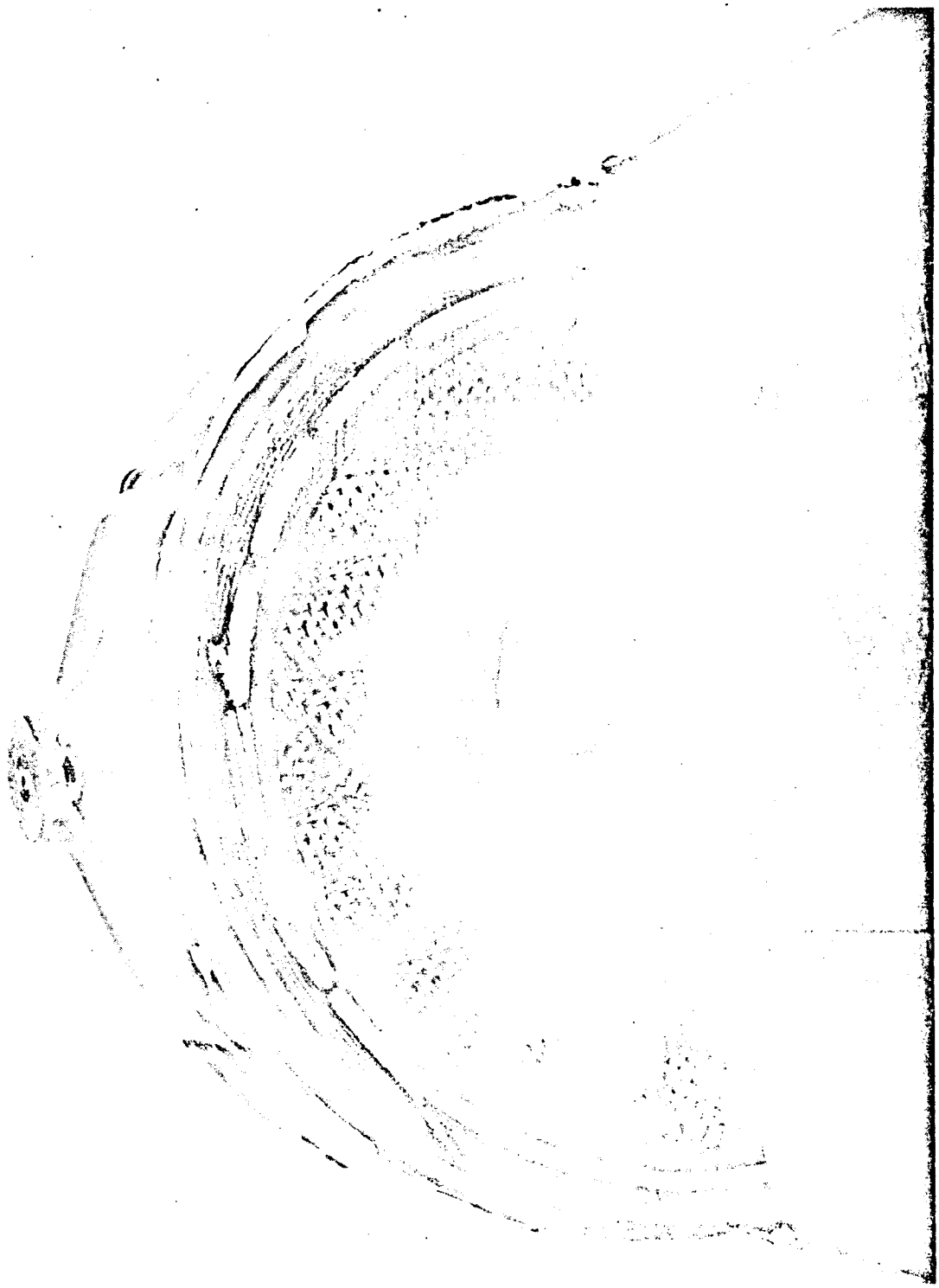
1HE27-10/21/64-S1B

Figure 26. 100-Pound-Thrust OAMS TCA Unit No. 2, Hot-Fire Test Setup, Cell 39K



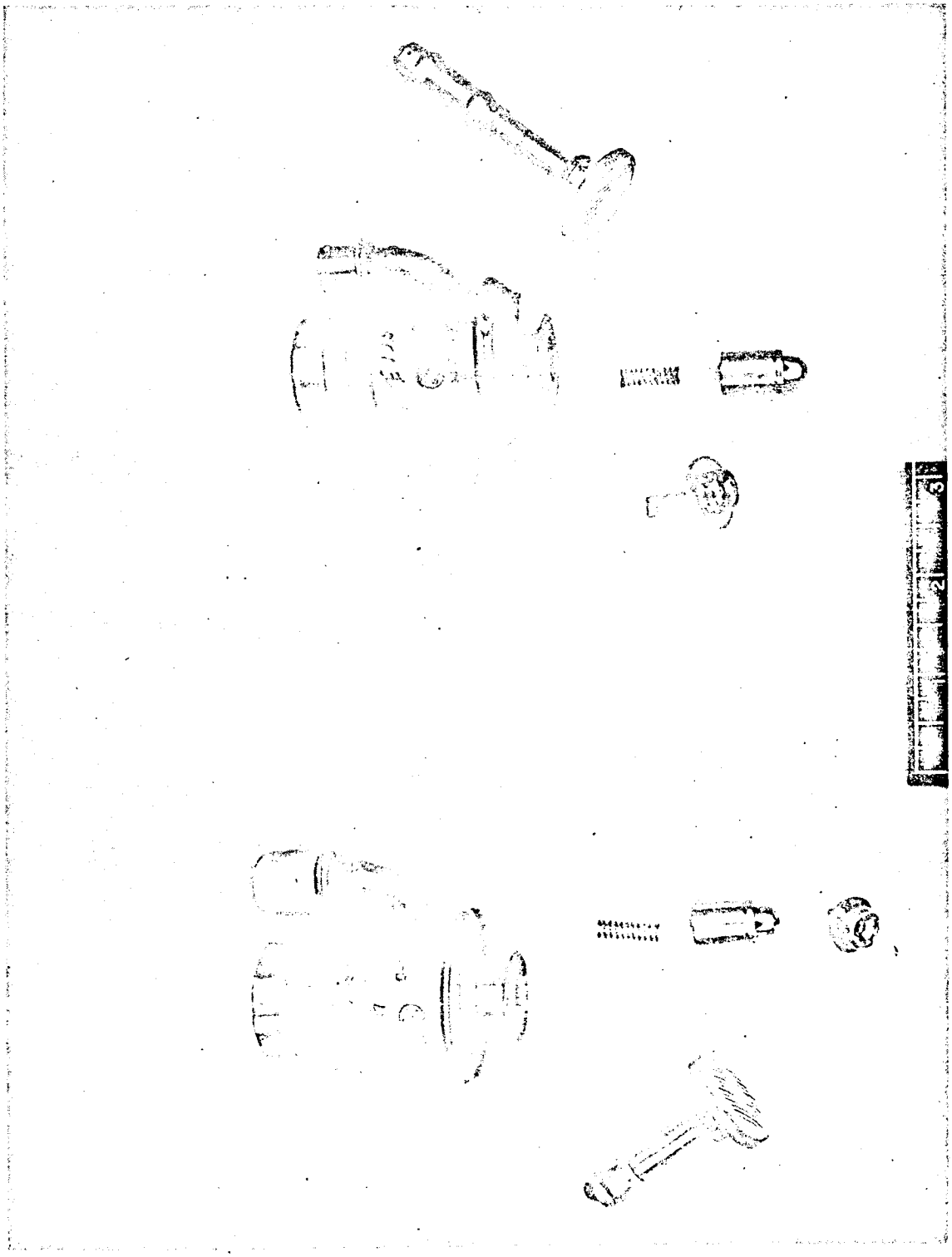
1HE35-4/1/65-C1B

Figure 27. 100-Pound-Thrust OAMS TCA Unit No. 2, Disassembly and Inspection



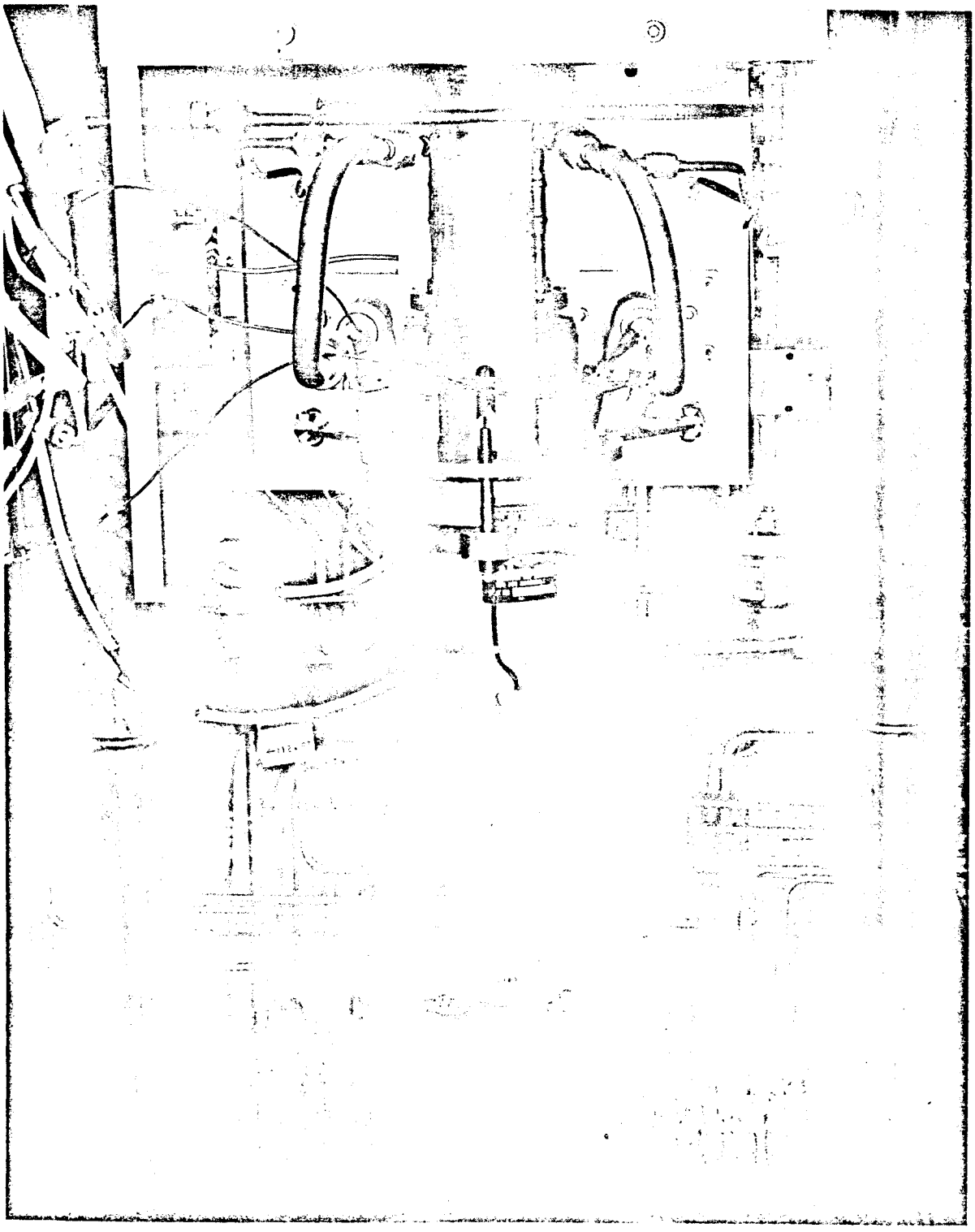
1HE35-4/1/65-C1A

Figure 28. 100-Pound-Thrust OAMS TCA Unit No. 2, Disassembly and Inspection



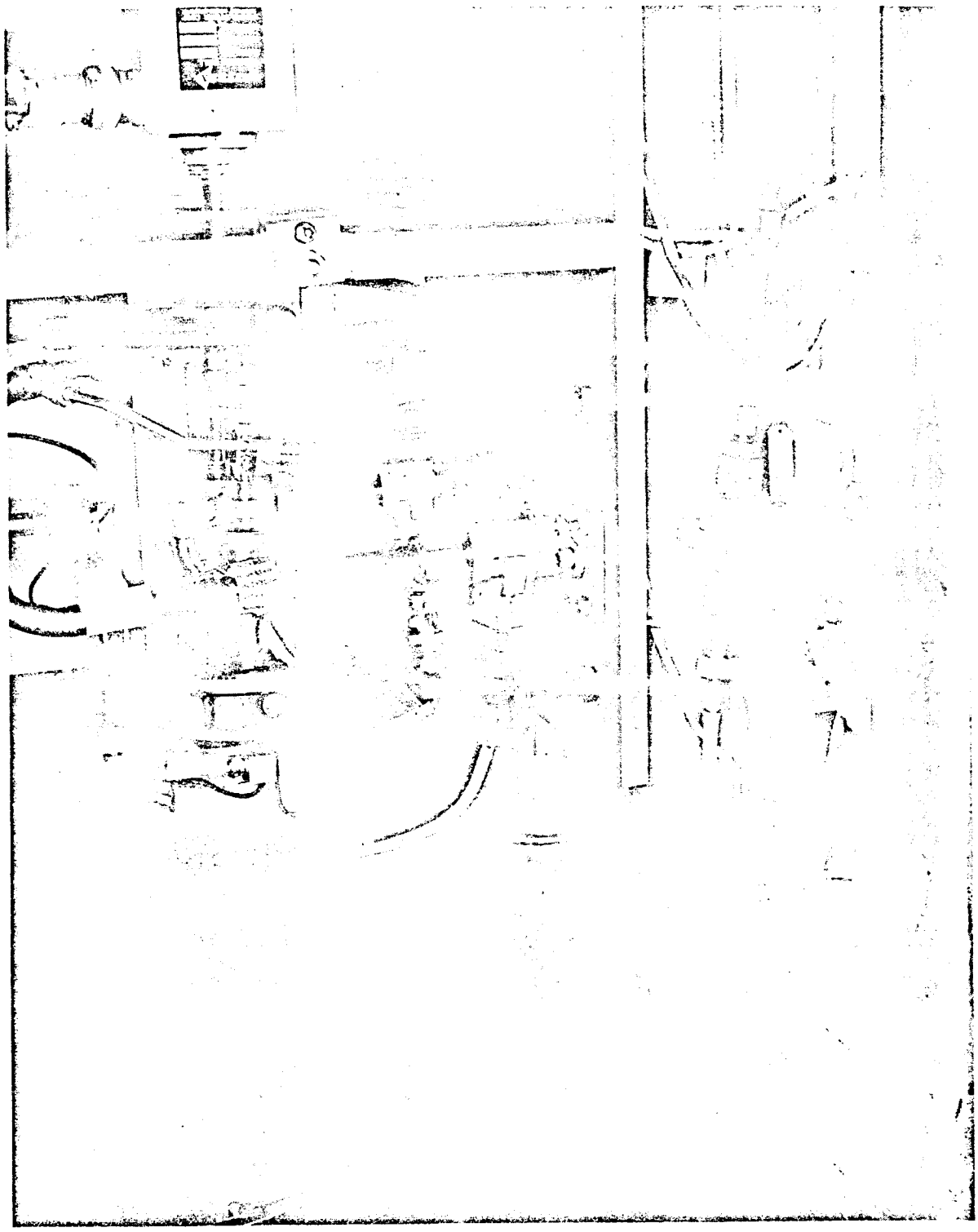
1HE65-4/7/65-C2

Figure 29. Propellant Valves From 100-Pound-Thrust OAMS TCA Unit No. 2, Disassembly and Inspection



1HE23-9/10/64-S2A

Figure 30. 100-Pound-Thrust OAMS TCA Unit No. 3, Hot-Fire Test Setup, Cell 39K

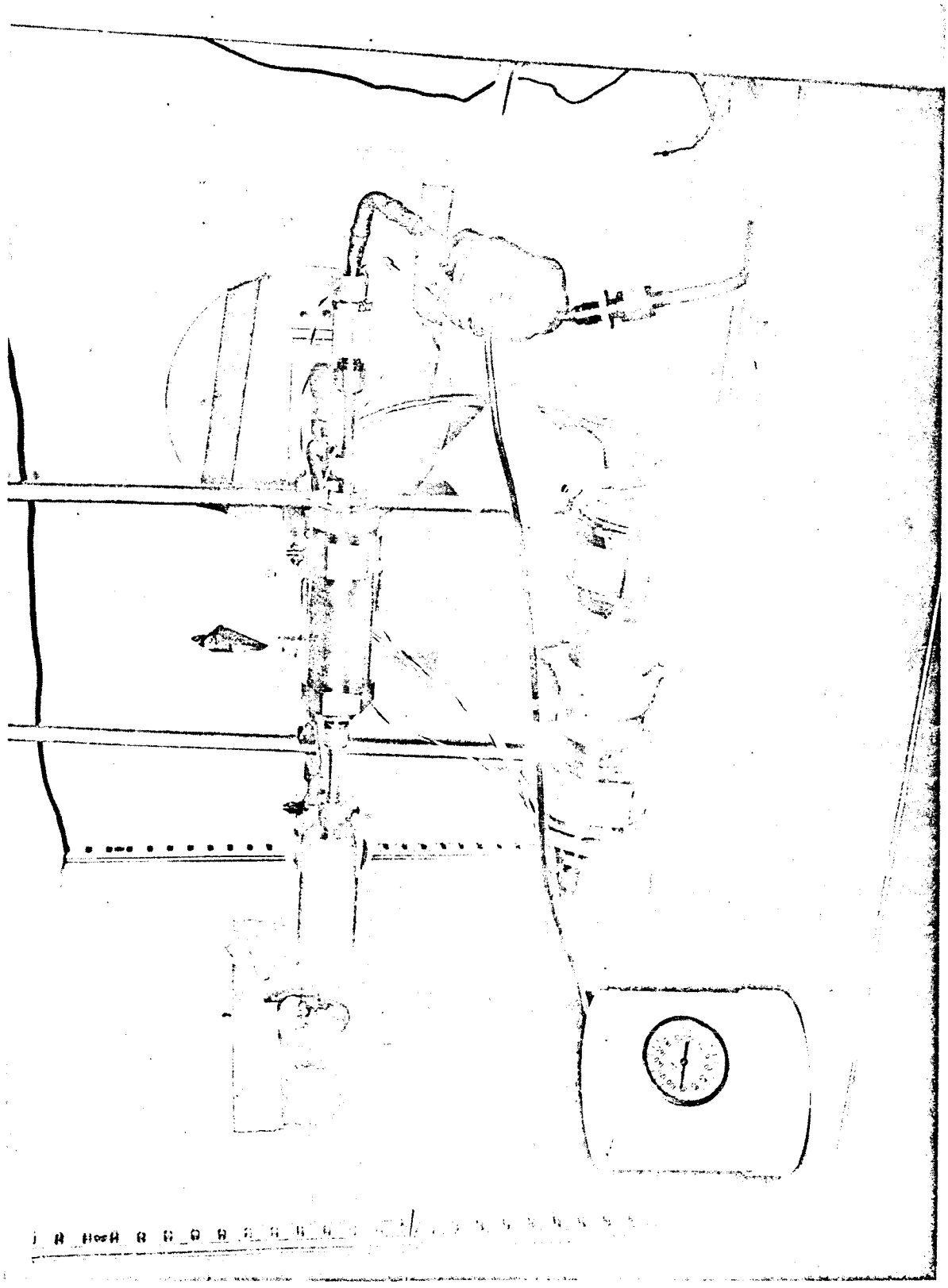


1HE23-9/10/64-S2C

Figure 31. 100-Pound-Thrust OAMS TCA UNIT NO. 3, Hot-Fire Test Setup, Cell 39K

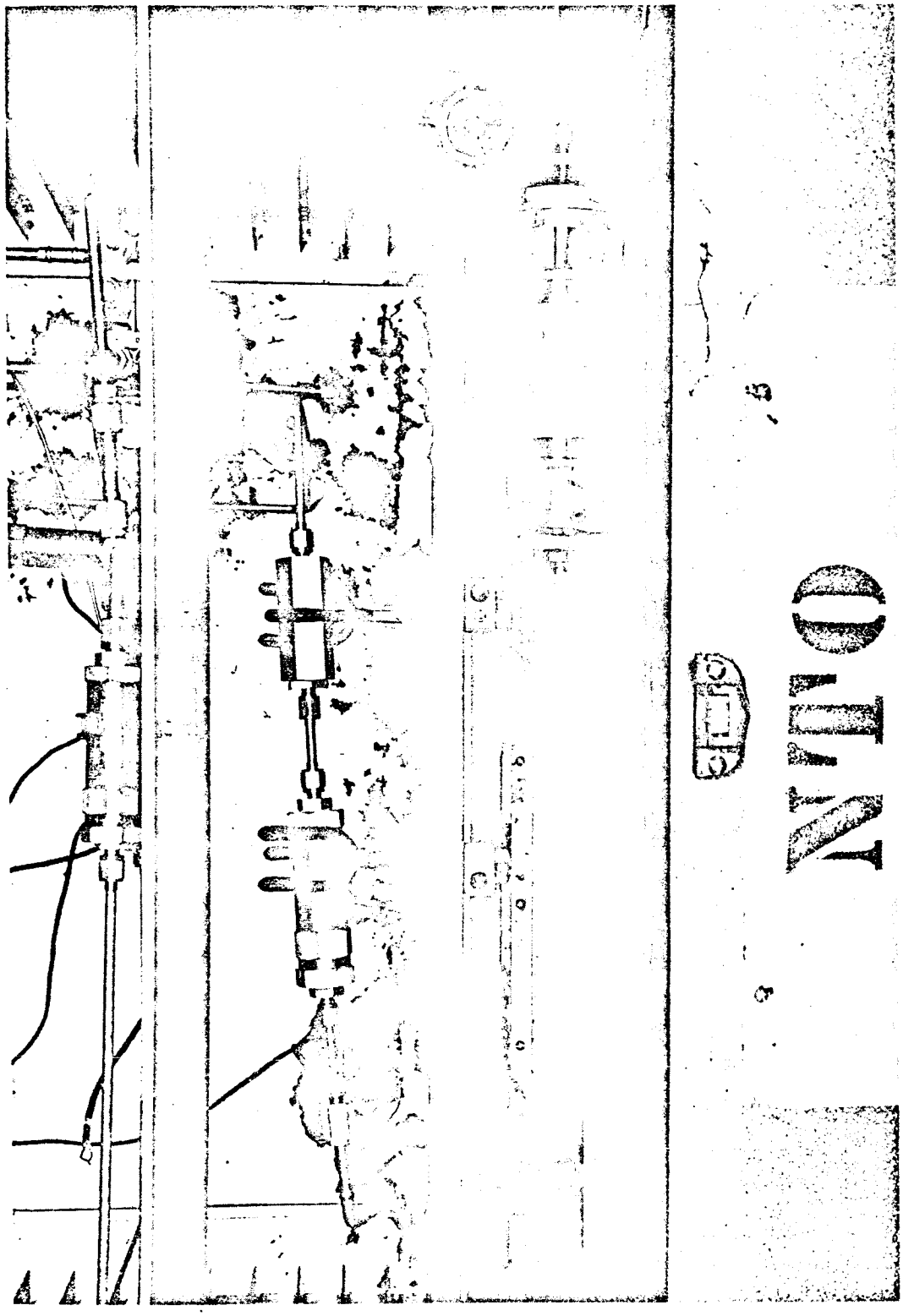
6CH36-9/18/64-S1B

Figure 32. 100-Pound-Thrust OAMS TCA Unit No. 3, Explosive Atmosphere Test



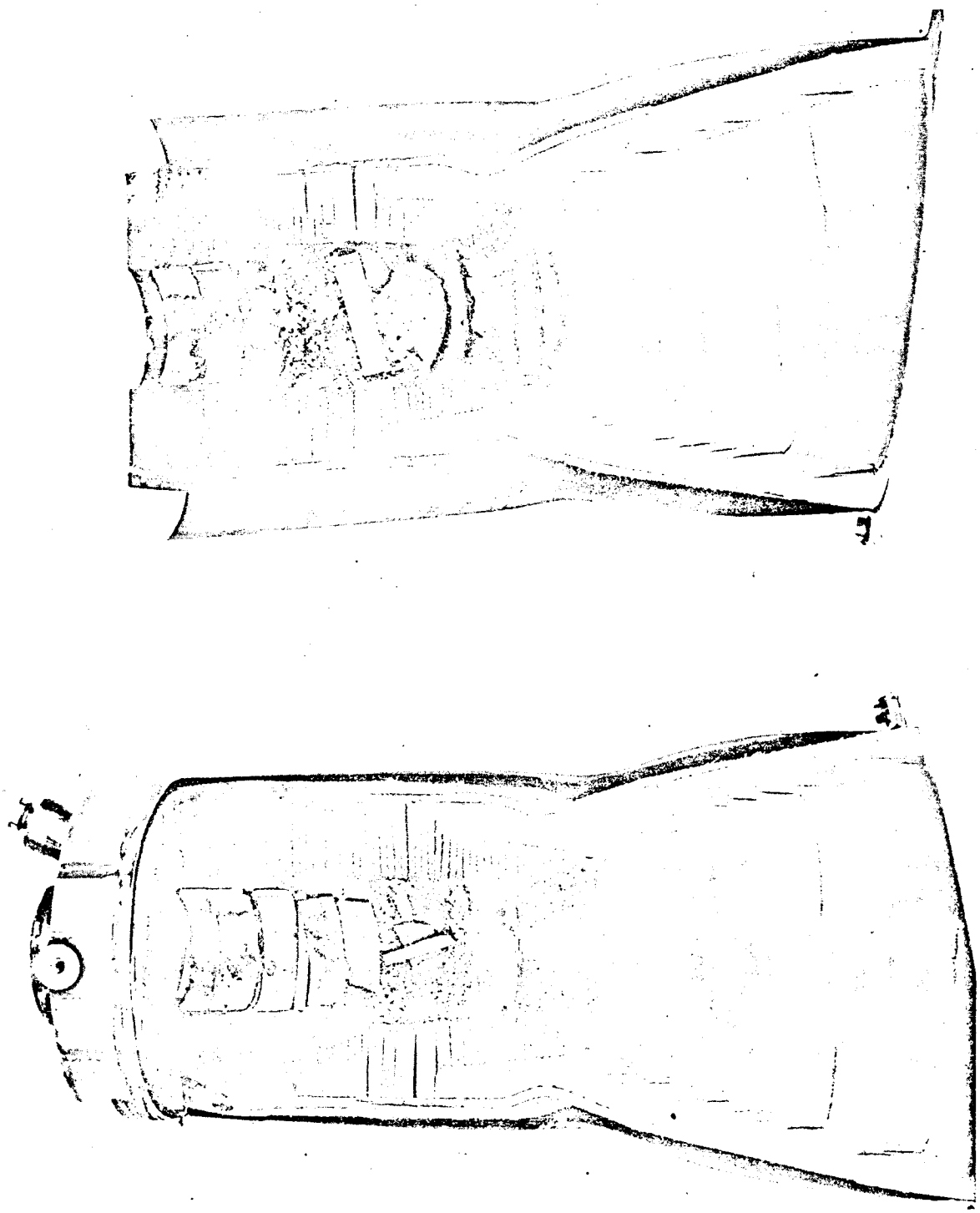
1HE63-10/3/64-S1B

Figure 33. Fuel Propellant Valve From 100-Pound-Thrust OAMS TCA Unit No. 3, Electrical Resistance Test



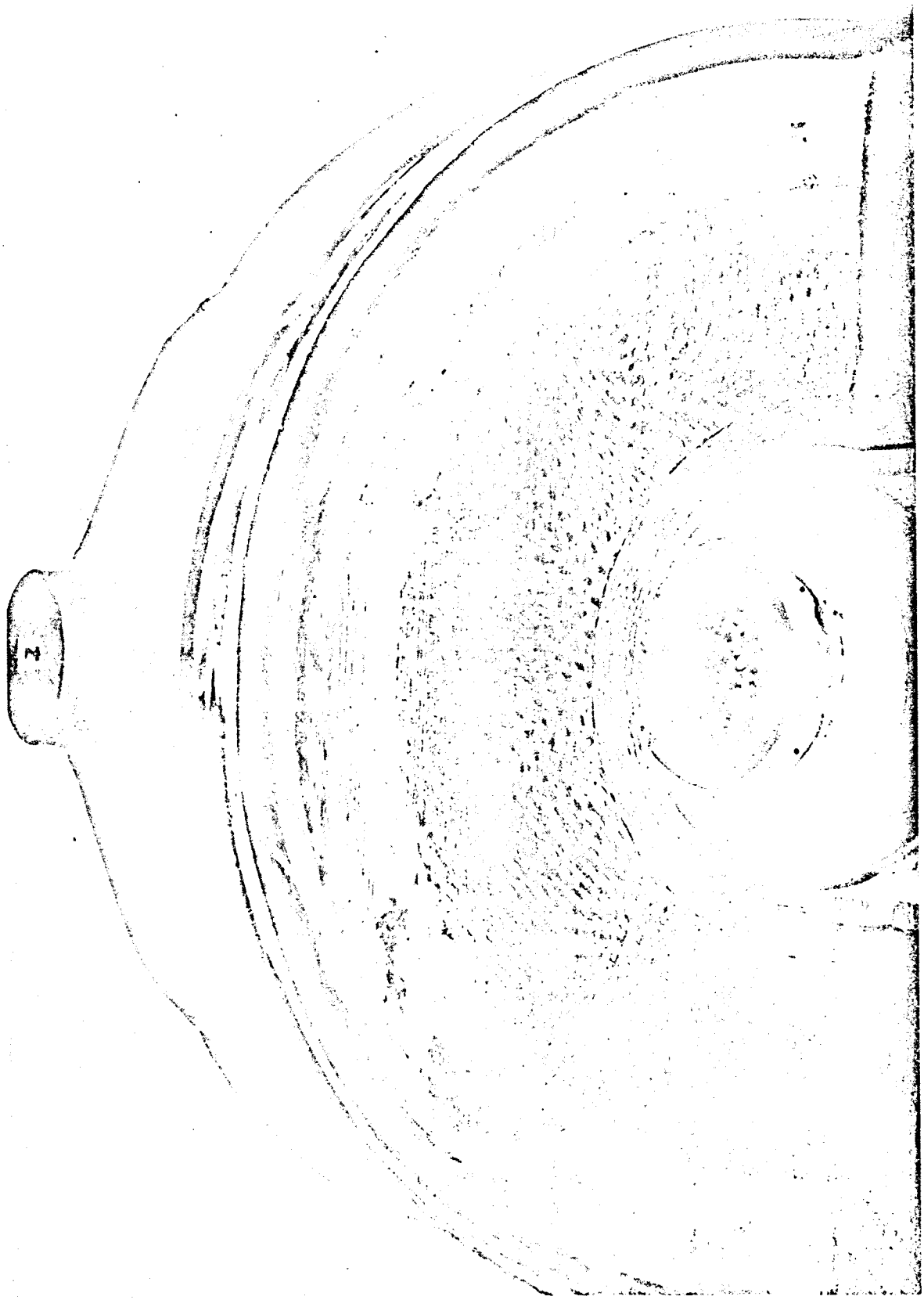
1HE32-10/8/64-S1C

Figure 34. Oxidizer Propellant Valve From 100-Pound-Thrust OAMS TCA Unit No. 3, Electrical Resistance Test



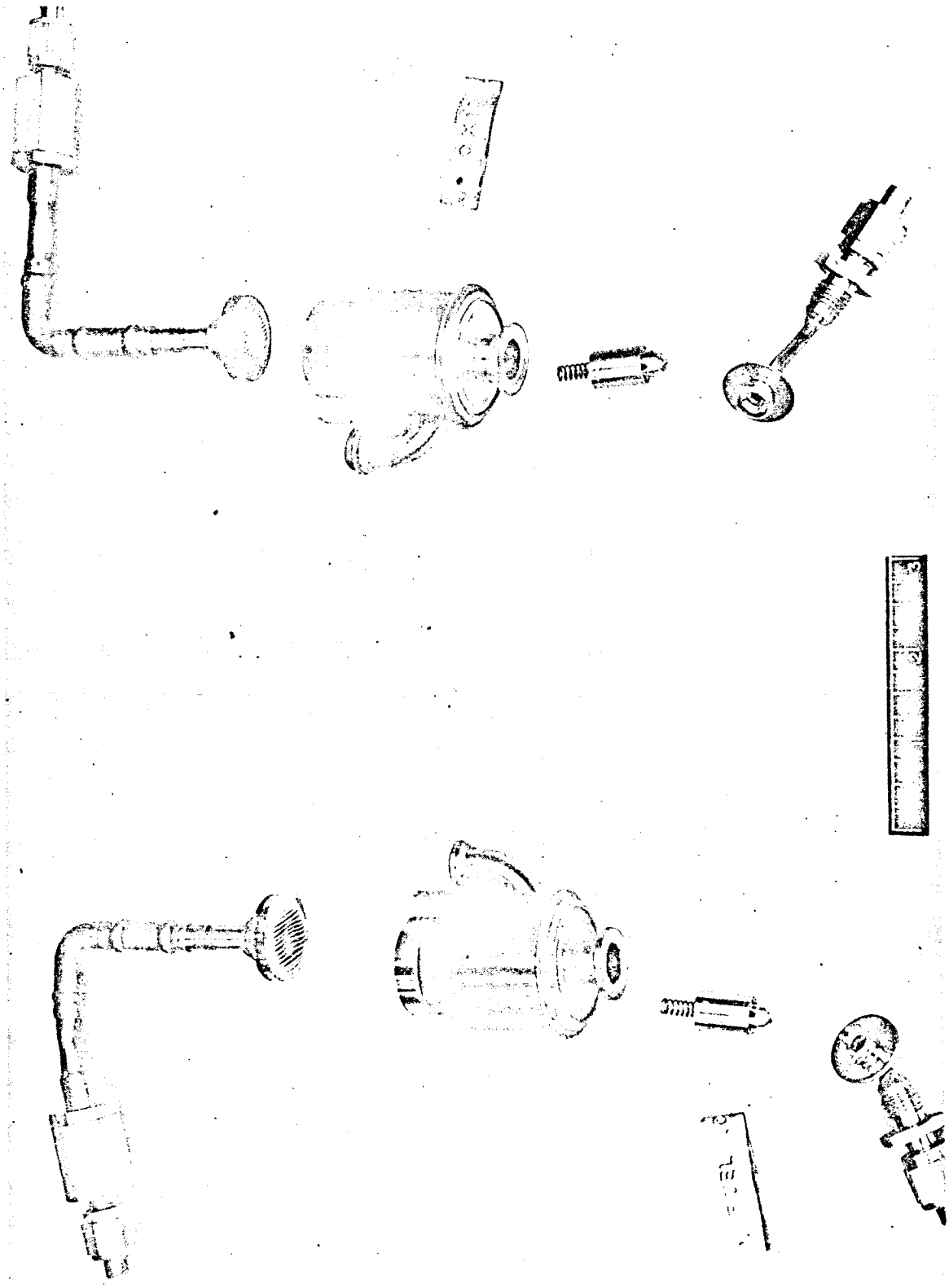
1HE35-12/4/64-C1C

Figure 35. 100-Pound-Thrust OAMS TCA Unit No. 3, MDC to Guaranteed Life, Disassembly and Inspection



1HE35-12/4/64-C1B

Figure 36. 100-Pound-Thrust OAMS TCA Unit No. 3, Disassembly and Inspection



1HE35-12/4/64-S1A

Figure 37. Propellant Valves From 100-Pound-Thrust OAMS TCA Unit No. 3, Disassembly and Inspection

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APPENDIX B

APPENDIX B

OPERATION AND FAILURE REPORTS AND FAILURE ANALYSIS REPORTS

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FAILURE | OPERATION | PROGRAM: SE7 DAT | LOCATION: C.P. | № 07432

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

1 PART NO. 207540-21	2 PART NAME 100-FTCA		
3 SERIAL NO. 4058958	4 MFG. NAME ROCKETDYNE	5 MFR. CODE 02102	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. SE7	14 SYSTEM CODE	
		15 COMPONENT CODE	
12 REJ. TAG NO. D086291	13 ENG/AGE SERIAL NO.	16 HARDWARE CODE	

17 FAILURE DATE 64 9 23 (YR. MO. DAY)	18 TEST/OPER. DATE 64 9 23 (YR. MO. DAY)	19 TEST/OPER. NO.	20 ITEMS 1
21 PROCEDURE—SPEC. & PARAGRAPH 207540-401 PARA. 7.1.2.1.6			
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

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

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 VNI

40 | 41

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

48 NAME R. MATHEWSON	49 GROUP 394	50 CODE AR	51 PART REQ. ☒ YES ☐ NO
52 YR. MO. DAY			53 YR. MO. DAY
54 TEST/OPER. NO.	55 1/2	57 NTH CODE	58 TAPE CODE

DESCRIPTION OF FAILURE

FAR DUE RELIABILITY

1 ⊙FAILURE ØCCURRED DURING RANDØN VIB 35
36 PATIØN IN THE Y AXIS. A CRACK WAS 70 | 71 TEST/OPER. NO. 77 07432R | 78 A | 79 80
1 ØBSERVED BETWEEN THE FUEL VALVE BØD 35
36 Y AND INLET TUBE AT THE WELD JØINT. 70 | 78 B
1 35
36 70 | 78 C
1 35
36 70 | 78 D
1 35
36 70 | 78 E
1 34

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

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	78 G
1 REPLACEMENT PART NO.		15 REPLACEMENT S/N		22 NAME		25 TYPE		31 MFR. 35			
36 INSTALLATION PART NO. R-15019-2		50 CONFIG. CODE		57 NAME		60 GR. RESP.		CH	CL	M	R	78 80

71

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
07432R	E. Adams	896/388	Canoga Park	9-23-64

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
07540-21	4058958	100# TCA	Rocketdyne
ENG/AGE MODEL NO.	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	
SE-7 DAT			

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
R. C. Mathewson	896-394	15 Feb. 65	[illegible] 2-25	

FAILURE ANALYSIS

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

RECEIVED 1 MAR 1965 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.

I. HISTORY

A 100# DAT thrust chamber subjected to random vibration testing exhibited leakage at the weld joint between the inlet tube and fuel valve orifice housing. The chronological history is as follows:

1) Thrust chamber was subjected to vibration testing per DAT TCA Specification 207540-401 dated 10 July 1964.

a) A 1g sine wave survey on TCA in X-axis from 5-2000 cps in 5.25 minutes.

b) X-axis equalization. The total equalization time was 111.5 seconds which exceeded the limits specified in paragraph 7.1.2.1.4.1 by 15.5 seconds. Some difficulty was experienced in verifying the spectrum shape and tolerance limits due to the non-rigid support of the MAC nozzle extension attached to the TCA exit flange.

c) Random vibration dwell in the X-axis was terminated after 1.9 minutes because of excessive "g" level recordings on the response accelerometers located on the MAC nozzle extension. It was found that a number of bolts were below the required torque values, but no structural damage was noted after visual inspection and dye penetrant tests.

d) A second 1 g resonant search of 5.16 second duration was performed.

e) A second equalization test in the X-axis for 63 seconds duration was performed to verify spectrum shape and tolerance.

OFR NO. 07432R

FAILURE ANALYSIS ACCEPTED	
[illegible]	3/1/65
[illegible]	3/1
[illegible]	3/1/65
RELIABILITY DEPT. 2[illegible]	

FORM 609 P-2 REV. 2-62

R-15010-2

I. HISTORY (Cont'd)

f) Random vibration tests followed. During the random vibration dwell in the X axis, it was observed that the vibration amplitude of the MAC fuel inlet line was less than that of the oxidizer line. The test was terminated after approximately 3.5 minutes. Visual inspection revealed a crack between the fuel inlet tube and the fuel valve orifice housing.

2) Failure Analysis effort was planned and executed.

a) The failed thrust chamber was x-rayed, photographed, and the inlet tube carefully removed to permit rework of the thrust chamber.

b) The inlet tube and orifice housing fracture surfaces were examined and analyzed.

c) Test data was collected and transmitted to stress analysis.

d) Stress analysis was performed.

II. ANALYSIS

Inlet Adapter Tube - Orifice Housing Weld Failure

A. Function - The inlet adapter tube orifice housing weld is a burn-down weld which provides a leak proof and structural connection between MAC inlet tubing and the 100 lb TCA valve orifice housing. The weld should connect the inlet adapter tube to the threaded orifice holder which is of .012 in. minimum thickness. The weld joint should be capable of sustaining random vibration loads at specification levels for 8.0 minutes.

B. Failure Mode - The TCA exhibited leakage from a crack at the base of the inlet tube/orifice housing weld after approximately 6.5 minutes of random vibration. The crack extended from the base of the weld at the exterior surface of the orifice housing (which was .010 in. thick) through the orifice housing parent material; and partially through the parent material of the inlet tube adapter. The crack extended for approximately 75% of the circumference.

C. Mechanism of Failure - The crack propogated through the orifice housing parent material by fatigue at high cycle stress. The crack initiated over the external periphery of the weld juncture at the orifice housing; propagated slowly inward from the surface, and later extended rapidly through the parent material of the orifice housing and inlet adapter tube.

II. ANALYSIS (Cont'd)

The following observations substantiated the above described mechanism:

1) There was no evidence of metallic inclusions, weld shrinkage cracks, or other metallurgical defects.

2) Cross sectioning revealed no evidence of crack propagation through weld material.

3) Beach marks, indicative of fatigue cyclic stress, extended inward in concentric circles over the fracture surface.

4) Two zones of fracture were observed. The outer zone had distinct beach marks, the inner zone was smeared and no distinct beach marks were observed.

III. CONCLUSIONS

The primary cause of the failure was excessive stress induced by the vibration of the unsupported MAC supplied tubing. The secondary causes were, (1) an orifice housing of .010 in. thickness, and (2) equalization testing difficulty to verify spectrum shape and tolerance between 100-300 cps which indicated excessive vibratory loads in the tubing at tube resonant frequencies of 234 cps and 271 cps. This conclusion is based on the following:

A. Failure cause due to external environment

1) TWX DGV-1064-793 from MAC to Rocketdyne dated 26 October 1964 approved the plan of action for failure analysis and stated: "Since the tube routing and mounting were incorrect, MAC believes that the stress analysis would not provide useful data." Subsequent stress analysis was, therefore, discontinued.

2) Stress analysis indicated that the time to failure, assuming a reasonable amplification factor of 15, would be approximately 8.0 minutes. This conclusion resulted from analysis of the random vibration usage factor, resonant tube frequency, and the DAT specification vibration spectrum.

3) Due to difficulties experienced in the 100-300 cps frequency range of the equalization tests, excessive power inputs were generated which resulted in excessive vibration amplification at the tubes. The lowest natural frequencies of the MAC tube were calculated by the "space frame" program as 234 cps to 271 cps.

4) The data indicates that g loadings during the equalization tests exceeded the spectrum tolerance by an undetermined amount. The first random vibration dwell in the X axis which was terminated due to high "g" level recordings on the response accelerometers also exceeded the specification tolerances by undetermined amounts. The combined excessive vibratory inputs near the natural frequencies inevitably reduced the fatigue life of the inlet tube-orifice housing weld and resulted in the failure.

B. Failure cause due to human error or defect

1) The fact that the fuel inlet tube failed and not the oxidizer tube indicated a possible physical difference between the inlets. Further examination revealed that the fuel orifice housing was .010 in. thick at the weld joint (should be .0120 minimum) and that the oxidizer orifice housing was within specification (.015). The .010" dimension was determined from radiographic inspection and is a minimum value.

2) The difference in stress which would result from a .010 in. vs .015 in. was calculated from the formula:

$$\text{Stress} = \frac{GM}{t^2} \pm \frac{F_Z}{t} \quad \text{where}$$

M = moment at weld
t = incremental element thickness
F_Z = axial force on element

The calculations indicated 13710 psi stress for .010 in. vs 7400 psi for .015 in. thickness.

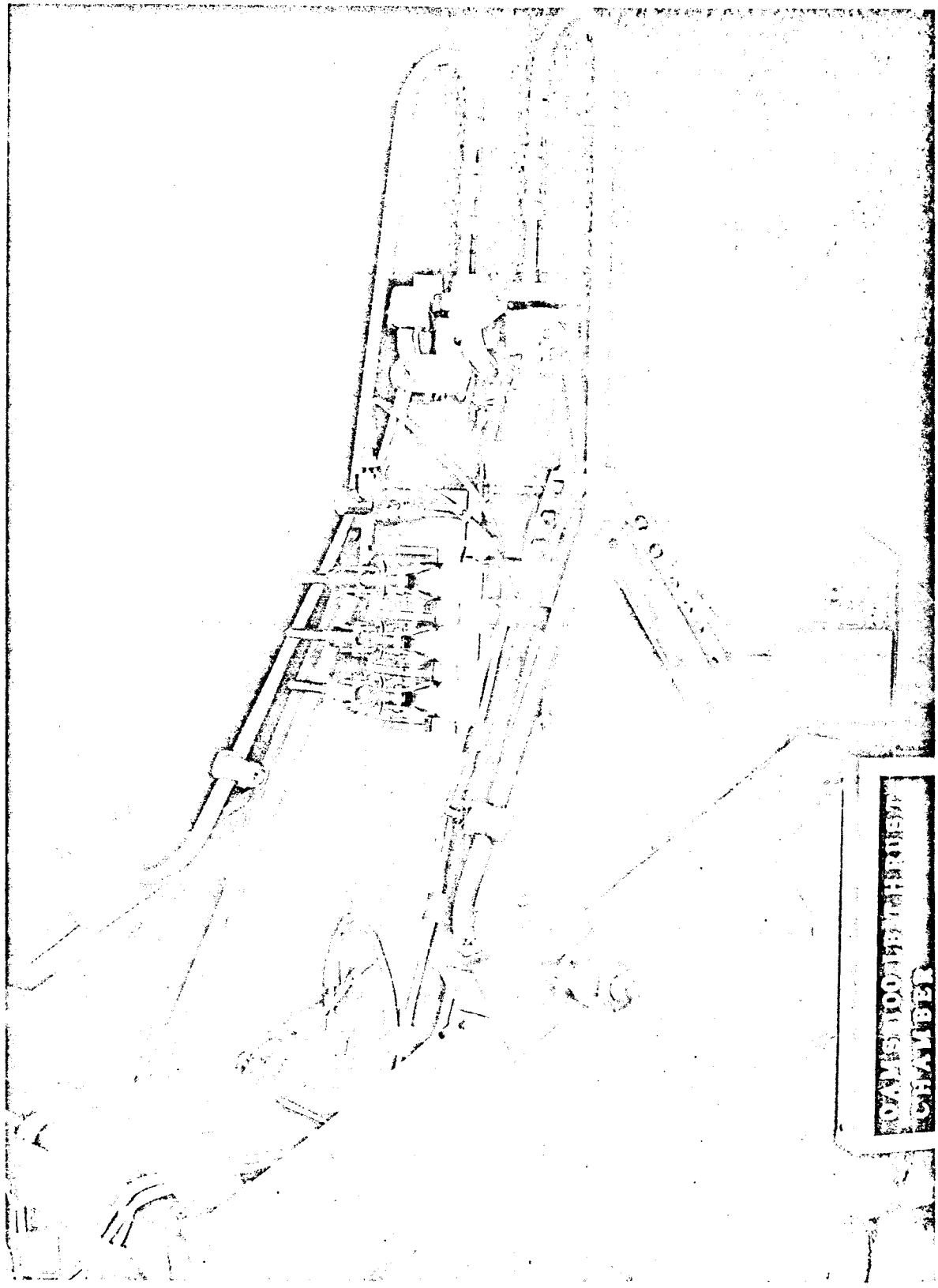
3) It was concluded that the thinner oxidizer orifice housing resulted in a shorted time to failure, and contributed to the fracture propagation by providing a highly stressed section prone to cyclic fatigue. The fact that the fracture initiated from the periphery and not from a local imperfection, however, indicates that the overstress vibratory load caused by the unsupported MAC tube was the primary cause, ile., the failure could not be obviated by a thicker section.

4) Further, there is doubt that radiographic inspection is accurate and that the orifice housing was actually .010.

C. Failure cause due to design deficiency

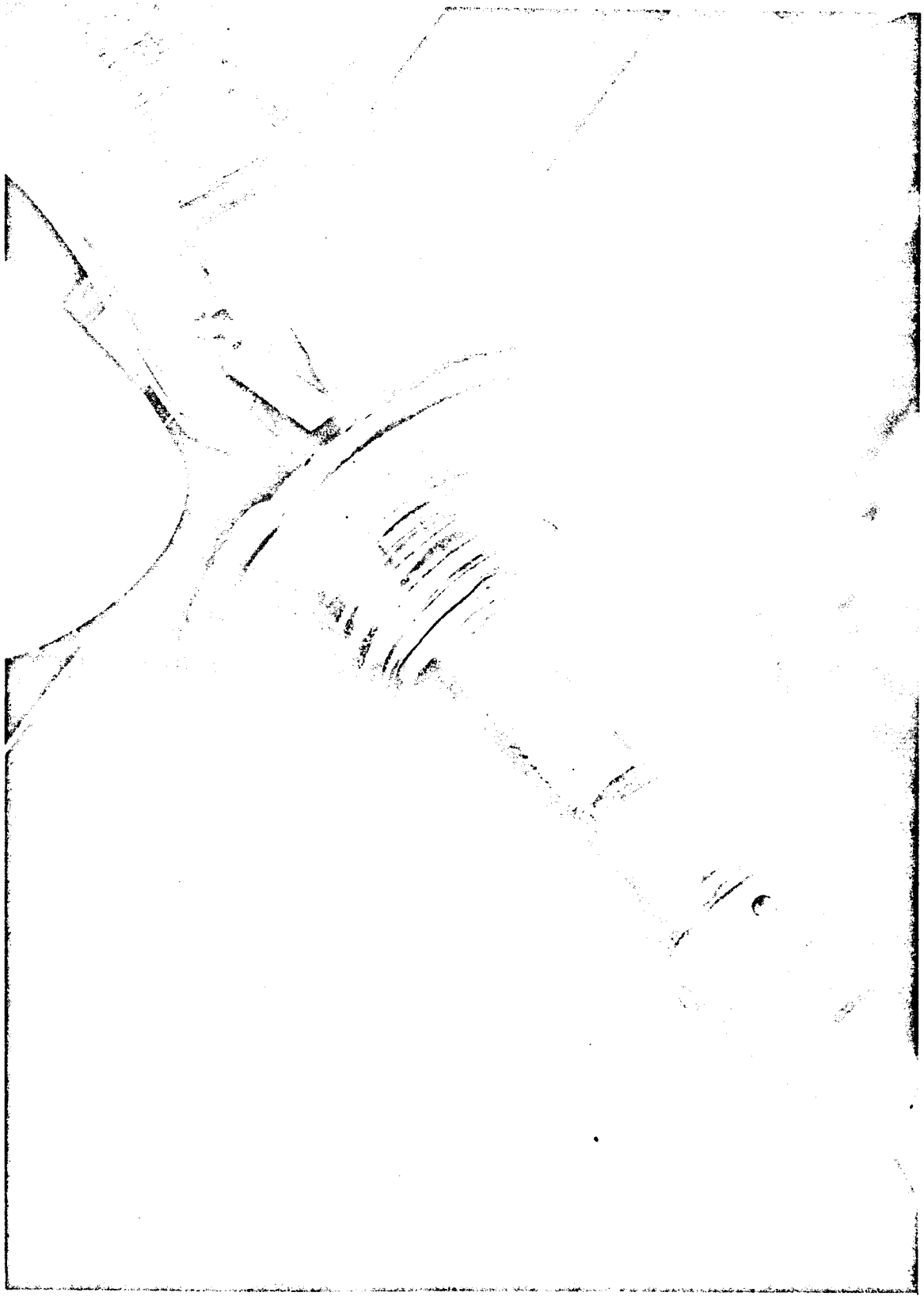
1) Review of past failures revealed several instances of failures at the orifice housing-inlet tube burndown welds (e.g., OFR 19442, OFR 04888, and OFR 19445). These failures were generally attributable to installation or handling stresses which cracked the weld or orifice housing parent material.

OFR 07432R
Enclosure 5



1HE35-9/23/64-C1C

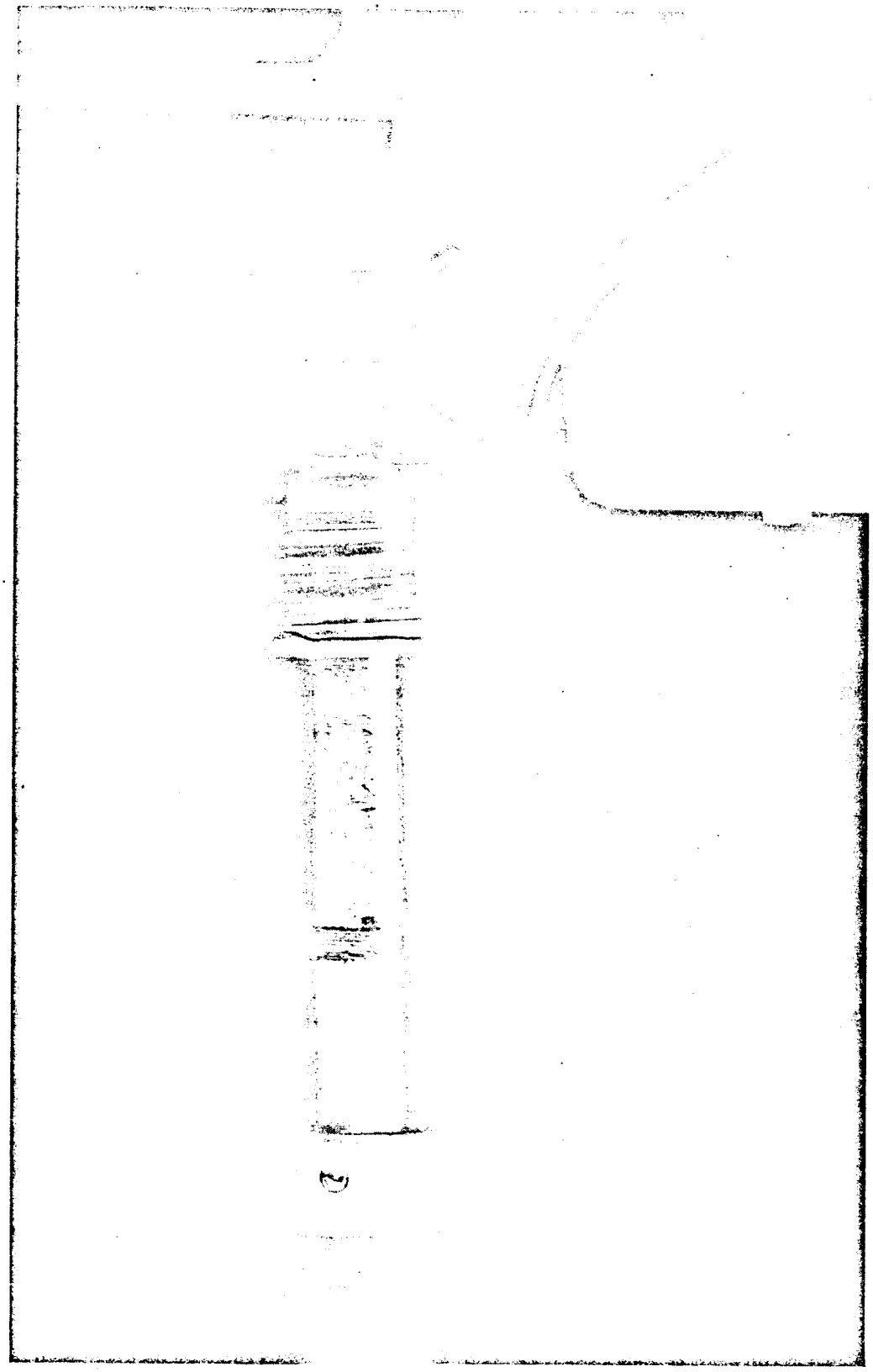
OFR 07432R
Enclosure 6



1HE35-9/23/64-C1A

OFR 07432R
Enclosure 6A

1HE35-9/23/64-C1B



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APPENDIX C

APPENDIX C

MODULE/COMPONENT LOG BOOK AND ACCEPTANCE TEST DATA

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~~CONFIDENTIAL~~ SCD 52-52701-277 (DAT CRD #4)

"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
[illegible]	S. H. [illegible]	[illegible]	[illegible]
DATE 24 June 1964	DATE 24 JUNE 1964	DATE 25 JUNE 64	DATE 25 JUNE 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	25 JUNE 1964
	DWG CHG LTR	DNA
Y-20161R	CONTRACT NO.	
	GEN ORDER NO.	5252
SCD52-52701-277	SPEC NO.	
DNA	SERIAL NO	4058958
52-52701-277	PART NO	207540-21

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

~~CONFIDENTIAL~~

DELIVERABLE END ITEM

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

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

THE FORMAT OF PAGES IN THIS LOG BOOK SHALL NOT BE REVISED WITHOUT OBTAINING APPROVAL OF ROCKETDYNE SPACE ENGINES QUALITY CONTROL.

	DNA	SERIAL NO.	4058958
	52-52701-277	PART NO.	207540-21
FOREWORD--SE-7 LOG BOOK	PART NAME	THRUST CHAMBER, 100 LB., ASSY OF	2.0

1.0	LOG BOOK IDENTIFICATION
2.0	FOREWORD
3.0	CONTENTS
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4.1	CONFIGURATION AND SERIALIZATION LOG
4.2	MCR VERIFICATION LOG
4.3	VARIATION LOG
4.4	REPLACEMENT LOG
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5.1	COMPONENT ACCEPTANCE TEST
5.1.1	COMPONENT ACCEPTANCE TEST
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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

	52-52701-277 PART NO. 207540-21	
SE-7 MODULE / COMPONENT ASSEMBLY LOG	PART NAME THRUST CHAMBER, 100 LB., ASSY OF	4.0

IND. NO.	PART NUMBER	REV. LTR.	PART NAME	SERIAL NO.	AGE CONTROL DATE OF MFG.	INSP.
1	207540-21	DNA	THRUST CHAMBER, 100 LB., ASSY OF	4058958	3Q63	ANA 142
2	207541-11	DNA	BODY, THRUST CHAMBER, ASSY OF	4056070	3Q63	ANA 142
2	207548	DNA	SHELL, THRUST CHAMBER, ASSY OF	8502150		ANA 142
3	207543	DNA	INJECTOR, THRUST CHAMBER, ASSY OF	4058076		ANA 142
2	407561	DNA	VALVE, OXIDIZER, T/C, ASSY OF	9174970		ANA 142
2	407662	DNA	VALVE, FUEL, T/C, ASSY OF	9183330		ANA 142

DNA SERIAL NO. 4058958

52-52701-277 PART NO. 207540-21

SE-7 CONFIGURATION & SERIALIZATION LOG

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

4.1

MCR / ECP NO.	DATE	TITLE	DATE	INSP.
SE6-062	6 JAN 64	COMPONENT CLEANING; PROVISION FOR	25 JUNE 64	ANR 142
SE6-064	30 JUL 63	TCA, ACCEPTANCE TESTS; REVISION OF	25 JUNE 64	ANR 142
SE6-133	22 APR 64	TCA PROPELLANT VALVES; ADDITIONAL REQUIREMENTS FOR	25 JUNE 64	ANR 142
SE6-139	15 APR 64	PLACEMENT OF HAYNES STELLITE #3 SAND CAST ON APPROVED MATERIAL LIST	25 JUNE 64	ANR 142
SE6-144	14 APR 64	TCA INJECTORS; REDESIGN OF	25 JUNE 64	ANR 142
SE6-179	13 MAR 64	TUBE STUBS; MARKINGS OF	25 JUNE 64	ANR 142
SE7-041	15 APR 64	85# AND 100# THRUST CHAMBER ASSEMBLIES, PROPELLANT VALVES, INLET TUBES, MATERIAL; CHANGES TO 304L BAR PER QQ-S-763	25 JUNE 64	ANR 142
SE6-75	4 FEB 64	MAC REPORT 8518, INCORPORATION OF	25 JUNE 64	ANR 142
SE6-80	28 DEC 63	THRUST CHAMBER ASSEMBLIES, FABRICATION MATERIAL; APPROVAL OF	25 JUNE 64	ANR 142
SE7-85	30 APR 64	85# & 100# TCA DIMENSIONS; CHANGES TO	25 JUNE 64	ANR 142
SE6-85	30 JUL 63	CUSTOMER TEST SURVEILLANCE; REQUIREMENTS FOR	25 JUNE 64	ANR 142

DNA	SERIAL NO.	4058958	
52-52701-277	PART NO.	207540-21	
SE-7 DELIVERABLE END ITEM-MCR VERIFICATION	PART NAME	THRUST CHAMBER, 100 LB., ASSY OF	4.2

MR NO.	PART OR COMP. INVOLVED	PART NUMBER	SERIAL NUMBER	BRIEF DESCRIPTION OF VARIATION AND MATERIAL REVIEW BOARD DISPOSITION	INSP.
MAC MRR #59944	THRUST CHAMBER 100 LB., ASSY OF	207540-21	4058958	DISCREPANCY: CONDITION A: 1.30 ± .03 DIM. FROM THE CENTERLINE OF THE FUEL TUBE TO THE BOSS CHECKS 1.322 AT THE BASE OF TUBE (WHERE TUBE IS WELDED TO THE VALVE) AND CHECKS 1.352 AT THE END OF THE TUBE. CONDITION B: 2.00 ± .03 DIM. FROM THE CENTERLINE OF THE FUEL TUBE TO THE CENTERLINE OF THE OXID. TUBE CHECKS 2.00 AT THE BASE OF THE TUBE (WHERE THE TUBE IS WELDED TO THE VALVE) AND CHECKS 2.052 AT THE END OF THE TUBE. CONDITION C: 5.20 ± .03 DIM. TUBE LENGTH CHECKS 5.164 OXID TUBE ONLY. DISPOSITION: ACCEPTABLE TO USE FOR DAT.	MRR 142
MAC MRR #55375	THRUST CHAMBER 100 LB., ASSY OF	207540-61	4058958	DISCREPANCY: THROAT INSERT HAS (1) ONE CRACK: THE CRACK EXISTS IN ONE QUADRANT: CRACK WIDTH MEASURES TO .0001 AT ANY POINT ON CRACK. NOTE: THIS CRACK IS NOT VISIBLE TO THE NAKED EYE. THE CRACK WAS LOCATED UNDER 40X POWER MICROSCOPE. REF. 23H R19052 DISPOSITION: ACCEPTABLE TO USE.	MRR 142

DNA SERIAL NO. 4058958
52-52701-277 PART NO. 207540-21

SE-7 DELIVERABLE END ITEM — VARIATION LOG

PART NAME THRUST CHAMBER, 100 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.
MAC MRR #56445	THRUST CHAMBER 100 LB., ASSY OF	207540-21	4058958	DISCREPANCY: CONDITION A: 3.55 ± .03 DIM. FROM THE C/L OF THE BOSS TO THE END OF THE ELECTRICAL CONNECTOR IS 3.499 ON THE FUEL SIDE. CONDITION B: 3.55 ± .03 DIM. FROM THE C/L OF THE BOSS TO THE END OF THE RECEPTACLE IS 3.516 ON THE OXIDIZER SIDE. REF. B/P 103892. REFERENCE: 600-N-5 C21033 DISPOSITION: ACCEPTABLE TO USE.	

DNA SERIAL NO. 4058958

52-52701-277 PART NO. 207540-21

SE-7 DELIVERABLE END ITEM — VARIATION LOG

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

4.3

PART NO.	PART NAME	SERIAL NO.	REASON FOR REPLACEMENT	REPLACED BY		INSP.
				PART NO.	SERIAL NO.	
			NONE THIS DATE 25 JUNE 1964			

DNA 52-52701-277	SERIAL NO.	4058958	
	PART NO.	207540-21	
SE-7 DELIVERABLE END ITEM--REPLACEMENT LOG	PART NAME	THRUST CHAMBER, 100 LB., ASSY OF	4.4

SECTION II

	52-52701-277 PART NO. 207540-21	
SE-7 COMPONENT ACCEPTANCE TEST LOG	PART NAME THRUST CHAMBER, 100 LB., ASSY OF	5.0

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
ELECTRICAL RESISTANCE TESTS--TCA PROPELLANT VALVES	4.2				
BODY TEMPERATURE					
OXIDIZER	4.2.4	DEGREES F	70 ± 5	68	ANR 721
FUEL	4.2.11	DEGREES F	70 ± 5	68	ANR 721
COIL RESISTANCE					
OXIDIZER	4.2.5	OHMS	42 ± 2	41.320	ANR 721
FUEL	4.2.11	OHMS	42 ± 2	41.370	ANR 721
CONTINUITY RESISTANCE					
OXIDIZER	4.2.9	OHMS	1.0 MAX.	.036	ANR 721
FUEL	4.2.11	OHMS	1.0 MAX.	.066	ANR 721
DIELECTRIC STRENGTH TEST--TCA PROPELLANT VALVES	4.3				
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICROAMPS	500 MAX.	58	ANR 721
FUEL	4.3.11	MICROAMPS	500 MAX.	59	ANR 721
PROOF PRESSURE TEST--TCA PROPELLANT VALVES	4.4				
VALVES PRESSURIZED FOR NOT LESS THAN 3 MINUTES					
OXIDIZER					
STEP I	4.4.3	PSIG	500	VERIFIED	ANR 721
STEP II	4.4.5	PSIG	500	VERIFIED	ANR 721

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-349	N/C	#1	DNA	SERIAL NO.	4058958
			52-52701-277	PART NO.	207540-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME	THRUST CHAMBER, 100 LB., ASSY OF	5.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE TEST--TCA PROPELLANT VALVES (CONTINUED)	4.4				
FUEL					
STEP I	4.4.7	PSIG	500	VERIFIED	ANR 721
STEP II	4.4.7	PSIG	500	VERIFIED	ANR 721
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION					
OXIDIZER					
STEP I	4.4.4	DNA	NONE ALLOWED	NONE DETECTED	ANR 721
STEP II	4.4.5	DNA	NONE ALLOWED	NONE DETECTED	ANR 721
FUEL					
STEP I	4.4.7	DNA	NONE ALLOWED	NONE DETECTED	ANR 721
STEP II	4.4.7	DNA	NONE ALLOWED	NONE DETECTED	ANR 721

SPECIFICATION NUMBER RA0220-349	REVISION N/C	AMENDMENT #1	DNA	SERIAL NO. 4058958
			52-52701-277	PART NO. 207540-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 100 LB., ASSY OF	5.1.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
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 721
STEP II	4.5.10	PSIG	392 ± 10	VERIFIED	ANR 721
LEAKAGE TEST					
STEP I	4.5.8	DNA	NONE ALLOWED	NONE DETECTED	ANR 721
STEP II	4.5.10	DNA	NONE ALLOWED	NONE DETECTED	ANR 721
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	NONE ALLOWED	NONE DETECTED	ANR 721
FUNCTIONAL TEST--TCA PROPELLANT VALVES	4.6				
OPENING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.021 MAX.	.017	ANR 721
FUEL	4.6.8	SEC.	0.021 MAX.	.018	ANR 721
CLOSING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.005 MAX.	.003	ANR 721
FUEL	4.6.10	SEC.	0.005 MAX.	.0032	ANR 721
CLOSING DROP OUT VOLTAGE					
OXIDIZER	4.6.17	VOLT (DC)	1 MIN.	1.8	ANR 721
FUEL	4.6.13	VOLT (DC)	1 MIN.	1.6	ANR 721

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-349	N/C	#1	DNA	SERIAL NO.	4058958
			52-52701-277	PART NO.	207540-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 100 LB., ASSY OF		5.1.2

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAKAGE TEST -TCA PROPELLANT VALVES	4.7				
SEAT LEAKAGE RATE					
OXIDIZER	4.7.17	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 721
FUEL	4.7.22	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 721
PRE-TEST DATA					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.1.3	LB.	DNA	8.73	ANR 721
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	4.449	ANR 721
THROAT DIAMETER					
SECTION A-A		INCH	DNA	.709	ANR 721
B-B		INCH	DNA	.709	ANR 721
C-C		INCH	DNA	.709	ANR 721
D-D		INCH	DNA	.709	ANR 721
POST HOT-FIRE DATA					
PROOF PRESSURE TEST					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.14.1	LB.	DNA	8.78	ANR 142
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES					

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-349	N/C	#1	DNA	SERIAL NO.	4058058
			52-52701-277	PART NO.	207540-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME	THRUST CHAMBER, 100 LB., ASSY OF	5.1.3

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
POST HOT-FIRE DATA (CONTINUED)					
PROOF PRESSURE TEST					
STEP I	4.14.5	PSIG	392 ± 10	VERIFIED	HWR 142
STEP II	4.14.5	PSIG	392 ± 10	VERIFIED	HWR 142
LEAKAGE TEST THRUST CHAMBER					
STEP I	4.14.5	DNA	NONE ALLOWED	NONE DETECTED	HWR 142
STEP II	4.14.5	DNA	NONE ALLOWED	NONE DETECTED	HWR 142
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.14.5	DNA	NONE ALLOWED	NONE DETECTED	HWR 142
LEAKAGE TEST--TCA PROPELLANT VALVES					
SEAT LEAKAGE RATE					
OXIDIZER	4.14.5	SCC/MIN	2.23 MAX.	LESS THAN 0.1	HWR 142
FUEL	4.14.5	SCC/MIN	2.23 MAX.	LESS THAN 0.1	HWR 142
LEAK TEST--WELDED JOINTS					
LEAK TEST					
PRESSURIZED INLET TUBE WITH GASEOUS HELIUM					
OXIDIZER	4.14.6	PSIG	500 ± 10	VERIFIED	HWR 142
FUEL	4.14.9	PSIG	500 ± 10	VERIFIED	HWR 142

SPECIFICATION NUMBER RA0220-349	REVISION A	AMENDMENT	DNA 52-52701-277
SERIAL NO. 4058085	PART NO. 207540-21		
SE-7 COMPONENT ACCEPTANCE TEST	PART NAME THRUST CHAMBER, 100 LB., ASSY OF		5.1.4

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAK TEST--WELDED JOINTS (CONTINUED)					
JOINT LEAKAGE RATE					
OXIDIZER	4.14.7	SCC/SEC	10^{-6} MAX.	8.6×10^{-9}	ANR 142
FUEL	4.14.9	SCC/SEC	10^{-6} MAX.	8.6×10^{-9}	ANR 142
INSPECTED VISUALLY FOR CLEANLINESS, CORROSION, DETERIORATION, DAMAGE OR DEFORMATION	4.14.10	DNA	NONE ALLOWED	NONE DETECTED	ANR 142
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	4.474	ANR 142
THROAT DIAMETER (DELIVERED CONDITION)	4.15.1				
SECTION A-A		INCH	DNA	.709	ANR 142
B-B		INCH	DNA	.709	ANR 142
C-C		INCH	DNA	.709	ANR 142
D-D		INCH	DNA	.709	ANR 142
DRY WEIGHT (DELIVERABLE CONDITION) (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.15.2	LB.	DNA	8.57	ANR 142
INSPECTED VISUALLY FOR CLEANLINESS, CORROSION, DETERIORATION, DAMAGE OR DEFORMATION	4.15.3	DNA	NONE ALLOWED	NONE DETECTED	ANR 142

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-349	A		DNA	SERIAL NO.	4058958
			52-52701-277	PART NO.	207540-21
SE- 7 COMPONENT ACCEPTANCE TEST			PART NAME	THRUST CHAMBER, 100 LB., ASSY OF	5.1.5

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 80 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	-	-	-	NTF	
CELL LOCATION	-	-	-	-	-	1-C	
CELL NUMBER	-	-	-	-	-	379	
TEST DATE	-	-	-	-	-	11 MAR 64	
TEST DURATION	SEC.	3 MIN.	-	-	-	3.0	
ENVIRONMENTAL Pc	PSIA	.16 MAX.	-	-	-	.0888	
AMBIENT PRESSURE	PSIA	DNA	-	-	-	11.96	
AMBIENT TEMPERATURE	°F	DNA	-	-	-	34.0	
TIME OF DATA SLICE-START	SEC.	DNA	-	-	-	2.8	
TIME OF DATA SLICE-END	SEC.	DNA	-	-	-	2.8	
OXIDIZER TEMPERATURE	°F	DNA	-	-	-	33.8	
FUEL TEMPERATURE	°F	DNA	-	-	-	35.0	
OXIDIZER DENSITY	LB/FT^3	DNA	-	-	-	93.33	
FUEL DENSITY	LB/FT^3	DNA	-	-	-	55.54	

SPECIFICATION NUMBER N/C AMEND. NO. 1 RA0220-349

DNA 52-52701-277

SERIAL NO. 4058958

PART NO. 207540-21

SE- 7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

5.2

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 80 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	-	-	-	NTF	
OXIDIZER INLET PRESSURE	PSIA	283 ± 10	-	-	-	284.8	
FUEL INLET PRESSURE	PSIA	286 ± 10	-	-	-	292.5	
OXIDIZER FLOWRATE	LB/SEC.	DNA	-	-	-	.1981	
FUEL FLOWRATE	LB/SEC.	DNA	-	-	-	.1248	
THRUST	LB.	DNA	-	-	-	96.9	
MIXTURE RATIO	O/F	DNA	-	-	-	1.59	
SPECIFIC IMPULSE	SEC.	DNA	-	-	-	300.	
INJECTOR END Pc	PAIA	DNA	-	-	-	137.7	
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	-	-	-	5418.	
THROAT DIAMETER	INCH	DNA	-	-	-	.709	
FUEL ORIFICE DIAMETER	INCH	DNA	-	-	-	.07765	
OXIDIZER ORIFICE DIAMETER	INCH	DNA	-	-	-	.08705	
TCA FIRING TIME (TOTAL)	SEC.	10 MAX.	-	-	-	3.0	
OXIDIZER SAMPLE NUMBER	-	-	-	-	-	160	
FUEL SAMPLE NUMBER	-	-	-	-	-	161	

SPECIFICATION NUMBER N/C AMEND. NO. 1 RA0220-349

DNA 52-52701-277 SERIAL NO. 4058958 PART NO. 207540-21

SE- 7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

5.2.1

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 80 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	-	-	-	NTF	
ADJUST TO STANDARD CONDITIONS							
THRUST	LB.	94.5 ± 4.7	-	-	-	96.5	
MIXTURE RATIO	O/F	1.60 ± .05	-	-	-	1.60	
SPECIFIC IMPULSE	SEC.	DNA	-	-	-	304.	
INJECTOR END Pc	PSIA	DNA	-	-	-	135.3	
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	-	-	-	5420.	
ADJUST TO RATED CONDITIONS							
THRUST	LB.	94.5	-	-	-	94.5	
MIXTURE RATIO	O/F	1.6	-	-	-	1.60	
SPECIFIC IMPULSE	SEC.	280 MIN.	-	-	-	304.	

* N/C AMEND. NO. 1
** N/C AMEND. NO. 1

SPECIFICATION NUMBER
* RA0220-349 and ** RA0220-232

DNA 52-52701-277

SERIAL NO. 4058958
PART NO. 207540-21

SE- 7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER, 100 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	*	284	161
10 - 25	500	152	52
25 - 50	100	75	8
50 - 100	18	17	2
100 - 300	6	2	1
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. APR 65

* REV. B	SPECIFICATION NUMBER * RA0615-003	DNA 52-52701-277	SERIAL NO. 4058958 PART NO. 207540-21
SE-7 INFORMATION - CONTAMINATION		PART NAME THRUST CHAMBER, 100 LB., ASSY OF	5.3

SEQUENCE NO. 1
MAC 861C (REV. 7 JUNE 57)
Q. C. No. 99

McDONNELL AIRCRAFT CORPORATION
MATERIAL REVIEW RECORD

N2 05302

PAGE 1 OF 1

DATE 8 June 1964

COPIES TO DEPTS.

NAME	Thrust Chamber Assy
PART NO.	207540-21
OF ASSEMBLY NO.	SCD52-52701-277
TYPE	
STOCK NO.	
VENDOR NAME AND ADDRESS	Rocketdyne, 6633 Canoga Avenue, Canoga Park, Calif
PURCHASE ORDER NO.	Y 20161
RECEIVING REPORT NO.	
DATE RECEIVED AT MAC	
QUANTITY REJECTED	(1) One
QUANTITY ACCEPTED	0
☐ GFE / ☐ GOM / ☐ MAC / ☐ CFE	
JOB ORDER	306
RELEASE OR ITEM	
CODE	
LOCATION OF PARTS	Vendor
BLDG.	
MODEL	133 P
SERIAL NO.	4058965
CUSTOMER AIRPLANE NO.	
TOOLING CHECK REQUESTED	

REASON FOR REJECTION Condition A: 5.20 ± .03 Dim. (Height of tube stub) is 5.165 (Oxidizer side only)

Shipment of this hardware in the condition reflected in this MRR must be authorized by a written waiver from the McDonnell Buyer or Resident Representative. 23H-1 16471

SIGNATURE OF PERSON INITIATING THIS MRR [signature] & DATE 6-8-64

INSPECTION SUPERVISION APPROVAL SIGNATURE T. J. [signature] & DATE 6-9-64

MATERIALS REVIEW BOARD'S INSTRUCTIONS

USE AS IS	SCRAP	REWORK	RESPONSIBILITY	RETURN TO VENDOR
( )	QTY.	QTY.	MAC ☐ VENDOR ☒	QTY.

DISCREPANCY IS NOT CONSIDERED SUFFICIENT TO MATERIALLY AFFECT THE PHYSICAL AND FUNCTIONAL DESIGN REQUIREMENTS, THEREFORE, ACCEPTABLE TO USE.

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DEPT. DETERMINATIONS BY	[signature] MAC-REPR 6/11/64 BUYER				VENDOR TO BE CHARGED			ESTIMATOR
RETURN TO VENDOR		RETAIN AT MAC		CHANGE		REWORK	SCRAP	
QTY.	S.R. NO.	REWORK ☐ REPLACE ☐	QTY	REWORK ☐ SCRAP ☐	VENDOR ☐ MAC ☐	UNIT $ LOT $	$ $	PROD. PLNG. APPROVAL
AGREED MAC SHOP REPR.		MAC Q. CONTR. APPROVAL & DATE [signature] 6/11/64		MAC ENG. REPR. APPROVAL & DATE [signature] 11 Jun 64				CUST. INSP. REPR. APPROVAL & DATE [signature] 6/12/64
REWORK SATISFACTORILY COMPLETED	MAC INSP. R-15019-2	DATE	CUSTOMER INSP.	DATE	CORRECTIVE ACTION GENERAL FOREMAN DEPT.			

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CONFIDENTIAL

SCD 52-52701-277

"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

RAT #3 (CRD #2)

SPACE ENGINES ENGINEERING	SPACE ENGINES QUALITY CONTROL	McDONNELL QUALITY REPRESENTATIVE	GOV'T INSPECTION AGENCY QUALITY REPRESENTATIVE
DATE 7-13-64	DATE 13 July 64	DATE 13 July 64	DATE 13 July 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	13 JULY 1964
	DWG CHG LTR	DNA
Y20161R	CONTRACT NO.	
	GEN ORDER NO.	5252
SCD52-52701-277	SPEC NO.	
DNA	SERIAL NO.	4058965
52-52701-277	PART NO.	207540-21

SE-7 DELIVERABLE END ITEM – LOG BOOK IDENTIFICATION

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

1.0

~~CONFIDENTIAL~~

DELIVERABLE END ITEM

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

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

THE FORMAT OF PAGES IN THIS LOG BOOK SHALL NOT BE REVISED WITHOUT OBTAINING APPROVAL OF ROCKETDYNE SPACE ENGINES QUALITY CONTROL.

	DNA	SERIAL NO.	4053965
	52-52701-277	PART NO.	207540-21
FOREWORD--SE-7 LOG BOOK	PART NAME THRUST CHAMBER ASSY, 100 LB.		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

107	52-52701-277 PART NO. 207540-21	
SE-7 MODULE / COMPONENT ASSEMBLY LOG	PART NAME THRUST CHAMBER, 100 LB., ASSY OF	4.0

IND. NO.	PART NUMBER	REV. LTR.	PART NAME	SERIAL NO.	AGE CONTROL DATE OF MFG.	INSP.
1	207540-21	DNA	THRUST CHAMBER, 100 LB., ASSY OF	4058965	3 Q 63	
2	207541-11	DNA	BODY, THRUST CHAMBER, ASSY OF	4054719	3 Q 63	
2	207548	DNA	SHELL, THRUST CHAMBER, ASSY OF	8500372		
3	207543	DNA	INJECTOR, THRUST CHAMBER, ASSY OF	7039140		
2	407561	DNA	VALVE, OXIDIZER, T/C, ASSY OF	4056529		
2	407662	DNA	VALVE, FUEL, T/C, ASSY OF	9183314		

DNA SERIAL NO. 4058965

52-52701-277 PART NO. 207540-21

SE-7 CONFIGURATION & SERIALIZATION LOG

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

4.1

MR NO.	PART OR COMP. INVOLVED	PART NUMBER	SERIAL NUMBER	BRIEF DESCRIPTION OF VARIATION AND MATERIAL REVIEW BOARD DISPOSITION	INSP.
600-N-5 C 16709	100 LB. T.C.A.	207540-21	4058965	DISCREPANCY: CHAMBER SHELL ASSY HAS AN INDENTATION IN IT NEXT TO FLANGE TO SHELL WELDMENT AT APPROX 7:00 O'CLOCK (REF: USE P/C BOSS AS 12:00 LOOKING FROM EXIT END) INDENTATION IS APPROX. .010" IN DEPTH DISPOSITION: REWORKED PER 600-N-5, C 16709	
MRR #56446	100 LB. T.C.A.	207540-21	4058965	DISCREPANCY: CONDITION A: 3.55 ± .03 DIM FROM C/L OF BOSS TO END OF ELECTRICAL CONNECTOR IS 3.511 ON THE OXIDIZER SIDE. CONDITION B: 3.55 ± .03 DIM FROM C/L OF BOSS END OF ELECTRICAL CONNECTOR IS 3.516 ON THE FUEL SIDE. REF. B/P 103892. DISPOSITION: ACCEPTABLE TO USE. REF: 600-N-5, C 21035	
MRR #55302	100 LB. T.C.A.	207540-21	4058965	DISCREPANCY: CONDITION A: 5.20 ± .03 DIM (HEIGHT OF TUBE STUB) IS 5.165 (OXIDIZER SIDE ONLY) DISPOSITION: ACCEPTABLE TO USE. REF. 23H 16471	

DNA 52-52701-277 SERIAL NO. 4058965 PART NO. 207540-21

SE-7 DELIVERABLE END ITEM — VARIATION LOG

PART NAME THRUST CHAMBER, 100 LB., ASSY OF 4.3

PART NO.	PART NAME	SERIAL NO.	REASON FOR REPLACEMENT	REPLACED BY		INSP.
				PART NO.	SERIAL NO.	
			NONE THIS DATE (13 JULY 1964)			

DNA	SERIAL NO.	4058965	
52-52701-277	PART NO.	207540-21	
SE-7 DELIVERABLE END ITEM--REPLACEMENT LOG	PART NAME	THRUST CHAMBER, 100 LB., ASSY OF	4.4

SECTION II

52-52701-277 PART NO. 207540-21

SE-7 COMPONENT ACCEPTANCE TEST LOG

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

5.0

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
ELECTRICAL RESISTANCE TESTS--TCA PROPELLANT VALVES	4.2				
BODY TEMPERATURE					
OXIDIZER	4.2.4	DEGREES F	70 ± 5	67	ANR 545
FUEL	4.2.11	DEGREES F	70 ± 5	67	ANR 545
COIL RESISTANCE					
OXIDIZER	4.2.5	OHMS	42 ± 2	40.93	ANR 545
FUEL	4.2.11	OHMS	42 ± 2	40.94	ANR 545
CONTINUITY RESISTANCE					
OXIDIZER	4.2.9	OHMS	1.0 MAX.	.41	ANR 545
FUEL	4.2.11	OHMS	1.0 MAX.	.18	ANR 545
DIELECTRIC STRENGTH TEST--TCA PROPELLANT VALVES	4.3				
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICROAMPS	500 MAX.	57	ANR 545
FUEL	4.3.11	MICROAMPS	500 MAX.	75	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	VERIFIED	ANR 545
STEP II	4.4.5	PSIG	500	VERIFIED	ANR 545
					17

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-349	NC	#1	DNA	SERIAL NO.	4058965
			52-52701-277	PART NO.	207540-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 100 LB., ASSY OF		5.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE TEST--TCA PROPELLANT VALVES (CONTINUED)	4.4				
FUEL					
STEP I	4.4.7	PSIG	500	VERIFIED	
STEP II	4.4.7	PSIG	500	VERIFIED	
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION					
OXIDIZER					
STEP I	4.4.4	DNA	NONE ALLOWED	NO DAMAGE OR DEFORMATION DETECTED	
STEP II	4.4.5	DNA	NONE ALLOWED	NO DAMAGE OR DEFORMATION DETECTED	
FUEL					
STEP I	4.4.7	DNA	NONE ALLOWED	NO DAMAGE OR DEFORMATION DETECTED	
STEP II	4.4.7	DNA	NONE ALLOWED	NO DAMAGE OR DEFORMATION DETECTED	

SPECIFICATION NUMBER RA0220-349	REVISION NC	AMENDMENT #1	DNA SERIAL NO. 4058965	
			52-52701-277 PART NO. 207540-21	
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 100 LB., ASSY OF	5.1.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
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	
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	NO DAMAGE OR DEFORMATION DETECTED	
FUNCTIONAL TEST--TCA PROPELLANT VALVES	4.6				
OPENING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.021 MAX.	.0175	
FUEL	4.6.8	SEC.	0.021 MAX.	.018	
CLOSING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.005 MAX.	.0032	
FUEL	4.6.10	SEC.	0.005 MAX.	.0038	
CLOSING DROP OUT VOLTAGE					
OXIDIZER	4.6.17	VOLT (DC)	1 MIN.	2	
FUEL	4.6.13	VOLT (DC)	1 MIN.	1.75	

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0220-349	NC	#1	DNA	SERIAL NO. 4058965
			52-52701-277	PART NO. 207540-21

SE-7 COMPONENT ACCEPTANCE TEST

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

5.1.2

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAKAGE TEST -TCA PROPELLANT VALVES	4.7				
SEAT LEAKAGE RATE					
OXIDIZER	4.7.17	SCC/MIN	2.23 MAX.	LESS THAN 0.1	
FUEL	4.7.22	SCC/MIN	2.23 MAX.	LESS THAN 0.1	
* PRE-TEST DATA					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.1.3	LB.	DNA	8.78	
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	4.500	
THROAT DIAMETER					
SECTION A-A		INCH	DNA	.7090	
B-B		INCH	DNA	.7090	
C-C		INCH	DNA	.7090	
D-D		INCH	DNA	.7090	
** POST HOT-FIRE DATA					
PROOF PRESSURE TEST					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.14.1	LB.	DNA	8.56	
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES					

SPECIFICATION NUMBER	REVISION	AMENDMENT
** RA0220-349	A	NONE
* RA0220-349	A	NONE

DNA SERIAL NO. 4058965

52-52701-277 PART NO. 207540-21

SE-7 COMPONENT ACCEPTANCE TEST

PART NAME THRUST CHAMBER, 100 LB. ASSY OF

5.1.3

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

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-349	A	NONE	DNA 52-52701-277	SERIAL NO. 4058965	
				PART NO. 207540-21	
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 100 LB., ASSY OF		5.1.4

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAK TEST--WELDED JOINTS (CONTINUED)					
JOINT LEAKAGE RATE					
OXIDIZER	4.14.7	SCC/SEC	10^{-6} MAX.	LESS THAN 10^{-6}	
FUEL	4.14.9	SCC/SEC	10^{-6} MAX.	LESS THAN 10^{-6}	
INSPECTED VISUALLY FOR CLEANLINESS, CORROSION, DETERIORATION, DAMAGE OR DEFORMATION	4.14.10	DNA	NONE ALLOWED	NONE DETECTED	
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	4.520	
THROAT DIAMETER (DELIVERED CONDITION)	4.15.1				
SECTION A-A		INCH	DNA	.709	
B-B		INCH	DNA	.7085	
C-C		INCH	DNA	.7085	
D-D		INCH	DNA	.709	
DRY WEIGHT (DELIVERABLE CONDITION) (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.15.2	LB.	DNA	8.57	
INSPECTED VISUALLY FOR CLEANLINESS, CORROSION, DETERIORATION, DAMAGE OR DEFORMATION	4.15.3	DNA	NONE ALLOWED	NONE DETECTED	

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-349	A	NONE	DNA	SERIAL NO.	4058965
			52-52701-277	PART NO.	207540-21
SE- 7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 100 LB., ASSY OF		5.1.5

[redacted]

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 143 FINAL TEST DATA	RUN SP. TEST DATA	RUN TEST DATA	RUN 143 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	--	NFL		-	NFL	
OXIDIZER INLET PRESSURE	PSIA	283 ± 10	379		-	284.2	
FUEL INLET PRESSURE	PSIA	286 ± 10	1-A		-	295.8	
OXIDIZER FLOWRATE	LB/SEC	DNA	30 APR 64		-	.1930	
FUEL FLOWRATE	LB/SEC	DNA	3.0		-	.1239	
THRUST	LB.	DNA	[illegible]		-	95.1	
MIXTURE RATIO	O/F	DNA	[illegible]		-	1.56	
SPECIFIC IMPULSE	SEC	DNA	[illegible]		-	300.	
INJECTOR END Pc	PSIA	DNA	2.3		-	135.5	
CHARACTERISTIC VELOCITY	FT/SEC	DNA	2.8		-	5432.	
THROAT DIAMETER	INCH	DNA	42.5		-	.709	
FUEL ORIFICE DIAMETER	INCH	DNA	43.7		-	.07835	
OXIDIZER ORIFICE DIAMETER	INCH	DNA	92.73		-	.08510	
TCA FIRING TIME (TOTAL)	SEC	10 MAX.	55.55		-	3.0	
OXIDIZER SAMPLE NUMBER	-	-	-	-	-	204	
FUEL SAMPLE NUMBER	-	-	-	-	-	201	

SPECIFICATION NUMBER RA0220-349	REVISION A	AMENDMENT #1	DNA 52-52701-277	SERIAL NO. 4058965	
				PART NO. 207540-21	
SE-7 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER, 100 LB., ASSY OF		5.2.1

[redacted]

[redacted]

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 143 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	-	-	-	NFL	
ADJUST TO STANDARD CONDITIONS	-	-	-	-	-	-	-
THRUST	LB.	94.5 ± 4.7	-	-	-	94.7	
MIXTURE RATIO	O/F	1.60 ± .05	-	-	-	1.59	
SPECIFIC IMPULSE	SEC	DNA	-	-	-	305.	
INJECTOR END Pc	PSIA	DNA	-	-	-	133.2	
CHARACTERISTIC VELOCITY	FT/SEC	DNA	-	-	-	5442.	
ADJUST TO RATED CONDITIONS	-	-	-	-	-	-	-
THRUST	LB.	94.5	-	-	-	94.5	
MIXTURE RATIO	O/F	1.60	-	-	-	1.60	
SPECIFICATION LIMITS	SEC	280 MIN.	-	-	-	305.	

SPECIFICATION NUMBER	REVISION	AMENDMENT
RA0220-349	A	#1
RA0220-232	N/C	NONE

DNA SERIAL NO. 4058965

52-52701-277 PART NO. 207540-21

SE-7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

5.2.2

[redacted]

R-15019-2

119

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	54	89
	25 - 50	20	12	0
	50 - 100	5	4	0
	100 - 300	1	0	1
	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	#1	52-52701-277 PART NO. 207540-21	
SE-7 INFORMATION - CONTAMINATION			PART NAME THRUST CHAMBER 100 LB., ASSY OF	5.3

SEQUENCE NO. 1

MAC 831C (REV. JUNE 61) - Q. C. No. 09

McDONNELL AIRCRAFT CORPORATION

MATERIAL REVIEW RECORD

No. 55088

PAGE 1 OF 2

DATE 7 July 1964

COPIES TO DEPTS.

1. NAME: Thrust Chamber Assy 100#

VENDOR NAME AND ADDRESS: Rocketdyne, 6633 Canoga Avenue, Canoga Park, Calif

PART NO.: 207540-21

OF ASSEMBLY NO.: SCD52-52701-277

TYPE

STOCK NO.

PURCHASE ORDER NO.: Y 20161

RECEIVING REPORT NO.

DATE RECEIVED AT MAC

QUANTITY REJECTED		JOB ORDER	RELEASE OR ITEM	CODE	LOCATION OF PARTS	BLDG.
(1) One	☐ GFE ☐ COM	306			Vendor	
QUANTITY ACCEPTED	☐ MAC ☐ CFE	MODEL: 133 P	SERIAL NO.: 4054757	CUSTOMER AIRPLANE NO.	TOOLING CHECK REQUESTED	

REASON FOR REJECTION 1. Threat insert is cracked in two (2) places. Crack #1 starts at the upstream edge & runs to downstream edge of threat insert. Crack #2 runs from the minor dia. to the downstream edge of the insert. Max. width of cracks is .0009. NOTE: Cracks do not intesect and are 80° apart at the downstream edge of throat insert. See Sketch and Photo attached.

Shipment of this hardware in the condition reflected in this MRR must be authorized by a written waiver from the McDonnell Buyer or Resident Representative. 600N-5 17242

SIGNATURE OF PERSON INITIATING THIS MRR & DATE: T. J. Crumlan 7-7-64

INSPECTION SUPERVISION APPROVAL SIGNATURE & DATE: T. J. Crumlan 7-7-64

MATERIALS REVIEW BOARD'S INSTRUCTIONS

USE AS IS	SCRAP	REWORK	RESPONSIBILITY	RETURN TO VENDOR
	QTY.	QTY.	MAC ☐ VENDOR ☐	QTY.

Discrepancy is not considered sufficient to materially affect the physical and functional design requirements, therefore, acceptable to use for DAT.

No TWX sent to MAC; dispositioned in-house at Rocketdyne.

DEPT. DETERMINATIONS-BY: J. Robinson 7/8/64 BUYER

VENDOR TO BE CHARGED X

ESTIMATOR

RETURN TO VENDOR			RETAIN AT MAC		CHARGE		REWORK	SCRAP
QTY.	S.R. NO.	REWORK ☐ REPLACE ☐	QTY.	REWORK ☐ SCRAP ☐	VENDOR ☐ MAC ☐	UNIT LOT	$ $	$ $

PROD. PLNG. APPROVAL

AGREED MAC SHOP REPR. J. E. Gulbrath 7-8-64

MAC ENG. REPR. APPROVAL & DATE: R. L. Martin 8 Jul 64

CUST. INSP. REPR. APPROVAL & DATE: 8 Jul 64

REWORK SATISFACTORILY COMPLETED

MAC INSP. R-15019-2 DATE

CUSTOMER INSP. DATE

CORRECTIVE ACTION GENERAL FOREMAN DEPT.

MRR No. C-17242

NOR No.

Page 2 of 2

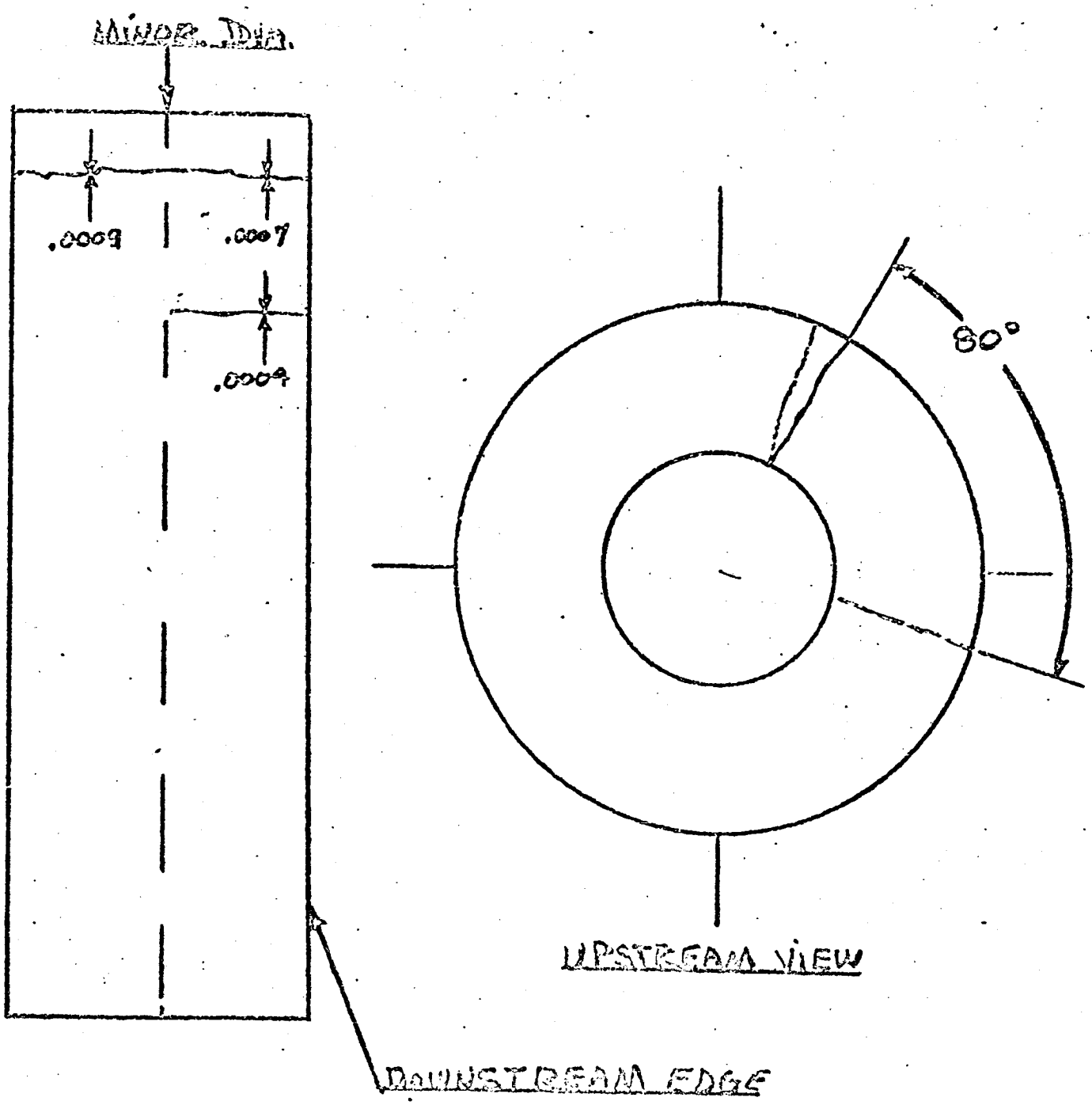
DISCREPANCY				DISPOSITION		
	DISC. CODE	MATL. CODE	QTY.		DISP CODE	QTY.
1				1		
2				2		
3				3		
4				4		
5				5		
6				6		
7				7		

ASSY. NO. 207540-21

DEFECTIVE DETAIL NO.

PART NAME THRUST CHAMBER ASSY

DATE 7/8/69



MAC 881A (REV. 24 APR. 58)

MATERIAL REVIEW RECORD
(CONTINUATION SHEET)

R-15019-2

SCD 52-52701-277
S/N 4054757

"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 #3 (CRD#5)

SPACE ENGINES ENGINEERING	SPACE ENGINES QUALITY CONTROL	McDONNELL QUALITY REPRESENTATIVE	GOV'T INSPECTION AGENCY QUALITY REPRESENTATIVE
A. W. Lallard	R. Smith	Lonnie L. Lewis	Kim Capone
DATE 7-27-64	DATE 7-27-64	DATE 7-27-64	DATE 27 July 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	27 JULY 1964
	DWG CHG LTR	DNA
Y20161R	CONTRACT NO.	
	GEN ORDER NO.	5252
SCD52-52701-277	SPEC NO.	
DNA	SERIAL NO.	4054757
52-52701-277	PART NO.	207540-21

SE-7 DELIVERABLE END ITEM – LOG BOOK IDENTIFICATION

PART NAME THRUST CHAMBER, 100 LB. ASSY OF

1.0

R-15019-2

123

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.

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

52-52701-277 PART NO. 207540-21

SE-7 MODULE / COMPONENT ASSEMBLY LOG

PART NAME THRUST CHAMBER, 100 LB., ASSY OF 4.0

IND. NO.	PART NUMBER	REV. LTR.	PART NAME	SERIAL NO.	AGE CONTROL DATE OF MFG.	INSP.
	207540-21	DNA	THRUST CHAMBER,100 LB., ASSY OF	4054757	2Q64	
	207541-11	DNA	BODY, THRUST CHAMBER, ASSY OF	4055462	2Q64	
	207548	DNA	SHELL, THRUST CHAMBER, ASSY OF	8502275		
	207543	DNA	INJECTOR, THRUST CHAMBER, ASSY OF	4058099		
	407561	DNA	VALVE, OXIDIZER, T/C, ASSY OF	4050856		
	407662	DNA	VALVE, FUEL, T/C, ASSY OF	4056547		

DNA SERIAL NO. 4054757

52-52701-277 PART NO. 207540-21

SE-7 CONFIGURATION & SERIALIZATION LOG

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

4.1

MCR ECP NO.	DATE	TITLE	DATE	INSP.
SE6-62	6 JAN 64	COMPONENT CLEANING; PROVISION FOR	27 JULY 64	
SE6-64	30 JULY 63	TCA, ACCEPTANCE TESTS; REVISION OF	27 JULY 64	
SE6-133	22 APR 64	TCA PROPELLANT VALVES; ADDITIONAL REQUIREMENTS FOR	27 JULY 64	
SE6-139	15 APR 64	PLACEMENT OF HAYNES STELLITE #3 SAND CAST ON APPROVED MATERIAL LIST	27 JULY 64	
SE6-144	15 APR 64	TCA INJECTORS; REDESIGN OF	27 JULY 64	
SE6-179	13 MAR 64	TUBE STUBS; MARKINGS OF	27 JULY 64	
SE7-41	15 APR 64	85# AND 100# THRUST CHAMBER ASSEMBLIES, PROPELLANT VALVES, INLET TUBES, MATERIAL; CHANGES TO 304L BAR PER QQ-S-763	27 JULY 64	
SE6-75	4 FEB 64	MAC REPORT 8518, INCORPORATION OF	27 JULY 64	
SE6-80	28 DEC 63	THRUST CHAMBER ASSEMBLIES, FABRICATION MATERIAL; APPROVAL OF	27 JULY 64	
SE7-85	30 APR 64	85# & 100 LB. TCA DIMENSIONS; CHANGES TO	27 JULY 64	
SE6-85	30 JUL 63	CUSTOMER TEST SURVEILLANCE; REQUIREMENTS FOR	27 JULY 64	
SE6-195	9 JUL 64	LIQUID CALIBRATION TESTS; DELETION OF	27 JULY 64	
SE6-[illegible]2	20 JULY 64	ELECTRICAL CONNECTOR REQUIREMENTS; REVISION OF	27 JULY 64	

	DNA	SERIAL NO.	4054757
	52-52701-277	PART NO.	207540-21
SE-7 DELIVERABLE END ITEM-MCR VERIFICATION	PART NAME THRUST CHAMBER, 100LB., 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 55336	T.C.A. 100 LB.	207540-21	4054757	DISCREPANCY: THROAT INSERT IS CRACKED IN TWO (2) PLACES. CRACK #1 STARTS AT THE UPSTREAM EDGE AND RUNS TO DOWNSTREAM EDGE OF THROAT INSERT. CRACK #2 RUNS FROM THE MINOR DIA. TO THE DOWNSTREAM EDGE OF THE INSERT. MAX. WIDTH OF CRACKS IS .0009. NOTE: CRACKS DO NOT INTERSECT AND ARE 80° APART AT THE DOWNSTREAM EDGE OF THROAT INSERT. DISPOSITION: ACCEPTABLE TO USE FOR DAT REF. 600-N-5 C17242	

DNA SERIAL NO. 4054757

52-52701-277 PART NO. 207540-21

SE-7 DELIVERABLE END ITEM --- VARIATION LOG

PART NAME THRUST CHAMBER, 100 LB. ASSY OF

4.3

PART NO.	PART NAME	SERIAL NO.	REASON FOR REPLACEMENT	REPLACED BY		INSP.
				PART NO.	SERIAL NO.	
			NONE THIS DATE(27 JULY 1964)			

DNA 52-52701-277	SERIAL NO.	4054757	
	PART NO.	207540-21	
SE-7 DELIVERABLE END ITEM--REPLACEMENT LOG	PART NAME THRUST CHAMBER, 100 LB., ASSY OF		4.4

SECTION II

52-52701-277 PART NO. 207540-21

SE-7 COMPONENT ACCEPTANCE TEST LOG

PART NAME THRUST CHAMBER, 100 LB., ASSY OF 5.0

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
ELECTRICAL RESISTANCE TESTS--TCA PROPELLANT VALVES	4.2				
BODY TEMPERATURE					
OXIDIZER	4.2.4	DEGREES F	70 ± 5	70	
FUEL	4.2.11	DEGREES F	70 ± 5	70	
COIL RESISTANCE					
OXIDIZER	4.2.5	OHMS	42 ± 2	40.89	
FUEL	4.2.11	OHMS	42 ± 2	40.62	
CONTINUITY RESISTANCE					
OXIDIZER	4.2.9	OHMS	1.0 MAX.	.170	
FUEL	4.2.11	OHMS	1.0 MAX.	.145	
DIELECTRIC STRENGTH TEST--TCA PROPELLANT VALVES	4.3				
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICROAMPS	500 MAX.	51	
FUEL	4.3.11	MICROAMPS	500 MAX.	53	
PROOF PRESSURE TEST--TCA PROPELLANT VALVES	4.4				
VALVES PRESSURIZED FOR NOT LESS THAN 3 MINUTES					
OXIDIZER					
STEP I	4.4.3	PSIG	500	NONE DETECTED	
STEP II	4.4.5	PSIG	500	NONE DETECTED	

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-349	A	NONE	DNA 52-52701-277	SERIAL NO. 4054757	PART NO. 207540-21

SE-7 COMPONENT ACCEPTANCE TEST

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

5.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE TEST--TCA PROPELLANT VALVES (CONTINUED)	4.4				
FUEL					
STEP I	4.4.7	PSIG	500	VERIFIED	
STEP II	4.4.7	PSIG	500	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	

SPECIFICATION NUMBER RA0220-349	REVISION A	AMENDMENT NONE	DNA 52-52701-277	SERIAL NO. 4054757 PART NO. 207540-21	
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 100 LB., ASSY OF		5.1.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
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	
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.	0.021 MAX.	.0175	
FUEL	4.6.8	SEC.	0.021 MAX.	.0185	
CLOSING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.005 MAX.	.0031	
FUEL	4.6.10	SEC.	0.005 MAX.	.0041	
CLOSING DROP OUT VOLTAGE					
OXIDIZER	4.6.17	VOLT (DC)	1 MIN.	2.5	
FUEL	4.6.13	VOLT (DC)	1 MIN.	2.0	

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-349	A	NONE	DNA	SERIAL NO.	4054757
			25-52701-277	PART NO.	207540-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME	THRUST CHAMBER, 100 LB., ASSY OF	5.1.2

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
* LEAKAGE TEST -TCA PROPELLANT VALVES	4.7				
SEAT LEAKAGE RATE					
OXIDIZER	4.7.17	SCC/MIN	2.23 MAX.	LESS THAN 0.1	
FUEL	4.7.22	SCC/MIN	2.23 MAX.	LESS THAN 0.1	
* PRE-TEST DATA					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.1.3	LB.	DNA	8.89	
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	4.470	
THROAT DIAMETER					
SECTION A-A		INCH	DNA	.710	
B-B		INCH	DNA	.710	
C-C		INCH	DNA	.710	
D-D		INCH	DNA	.710	
** POST HOT-FIRE DATA					
PROOF PRESSURE TEST					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.14.1	LB.	DNA	9.50	
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES					

SPECIFICATION NUMBER	REVISION	AMENDMENT
* RA0220-349	A	NONE
** RA0220-349	A	NONE

DNA SERIAL NO. 4054757

52-52701-277 PART NO. 207540-21

SE-7 COMPONENT ACCEPTANCE TEST

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

5.1.3

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

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-349	A	NONE	DNA	SERIAL NO.	4054757
			52-52701-277	PART NO.	207540-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME	THRUST CHAMBER, 100 LB., ASSY OF	5.1.4

R-15019-2

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAK TEST--WELDED JOINTS (CONTINUED)					
JOINT LEAKAGE RATE					
OXIDIZER	4.14.7	SCC/SEC	10^{-6} MAX.	LESS THAN 10^{-6}	ANR 495
FUEL	4.14.9	SCC/SEC	10^{-6} MAX.	LESS THAN 10^{-6}	ANR 495
INSPECTED VISUALLY FOR CLEANLINESS, CORROSION, DETERIORATION, DAMAGE OR DEFORMATION	4.14.10	DNA	NONE ALLOWED	NONE DETECTED	ANR 495
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	4.527	ANR 495
THROAT DIAMETER (DELIVERED CONDITION)	4.15.1				
SECTION A-A		INCH	DNA	.709	ANR 495
B-B		INCH	DNA	.709	ANR 495
C-C		INCH	DNA	.709	ANR 495
D-D		INCH	DNA	.709	ANR 495
DRY WEIGHT (DELIVERABLE CONDITION) (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.15.2	LB.	DNA	8.78	ANR 495
INSPECTED VISUALLY FOR CLEANLINESS, CORROSION, DETERIORATION, DAMAGE OR DEFORMATION	4.15.3	DNA	NONE ALLOWED	NONE DETECTED	ANR 495

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0220-349	A	NONE	DNA	SERIAL NO. 4054757
			52-52701-277	PART NO. 207540-21
SE- 7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 100 LB., ASSY OF	5.1.5

~~CONFIDENTIAL~~

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 183 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	-	-	-	NFL	-
CELL LOCATION	-	-	-	-	-	1-A	
CELL NUMBER	-	-	-	-	-	379	
TEST DATE	-	-	-	-	-	18 JUNE 64	
TEST DURATION	SEC.	3.0	-	-	-	3.0	
ENVIRONMENTAL Pc	PSIA	0.16 MAX	-	-	-	.0810	
AMBIENT PRESSURE	PSIA	DNA	-	-	-	12.02	
AMBIENT TEMPERATURE	°F	DNA	-	-	-	62.0	
TIME OF DATA SLICE-START	SEC.	DNA	-	-	-	2.8	
TIME OF DATA SLICE-END	SEC.	DNA	-	-	-	2.8	
OXIDIZER TEMPERATURE	°F	DNA	-	-	-	49.5	
FUEL TEMPERATURE	°F	DNA	-	-	-	53.0	
OXIDIZER DENSITY	LB/FT^3	DNA	-	-	-	91.96	
FUEL DENSITY	LB/FT^3	DNA	-	-	-	54.54	

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0220-349	A	NONE	DNA / 52-52701-277	SERIAL NO. 4054757 / PART NO. 207540-21
SE- 7 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER, 100 LB., ASSY OF	5.2

~~CONFIDENTIAL~~

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 183 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	-	-	-	NFL	
OXIDIZER INLET PRESSURE	PSIA	283 ± 10	-	-	-	279.1	
FUEL INLET PRESSURE	PSIA	286 ± 10	-	-	-	286.5	
OXIDIZER FLOWRATE	LB/SEC	DNA	-	-	-	.1944	
FUEL FLOWRATE	LB/SEC	DNA	-	-	-	.1226	
THRUST	LB.	DNA	-	-	-	92.9	
MIXTURE RATIO	O/F	DNA	-	-	-	1.59	
SPECIFIC IMPULSE	SEC	DNA	-	-	-	293.	
INJECTOR END Pc	PSIA	DNA	-	-	-	132.7	
CHARACTERISTIC VELOCITY	FT/SEC	DNA	-	-	-	5333.	
THROAT DIAMETER	INCH	DNA	-	-	-	.710	
FUEL ORIFICE DIAMETER	INCH	DNA	-	-	-	.07810	
OXIDIZER ORIFICE DIAMETER	INCH	DNA	-	-	-	.08628	
TCA FIRING TIME (TOTAL)	SEC	10 MAX.	-	-	-	3.0	
OXIDIZER SAMPLE NUMBER	-	-	-	-	-	242	
FUEL SAMPLE NUMBER	-	-	-	-	-	239	

SPECIFICATION NUMBER	REVISION	AMENDMENT	DNA	SERIAL NO. 4054757
RA0220-349	A	NONE	52-52701-277	PART NO. 207540-21

SE- 7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

5.2.1

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 183 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	-	-	-	NFL	
ADJUST TO STANDARD CONDITIONS	-	-	-	-	-	-	
THRUST	LB.	94.5 $^{+}_{-}$ 4.7	-	-	-	94.2	
MIXTURE RATIO	O/F	1.60 $^{+}_{-}$ .05	-	-	-	1.59	
SPECIFIC IMPULSE	SEC	DNA	-	-	-	297	
INJECTOR END Pc	PSIA	DNA	-	-	-	132.9	
CHARACTERISTIC VELOCITY	FT/SEC	DNA	-	-	-	5334.	
ADJUST TO RATED CONDITIONS	-	-	-	-	-	-	-
THRUST	LB.	94.5	-	-	-	94.5	
MIXTURE RATIO	O/F	1.60	-	-	-	1.60	
SPECIFIC IMPULSE	SEC	280 MIN.	-	-	-	297	

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0220-349	A	NONE	DNA	SERIAL NO. 4054757
RA0220-232	N/C	#1	52-52701-277	PART NO. 207540-21

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

[redacted]

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	49	94
	25 - 50	20	9	5
	50 - 100	5	2	3
	100 - 300	1	1	1
	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).

INSP. AWR 142

CLASS 4

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0615-003	B	#1	52-52701-277 PART NO. 207540-21	
SE-7 INFORMATION - CONTAMINATION			PART NAME THRUST CHAMBER, 100 LB., ASSY OF	5.3

[redacted]

SCD 52-52701-277
S/N 4054759

"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# 5 (CRD #7)

SPACE ENGINES ENGINEERING	SPACE ENGINES QUALITY CONTROL	McDONNELL QUALITY REPRESENTATIVE	GOV'T INSPECTION AGENCY QUALITY REPRESENTATIVE
[illegible]	W. E. Reitz	[illegible]	[illegible]
DATE 8/13/64	DATE 8/13/64	DATE 8/13/64	DATE 13 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	12 AUGUST 1964
	DWG CHG LTR	DNA
Y20161R	CONTRACT NO.	
	GEN ORDER NO.	5252
SCD 52-52701-277	SPEC NO.	
DNA	SERIAL NO.	4054759
52-52701-277	PART NO	207540-21

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

[redacted]

DELIVERABLE END ITEM

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

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

THE FORMAT OF PAGES IN THIS LOG BOOK SHALL NOT BE REVISED WITHOUT OBTAINING APPROVAL OF ROCKETDYNE SPACE ENGINES 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

5.1.4 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

	52-52701-277 PART NO. 207540-21
SE-7 MODULE / COMPONENT ASSEMBLY LOG	PART NAME THRUST CHAMBER, 100 LB., ASSY OF 4.0

IND. NO.	PART NUMBER	REV. LTR.	PART NAME	SERIAL NO.	AGE CONTROL DATE OF MFG.	INSP.
1	207540-21	DNA	THRUST CHAMBER, 100 LB., ASSY OF	4054759	2 Q 64	ANR 208
2	207541-11	DNA	BODY, THRUST CHAMBER, ASSY OF	4059354	2 Q 64	ANR 208
2	207548	DNA	SHELL, THRUST CHAMBER, ASSY OF	8502302		ANR 208
3	207543	DNA	INJECTOR, THRUST CHAMBER, ASSY OF	4060040		ANR 208
2	407561	DNA	VALVE, OXIDIZER, T/C, ASSY OF	8722092		ANR 208
2	407662	DNA	VALVE, FUEL, T/C, ASSY OF	9183322		ANR 208

M NASA 1

DNA SERIAL NO. 4054759

52-52701-277 PART NO. 207540-21

SE-7 CONFIGURATION & SERIALIZATION LOG

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

4.1

MCR / ECP NO.	DATE	TITLE	DATE	INSP.
SE6-62	6 JAN 64	COMPONENT CLEANING; PROVISION FOR	12 AUG 64	ANR 208
SE6-64	30 JUL 63	TCA, ACCEPTANCE TESTS; REVISION OF	12 AUG 64	ANR 208
SE6-80	28 DEC 63	THRUST CHAMBER ASSEMBLIES, FABRICATION MATERIAL; APPROVAL OF	12 AUG 64	ANR 208
SE6-85	30 JUL 63	CUSTOMER TEST SURVEILLANCE; REQUIREMENTS FOR	12 AUG 64	ANR 208
SE6-133	22 APR 64	TCA PROPELLANT VALVES; ADDITIONAL REQUIREMENTS FOR	12 AUG 64	ANR 208
SE6-139	15 APR 64	PLACEMENT OF HAYNES STELLITE #3 SAND CAST ON APPROVED MATERIAL LIST	12 AUG 64	ANR 208
SE6-144	15 APR 64	TCA INJECTORS; REDESIGN OF	12 AUG 64	ANR 208
SE6-179	16 JUN 64	TUBE STUBS; MARKINGS OF	12 AUG 64	ANR 208
SE7-41	15 APR 64	85# AND 100# THRUST CHAMBER ASSEMBLIES, PROPELLANT VALVES, INLET TUBES, MATERIAL; CHANGES TO 304L BAR PER QQ-S-763	12 AUG 64	ANR 208
SE7-85	30 APR 64	85 AND 100 LB. TCA DIMENSIONS; CHANGES TO	12 AUG 64	ANR 208

DNA	SERIAL NO.	4054759	
52-52701-277	PART NO.	207540-21	
SE-7 DELIVERABLE END ITEM-MCR VERIFICATION	PART NAME	THRUST CHAMBER, 100 LB., ASSY OF	4.2

MR NO.	PART OR COMP. INVOLVED	PART NUMBER	SERIAL NUMBER	BRIEF DESCRIPTION OF VARIATION AND MATERIAL REVIEW BOARD DISPOSITION	INSP.
				NONE THIS DATE - 12 AUGUST 1964	

	DNA	SERIAL NO.	4054759
	52-52701-277	PART NO.	207540-21
SE-7 DELIVERABLE END ITEM — VARIATION LOG	PART NAME	THRUST CHAMBER, 100 LB., ASSY OF	4.3

PART NO.	PART NAME	SERIAL NO.	REASON FOR REPLACEMENT	REPLACED BY		INSP.
				PART NO.	SERIAL NO.	
			NONE THIS DATE - 12 AUGUST 1964			ANR 208

DNA SERIAL NO. 4054759

52-52701-277 PART NO. 207540-21

SE-7 DELIVERABLE END ITEM--REPLACEMENT LOG

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

SECTION II

	52-52701-277 PART NO. 207540-21	
SE-7 COMPONENT ACCEPTANCE TEST LOG	PART NAME THRUST CHAMBER, 100 LB., ASSY OF	5.0

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
ELECTRICAL RESISTANCE TESTS--TCA PROPELLANT VALVES	4.2				
BODY TEMPERATURE					
OXIDIZER	4.2.4	DEGREES F	70 ± 5	70	ANR 208
FUEL	4.2.11	DEGREES F	70 ± 5	70	ANR 208
COIL RESISTANCE					
OXIDIZER	4.2.5	OHMS	42 ± 2	41.00	ANR 208
FUEL	4.2.11	OHMS	42 ± 2	41.60	ANR 208
CONTINUITY RESISTANCE					
OXIDIZER	4.2.9	OHMS	1.0 MAX.	.193	ANR 208
FUEL	4.2.11	OHMS	1.0 MAX.	.151	ANR 208
DIELECTRIC STRENGTH TEST--TCA PROPELLANT VALVES	4.3				
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICROAMPS	500 MAX.	33	ANR 208
FUEL	4.3.11	MICROAMPS	500 MAX.	49	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	VERIFIED	ANR 208
STEP II	4.4.5	PSIG	500	VERIFIED	ANR 208

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-349	A	NONE	DNA 52-52701-277	SERIAL NO. 4054759	
				PART NO. 207540-21	
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 100 LB., ASSY OF		5.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE TEST--TCA PROPELLANT VALVES (CONTINUED)	4.4				
FUEL					
STEP I	4.4.7	PSIG	500	VERIFIED	ANR 208
STEP II	4.4.7	PSIG	500	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

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-349	A	NONE	DNA	SERIAL NO.	1054759
			52-52701-277	PART NO.	207540-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME	THRUST CHAMBER, 100 LB., ASSY OF	5.1.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
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
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.	0.021 MAX.	.0175	ANR 208
FUEL	4.6.8	SEC.	0.021 MAX.	.017	ANR 208
CLOSING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.005 MAX.	.0031	ANR 208
FUEL	4.6.10	SEC.	0.005 MAX.	.0035	ANR 208
CLOSING DROP OUT VOLTAGE					
OXIDIZER	4.6.17	VOLT (DC)	1 MIN.	2	ANR 208
FUEL	4.6.13	VOLT (DC)	1 MIN.	1.5	ANR 208

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-349	A	NONE	DNA	SERIAL NO.	4054759
			52-52701-277	PART NO.	207540-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 100 LB., ASSY OF		5.1.2

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
* LEAKAGE TEST -TCA PROPELLANT VALVES	4.7				
SEAT LEAKAGE RATE					
OXIDIZER	4.7.17	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 208
FUEL	4.7.22	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 208
** PRE-TEST DATA					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.1.3	LB.	DNA	8.91	ANR 208
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	4.440	ANR 208
THROAT DIAMETER					
SECTION A-A		INCH	DNA	.710	ANR 208
B-B		INCH	DNA	.710	ANR 208
C-C		INCH	DNA	.710	ANR 208
D-D		INCH	DNA	.710	ANR 208
** POST HOT-FIRE DATA					
PROOF PRESSURE TEST					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.14.1	LB.	DNA	8.92	ANR 208
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES					

SPECIFICATION NUMBER	REVISION	AMENDMENT
* RA0220-349	A	NONE
** RA0220-349	B	NONE

DNA SERIAL NO. 4054759

52-52701-277 PART NO. 207540-21

SE-7 COMPONENT ACCEPTANCE TEST

PART NAME THRUST CHAMBER, 100 LB., ASSY OF

5.1.3

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

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-349	B	NONE	DNA	SERIAL NO.	4054759
			52-52701-277	PART NO.	207510-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 100 LB., ASSY		5.2.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAK TEST--WELDED JOINTS (CONTINUED)					
JOINT LEAKAGE RATE					
OXIDIZER	4.14.7	SCC/SEC	10^{-6} MAX.	3.1×10^{-7}	ANR 208
FUEL	4.14.9	SCC/SEC	10^{-6} MAX.	$<9.7 \times 10^{-7}$	ANR 208
INSPECTED VISUALLY FOR CLEANLINESS, CORROSION, DETERIORATION, DAMAGE OR DEFORMATION	4.14.10	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	4.450	ANR 208
THROAT DIAMETER (DELIVERED CONDITION)	4.15.1				
SECTION A-A		INCH	DNA	.7095	ANR 208
B-B		INCH	DNA	.7090	ANR 208
C-C		INCH	DNA	.7095	ANR 208
D-D		INCH	DNA	.7090	ANR 208
DRY WEIGHT (DELIVERABLE CONDITION) (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.15.2	LB.	DNA	8.76	ANR 208
INSPECTED VISUALLY FOR CLEANLINESS, CORROSION, DETERIORATION, DAMAGE OR DEFORMATION	4.15.3	DNA	NONE ALLOWED	NONE DETECTED	ANR 208

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-349	B	NONE	DNA	SERIAL NO.	4054759
			52-52701-277	PART NO.	207540-21
SE- 7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 100 LB., ASSY OF		5.1.5

GROUP 4
Downgraded at 3 year intervals
Declassified after 12 years

CONFIDENTIAL

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 ****** TEST DATA	RUN ******* TEST DATA	RUN ****** TEST DATA	RUN 196 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	--	--	--	--	--	NFL	
CELL LOCATION	--	--	--	--	--	1-A	
CELL NUMBER	--	--	--	--	--	379	
TEST DATE	--	--	--	--	--	9 July 1964	
TEST DURATION	SEC.	3.0 MIN.	--	--	--	3.0	
ENVIRONMENTAL Pc	PSIA	0.16 MAX.	--	--	--	.07540	
AMBIENT PRESSURE	PSIA	DNA	--	--	--	12.08	
AMBIENT TEMPERATURE	°F	DNA	--	--	--	68.0	
TIME OF DATA SLICE-START	SEC.	DNA	--	--	--	2.8	
TIME OF DATA SLICE-END	SEC.	DNA	--	--	--	2.8	
OXIDIZER TEMPERATURE	°F	DNA	--	--	--	60.0	
FUEL TEMPERATURE	°F	DNA	--	--	--	60.3	
OXIDIZER DENSITY	LB/FT^3	DNA	--	--	--	91.45	
FUEL DENSITY	LB/FT^3	DNA	--	--	--	54.94	

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RAO 220-349	A	NC	DNA 52-52701-277	SERIAL NO. 4054759 PART NO. 207540-21
SE- 7 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER 100 LB ASSY OF	5.2

CONFIDENTIAL

Downgraded 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 ****** TEST DATA	RUN ******* TEST DATA	RUN****** TEST DATA	RUN 196 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	---	—	—	—	—	NFL	
OXIDIZER INLET PRESSURE	PSIA	283 ± 10	—	—	—	288.8	
FUEL INLET PRESSURE	PSIA	286 ± 10	—	—	—	286.1	
OXIDIZER FLOWRATE	LB/SEC	DNA	—	—	—	.1962	
FUEL FLOWRATE	LB/SEC	DNA	—	—	—	.1200	
THRUST	LB.	DNA	—	—	—	96.3	
MIXTURE RATIO	O/F	DNA	—	—	—	1.64	
SPECIFIC IMPULSE	SEC	DNA	—	—	—	304.	
INJECTOR END Pc	PSIA	DNA	—	—	—	137.2	
CHARACTERISTIC VELOCITY	FT/SEC	DNA	—	—	—	5526.	
THROAT DIAMETER	INCH	DNA	—	—	—	.710	
FUEL ORIFICE DIAMETER	INCH	DNA	—	—	—	.07765	
OXIDIZER ORIFICE DIAMETER	INCH	DNA	—	—	—	.08570	
TCA FIRING TIME (TOTAL)	SEC	10 MAX.	—	—	—	3.0	
OXIDIZER SAMPLE NUMBER	—	—	—	—	—	249.	
FUEL SAMPLE NUMBER	—	—	—	—	—	250.	

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RAO 220-349	A	NC	DNA 52-52701-277	SERIAL NO. 4034759 PART NO. 207540-21
SE- 7 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER 100 LB ASSY OF	5.2.1

CONFIDENTIAL

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

[redacted]

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.

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN ***** TEST DATA	RUN ****** TEST DATA	RUN ***** TEST DATA	RUN 196 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	--	--	--	--	--	NEL	
ADJUST TO STANDARD CONDITIONS							
THRUST	LB.	94.5 ± 4.7	--	--	--	96.1	
MIXTURE RATIO	O/F	1.60 ± .05	--	--	--	1.59	
SPECIFIC IMPULSE	SEC	DNA	--	--	--	308.	
INJECTOR END Pc	PSIA	DNA	--	--	--	135.2	
CHARACTERISTIC VELOCITY	FT/SEC	DNA	--	--	--	5514.	
ADJUST TO RATED CONDITIONS							
THRUST	LB.	94.5 ± 4.7	--	--	--	94.5	
MIXTURE RATIO	O/F	1.60 ± .05	--	--	--	1.60	
SPECIFIC IMPULSE	SEC	280 MIN.	--	--	--	308.	

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RAO 220-349	A	NC	DNA 52-52701-277	SERIAL NO. 4054759 PART NO. 207540-21
SE-7 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER 100 LB ASSY OF	5.2.2

[redacted]

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	67	71
	25 - 50	20	3	3
	50 - 100	5	1	3
	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. ANA 208

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0615-003	B	#1	52-52701-277 PART NO. 207540-21	
SE- 7 INFORMATION - CONTAMINATION			PART NAME THRUST CHAMBER, 100 LB. , ASSY OF	5.3

APPENDIX D

APPENDIX D

DESIGN APPROVAL TEST SPECIFICATION AND DATA

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DESIGN APPROVAL TEST OF COMPONENTS

FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

(SE-7)

THRUST CHAMBER ASSEMBLY - 100#

McDonnell Part Number - 52-52701-277
Rocketdyne Part Number - 207540-21
Test Number - 207540-401

(FINAL) APPROVAL

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

EFF: DAT | CONT. DWG: 52-52701-277

7-15-65 — all pages

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 180

REVISIONS

DATE 10 July 1964

DATE	REV. BY	PAGES AFFECTED	REMARKS
9-1-64	E.A.	2 & 163	Deleted Four Accelerometers
		175	Added Two Dimensions
		176	Repositioned Inlet Adapters
9-3-64	E.A.	36	Deleted Lockup Pressure
		121 & 123, 128.1	Added Cape Cycle & MDC Data Sheets
		124, 126, 128, 128.1	Changed PSIA to in. Hg
		125, 127, 128, 128.1	Added Start and Shutdown Times
		160, 169	Revised Table I & II

A A A A A A A A

5019-2

FORM R 18-0

DATE	REV. BY	PAGES AFFECTED	REMARKS	
9-3-64	E.A.	35	Revised para. 6.7.4	A
10-12-64	R.C.	43.1	Added Note & Change Page No.	A
10-13-64	E. A.	5	Added DWG Numbers	A
10-13-64	E.A.	6	Added Shipping Container DWG No.	A
10-13-64	E. A.	46	Change DWG Nos.	A
10-15-64	E.A.	12.1	Added Definition and Page	A
9-9-64	E. A.	36 & 37	Revised Note (2) & para. 6.7.13	B
9-10-64	J.G.	121	Added Note	B
10-12-64	E.A.	45	Added Note	B
10-12-64	J.G.	49,50,52,53,54	Revised Vibration Rerun Procedure	B
		55,56,57,58,59		
		60,61,62 & 63		
10-12-64	R.C.	54.1 & 56.1	Added Data Sheets	B
10-13-64	E.A.	47.1	Added Page No.	B
10-15-64	R.C.	64	Revised Procedure	B
10-19-64	J.G.	169	Revised Figure 6	B
10-21-64	R.C.	38,39,40	Revised Procedure	C
10-21-64	R.C.	40.1	Added Page	C
10-22-64	J.G.	160, 161	Revised Table I	C
10-22-64	J.G.	161.1	Added Page	C
10-22-64	J.G.	169	Revised Figure 6	C
10-31-64	R.C.	64, 66	Changed Unit #1 to 1A and RA0616-005	C
			to RA0616-008	
11-18-64	R.C.	91,115 & 158	Revised Procedure	C
11-18-64	R.C.	91.1,92.1,115.1,	Added Pages	C
		116.1, 158.1 &		
		159.1		
11-6-64	J.G.	161	Revised Table I	D
			R-15019-2	

FORM R 18-G-4

THRUST CHAMBER ASSEMBLY -100#

McDonnell Part Number	52-52701-277
Rocketdyne Part Number	207540-21
Test Number	207540-401

DESCRIPTION OF COMPONENT

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

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TABLES

Table No. No.	Page	Title
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II		Design Approval Test Duty Cycle

FIGURES

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2.		Schematic - Propellant Valve Proof Pressure and Leakage
3.		Schematic - Thrust Chamber Proof Pressure and Leakage
4.		Schematic - Propellant Valve Functional
5.		Graph - Solenoid Valve Response
6.		Schematic - TCA Propellant Feed System
7.		Schematic - Vibration and Shock
8.		Graph - Random Vibration
9.		Schematic - Explosive Atmosphere
10.		Schematic - Propellant Valve Continuous Duty
11.		Graph - Propellant Valve Electrical Resistance
12, 12A		Drawing - Component Test Modification
13.		Curve - Thrust Pulse Parameters
14.		Schematic - Fuel and Oxidizer Resistance
15.		Schematic - Propellant Valve Load Analysis
16.		Schematic - Sectioning Diagram

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

TEST NO. 207540-401 SHEET 1 OF 180

Reference: MAC SCD 52-52701, Rev. F

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 Orbit Attitude and Maneuver System as specified in McDonnell Aircraft Corporation Specification Control Drawing 52-52701, Rev. F, paragraph 6.3.1.3.2.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
T. G. Kniffin 7-10-64	4/14/64	R. H. Eide	7-22-64		
CHECKED BY:	DATE				
	4/16/64				

FORM 608-B-40 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

TEST NO. 207540-401 SHEET 2 OF 180

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

2.0 APPLICABLE DOCUMENTS

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

2.1 McDonnell Aircraft Specifications

SCD 52-52701	Specification Control Drawing, MAC Model 133P, Orbit Attitude and Maneuver System Rev. F, 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 McDonnell Aircraft Drawings

Drawing 52-52067	Modification - 100# TCA Nozzle Extension, dated 19 February 1964.
Drawing 506612	Elbow
Drawing 506737	Union

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2.3 Military Specifications

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

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
T.G. Kniffin	7-27-64				
CHECKED BY:	DATE				
[illegible]	7-27-64	[illegible]	7-27-64		

FORM 608-B-40 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

TEST NO. 207540-401 SHEET 3 OF 180

2.3 (continued)	MIL-L-25567	Leak Test Compound, Oxygen System, dated 7 January 1959.
	MIL-P-26539A	Propellant, Nitrogen Tetroxide, dated 31 July 1961.
	MIL-P-27401A	Propellant, Nitrogen Pressurizing, dated 7 November 1960.
	MIL-P-27404	Propellant, Monomethyl Hydrazine, dated 3 April 1962.
	MIL-A-6091B	Alcohol; Ethyl, Specially denatured, dated 12 January 1962.
	Federal Stock No. 6830-263-9842	Helium
2.4	Rocketdyne Specifications	
	RA0107-003	Fusion Welding of Rocketdyne Components, dated 18 October 1961.
	* RA0220-232	SE7 207540 Assembly Data Reduction and Adjustments, dated 15 July 1963. (CONFIDENTIAL)
	*RA0220-349	SE7 Thrust Chamber Assembly Acceptance Testing, dated 2 January 1964.
	*RA0112-002	Lubricants, Anti-Seize Compounds and Gasketing Type Seal Compounds for Rocket Engines, dated 29 July 1963.
	*RA0220-290	SE7 Weight Determination, dated Oct 2, 1963.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64	[signature]	7-22-64		
CHECKED BY: [signature]	DATE 4/16				

FORM 608-B-40 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

TEST NO. 207540-401 SHEET 4 OF 180

2.4 (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 Engines Hardware, dated 20 June 1963
	*RA0610-003	Cleaning Space Engine Hardware by Liquid Flushing, dated 24 October 1963
	*RA0610-009	Chemical Cleaning of Filter Elements for Space Engines
	*RA0616-005	SE7 Propulsion System Inter and Intra Plant Handling, dated 20 March 1963
	*RA0616-008	SE7 Propulsion System; Preparation for Customer Delivery, dated 4 September 1963
	SEM 4388-4040	Pulse Performance Data Reduction Procedure, dated 22 July 1964
	*PEM 25.01 G	Environmentally Controlled Areas, Definitions and Specification for, dated 2 December 1963
2.5	Rocketdyne Drawings	
	Drawing 207540 (-21)	Thrust Chamber, 100 lbs, 9 Min., Assy. of, dated 10 July 1963
	Drawing T5030469	Pressure Test and Water Flow Fixture, dated 10 December 1962
	Drawing 99-106417	Propellant Valve Outlet Adapter, dated 30 January 1964

PREPARED BY: DATE	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL DATE
T.G. Kniffin 6-27-64	7-27-64	
CHECKED BY: DATE 7.27.64		

FORM 608-B-40 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

TEST NO. 207540-401 SHEET 5 OF 180

2.5 (cont'd)	Drawing 99-106126	Adapter - Fitting, Assy. of, dated 22 October 1963	
	Drawing 9017844	Seal Assembly, Thrust Chamber Drain, 100 lb TC, dated 11 September 1962	
	Drawing 99-106715	Tube, Assy of, (Fuel), dated	A
	Drawing 99-106716	Tube, Assy of, (Oxidizer), dated	A
	Drawing 99-106717	100# TCA Installation (DAT), dated	A
	Drawing RK 398-10035	Shipping Container, SE7 TCA (100#) with Extended Inlet Adapters, dated 23 Sept. 64	A
	Drawing 99-106726	Propellant Valve Orifice Adapter, (85&100) dated, 22 september 1964	A
	Drawing 99-106 727	Propellant Valve Orifice Adapter, (85&100) dated ,23 September 1964	A

PREPARED BY: DATE	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL DATE
T.G. Kniffin 7-10-64 10-10-64	R Heide 7-22-64	
CHECKED BY: DATE		
S.T. Duncan 7-22-64		

FORM 608-B-40 NEW 6-63

REVISION A James D. Morrison Dated 10-13-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

TEST NO. 207540-401 SHEET 6 OF 180

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

3.0 GENERAL REQUIREMENTS

3.1 Safety

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

3.2 Handling

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

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

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
T.G. Kniffin	7-10-64	[illegible]	7-22-64		
CHECKED BY: [illegible]	DATE 7-22-64				

FORM 608-B-40 NEW 6-63

REVISION A [illegible] dated 7-13-65

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

TEST NO. 207540-401 SHEET 7 OF 180

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

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

3.5 Maintenance (paragraph 6.2.3 of reference a)

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

3.6 Failures (paragraph 2.5.2 of McDonnell Report 8392)

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

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

3.7 Test Witnessing (paragraph 6.2.1.3 of reference a)

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
T. G. Kniffin	6/22/64	B H Eide	7-22-64		
CHECKED BY:	DATE				
[illegible]	7-22-64				

FORM 608-B-40 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

TEST NO. 207540-401 SHEET 8 OF 180

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

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

3.8 Cleanliness Requirements

Hot Fire Test and Decontamination Facilities: During the time that the TCA is being installed in or removed from a hot fire test facility or a decontamination facility, the TCA propellant valve inlets, when open, shall be protected by a plastic enclosure. A low volume nitrogen purge, filtered through two, 10 micron absolute, stainless steel wire mesh filters, installed in series, shall be used to prevent entrance of foreign material into the 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 25.01G. It shall be a requirement that a ten (10) micron absolute wire mesh stainless steel filter be installed on the propellant valve inlets in a Class IV area. The entire test setup shall be assembled and disassembled in a Class IV area.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
T.G. Kniffin	7-10-64	[illegible]	7-22-64		
CHECKED BY: [illegible]	DATE 7-22-64				

FORM 608-B-40 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

TEST NO. 207540-401 SHEET 9 OF 180

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

3.9 Report

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

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

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

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
T.G. Kniffin	7-7-64				
CHECKED BY:	DATE				
[illegible]	7-22-64	[illegible]	7-22-64		

FORM 608-B-40 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

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3.10 Component Test Modification

The propellant valve inlets of each TCA shall be modified following Pre-Test Inspection by the addition of an inlet tube adapter. See Figure 12 . 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 tent subsequent hot fire testing shall be delayed pending the results of the analysis of the new propellant.

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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	-	Geseous Nitrogen
He	-	Helium
Hr	-	Hour
L	-	Lower
MAC	-	McDonnell Aircraft Corporation
Min	-	Minimum
NOM	-	Nominal
OAMS	-	Orbit Attitude and Maneuver System
Prop	-	Propellant
psia	-	Pounds per Square Inch Absolute
psig	-	Pounds per Square Inch Gauge
RMS	-	Root - Mean - Square
SCC	-	Standard Cubic Centimeters
SCD	-	Specification Control Drawing
Sec	-	Seconds
TCA	-	Thrust Chamber Assembly
U	-	Upper
V	-	Volts or Valve
P_m	-	Maximum Pressure

3.13 Post Test Hardware Disposition

Upon successful completion of all Design Approval Test, the components shall be cleaned as required for shipment, packaged in accordance with RA0616-008, 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 components showing unusual failure

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3.13 (cont') 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.

* See Figure 13

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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. A

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

4.0 Test Program

Three Thrust Chamber Assemblies (P/N 207540-21), having passed the acceptance tests of RA0220-349, 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.

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.

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4.1.1 Thrust Chamber Assembly Number One

	Para.	Page	SCD Reference
Pre-Test Inspection	7.1.1		6.2.2.1
Weight Determination	6.6		6.3.1.4.1
Vibration	7.1.2		6.2.3.17.1
Propellant Valve Proof Pressure & Leakage	6.1		6.2.3.1
Thrust Chamber Proof Pressure & Leakage	6.2		6.2.3.1
Propellant Valve Electrical Resistance	6.3		6.2.3.2
Propellant Valve Dielectric Strength	6.4		6.2.3.3
Propellant Valve Functional	6.5		6.3.1.3.1
Visual Inspection			6.2.2.1
Mechanical Shock	7.1.3		6.2.3.16
Propellant Valve Proof Pressure & Leakage	6.1		6.2.3.1
Thrust Chamber Proof Pressure & Leakage	6.2		6.2.3.1
Propellant Valve Electrical Resistance	6.3		6.2.3.2
Propellant Valve Dielectric Strength	6.4		6.2.3.3
Propellant Valve Functional	6.5		6.3.1.3.1
Visual Inspection			6.2.2.1
Temperature Shock	7.1.4		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 Failure	7.1.5		6.3.1.3.2.2
Disassembly and Inspection	7.1.6		6.2.3.20

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4.1.4 Thrust Chamber Assembly Number Two

	Para.	Page	SCD Reference
Pre-Test Inspection	7.2.1		6.2.2.1
Weight Determination	6.6		6.3.1.4.1
Propellant Valve Continuous Duty	7.2.2		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
DAT Duty Cycle to Minimum Duration	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

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4.1.5 Thrust Chamber Assembly Number Three

	Para.	Page	SCD Reference
Pre-Test Inspection	7.3.1		6.2.2.1
Weight Determination	6.6		6.3.1.4.1
DAT Duty Cycle to Guaranteed Life	7.3.2		6.3.1.3.2.2
Weight Determination	6.6		6.3.1.4.1
Explosive Atmosphere (Prop valves only)	7.3.3		6.2.3.13
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
Fuel & Oxidizer Resistance(Prop valves only)	7.3.4		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
Disassembly and Inspection	7.3.5		6.2.3.20

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Reference: MAC SCD 52-52701, Revision F

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 permissable 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-4091B (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.

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

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

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

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

5.2.2 Vibration Testing Facility

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

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

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

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

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5.2.2 (cont'd) attaching the extended propellant valve inlet lines to the test fixture.

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

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

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

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

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

5.2.3 Temperature Chamber

An enclosure in which the TCA or 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.

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5.2.4 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. The facility shall be equipped with a rigid jig test fixture to which the TCA shipping container, as specified in RA0616-0C8, can be rigidly attached. The rigid jig test fixture shall be capable of being mounted on the shock machine such that the TCA, in its shipping container, can be shocked along the plus and minus direction of each of the three mutually perpendicular axes shown in Figure 7. The facility shall be equipped with an accelerometer (Statham, Model A5TCA-50-35C) which shall be mounted on the rigid jig test fixture.

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

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5.2.5 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 include a counter for counting the cycles.

5.2.6 Electrical Harness

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

5.3 Standard Pneumatic and Hydraulic Equipment

5.3.1 Pressure Gauges

G_1, G_2 - 0 to 600 psig, $\pm 1/4$ % accuracy, full scale

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

G_4 - 0 to 1000 psig, $\pm 1/4$ % accuracy, full scale

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5.3.2 Valves

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

5.3.3 Regulators

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

5.3.4 Filters

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

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

5.4 Standard Electrical Equipment

(Equivalent items may be used)

5.4.1 DC Power Supply - 0 to 36 VDC

5.4.2 AC Power Supply - 110 VAC nominal, 60 cps

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

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

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5.4.5	Switch - 40 watt minimum power rating
5.4.6	High Voltage Leak Detector - Associated Research, Model 411
5.4.7	Impedance Bridge - 0 to 50 ohms, ±1/10 % accuracy
5.4.8	Voltmeter - Hewlett Packard, Model 412A, 0 to 30 VDC and 0 to 100 VDC, ±1 % full scale accuracy
5.4.9	Temperature Recorder - Leeds and Northrop, ±3 % accuracy
5.4.10	Thermocouple - Bare wire junction, accuracy class D per RA)201-050
5.4.11	Mercury Switch - 20 watt minimum power rating
5.4.12	Resistor - 0.1 ohms
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 T5030469
5.6.2	Camera-Polaroid (with oscilloscope adapter)
5.6.3	Propellant Valve Inlet Adapter
	Adapter - P/N 99-106126-31

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5.6.3 (continued) Elbow - MAC P/N 506612 -5 -5

Union - MAC P/N 506737 -5 -5

5.6.4 Scale - 0 to 25 pounds, 0.01 pound subdivisions

5.6.5 Stop Watch - One second subdivisions

5.6.6 Seal Assembly - 9017844

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NAME OF TEST OPERATIONAL TESTS AND PROCEDURES TEST NO. 207540-401 SHEET 25 OF 180

Reference: MAC SCD 52-52701, Revision F

6.0 Operational Tests and Procedures

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

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST: PROPELLANT VALVE PROOF PRESSURE AND LEAKAGE TEST NO. 207540-401 SHEET 26 OF 180

Reference: MAC SCD 52-52701, Revision F, 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 propellant valve.

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

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

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

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

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

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST PROPELLANT VALVE PROOF PRESSURE AND LEAKAGE TEST NO. 207540-401 SHEET 27 OF 180

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

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

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

6.1.13 Repeat the above procedure on the fuel propellant valve.

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

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST THRUST CHAMBER PROOF PRESSURE AND LEAKAGE TEST NO. 207540-401 SHEET 28 OF 180

Reference: MAC SCD 52-52701 Revision F, 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.

PREPARED BY: T. G. Kniffin	DATE 4/14/64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100#
PART NO.: MAC 52-52701-277; NAA 207540-21
NAME OF TEST: PROPELLANT VALVE ELECTRICAL RESISTANCE
TEST NO. 207540-401 SHEET 29 OF 180

Reference: MAC SCD 52-52701 Revision F, 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 11.

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 Repeat paragraphs 6.3.3 and 6.3.4 on the fuel valve.

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

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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L Wade	4/16				

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100#
PART NO. MAC 52-52701-277 / NAA 207540-21
NAME OF TEST: ~~PROPELLANT VALVE DIELECTRIC~~ STRENGTH
TEST NO. 207540-401 SHEET 30 OF 180

Reference: MAC SCD 52-52701 Revision F, 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.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

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

PART NO.: MAC 52-52701-277; NAA 207540-21

NAME OF TEST: 207540-401

TEST NO.: SHEET 31 OF 180

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.

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.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21 }

NAME OF TEST PROPELLANT VALVE FUNCTIONAL TEST NO. 207540-401 SHEET 32 OF 180

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.3.1.3.1

6.5 Propellant Valve Functional

6.5.1 Install the TCA in a test setup as shown in Figure 4. Provide a temperature environment of 70 ±5 F until temperature stabilization is obtained. Stabilization is defined as a temperature variation of not more than ±3 F for a 30 minute time period. Connect the current trace lead to the 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 0.021 seconds from electrical signal to poppet open. See Figure 5 for typical valve opening response characteristics. Open the mercury switch.

6.5.5 Reduce the 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 0.075 seconds from electrical signal to poppet closed.

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CHECKED BY: [illegible]	DATE 7-22-64				

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST PROPELLANT VALVE FUNCTIONAL TEST NO. 207540-401 SHEET 33 OF 180

6.5.8 Adjust the GN_2 supply pressure to 300 ±10 psig.

6.5.9 Adjust the DC power supply voltage to zero.

6.6.10 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.

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.

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.

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 GN_2 supply.

6.5.18 Replace all protective closures.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	7-10-64				
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FORM 608-B-38 NEW 6-63

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100#

PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST: WEIGHT DETERMINATION

TEST NO. 207540-401 SHEET 34 OF 180

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

6.6 Weight Determination

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

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FORM 608-B-38 NEW 6-63

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST: THRUST CHAMBER ASSEMBLY FIRING PROCEDURE TEST NO. 207540-401 SHEET 35 OF 180

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.3.1.3.2.2

6.7 Thrust Chamber Assembly Firing Procedures

6.7.1 Inspect TCA for proper location of combustion chamber liner chamber pressure hole, using a light source.

6.7.2 Install the TCA in the applicable 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 9017844, and leak test compound. The required propellant feed system is shown schematically in figure 6.

6.7.2.1 For cape cycle firings, the firing duration can be controlled automatically.

6.7.2.2 For continuous (steady state) firings the firing control shall be manual.

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

6.7.3 Open facility propellant valves.

6.7.4 Pressurize facility propellant tanks to approximate run pressure. A

6.7.5 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.

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PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	7-15-64				
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FORM 608-B-38 NEW 6-63

REVISION A Dated 9-3-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST THRUST CHAMBER ASSEMBLY FIRING PROCEDURE TEST NO. 207540-401 SHEET 36 OF 180

6.7.6 Close oxidizer bleed valve.

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

6.7.8 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.

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

Oxidizer Inlet Pressure	283 ±10 psia	A
Fuel Inlet Pressure	286 ±10 psia	A

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

6.7.11 Fire TCA as required to accomplish test objectives.

6.7.12 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 700 °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. B

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J A Sanger	10-22-64				

FORM 608-B-38 NEW 6-63

Rev. B J.D. Marrogenis Date 9-9-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST THRUST CHAMBER ASSEMBLY FIRING PROCEDURE TEST NO. 207540-401 SHEET 37 OF 180

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

6.7.14 Close the propellant bleed valves.

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

6.7.16 Continue to purge for two minutes.

6.7.17 Close the TCA oxidizer and fuel valves.

6.7.18 Secure the test facility.

6.7.19 Remove the TCA from the Hot Fire Test installation.

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PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	9-8-64	[signature]	9-9-64		
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FORM 608-B-38 NEW 6-63

Rev. B J.D. Marrogeni Date 9-9-64

R-15019-2

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 207540-401 SHEET 38 OF 180

6.8 Decontamination Procedure

6.8.1 The TCA shall be decontaminated as follows, using a hot GN_2 purge and anhydrous isopropyl 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 26 VDC (nominal) electrical power supply leads to the TCA electrical connectors.

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

6.8.4 Open the GN_2 supply valve and purge the oxidizer side for ten minutes using 12 ±2 VDC to open the oxidizer valve. C

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

6.8.5 Open the GN_2 supply valve and purge the oxidizer side as follows for ten (10) cycles, using 26 ±1 VDC. C

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

NOTE: The GN_2 pressure and temperature will be the 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.

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: [signature]	DATE 10-20-64	[signature]	10-20-64		

FORM 608-B-38 NEW 6-63

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

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 207540-401 SHEET 39 OF 180

6.8.7 Disconnect the supply line from the oxidizer valve.

6.8.8 Cap the valve adapter.

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 inlet. See paragraph 3.8.

6.8.12 Cap the TCA oxidizer inlet line and the chamber pressure instrumentation tap.

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.

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

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

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 207540-401 SHEET 40 OF 180

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

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 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 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.

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA: R J Eide	DATE 10-20-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY: R. Dennis	DATE 10-20-64				

FORM 608-B-38 NEW 6-63

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

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 207540-401 SHEET 40.1 OF 180

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

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 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 and remove the electrical harness.

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

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

6.8.37 Operate the vacuum equipment so that the TCA is subjected to an internal pressure of 1.0 psia or less for a period of not less than fifteen minutes. The propellant valves and injector shall be heated and maintained at a temperature of 160 ±10 F for the entire fifteen minute period.

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

6.8.39 Replace all protective closures.

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: [signature]	DATE 10-20-64	[signature]	10-20-64		

FORM 608-B-38 NEW 6-63

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

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100#
PART NO. { MAC 52-52701-277 / NAA 207540-21
NAME OF TEST: PROPELLANT VALVE LOAD ANALYSIS
TEST NO. 207540-401 SHEET 41 OF 180

Reference: MAC SCD 52-52701, Revision F, 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 15. 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 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: E. Adams	DATE 4/15/64	APPROVED FOR NAA: R. Eide	DATE 4-18-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY: H. Cole	DATE 4/17				

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100#
PART NO. { MAC 52-52701-277 / NAA 207540-21-401
NAME OF TEST: PROPELLANT VALVE LOAD ANALYSIS
TEST NO. 207540 SHEET 42 OF 180

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: E. Adams	DATE 4/15/64	APPROVED FOR NAA:	DATE 4-18-64	APPROVED FOR McDONNELL:	DATE
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FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 207540-401 SHEET 43 OF 180

6.10 Propellant Valve Removal

6.10.1 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.

6.10.2 Separate the propellant valves from the mounting bracket.

6.10.3 Attach a propellant valve outlet adapter to the oxidizer and fuel valve. The method of attaching the outlet adapter to the propellant valves shall be sleeve welding per RA0107-003.

6.10.4 Package the thrust chamber for storage per RA0616-005.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T.G. Kniffin	7-10-64				
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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 207540-401 SHEET 431 OF 180

6.11 Propellant Valve Orifice Removal

6.11.1 Remove oxidizer and fuel valve tube assemblies (P/N 407572) 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 the propellant valves.
NOTE: Orient propellant valve inlet adapters per Figure I2A. A

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 207540-21 as 207540-21 DAT.

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PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
E. Adams	9-30-64	B Heide	10-8-64		
CHECKED BY: R Cole	DATE 10-1-64				

FORM 608-B-38 NEW 6-63

Rev. A J. D. Harrogans dated 10-12-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 207540-401 SHEET 44 OF 180

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

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	7-10-64	R Heide	7-22-64		
CHECKED BY:	DATE				
[illegible]	7-22-64				

FORM 608-B-38 NEW 6-63

UNIT #1

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4058958

Dwg. No. 207540-21

Model OAMS SE-7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
		CUSTOMER			
1	10/23/64	PART NO. The vibration of the Z axis is considered invalid until the calibration decals on consoles HARMONIC WAVE ANALYZER (USAF # F-400-600) and AMPEX MAGNETIC TAPE RECORDER (U.S. TSC 72203) are acknowledged by the QCL LAB			
		ACTION TAKEN			
		PART NO.			
		ACTION TAKEN QCL LAB HAS ACKNOWLEDGED & STAMPED DECAL 10/6/64 [signature] 554/9411			
2	10/25/64	PART NO. REFERENCE TO DISCREPANCY NO. 1, AFQA willing to have testing continue pending corrective action for above discrepancy. [signature]			
		ACTION TAKEN INFORMATION ONLY			
3.	10/29/64	PART NO. REFER. TO DISCREPANCY NO. 1., PER TELECOM WITH WM. ARKIN AF ENGR. WORK CAN CONTINUE BUT THE EQUIPMENT IN THE VIBRATION ROOM HAS TO BE CALIBRATED BY ROCKETDYNE QCL			
		ACTION TAKEN WITHIN 24 HOURS OR AN AF 50E TAG (RED TAG) will be hung on the hardware and testing stopped			
		PART NO.			
		ACTION TAKEN REF ACTION TAKEN ON DCP # 1 [signature] 10/6/64 [signature] 554/9411			

Form R 25-, Rev. 12-57
R-15019-2

UNIT #1

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4058958

Dwg. No. 207540-21

Model SE-7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
#1	9/21/64	PART NO. NOZZLE EXTENSION AT APPROX. 9:00 & 11:00 O-CLOCK HAS BEEN GROUND TO FIT VIBRATION FIXTURE. REF. FORWARD MOUNTING BRACKET @ 12:00 O-CLOCK.			
ACTION TAKEN		Acceptable to MAC Engrg. James D. Marrogenis 9/21/64 E Adams Gemini DAT UNIT 9-21-64	X 10/28/64		
#2	9/23/64	PART NO. 207540-21 S/N - 4058958 FAILED RANDOM VIBRATION TEST PER 7.1.2.2.3.6. THE FUEL INLET ADAPTER TUBE HAS A CRACK AT POINT WHERE TUBE MATES WITH THREADS OF FUEL VALVE REF CFR # 07432R & 59B TAG # P 086291			
ACTION TAKEN		Rework Completed PER YEOR-917959	10	14	14
#3	10/14	PART NO. 207540-21 S/N 4058958 EXTENDED PROPELLANT VALVE INLET TUBE ADAPTERS WERE INSTALLED PER ENGINEERING INSTRUCTIONS REF PARA 7.1.2.2.5. James D. Marrogenis MAC Engrg 10/14/64 J.F. Krestel 896-388			
ACTION TAKEN		INFORMATION ONLY NO ACTION REQUIRED	10/14	10/14	10/14
#4	10/23/64	PART NO. DURING VIBRATION IN THE "Z" AXIS A 5G RANDOM RUN, FOR A PERIOD OF 3 MIN 40 SEC. DUE TO READ OUT ERROR, TEST WAS STOPPED AND RERUN A CORRECT LEVEL.			
ACTION TAKEN		REF. IL Dated 10/23/64 R Cole	X 10/28/64		
5	10/23/64	PART NO. DURING "Z" AXIS OF RANDOM VIBRATION, THE SPECTRUM SHAPE WAS OUT OF TOLERANCE IN THE 720 TO 810 CPS BAND WIDTH BY APPROX. 4.5 db ABOVE MAC. TOL. .042 g²/cps PEAK			
ACTION TAKEN		REF. IL Dated 10/23/64 R Cole	X 10/28/64		

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UNIT #1

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4058958

Dwg. No. 207540-21

Model OAMS SE-7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
1	10/23/64	PART NO. The vibration of the Z AXIS is considered invalid until the calibration decals on consoles HARMONIC WAVE ANALYZER (USAF# E-400-[illegible]) AMPEX MAGNETIC TAPE RECORDER (U.S.TS-C 72208) are acknowledged by the QCL LAB			
		ACTION TAKEN			
		PART NO.			
		ACTION TAKEN			
		QCL LAB HAS ACKNOWLEDGED & STAMPED DECALS [illegible]			
2	10/25/64	PART NO. REFERENCE TO DISCREPANCY NO. 1, AFGA WILLING TO HAVE TESTING CONTINUE PENDING CORRECTIVE ACTION FOR ABOVE DISCREPANCY [illegible]			
		ACTION TAKEN			
		INFORMATION ONLY			
3	10/27/64	PART NO. REFER. TO DISCREPANCY NO. 1, PER TELECOM WITH WM. ARKIN AF ENGR. WORK CAN CONTINUE BUT THE EQUIPMENT IN THE VIBRATION ROOM HAS TO BE CALIBRATED BY ROCKETDYNE QCL			
		ACTION TAKEN			
		WITHIN 24 HOURS OR AN AF 50E TAG (RED TAG) WILL BE HUNG ON THE HARDWARE AND TESTING STOPPED			
		PART NO.			
		ACTION TAKEN			
		REF ACTION TAKEN ON DCP #1 [illegible]			

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UNIT #1

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4058958

Dwg. No. 207540-21

Model

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
#6	10/23/64 (ANR 921)	PART NO. TEST NOTE FOLLOWING PARA. 4.1 REQUIRES TEST (PROOF PRESS. AND LEAK) TO BE RUN IN A HAZARDOUS TEST CELL, THIS WAS NOT COMPLIED WITH UNDER VIBRATION TEST "Z" PARA 7.1.2.2.3.5			
ACTION TAKEN		REF I.L. DATED 10/1/64	X		
			10/28/64		
#7	10/28/64	PART NO. FAILED RESPONSE TEST, WITH THE INLET PRESSURE AT ZERO. THE CLOSING TIME WAS .078 SECONDS. S/B REF PARA. 7.1.2.2.3.16. .075 SECONDS MAX. REF 59B THG # D-078753			
ACTION TAKEN		REF I.L. DATE 10/29/64. NOT A FUNCTIONAL COMPONENT FAILURE	X		
			10/29/64		
#8	10/30/64	PART NO. 207540-21 S/N 4058958 MECHANICAL SHOCK PARA 7.1.3 DISCONTINUED TEST PER PHONE CONVERSATION WITH R. COLE			
ACTION TAKEN		REF IL DATED 10-31-64 R Cole 896-388 CN-120 10-31-64			
				10-31-64	
#9	11/10/64 (ANR 930)	PART NO. 207540-21 S/N 4058958 NO CHAMBER PRESSURE INSTRUMENTATION INSTALLED FOR H/F TEST PER TABLE I			
ACTION TAKEN		CHAMBER PRESSURE REQUIREMENTS DELETED PER I.L. of 11/1/64 FROM D/896-388	11-11-64 (ANR 930)	(ANR 930)	(ANR 930)
#10	11/11/64 (ANR 930)	PART NO. GENERAL MAC TEST WITNESS WAIVER PER TEL-CON TO J. MAVROGENIS			
ACTION TAKEN		INFORMATION ONLY	11-11-64 (ANR 930)	(ANR 930)	(ANR 930)

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UNIT #1

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4058958
Dwg. No. 207540-21
Model S27

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
		CTL-3 Cell 39-K			
11		PART NO. 207540-21 S/N 4058958 TCA. Duty cycle Test PER PARA 6.7 Cancelled due to irregular MMH Flow indications			
		ACTION TAKEN: Installed new MMH Flm s/n 3032			
12		PART NO. General: SPG's For Duty cycle Test 14 NOV 64 ARB As Follows NTO 1.465 AT 44° MMH .870 AT 47°			
		ACTION TAKEN			
13		PART NO. General: PARA 7.1.5.1.2 states TCA. Skin Temp Shall Return to Ambient Temp of F 70° ± 20°F Prior To Performing DAT Duty cycle Actual			
		ACTION TAKEN: Ambient temp At time of HIF was 42.5° information only			
14		PART NO. General: Tape was stopped At 180 min. into Duty-cycle for 10 minutes due to not Being Able to Acquire Altitude.			
		ACTION TAKEN: Information only			
15		PART NO. General: Test #098 was terminated After 58 sec. of 15th Pulse due to irratic thrust indications			
		ACTION TAKEN: information only			

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UNIT #1

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4058958

Dwg. No. 207540-21

Model SE7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
		CTL-3 Cell 39K			
4		PART NO. 207540-21 S/N 4058958 TCR Post inspection Revealed Liner drop out at approx 6" downstream of injector face.			
		ACTION TAKEN: Information only			
12		PART NO. 207540-21 S/N 4058958 TCR Post H/F Test 098 - Decontaminated up to PART 6.8.35			
		ACTION TAKEN: Decontamination complete			
		PART NO. Trans Comp CTL III Cell 39 26 Nov 64			
		ACTION TAKEN			
		PART NO.			
		ACTION TAKEN			
		PART NO.			
		ACTION TAKEN			

R-15019-2

Form R 25-, Rev. 12-57

UNIT #1

SHORTAGE REPORT

☑ ELEC. ☑ MECH. ☐ ORIG. ☐ DUP.

ASSEMBLY NAME	ASSEMBLY NO.	L.H.	R.H.	UPPER	LOWER
100# ~~85#~~ Gemini TCA	207540-21	—	—	—	—

DEPARTMENT NO.	SHIP OR UNIT NO.	CONTRACT NO.	SERIAL NO.	DATE
056			4058958	11 14 64

SHORTAGES CHECK ONE ACTUAL	HELD UP	INSP. VERI.	QUAN.	PART NUMBER	COMPLETE PART NAME	DATE	MECH.	L.M.	INSP.
				None	Insp Comp CTL III				
					Coll 39 16 Nov 64				
					OK TO SHIP J. Wilson 11/16/64				

R-15019-2

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This sheet is to be prepared in duplicate by the production department. All entries will be made with pen, indelible pencil or with a typewriter. Responsible production personnel will place a check mark (✓) in the applicable column to indicate whether the shortage is actual or held up. Inspection will add the original and or the duplicate shortage sheets to the sign-off book and verify correct entries by placing an inspection stamp impression in the applicable block.

PAGE NO. _____ OF _____ PAGES

FORM 61-Y, REV. 3-58

UNIT #1

SHORTAGE REPORT

[X] ELEC. [X] MECH. [ ] ORIG. [X] DUP.

ASSEMBLY NAME	ASSEMBLY NO.	L.H.	R.H.	UPPER	LOWER
P. Thrust Chamber Assy	207540-21				

DEPARTMENT NO.	SHIP OR UNIT NO.	CONTRACT NO.	SERIAL NO.	DATE
D/427	1	5252	H058958	6-24-64

SHORTAGES CHECK ONE ACTUAL	HELD UP	INSP. VER.	QUAN.	PART NUMBER	COMPLETE PART NAME	DATE	MECH.	L.M.	INSP.
				none	C. Emery D/427 6/24/64				
		222							

R-15019-2

This sheet is to be prepared in duplicate by the production department. All entries will be made with pen, indelible pencil or with a typewriter. Responsible production personnel will place a check mark (V) in the applicable column to indicate whether the shortage is actual or held up. Inspection will add the original and or the duplicate shortage sheets to the sign-off book and verify correct entries by placing an inspection stamp impression in the applicable block.

FORM 61-Y, REV. 3-58

PAGE NO. 1 OF 1 PAGES

UNIT #1

GEMINI R-4/B HARDWARE TEST RECORD

Date: _____ Coll 39 K Thrust Level 100# Inspector: KELLY

HARDWARE IDENTIFICATION:

Test Objective: DAT CAPE CYCLE

Name	P/N	S/N	Verified
TCA	207540-21	4053958	
Injector			
Ablative Liner	UNK	UNK	
Oxid. Valve	407561	9174970	
Fuel Valve	407662	9183330	

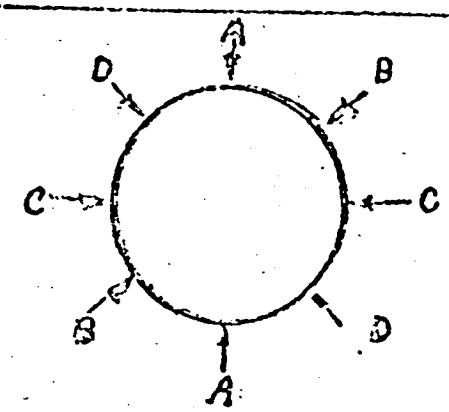
Test No.	Time	Duration	Altitude	Test Remarks
094	START 1421		AMB.	CAPE CYCLE
	STOP 1456	6 SEC		

TCA Leak Check Performed _____ System Leak Check Performed _____

Oxid. Valve Opening Verified _____ Fuel Valve Opening Verified _____

Pre Test Injector Inspection. Remarks: GOOD

Pre Test Throat Insert Inspection. Remarks: GOOD



THROAT AND EXIT DIMENSIONS

Pre - Test		Post - Test	
A.A.	.7085	A.A.	.7086
B.B.	.7085	B.B.	.7056
C.C.	.7086	C.C.	.7056
D.D.	.7086	D.D.	.7056
Exit	4.871	Exit	4.871
Weight		Weight	

Cox NTO F/M S/N 2858 Cox MMH F/M S/N 3156

Ramapo NTO F/M S/N _____ Ramapo MMH F/M S/N _____

Remarks: OXID ORIFICE .08705 FUEL ORIFICE .07765

UNIT #1

GEMINI ~~[illegible]~~ HARDWARE TEST RECORD

Date: 11-14-64 Cell 39 K Thrust Level 100# Inspector: Moore

HARDWARE IDENTIFICATION:

Test Selection:	Name	P/N	S/N	Verified
	TCA	207546-21	3/05 8458	
D.H.F.	Injector		UNK	
Duty Cycle	Ablative Liner		UNK	
	Oxid. Valve	407561	9174970	
	Fuel Valve	407562	9183330	

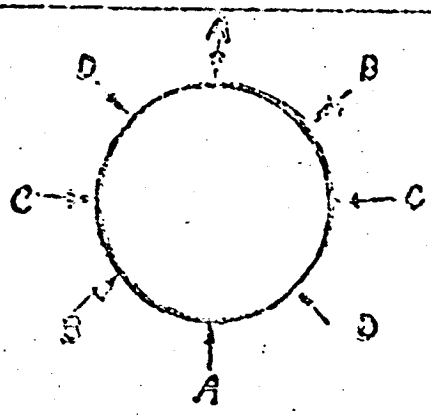
Test No.	Time	Duration	Altitude	Test Remarks
098	start 2015		145,000	Duty Cycle
	stop 0021			

TCA Leak Check Performed (✓) System Leak Check Performed (✓)

Oxid. Valve Opening Verified (✓) Fuel Valve Opening Verified (✓)

Pre Test Injector Inspection, Remarks: Good

Pre Test Throat Insert Inspection. Remarks: Good



THROAT AND EXIT DIMENSIONS

Pre - Test		Post - Test	
A.A.	7086	A.A.	
B.B.	7087	B.B.	Ref Dip 8/16
C.C.	7086	C.C.	
D.D.	7086	D.D.	
Exit	4.871	Exit	
Weight		Weight	

Cox NTO F/M S/N 2858 Cox MMH F/M S/N 3632

Ramapo NTO F/M S/N — Ramapo MMH F/M S/N —

Remarks: Oxid orifice .08705
Fuel orifice .07705

UNIT #1A

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4058965

Dwg. No. 207540-21

Model SE-7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
		INVIRONMENTAL TEST LAB. D596/146 C/P			
1	3/14/64	PART NO. PARA. 7.3.1.23 Weight determination test waived by McDonnell Rep. (J. D. Marcogeni) per phone conversation.			
ACTION TAKEN		INFO ONLY NO ACTION REQ		4-14-64	
2	11/9/64	PART NO. 207540-21 S/N 4058965 REF PAGE 119 NO CERTIFICATION BY McDONNELL AIRCRAFT REP PER IL 4388-5116 DATED 16 SEPT 64			
ACTION TAKEN		NOTATION OF WAIVED OPERATION MADE	11-10-64		
3	11/10/64	PART NO. 207540-21 S/N 4058965 THE OXID VALVE INLET TUBE ADAPTER WAS REMOVED PER I.L. FROM E. ADAMS 11/6/64			
ACTION TAKEN		INFORMATION ONLY	11-10-64		
		PART NO.			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 207540-101 SHEET 15 OF 180

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

7.1 Thrust Chamber Assembly Number One

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

NOTE: TCA extended propellant valve inlet tube adapters were fabricated per MAC Engineering instructions and installed prior to rerunning vibration test. B

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T. G. Kniffin 10-12-64	4/14/64		7-22-64		
CHECKED BY:	DATE				
	4/16				

FORM 608-B-38 NEW 6-63

Rev. B J. D. Marrugeno dated 10-12-64

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5350

Deviation Request:

Present dimensions of inlet adapter lengths are acceptable to continue test.

Recopied from original request dated 3 September 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-8-64

R. Cole
R. Cole
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

IL 4388-5119

INTERNAL LETTER

NORTH AMERICAN AVIATION, INC.

DATE 14 September 1964

TO ADDRESS (Show Dept., Group, Div. & Location) Those Concerned

FROM ADDRESS Gemini DAT-RAT Unit D/896-388

PHONE 6608

SUBJECT DAT SE7 100 lb TCA Unit No. 1 - Installation of Extended Tube Stubs for Vibration Testing

REFERENCE (a) Design Approval Test Specification No. 207540-401, paragraph 7.1.1.1.2.

To expedite Design Approval Test this letter authorizes installation of the extended propellant valve tube inlet adapters, P/N 99-106715 and 99-106716, be performed per D/896-388 engineering instruction.

R. G. Eide
Supervisor
Gemini DAT-RAT Unit

RGE:j

Approved: J. Mavrogenis
McDonnell Representative

R-15019-2

FORM 121-R NEW 1-64

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST: PRE-TEST INSPECTION TEST NO. 207540-401 SHEET 46 OF 180

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

7.1.1 Pre-Test Inspection - TCA #1

7.1.1.1 Test Procedure

7.1.1.1.1 Verify that the TCA is of the proper configuration, that it has been properly packaged and that it contains no defects such as broken parts, corrosion, damage or deterioration. Also verify that the TCA has passed the acceptance tests of RA0220-349. Only those TCA's meeting the above requirements shall be accepted for DAT. An exception to the above configuration requirement is the TCA modified by MAC for the vibration test. Reference MAC Drawing 52-52067.

7.1.1.1.2 Braze the extended propellant valve inlet tube adapters (P/N 99-106715 and 99-106716) 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.

PREPARED BY:	APPROVED FOR NAA:	APPROVED FOR McDONNELL:
10-10-64 DATE T.G. Kniffin 7-28-64	DATE 7-28-64	DATE
CHECKED BY: DATE 7-28-64		

FORM 608-B-38 NEW 6-63

Rev. A dated 10-13-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207540-401 SHEET 47 OF 180

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.	52701-277		
Rocketdyne Part No.	207540-21	407561	407662
Component Serial No.	4058958	9174970	9183330

7.1.1.2.2 Inspection (refer nce paragraph 7.1.1.1)

7.1.1.2.2.1 The TCA was inspected to insure that it was of the proper configuration (with the exception of the vibration test TCA), that it had been properly packaged and that it contained no defects such as broken parts, corrosion, damage or deterioration. Also the TCA records were inspected and it was verified that the TCA had passed the acceptance tests of RA0220-349 YES (yes or no)

7.1.1.2.2.2 The extended inlet tube adapters were installed on the propellant valves per paragraph 7.1.1.1.2 for vibration tests only. YES (yes or no) REF. PARA. 7.1.2.2.4

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)

7.1.1.2.2.4 Inspection Remarks

4/15/64 INSTALLED TUBE ADAPTERS PO 99-106715 & 99-106716 PER TL 4286-5119 & ENGINEERING INSTRUCTION

O.K. as is J.H. Bretel 5/15/64 896-388

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	7-28-64		10/29/64	Eugene Fricione	10/29	WAIVED BY MICHAEL	10/29
						VERIFIED BY USAF	DATE
						WAIVED BY MACEN	

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207540-401 SHEET 47.1 OF 180

7.1.1.2 Test Data - TCA #1 (cont'd) B

7.1.1.2.2.5 The extended inlet tube adapters were installed on the propellant valves per paragraph 7.1.1.1.2 prior to rerunning vibration tests. YES (yes or no) (Vibration Test only) REF DCP #3 (ANR 815)

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	10-12-64	(B 14)	10/14	Eugene Fricioni (ANR 815)	10/14/64	J. D. Marrogenis	10/14/64
						VERIFIED BY USAF	DATE
						[illegible]	10/14/64

FORM 608-B-39 NEW 6-63

USAF WAIVED BY MACENTHIEFER OF TELCON 10-14-64 (ANR 815)

REVISION B J. D. Marrogenis Dated 10-13-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207540-401 SHEET 48 OF 180

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 13.09 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	4/14/64	F. T. Pope	10-30-64	Coffin	10/30/64	WAIVED BY JIM MAURUCENIS OF E. ADAMS	10-30-64
						VERIFIED BY USAF	DATE
							10/30/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5351

Deviation Request:

The Equalization test time to verify spectrum shape in the X-axis exceeded the limits of paragraph 7.1.2.1.4.1 by six (6) seconds. Received verbal authorization from MAC representative to continue testing. For data reduction purposes change sample #2 and 3 to read 3 and 6 minutes.

Recopied from original request dated 19 September 1964 .

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-8-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5352

Deviation Request:

Change paragraph 7.1.2.2.2 "TCA shell at exit" to read -

TCA shell at exit (extension) for X, Y and Z Axis.

Recopied from original request dated 21 September 1964.

James D. Mavrogenis
James D.Mavrogenis
MAC Engineering
12-8-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5353

Deviation Request:

No accelerometer response recording during last 30 seconds of Vibration Test in the X-axis.

Recopied from original request dated 21 September 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-8-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21 }

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5354

Reference IL Dated 9-17-64

Deviation Request:

Mount three (3) additional accelerometers on TCA nozzle exit. Perform additional Equalization Test to verify spectrum shape in the X-axis. Equalization test time exceeded the limits specified in paragraph 7.1.2.1.4.1 and the above reference by 9.5 seconds. Received verbal instructions from MAC Engineering to continue X-axis Vibration Test. The total equalization test time is now 111.5 seconds. Accelerometers will remain on TCA for Y and Z Axes vibration test.

Recopied from original request dated 21 September 1964.

James D. Mavrogenis
MAC Engineering

E. Adams
Gemini DAT-RAT Unit

12-9-64

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 49 OF 180

REFERENCE: MAC SCD 52-52701, Revision F, Paragraph 6.2.3.17.3

7.1.2 Vibration - TCA #1

7.1.2.1 Test Procedure

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

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

7.1.2.1.2 Perform a sine wave survey on the thrust chamber.

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

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

7.1.2.1.3 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.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
J. Ganger	8-7-64		8-10-64		
CHECKED BY:	DATE				
	8-10-64				

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 50 OF 180

7.1.2.1.3.4	The overall RMS acceleration level is to be 9.6 G's, plus fifteen (15) percent, minus zero (0) percent.
7.1.2.1.3.5	No smaller than three (3) sigma clippers shall be used to limit the input level.
7.1.2.1.4	Readjust the controls and repeat paragraphs 7.1.2.1.3 and 7.1.2.1.3.1 as required to conform to paragraphs 7.1.2.1.3.2 through 7.1.2.1.3.4.
7.1.2.1.4.1	Full level equalization time for the purpose of 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 eight (8) ±0.1 minutes less the time accumulated, for each respective axis, in paragraphs 7.1.2.1.3 and 7.1.2.1.4.
7.1.2.1.5.1	Record and analyze the input and output accelerations at selected intervals.
7.1.2.1.6	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
J. Ganger	8-10-64	A G Eide by EA	8-10-64		
CHECKED BY:	DATE				
[signature]	8-10-64				

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 51 OF 180

7.1.2.1.10	Perform Thrust Chamber Proof Pressure and Leakage Test per paragraph 6.2.
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 extended inlet tube adapters and install 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
J. Ganger	7-9-64	R H Eide	7-22-64		
CHECKED BY:	DATE				
F. Simmons	7-22-64				

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 52 OF 180

7.1.2.2 Test Data - TCA #1

7.1.2.2.1 Component Identification

Component Name 100# TCA

McDonnell Part No. 52-52701-277

Rocketdyne Part No. 207540-21

Component Serial No. 4058958

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	
TCA NOZZLE EXIT	X	1228	A
TCA NOZZLE EXIT	Y	1444	A
TCA NOZZLE EXIT	Z	1431	A
TCA Shell at Comb. Zone	X	1090	
TCA Shell at Comb. Zone	Y	1127	
TCA Shell at Comb. Zone	Z	1119	
TCA Shell at Exit (EXTENSION)	X	903	
TCA Shell at Exit (EXTENSION)	Y	1005	
TCA Shell at Exit (EXTENSION)	Z	944	

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	7-9-64	KING	9/18/64	[signature]	18 SEPT 64	J.D. Marrogenis	9/21/64
						VERIFIED BY USAF	DATE
						H.P. Braaten	9/18/64

FORM 608-B-39 NEW 6-63

REVISION A J.D. Marrogenis Dated 7-31-64

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100#
PART NO. { MAC 52-52701-277 / NAA 207540-21 -401
NAME OF TEST: VIBRATION
TEST NO. 207540 SHEET 53 OF 180

7.1.2.2.3 Vibration Test (Reference paragraph 7.1.2.1)

7.1.2.2.3.1 Resonant Survey - X Axis

Freq. cps	Input g's	Output g's	Identification (no)
138	1	9	ACCEL #944
230	1	16.3	" #903
279	1	3.2	" #903
365	1	14.3	" #1090
590	1	7	" #903
1194	1	6	" #903
1314	1	5	" #903
1628	1	3.9	" #903

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	NO	9.6	30 SEC	30 SEC
9/19/64	2	NO	9.6	11 SEC	41 SEC
	3	NO	9.6	10 SEC	51 SEC
	4	NO	9.6	10 SEC	61 SEC
	5	NO	9.6	10 SEC	71 SEC
	6	NO	9.6	10 SEC	81 SEC
	7	NO	9.6	10 SEC	91 SEC
	8	YES	9.6	11 SEC	102 SEC
	9	YES	9.6	9.5 SEC	111.5 SEC

* SEE I.L. FOR EQUALIZATION TIME CHANGE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	7-9-64	R.A. Hoch	9-19-64	[illegible]	9/19/64 *	J.D. Mavrogenis	9/21/64
						VERIFIED BY USAF	DATE 9/21/

FORM 608-B-39 NEW 6-63

* STAMPED IN ERROR

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 54 OF 180

7.1.2.2.3.3 Random Vibration Test - X Axis

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

SAMPLE #1 (1 ±0.5 Minute) 60 to 65 sec.
* SAMPLE #2 (~~4~~3 ±0.5 Minutes) 180 to 185 sec
* SAMPLE #3 (~~4~~5 ±0.5 Minutes) 330 to 335 sec

9-21-64

The elapsed time at test cutoff was 8.0 minutes.

Results of the Analysis:

SAMPLE #1 See 4M20-5-32- X- Shaped 60 to 65 SECOND Slice time

SAMPLE #2 See 4M20-5-32-X- Shaped 180 to 185 SECOND Slice Time

SAMPLE #3 See 4M20-5-32-X- Shaped 330 to 335 SECOND Slice Time

*SEE I.L. DATED 19 SEPT. 1964 FOR DEVIATION-

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	7-9-64	R.O. Hoch	10-28-64	L. Johnson	10/28/64	WAIVED BY L. MAVROLEENIS	10/25/64
						VERIFIED BY USAF	DATE
						[illegible]	10/29/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 55 OF 180

7.1.2.2.3.4 Resonant Survey - Y Axis

Freq. cps	Input g's	Output g's	Identification (no)
237	1	23	S/N 903
345	1	14	S/N 1090
373	1	7.6	S/N 1090
609	1	9.4	S/N 903
880	1	3	S/N 903
1058	1	2.8	S/N 903
1136	1	4.6	S/N 903
1566	1	2.4	S/N 903

9/22/64

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	NO	9.6	9.0	9.0
2	NO	9.6	10.0	19.0
3	NO	9.6	9.0	28.0
4	NO	9.6	25.0	53.0
5	YES	9.6	10.0	63.0

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	7-9-64	[signature]	10-28-64	[signature]	10/28/64	WAIVED BY 10/28/64 J. MAVROGEINS	
						VERIFIED BY USAF	DATE
						[signature]	10/29/64

FORM 608-B-39 NEW 6-63

R-15019-2

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207510-21 -401

NAME OF TEST VIBRATION TEST NO. 207510 SHEET 56 OF 180

7.1.2.2.3.6 Random Vibration Test - Y Axis

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

SAMPLE #1 (1 ±0.5 Minute) 60 to 65 sec
SAMPLE #2 3(X ±0.5 Minutes) 180 to 185 sec
SAMPLE #3 6(X ±0.5 Minutes) _____

* REF DCP #2

The elapsed time at test cutoff was 3.6 minutes.

Results of the Analysis:

SAMPLE #1 SEE 4M20-5-32-Y- Shaped 60 to 65 SECOND Slice Time

SAMPLE #2 See 4M20-5-32-Y-Shaped 180 to 185 SECOND slice Time

SAMPLE #3 Does Not exist Due to Failure.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	7-9-64	F. R. Hitchcock	11-6-64	R. Johnson	11/6/64	CERTIFIED BY J. DAVIDSONS	11/25/64
						VERIFIED BY USAF	DATE 11/6/64

FORM 608-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21 }

NAME OF TEST VIBRATION (RERUN) TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5355

Deviation Request:

Accelerometer #1 rotated 180° from that shown in Figure 7 for Rerun of Vibration Test.

Recopied from original request dated 21 October 1964.

James D. Mavrogenis
MAC Engineering
12-8-64

E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION (RERUN) TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5356

Deviation Request:

The Random Vibration Test in the Z-Axis was modified and approved by MAC Engineering.

1) Total Equalization Time (96 sec + 6 sec) 102 seconds
2) Total Random Dwell @9.6 G. level (2 min, 1 sec + 2 min, 48 sec) was 4 min 49 sec.
3) Total Accumulated Time (excluding 5 G RMS run time) Equal.+ Random= 1 min 42 sec + 4 min 49 sec = 6 min 31 sec.
4) A 5 G RMS run of 3.66 minutes was performed (due to readout error).
6) MAC St.Louis authorized an added 3 minute maximum run time on TCA because of the 5 G level run duration
7) The three (3) minute maximum run time was reduced by the two 6 second equalization runs. (3 min less 12 seconds) or 2 minutes 48 second random Dwell Time.

Recopied from original request dated 23 October 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-8-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION (RERUN) TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5357

Deviation Request:

For Random Vibration Data Reduction Analysis in the Z-Axis change sample #2 and #3 to read 3 and 4.5 minutes respectively. (See sheet #56.)

Recopied from original request dated 23 October 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-8-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

R-1501992

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION (RERUN) TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5358

Deviation Request:

The spectrum shape in the Z-Axis was out of tolerance in the 720 to 810 cps bandwidth by approximately 4½ db (0.042 g^2/cps peak) above MAC tolerance. Received verbal authorization from MAC Engineering to continue random dwell in Z-Axis.

Recopied from original request dated 23 October 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-8-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION (RERUN) TEST NO 207540-401 SHEET ___ OF ___

IL 4388-5379

Deviation Request:

The sine wave survey in the X-axis will be deleted for 100# TCA Unit #1 on the vibration rerun (reference paragraphs 7.1.2.1.2.1 and 7.1.2.1.2.2).

Recopied from original request dated 24 October 1964.

James D. Mavrogenis
MAC Engineering
12-8-64

R. Cole
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

R-15019-2

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21 }

NAME OF TEST VIBRATION (RERUN) TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5359

Deviation Request:

The Sine wave survey in the Y-Axis will be deleted on the Vibration Rerun Test on 100# TCA Unit #1. (Reference paragraphs 7.1.2.1.2 and 7.1.2.2.3.1).

Recopied from original request dated 24 October 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering

E. Adams
E. Adams
Gemini DAT-RAT Unit

12-9-64

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION (RERUN) TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5360

Deviation Request:

It is hereby authorized to inspect as many welds as possible when doing paragraph 6.2 on 100# TCA Unit #1. This will effect data sheets 7.1.2.2.3.13, 7.1.3.2.4, and 7.1.4.2.4.

Recopied from original request dated 28 October 1964.

James D. Mavrogenis
MAC Engineering
12-8-64

R. Cole
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION (RERUN) TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5361

Deviation Request:

The three sample slice times for the X-axis rerun will be 1, 3, and 6 minutes. (Reference paragraph 7.1.2.2.3.11).

Recopied from original request dated 28 October 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering

R. Cole
R. Cole
Gemini DAT-RAT Unit

12-9-64

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION (RERUN) TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5362

Deviation Request:

The Oxidizer Valve Closing Time of paragraph 7.1.2.2.3.16 will be performed without the diode in the circuit (see Figure 4). If the closing time is 5 msec or less the test shall continue with the low voltage operation.

Recopied from original request dated 29 October 1964.

James D. Mavrogenis
James D Mavrogenis
MAC Engineering
12-8-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21 }

NAME OF TEST VIBRATION (RERUN) TEST NO 207540-401 SHEET ___ OF ___

IL 4388-5363

Deviation Request:

In order to continue testing with 100# TCA Unit #1 without unnecessary delays the results of Vibration Test Analyses for paragraphs 7.1.2.2.3.7 and 7.1.2.2.3.11 will be completed when data is available.

Recopied from original request dated 6 November 1964.

James D. Mavrogenis
MAC Engineering
12-8-64

E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

MCDONNELL FIELD OFFICE - ROCKETDYNE - VAN NUYS, BLDG. #2

1064/RLM-23

12 October 1964

TO: R. Eide

CC: J. Garrison, R. Herzmark, J. Mavrogenis, J. Mazzoni, A. C. Wright

FROM: R. L. Mantler

PHONE: 6263

SUBJECT: Rework and Retest of DAT 100 lb. TCA #1

1. The failure of 100 lb. TCA #1, P/N 207540-21, S/N 4058958, during vibration in the "Y" axis on 23 September 1964, is considered, by McDonnell, to have been caused by excessive overstressing of the part. The failure mode was a crack in the fuel tube - fuel orifice holder interface. Because of the overstressing which the TCA had experienced, McDonnell does not consider the part as having failed.

2. McDonnell-St. Louis requests that this unit be repaired and testing be resumed according to the following modified vibration schedule:

   (a) Start the random vibration in the "Y" axis with equalization. (91-seconds maximum allowable) Run random for a total of 8-minutes. All equalization time is to be included as part of the 8-minutes. A failure of any part of the TCA or tubes during "Y" axis vibration, with the exception of the oxidizer tube - orifice holder interface, will constitute a failure of the TCA. A failure of the oxidizer tube - orifice holder interface, will be considered as an overstress condition by McDonnell.

   (b) Run the "Z" axis, random vibration spectrum, starting with the (1) "G" sine sweep. Equalization shall not exceed 91-seconds and all equalization time shall be included as a part of the 8-minutes of total random vibration. The same failure criteria will apply for the "Z" axis as outlined for the "Y" axis, section (a) above.

   (c) Run the "X" axis starting with the (1) "G" sine sweep. Equalization shall not exceed 91-seconds and all equalization time shall be included as a part of the 8-minutes of total random vibration. A failure of the fuel tube - orifice holder interface, during any portion of the "X" axis vibration, shall constitute a failure of the TCA. Any other failure will be considered an overstress condition by McDonnell.

3. All other testing requirements are to remain unchanged for this TCA.

4. Your expedient handling of this request will be appreciated.

R. L. Mantler
MAC Resident Engineering Rep.
Rocketdyne

R-15019-2

255

JDM/RLM/rj

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 49 OF 180

REFERENCE: MAC SCD 52-52701, Revision F, Paragraph 6.2.3.17.3

7.1.2 Vibration - TCA #1 (Rerun) B

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 Y axis of the TCA (see Figure 7). B

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.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
J. Ganger	8-7-64	[illegible]	8-12-64		
CHECKED BY:	DATE				
[illegible]	8-12-64				

FORM 608-B-38 NEW 6-63

REVISION B [illegible] Dated 7-13-65

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 50 OF 180

7.1.2.1.3.4	The overall RMS acceleration level is to be 9.6 G's plus fifteen (15) percent, minus zero (0) percent.	
7.1.2.1.3.5	No smaller than three (3) sigma clippers shall be used to limit the input level.	
7.1.2.1.4	Readjust the controls and repeat paragraphs 7.1.2.1.3 and 7.1.2.1.3.1 as required to conform to paragraphs 7.1.2.1.3.2 through 7.1.2.1.3.4.	
7.1.2.1.4.1	Full level equalization time for the purpose of 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 eight (8) ± 0.1 minutes less the time accumulated, for each respective axis, in paragraphs 7.1.2.1.3 and 7.1.2.1.4.	
7.1.2.1.5.1	Record and analyze the input and output accelerations at selected intervals.	
7.1.2.1.6	Remove the TCA from the test setup.	B
7.1.2.1.7	Perform 6.1 thru 6.1.4 of the Propellant Valve Proof Pressure and Leakage Test for both valves.	B
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 Z axis (see Figure 7).	B
7.1.2.1.9	Repeat paragraphs 7.1.2.1.1 through 7.1.2.1.6 except that the direction of vibration input shall be along the X axis (see Figure 7).	B

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole RC	9-26-64	R. H. Eide	9-26-64		
CHECKED BY:	DATE				
[signature]	9-26-64				

FORM 608-B-38 NEW 6-63

Revision B J. D. Marrogenis Date 9-26-64

R-15019-2

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21 -401

NAME OF TEST VIBRATION TEST NO 207540 SHEET 51 OF 180

7.1.2.1.10 Perform Propellant Valve Proof Pressure and Leakage Test per paragraph 6.1.

7.1.2.1.11 Perform Thrust Chamber Proof Pressure and Leakage Test per paragraph 6.2.

7.1.2.1.12 Perform Propellant Valve Electrical Resistance Test per paragraph 6.3.

7.1.2.1.13 Perform Propellant Valve Dielectric Strength Test per paragraph 6.4.

7.1.2.1.14 Perform Propellant Valve Functional Test per paragraph 6.5.

7.1.2.1.15 Remove extended inlet tube adapters and install basic inlet tube adapters per paragraph 7.1.1.1.2.

7.1.2.1.16 Perform weight determination per paragraph 7.1.1.1.3

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole	9-26-64				
CHECKED BY:	DATE				
	9-26-64		9-26-64		

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 52 OF 180

7.1.2.2 Test Data - TCA #1 (Rerun) B

7.1.2.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52701-277

Rocketdyne Part No. 207540-21

Component Serial No. 4058958

7.1.2.2.2 Accelerometer Identification (Reference Figure 7) (Rerun) B

Location	Sensitive Axis	Identification No.	
TCA Input	X	113	
TCA Input	Y	113	
TCA Input	Z	113	
TCA Nozzle Exit	X	1086	A
TCA Nozzle Exit	Y	961	A
TCA Nozzle Exit	Z	1099	A
TCA Shell at Comb. Zone	X	1228	
TCA Shell at Comb. Zone	Y	1127	
TCA Shell at Comb. Zone	Z	1119	
TCA Shell at Exit (Extension)	X	903	
TCA Shell at Exit (Extension)	Y	1005	
TCA Shell at Exit (Extension)	Z	944	

7.1.2.2.3 Vibration Test (Reference paragraph 7.1.2.1) B

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	10-12-64	R.A. Hock	10-17-64	R.E. Holder	10-17-64	10-17-64	
	7-9-64					VERIFIED BY USAF	10/17/64 DATE

FORM 608-B-39 NEW 6-63

REVISION A J.D. Mangione Dated 8-31-64

Rev. B J.D. Mangione dated 10-12-64

R-15019-2

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 53 OF 180

7.1.2.2.3.1 Resonant Survey - Y Axis (Rerun) B

Freq. cps	Input g's	Output g's	Identification (no)

REF PAGE 55 PARA 7.1.2.2.3.4

7.1.2.2.3.2 Vibration Table Equalization Test - Y Axis (Rerun) B

Test No	Satisfactory Spectrum Shape	Satisfactory RMS G Level	Test Duration	Accumulated Duration
1	NO	9.6 GRMS	8 SEC	8 SEC
2	NO	9.6 GRMS	14 SEC	22 SEC
3	YES	9.6 GRMS	8 SEC	30 SEC

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	10-12-64 7-9-64	R.A. Hook	10-17-64	B.J. Gerdes	10-17-64	[illegible] by R.L. Marcher	10-17-64
						VERIFIED BY USAF	DATE
						[illegible]	11/6/64

FORM 608-B-39 NEW 6-63

Rev. B J.D. Mavrogenis dated 10-12-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 54 OF 180

7.1.2.2.3.3 Random Vibration Test - Y Axis (Rerun) B

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

SAMPLE #1 (1 ±0.5 Minute) 60-65 SEC.
SAMPLE #2 (4 ±0.5 Minutes) 240-245 SEC
SAMPLE #3 (7 ±0.5 Minutes) 420-425 SEC

The elapsed time at test cutoff was 8.0 minutes.

Results of the Analysis:

SAMPLE #1 SEE 4M20-5-37-Y SHAPED 60 TO 65 SECOND SLICE TIME

SAMPLE #2 SEE 4M20-5-37-Y SHAPED 240=245 SECOND SLICE TIME

SAMPLE #3 SEE 4M20-5-37-Y SHAPED 420-425 SECOND SLICE TIME

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	10-12-64 7-9-64	F.M. Hitchcock	11-6-64	L. Johnson	11/6/64	WAIVED BY J. MAVRONGENIS	11/6/64
						VERIFIED BY USAF	DATE
						R.T. McNamee	11/6/64

FORM 608-B-39 NEW 6-63

Rev. B J.D. Mavrongenis dated 10-12-64

R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION Y AXIS TEST NO 207540-401 SHEET 54 OF 180

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

Proof Pressure	Oxidizer Valve	Fuel Valve
Pressure ($500 \pm^{10}_{0}$)	500 psig (ANR 941) W	500 psig (ANR 941) W
Time Duration (3 minimum)	3 minutes (ANR 941) W	3 minutes (ANR 941) W

Inspection Remarks

NONE (ANR 941)

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R. Cole		[signature] 10-17-64 2315		[signature] 17 Oct 64 (ANR 941)		WAIVED BY [signature] Roger Free	(ANR 941)
						VERIFIED BY USAF	DATE
						[signature] 10/17/64	

FORM 608-B-39 NEW 6-63

Rev. B J.D. Marrogonis Dated 10-13-64

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST: VIBRATION TEST NO. 207540-401 SHEET 55 OF 180

7.1.2.2.3.5 Resonant Survey - Z Axis

Freq. cps	Input g's	Output g's	Identification (no.)
122	.5	20.0	S/N 944
222	.5	8.0	S/N 944
226	.5	6.0	S/N 903
428	.5	3.0	S/N 944

7.1.2.2.3.6 Vibration Table Equalization Test - Z Axis

Test No	Satisfactory Spectrum Shape	Satisfactory RMS G Level	Test Duration	Accumulated Duration
1	NO	9.6	20 SEC	20 SEC
2	YES	9.6	12 SEC	32 SEC
3	NO	9.6	8 SEC	40 SEC
4	NO	9.6	9 SEC	49 SEC
5	NO	9.6	10 SEC	59 SEC
6	NO	9.6	9 SEC	68 SEC
7	NO	9.6	8 SEC	76 SEC
8	NO	9.6	9 SEC	85 SEC
9	YES	9.6	5 SEC	90 SEC
10	NO	9.6	6 SEC	96 SEC
11	YES	9.6	6 SEC	102 SEC

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	7-9-64	J. Doyle	Oct. 26 '64				
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

Revision B D. Morrison dated 9-9-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 56 OF 180

7.1.2.2.3.7 Random Vibration Test-Z Axis

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

SAMPLE #1 (1 ±0.5 Minute) 60 to 65 sec.
SAMPLE #2 3 (~~4~~ ±0.5 Minutes) 180 to 185 Sec.
SAMPLE #3 4.5 (~~7~~ ±0.5 Minutes) 270 to 275 sec REF DCP #4
*SEE DCR #4

The elapsed time at test cutoff was 6 MIN 31 SEC minutes.
3 MIN 40 SEC additional Run made at 5 GRMS

Results of the Analysis:

SAMPLE #1 see 4M20-5-37-Z Shaped 60 to 65 seconds splice Time

SAMPLE #2 see 4M20-5-37 Z Shaped 180-185 seconds splice time

SAMPLE #3 see 4M20-5-37 Z shaped 270 to 275 seconds splice Time

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	7-9-64	P.S. Lantz	10-29-64	C.T. Lamb	11-17-64	WAIVER 64 RL FREE 10-16-64	
						VERIFIED BY USAF	DATE
						R.L. McManus	11/17/64

FORM 608-B-39 NEW 6-63

REVISION B J.D. Mavrogenis Dated 10-13-64

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION Z AXIS TEST NO 207540-401 SHEET 56 OF 180

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

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

Inspection Remarks

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R. Cole		C. Gordon	10/23/64	[signature]	10-23-64	WAIVED BY [signature]	
						VERIFIED BY USAF	DATE
						[signature]	23 Oct 64

FORM 608-B-39 NEW 6-63

REVISION B J. D. Murrey Dated 10-13-64

R-15019-2

DESIGN APPROV . TEST OF COMPONENTS
FOR THE ORBIT ATT JDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 57 OF 180

7.1.2.2.3.9 Resonant Survy - X Axis (Rerun) B

Freq. cps	Input g's	Output g's	Identification (no)

REF PAGE 53 FOR DATA. PARA. 7.1.2.2.3.1

7.1.2.2.3.10 Vibration Table Equalization Test - X Axis (Rerun) B

Test No	Satisfactory Spectrum Shape	Satisfactory RMS G Level	Test Duration	Accumulated Duration
1	NO	9.6 GRMS	9.0 SEC.	8. SEC.
2	NO	9.6 GRMS	10. SEC	19. SEC.
3	Yes	9.6 GRMS	13. SEC	32. SEC.
4	Yes	9.6	53.0 SEC	85.0 SEC

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	10-12-64 7-9-64	D. J. Berry	10-24-64	[signature]	10-24-64	[signature]	10-24-64
						VERIFIED BY USAF	DATE
						[signature]	10-24-64

FORM 608-B-39 NEW 6-63

Rev. B J. D. Harrogems dated 10-12-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 58 OF 180

7.1.2.2.3.11 Random Vibration Test - X Axis (Rerun) B

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

SAMPLE #1 (1 ±0.5 Minute) 60 to 65 sec.
SAMPLE #2 3(~~1~~ ±0.5 Minutes) 180 to 185 sec.
SAMPLE #3 6(~~1~~ ±0.5 Minutes) 360 to 365 sec.

The elapsed time at test cutoff was 8.0 minutes.

Results of the Analysis:

SAMPLE #1 See 4M20-5-37 X shaped 60 to 65 seconds splice time

SAMPLE #2 see 4M20-5-37 X shaped 180 to 185 seconds splice time

SAMPLE #3 see 4M20-5-37 X shaped 360 to 365 splice time.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	10-12-64 7-9-64	[signature]	11-2-64	[signature]	11/17/64	[signature]	10-16-64
						VERIFIED BY USAF	DATE
						[signature]	11/17/64

FORM 608-B-39 NEW 6-63

Rev. B J.D. Marrogenis dated 10-12-64

R-15019-2

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-211

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 59 OF 180

7.1.2.2.3.12 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~~ DNA Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (500±10)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	6 minutes
Leakage Rate (2.23 maximum)	<.1 scc He/min	<.1 scc He/min

Inspection Remarks

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	7-10-64 4/14/64	F. S. Pope	10-28-64	L. Johnson	10/28/64	WAIVED BY J. MAVROGENIS	10/28/64
						VERIFIED BY USAF	DATE 28 OCT 64

FORM 608-B-39 NEW 6-63

REVISION B J. D. Mavrogenis Dated 10-13-64

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 60 OF 180

7.1.2.2.3.13 Thrust Chamber Proof Pressure and Leakage test (reference paragraph 6.2) B

Proof Pressure

	1st Application	2nd Application
Pressure (392+10)	392 psig	392 psig
Time Duration (3±.25)	3 minutes	3 minutes
Voltage (12.±2)	14 VDC	12 VDC

Inspection Remarks: NONE — SEE I.L. DATED 10/28/64.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	7-10-64 4/14/64	F. E. Pope	10-28-64	[signature]	10/28/64	[signature]	10/28/64
						VERIFIED BY USAF	10/28/64

FORM 608-B-39 NEW 6-63

REVISION B. J. D. Mavrogenis Dated 10-13-64

R-15019-2

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 61 OF 180

7.1.2.2.3.14 Propellant Valve Electrical Resistance test (reference paragraph 6.3) B

Environmental Temperature 70 °F (70±10F).

Resistance A - B

Oxidizer Valve 42.02 ohms (Acceptable per Figure 11, yes or no YES)

Fuel Valve 42.02 ohms (Acceptable per Figure 11, yes or no YES)

Resistance C - D (1.0 maximum)

Oxidizer Valve .09 ohms

Fuel Valve .15 ohms

Inspection Remarks

NONE 10/28/64

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	7-10-64 4/14/64	F. E. Pope	10-28-64	L. Johnson	10/28/64	CLAIMED BY J. MAUROKINES	10/28/64
						VERIFIED BY USAF 10/28/64	DATE

FORM 608-B-39 NEW 6-63

REVISION B [signature] DATED 10-13-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST VIBRATION TEST NO. 207540-401 SHEET 62 OF 180

7.1.2.2.3.1.5 Propellant Valve Dielectric Strength test (reference paragraph 6.4) B

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500±10	Current Microamps 500 max.	Voltage Volts 500±10	Current Microamps 500 max.
A to Ground	500	34	500	34
C to Ground	500	63	500	66
A to C	500	19	500	20

Inspection Remarks

NONE 10/28/64

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T. G. Kniffin 7-10-64 4/14/64	F. J. Pope 10/28/64	L. Johnson 10/28/64	SLAVED BY [illegible] 10/28/64 VERIFIED BY USAF 10/28/64 DATE [illegible]

FORM 608-B-39 NEW 6-63

REVISION B J. D. Marzyens Dated 10-13-64

R-15019-2

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

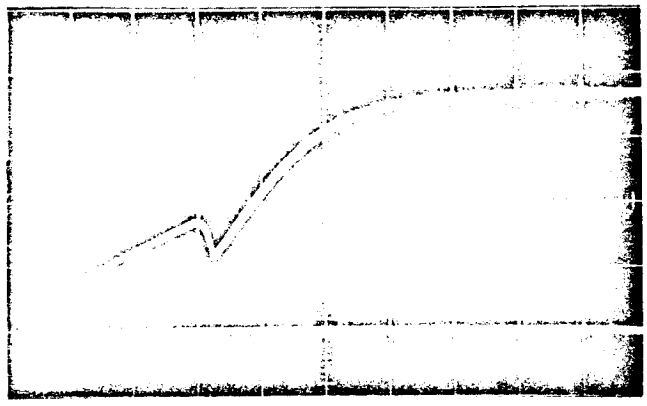
PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
C. Kudzia	595397	ENV.L/B.	2061	10-28-64

PART	PART NO.	TYPE OF TEST
100# OAMS TCA UNIT #1	207540-21 S/N 4058958	FUNCTIONAL-POST VIBRATION

OXIDIZER VALVE

P/N 407561 S/n 9174970

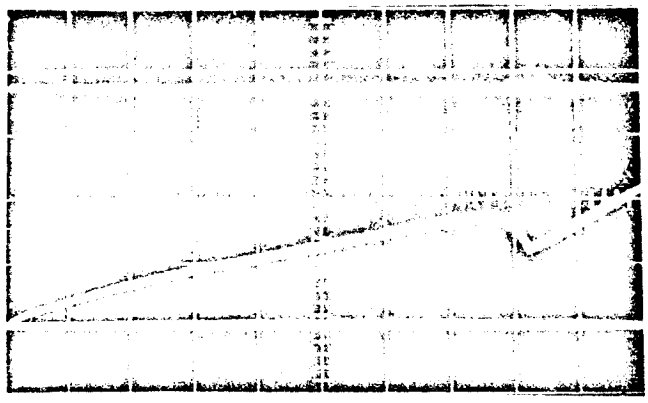
CURRENT TRACE
(OPENING TIME)



Horizontal = 5 ms/cm
Vertical = 20 mv/cm

Requirement = 0.021 sec/max
Actual = 0.0162 sec

CURRENT TRACE
(OPENING TIME)



Horizontal = 2 ms/cm
Vertical = 20 mv/cm

Requirement = 0.021 sec/max
Actual = 0.062 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
C. Kudzia	595397	ENV.LAB.	2061	10-28-64

PART	PART NO.	TYPE OF TEST
100# OAMS TCA UNIT #1	207540-21 S/N 4058958	FUNCTIONAL-POST VIBRATION

OXIDIZER VALVE

P/N 407561 S/N 9174970

VOLTAGE TRACE
(CLOSING TIME)
(WITH DIODE)

Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = 0.075 sec/max
Actual = 0.080 sec *

VOLTAGE TRACE
(CLOSING TIME)
(WITHOUT DIODE)

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

Requirement = 0.075 sec/max
Actual = 0.0044 sec

* Reference Deviation

R-15019-2

Form 600-V-67 New 10-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

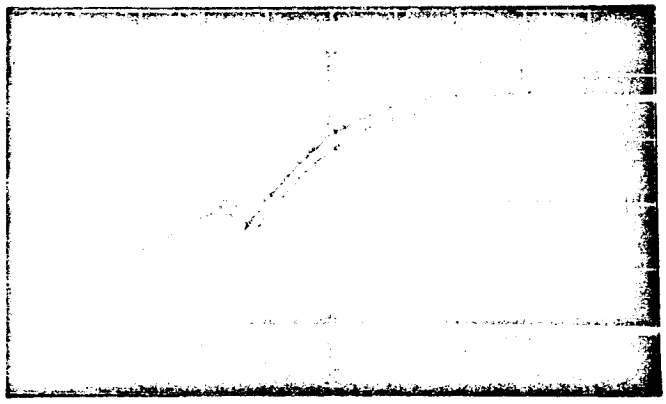
PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
C. Kudzia	595397	ENV.LAB.	2061	10-29-64

PART	PART NO	TYPE OF TEST
100# OAMS TCA UNIT #1	207540-21 S/N 4058958	FUNCTIONAL - POST VIBRATION

FUEL VALVE

P/N 407662 S/N 9183330

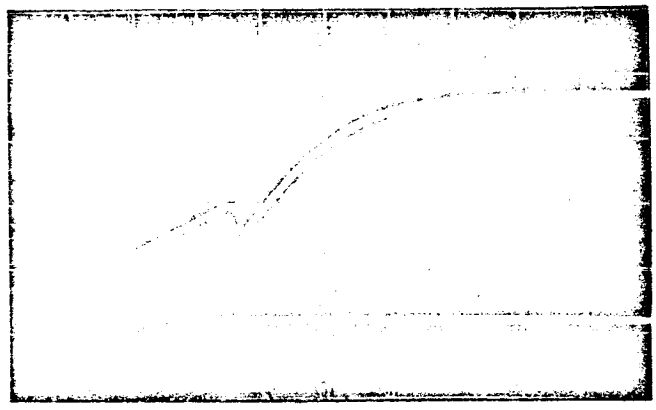
CURRENT TRACE
(OPENING TIME)
(WITH DIODE)



Horizontal = 5 ms/cm
Vertical = 20 mv/cm

Requirement = 0.021 sec/max
Actual = 0.018 sec

CURRENT TRACE
(OPENING TIME)
(WITHOUT DIODE)



Horizontal = 5 ms/cm
Vertical = mv/cm

Requirement = 0.021 sec/max
Actual = 0.018 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
C. Kudzia	595397	ENV.LAB	2061	10-29-64

PART	PART NO.	TYPE OF TEST
100# OAMS TCA UNIT #1	207540-21 S/N 4058958	FUNCTIONAL-POST VIBRATION

FUEL VALVE

P/N 407662 S/N 9188330

VOLTAGE TRACE
(CLOSING TIME)
WITH DIODE

Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = 0.075 sec/max
Actual = 0.067 sec

VOLTAGE TRACE
(CLOSING TIME)
WITHOUT DIODE

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

Requirement = 0.075 sec/max
Actual = 0.0036 sec

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST: VIBRATION TEST NO. 207540-401 SHEET 63 OF 180

7.1.2.2.3.16 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 (0.021 maximum)	.0162 seconds	.018 seconds
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Time (0.075 maximum)	* .078 seconds	⊗ .067 seconds
Low Voltage Operation		
Ambient Temperature (70±10)	70°F F	70°F. F
Inlet Pressure (300±10 for "pull-in")	300 psig	300 psig
Opening Voltage (16 maximum)	11.0 VDC	12.5 VDC
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Voltage (1.0 minimum)	1.1 VDC	1.45 VDC

REF DEP # 7
** RE-RUN CLOSING 0.0044 SEC
⊗ REF. IL. DTD 10/29/64

Inspection Remarks

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
T. G. Kniffin 7-10-64 4/14/64	F. T. Pope 10/29/64	L. Johnson 10/29/64	WAIVED BY J. MALCOLM 10/29/64
			VERIFIED BY USAF / DATE: C. H. McNamee 10/29/64

FORM 608-B-39 NEW 6-63

REVISION B J. D. Montgomery Dated 10-13-64

119

1 of 4

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207540-401 SHEET 119 OF 180

7.3.1.2 Test Data - TCA #3

7.3.1.2.1 Component Identification

Component Name	TCA	Oxidizer Valve	Fuel Valve
McDonnell Part No.	52-52701-277		
Rocketdyne Part No.	207540-21	407561	407662
Component Serial No.	4058965	4056529	9183314

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 RA0220-349. YES (Yes or No) ANR 719

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	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64	KS Kubo	8/12/64	P. [illegible]	8/12/64	WAIVED BY J. MAVROGENIS B-12-64 R. FREE	
						VERIFIED BY USAF WAIVED BY M. PINTO	8/12/64

FORM 608-B-39 NEW 6-63

R-15019-2

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207540-401 SHEET 120 OF 180

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 8.72 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	4/14/64	F. E. Pope	8-14-64	George Kruse	8-14-64	WAIVED BY J. [illegible]	8-14-64
						VERIFIED BY USAF	8/14/64

FORM 608-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST MECHANICAL SHOCK TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5364

Deviation Request:

It is hereby authorized to delete the Mechanical Shock test (Reference paragraph 7.1.3) for 100# TCA Unit #1. This test for mechanical shock will be done at a later time on a unit more representative of the test objectives.

Recopied from original request dated 31 October 1964.

James D. Mavrogenis
MAC Engineering
12-8-64

R. Cole
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

R-15019-2

IL 4388-5164

INTERNAL LETTER
North American Aviation, Inc.

DATE 2 November 1964

TO Those Concerned
Address

FROM Gemini DAT-RAT Unit
Address D/896-388

PHONE 6107

SUBJECT Plan of Action - Deviation to Gemini DAT TCA Specification 207540-401

The mechanical shock test was originally scheduled for 100 lb TCA Unit #1 (P/N 207540-21, S/N 4058958). However TCA Unit #1 is not representative of the production configuration. This unit was modified at McDonnell, St. Louis, with support brackets mounted on the TCA body and propellant valves. In addition, a MAC supplied nozzle extension was attached to the TCA exit.

The objective of the mechanical shock test is to verify that the customer shipping container for the Gemini 100 lb thrust chamber assemblies is structurally adequate to protect the production hardware from damage during transportation from Rocketdyne to McDonnell, St. Louis.

Therefore, it is proposed that 100 lb TCA, P/N 207540-21, S/N 4058965, be substituted to complete the mechanical shock test requirement. The TCA shall be designated as Unit #1A.(Spare DAT TCA hardware).

Post shock functional tests will be performed with propellant valve inlet adapters supplied by manufacturing.

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
MAC Engineering

FORM R 18-G-4

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST PRE-TEST INSPECTION TEST NO 207540-401 SHEET ___ OF ___

IL 4388-5365

Deviation Request:

The oxidizer valve inlet tube adapter was removed from the 100# TCA Unit #1A P/N 207540-21, S/N 4058965 yes (yes or no). The fuel valve inlet tube was replaced by manufacturing per EOR154176 and inlet adapter was not brazed on fuel side.

Recopied from original request dated 9 November 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-7-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

IL 4388-5189

INTERNAL LETTER
North American Aviation, Inc.

DATE 10 November 1964

TO Those Concerned
Address

FROM Gemini DAT-RAT Unit
Address D/896-388

SUBJECT Rework 100 lb OAMS TCA, P/N 207540-21, S/N 4058965

This TCA, P/N 207540-21, S/N 4058965, was accidently dropped at Santa Susana. As a result of this the inlet tube stub was inadvertantly bent and cracked. An authorizing document was initiated by Engineering to verify that the valves operated as per RA0220-349. Upon the valves passing the functional tests, E.O. 154176 was generated to replace the fuel inlet stub.

Standard di-penetrant proof pressure and leakage tests were performed on the TCA. The rework was accomplished by D/827 and verified by D/854.

R. A. Cole
R. A. Cole
Gemini DAT-RAT Unit

Approved: R. G. Eide
R. G. Eide
Supervisor
Gemini DAT-RAT Unit
McDonnell Engineering
McDonnell Quality Control J. D. Marrogenis
Air Force Quality Control
Rocketdyne Quality Control

FORM R 18-0-4

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST MECHANICAL SHOCK TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5366

Deviation Request:

The Post Functional (Shock) tests of paragraphs 7.1.3.2.3, 7.1.3.2.4, 7.1.3.2.5, 7.1.3.2.6 and 7.1.3.2.7 will be conducted on the oxidizer valve without interruption. The same procedure will be employed on the fuel valve. This change will reduce test time. Post shock functionals performed on 100# TCA Unit #1A with slip-on inlet adapters provided by manufacturing.

Recopied from original request dated 14 November 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-8-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21 }

NAME OF TEST: MECHANICAL SHOCK TEST NO. 207540-401 SHEET 64 OF 180

Reference: MAC SCD 52-52701, Revision F, paragraph 6.2.3.16

7.1.3 Shock - TCA #1

7.1.3.1 Test Procedure

7.1.3.1.1 Place the TCA into its shipping container per RA0616-008. Then install the container into the shock test facility. The direction of shock input shall be along the + X axis of the TCA (see Figure 7). C

7.1.3.1.2 Apply a half sine wave shock of 15 $^{+1.5}_{-0}$ 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. B

7.1.3.1.3 Repeat paragraph 7.1.3.1.2 two times for a total of three shocks.

7.1.3.1.4 Repeat paragraphs 7.1.3.1.1 through 7.1.3.1.3 for the - X Axis of the TCA. Inspect the TCA for visible evidence of damage following the application of the shocks. B

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: DATE	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
R. Cole		
CHECKED BY: DATE		
[illegible] 10-15-64	[illegible] 10-15-64	

FORM 608-B-38 NEW 6-63

Rev. B J.D. Morrison dated 10-15-64

Rev. C J.D. Morrison dated 10/31/64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST MECHANICAL SHOCK TEST NO 207540-401 SHEET 65 OF 180

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.

7.1.3.1.12 Perform Visual Inspection.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
T. G. Kniffin	7-10-64 4/14/64	R H Eide	7-22-64		
CHECKED BY:	DATE				
H Vale	4/16				

FORM 608-B-38 NEW 6-63

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Page 1 of 6
Lab Test No. 41520-17-29

Prepared by	EWR No.	Facility	Date
V DAVIS	5-95397	CANOGA	11-13-64
Part	**Part No.**	**Serial No.**	
TCA	207540-21	SIN 4058965	

Metering Pin Data

Hyge Unit 6041
Acceleration 13 G + 1.5 G
Acc. Waveshape HALF-SINE
Acc. Time 11 MSEC ± 1 MSEC

Hydraulic Fluid Level

a. 30 ~~inches~~ cc as measured down from top of top cylinder.
b. _____

Deceleration Orifice Position

a. _____ Contour side up
b. ✓ Contour side down

Calibration

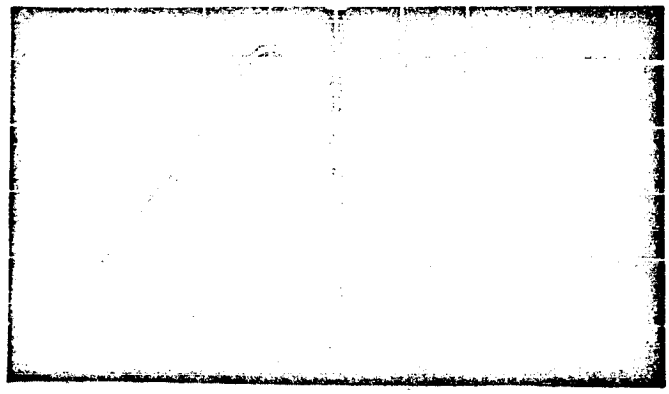
Vertical (G's/square) 3
Horizontal (MS/square) 2
Accelerometer AS TCA-50-350 S/N 7030

Accelerated Mass

a. Specimen and fixture 45 lbs.
b. Carriage 30.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 125 lbs.

Operational Data

Set Pressure 16 psig
Firing Pressure 400 psig
Brake Pressure 65 psig
Accumulator Pressure — psig
(Alternate Firing)



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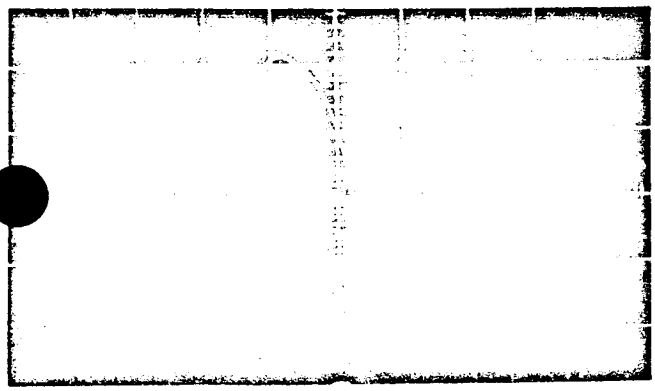

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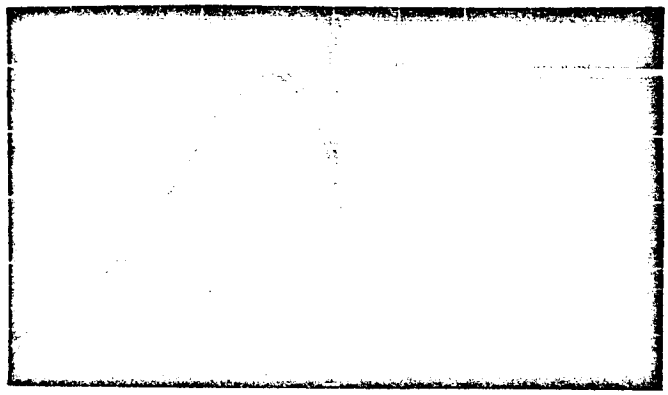


+Z AXIS

Remarks: NO VISIBLE DAMAGE

R-15519-2

Form 600-V-69 New 3-64

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Lab Test No. 4K20-17-29

Prepared by	EWR No.	Facility	Date
V DAVIS	595397	CANOGA	11-13-64
Part	**Part No.**	**Serial No.**	
TCA	207540-21	405-8965	

Metering Pin Data

Hyge Unit 6401
Acceleration 15.4 ± 1.5 G
Acc. Waveshape HALF-SINE
Acc. Time 11 msec ± 1 msec

Hydraulic Fluid Level

a. 30. ~~inches~~ cc as measured down from top of top cylinder.
b. _____

Deceleration Orifice Position

a. _____ Contour side up
b. ✓ Contour side down

Calibration

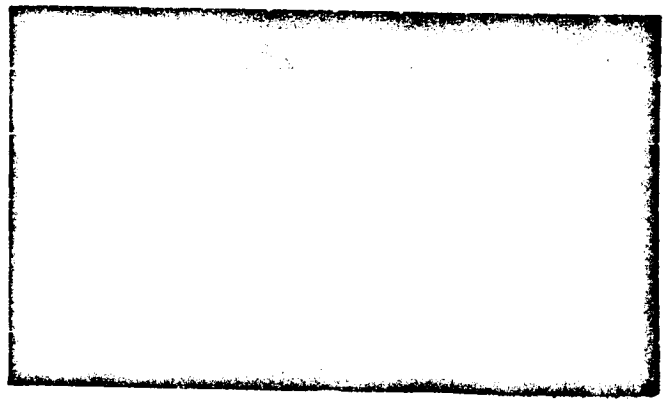
Vertical (G's/square) 3.
Horizontal (MS/square) 2.
Accelerometer 45TCA-50-350 SN 7030

Accelerated Mass

a. Specimen and fixture 45. lbs.
b. Carriage 30.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 125. lbs.

Operational Data

Set Pressure 16. psig
Firing Pressure 400. psig
Brake Pressure 65. psig
Accumulator Pressure — psig
(Alternate Firing)



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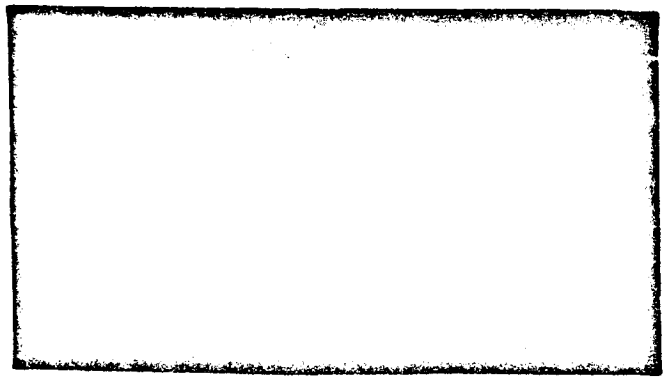

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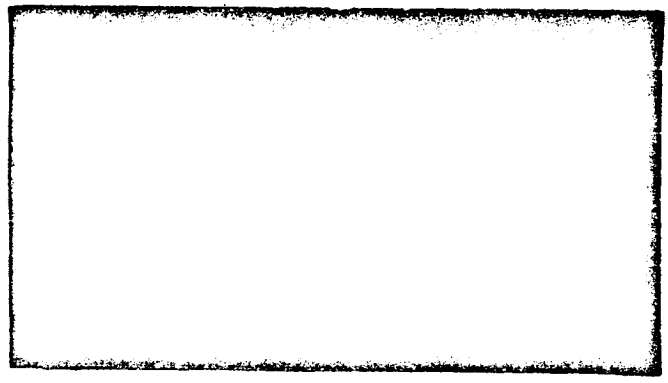


—X AXIS

Remarks: NO VISUAL DAMAGE

E-15019-2

Form 600-V-69 New 3-64

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Lab Test No. 4K20-17-29

Prepared by	EWR No.	Facility	Date
V DAVIS	595397	CANOGA	11-13-64
Part	**Part No.**	**Serial No.**	
TCA	207540-21	SIN 4058965	

Metering Pin Data

Hyge Unit 6041
Acceleration 150 + 1.5 G
Acc. Waveshape HALF-SINE
Acc. Time 11 MSEC ± 1 MSEC

Accelerated Mass

a. Specimen and fixture 45 lbs.
b. Carriage 80.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 175 lbs.

Hydraulic Fluid Level

a. 30 ~~inches~~ cc as measured down from top of top cylinder.
b.

Operational Data

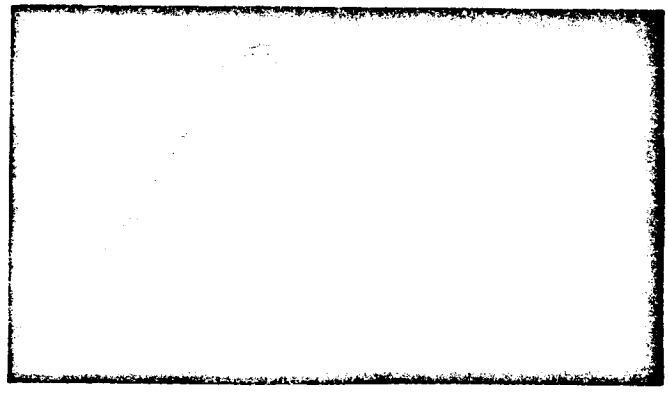
Set Pressure 16 psig
Firing Pressure 400 psig
Brake Pressure 63 psig
Accumulator Pressure psig
(Alternate Firing)

Deceleration Orifice Position

a. Contour side up
b. ✓ Contour side down

Calibration

Vertical (G's/square) 3
Horizontal (MS/square) 2
Accelerometer ASTCA-50-350
SIN 7030



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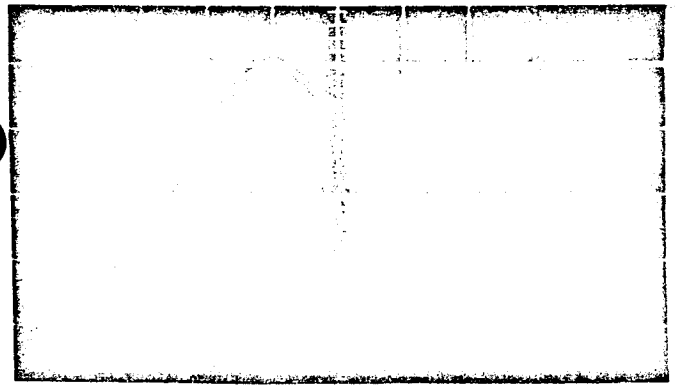

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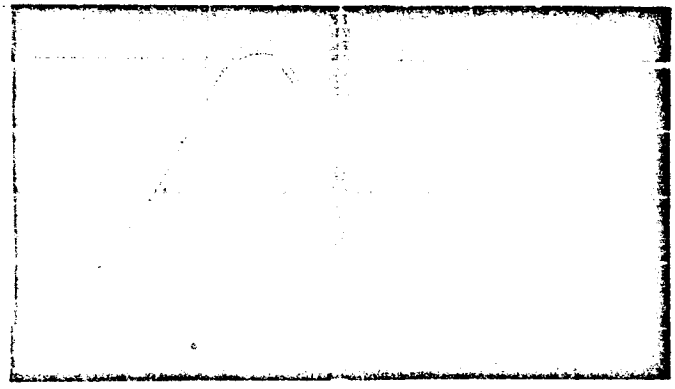


+ Y AXIS

Remarks: NO VISUAL DAMAGE

R-15019-2

Form 600-V-69 New 3-64

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Lab Test No. 4K20-17-29

Prepared by	EWR No.	Facility	Date
V. DAVIS	595397	CANOGA	11-13-64

Part	Part No.	Serial No.
TCA	207540-21	4058965

Metering Pin Data

Hyge Unit 6401
Acceleration 15. G + 1.5 G
Acc. Waveshape HALF-SINE
Acc. Time 11 mSEC ± 1 mSEC

Accelerated Mass

a. Specimen and fixture 45. lbs.
b. Carriage 30.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 125. lbs.

Hydraulic Fluid Level

a. 30. ~~inches~~ cc as measured down from top of top cylinder.
b.

Operational Data

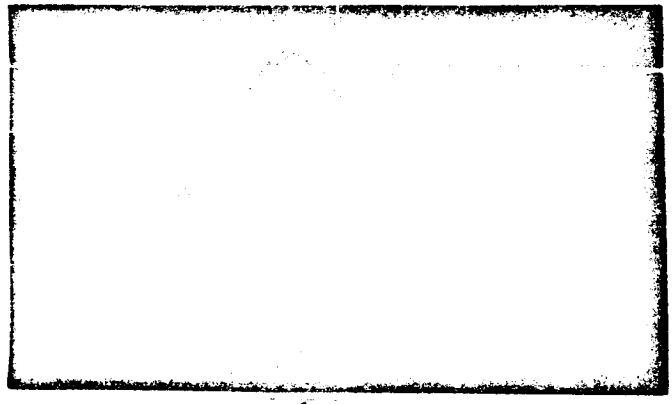
Set Pressure 16. psig
Firing Pressure 400. psig
Brake Pressure 65. psig
Accumulator Pressure — psig
(Alternate Firing)

Deceleration Orifice Position

a. ____ Contour side up
b. ✓ Contour side down

Calibration

Vertical (G's/square) 3.
Horizontal (MS/square) 2.
Accelerometer A5TCA-50-350 SN 7030



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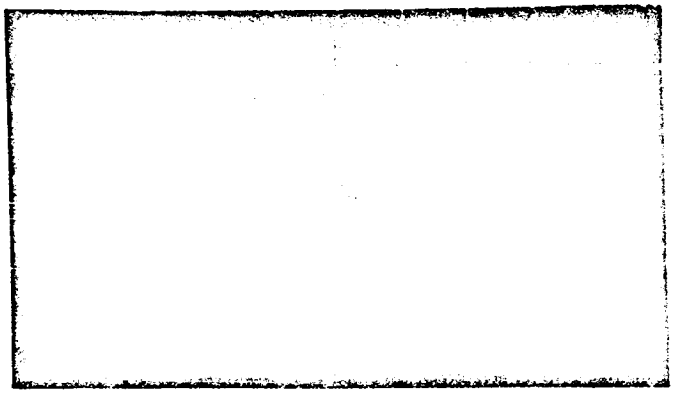

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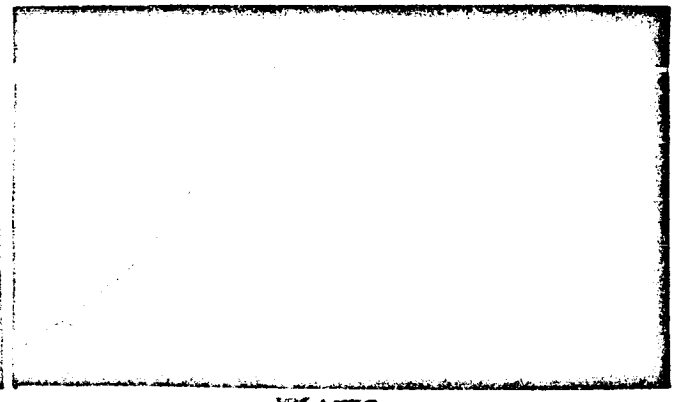


— Z AXIS

Remarks: NO VISUAL DAMAGE

R-15019-2

Form 600-V-69 New 3-64

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Lab Test No. 4K20-17-29

Prepared by	EWR No.	Facility	Date
V. DAVIS	595397	CANOGA	11-13-64
Part	**Part No.**	**Serial No.**	
TCA.	207540-21	SIN 058965	

Metering Pin Data

Hyge Unit 6041
Acceleration 15G ± 1.5G
Acc. Waveshape HALF-SINE
Acc. Time 11MSEC ± 1 MSEC

Accelerated Mass

a. Specimen and fixture 45 lbs.
b. Carriage 30.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 125 lbs.

Hydraulic Fluid Level

a. 30 ~~inches~~ CC as measured down from top of top cylinder.
b.

Operational Data

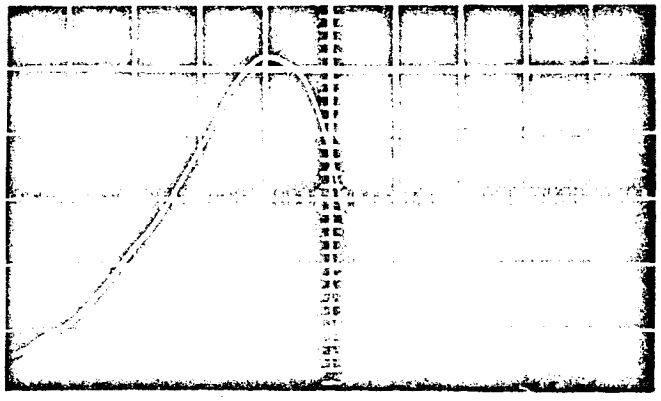
Set Pressure 16 psig
Firing Pressure 400 psig
Brake Pressure 65 psig
Accumulator Pressure — psig
(Alternate Firing)

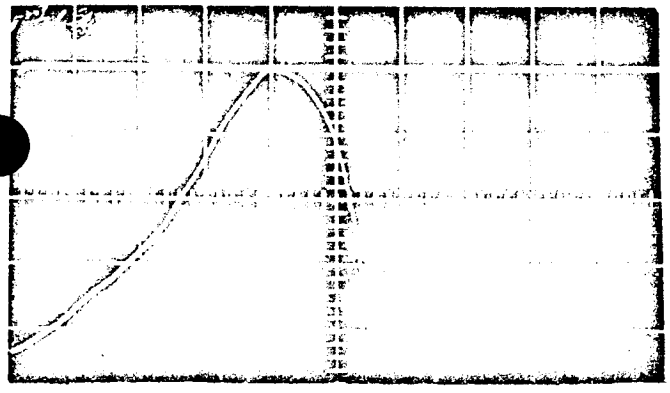
Deceleration Orifice Position

a. _____ Contour side up
b. ✓ Contour side down

Calibration

Vertical (G's/square) 3
Horizontal (MS/square) 2
Accelerometer ASTCA-50-350 S/N 7030





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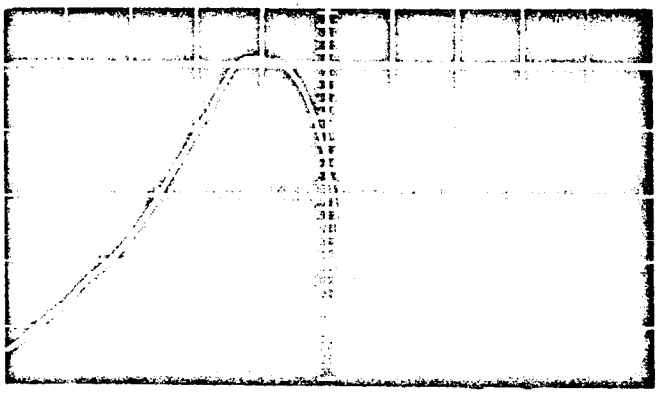


+ Z AXIS

Remarks: NO VISUAL DAMAGE

R-15019-2

Form 600-V-69 New 3-64

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Page 6 of 6
Lab Test No. 4K20-17-29

Prepared by	EWR No.	Facility	Date
V. DAVIS	595397	CANOGA	11-13-64

Part	Part No.	Serial No.
T.C.A.	207540-21	S/N 40589 65

Metering Pin Data

Hyge Unit 6041
Acceleration 15G + 1.5 G'S
Acc. Waveshape HALF-SINE
Acc. Time 11 M.SEC ± 1 M.SEC

Hydraulic Fluid Level

a. 30 ~~inches~~ cc as measured down from top of top cylinder.
b. _____

Deceleration Orifice Position

a. _____ Contour side up
b. ✓ Contour side down

Calibration

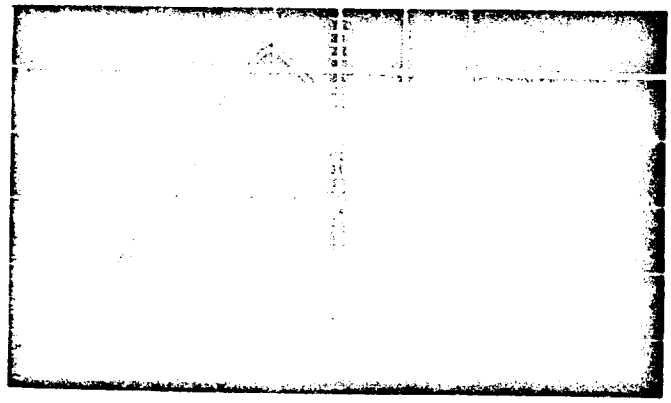
Vertical (G's/square) 3
Horizontal (MS/square) 2
Accelerometer ASTCA-50-350 S/N 7030

Accelerated Mass

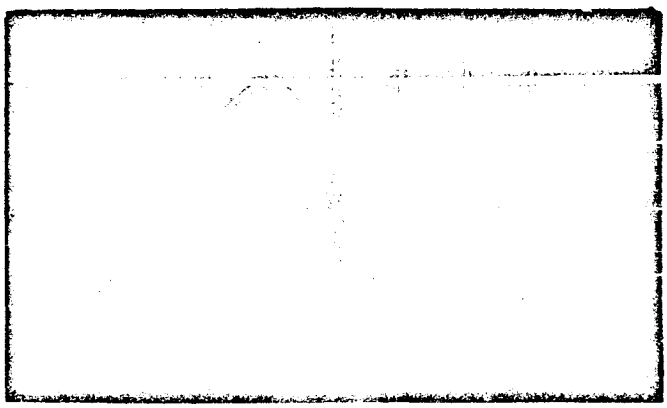
a. Specimen and fixture 45 lbs.
b. Carriage 30.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 125 lbs.

Operational Data

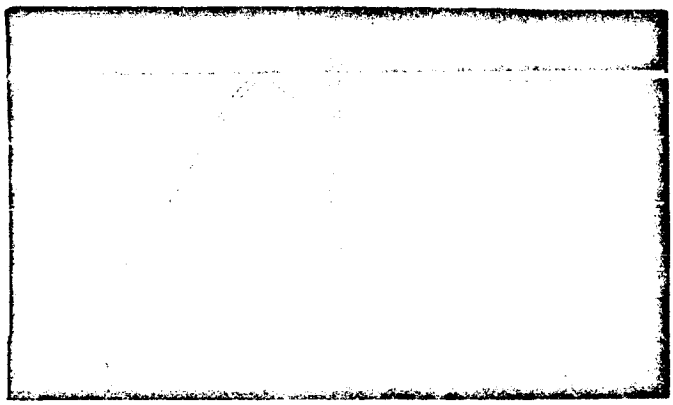
Set Pressure 16 psig
Firing Pressure 400 psig
Brake Pressure 65 psig
Accumulator Pressure _____ psig
(Alternate Firing)



— Z AXIS



— X AXIS



— Y AXIS

Remarks: NO VISUAL DAMAGE

R-15019-2

Form 600-V-69 New 3-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST MECHANICAL SHOCK TEST NO. 207540-401 SHEET 66 OF 180

7.1.3.2 Test Data - TCA #1A C

7.1.3.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52701-277

Rocketdyne Part No. 207540-21

Component Serial No. 4058965

7.1.3.2.2 Shock Test (reference paragraph 7.1.3.1)

Magnitude 15±1.5 g's	Duration 11±1.0 milliseconds
+X Axis	
15.6	11.
15.6	11.
15.0	11.
-X Axis	
16.2	11.
16.	11.
15	11.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64	C. Kudzia	11 13 64	J. F. Murchison	11-13-64	Waived By J. Marrogenius 11-13-64	
						VERIFIED BY USAF	DATE
						R L McNamee 11/13/64	

FORM 608-B-39 NEW 6-63

Revision C J. D. Marrogenius 11/2/64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST MECHANICAL SHOCK TEST NO. 207540-401 SHEET 67 OF 180

7.1.3.2.2 (continued) 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	
15.8	10.8	15.6	11
15.	11.	15	11
15.4	10.5	15.2	11
-Y Axis		-Z Axis	
14	11.25	16.	11
15	11.25	15.	10.75
15	11.	15.	10.75

Inspection Remarks

None 11-13-64

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64	C. Kudzia	11-13-69	J. F. Muschewski	11-13-64	[illegible] 11-13-64	
						VERIFIED BY USAF	DATE
						[illegible]	11/13/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-211

NAME OF TEST: MECHANICAL SHOCK TEST NO. 207540-401 SHEET 66 OF 180

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)	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 scc He/min	<.1 scc He/min

Inspection Remarks

None 11-14-64

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64 7-10-64	L Bracraft	11-14-64	[illegible]	11-14-64	[illegible]	11-14-64
						VERIFIED BY USAF	DATE
						[illegible]	11/6/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST MECHANICAL SHOCK TEST NO. 207540-401 SHEET 69 OF 180

7.1.3.2.4 Thrust Chamber Proof Pressure and Leakage test (reference paragraph 6.2)

Proof Pressure	1st Application 392 psig	2nd Application 392 psig
Pressure (392+10)		
Time Duration (3±.25)	3 minutes	3 minutes
Voltage (12 ±2)	14 VDC	14 VDC

Inspection Remarks

None 11-14-64

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64 7-10-64	L Crocroft	11-14-64	J. F. Murchison	11-14-64	[illegible]	11-14-64
						VERIFIED BY USAF	DATE
						[illegible]	11/16/64

FORM 608-B-39 NEW 6-63

R-15019-2

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST MECHANICAL SHOCK TEST NO. 207540-401 SHEET 70 OF 180

7.1.3.2.5 Propellant Valve Electrical Resistance test (reference paragraph 6.3)

Environmental Temperature 75° (70±10F).

Resistance A - B

Oxidizer Valve 44.3 ohms (Acceptable per Figure 11, yes or no yes)

Fuel Valve 40 ohms (Acceptable per Figure 11, yes or no yes)

Resistance C - D (1.0 maximum)

Oxidizer Valve .375 ohms

Fuel Valve .245 ohms

Inspection Remarks

None 11-14-64

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64 7-10-64	L Cracroft	11-14-64	[signature]	11-14-64	Waived By [signature] 11-14-64	
						VERIFIED BY USAF [signature]	11/16/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST MECHANICAL SHOCK TEST NO. 207540-401 SHEET 71 OF 180

7.1.3.2.6 **Propellant Valve Dielectric Strength test (reference paragraph 6.4)**

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500±10	Current Microamps 500 max.	Voltage Volts 500±10	Current Microamps 500 max.
A to Ground	500 ANR 70	47 ANR 70	500 ANR 70	31 ANR 70
C to Ground	500 ANR 70	54 ANR 70	500 ANR 70	56 ANR 70
A to C	500 ANR 70	10 ANR 70	500 ANR 70	11 ANR 70

Inspection Remarks

None 11-14-64 ANR 70

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64 7-10-64	L Cracraft	11-14-64	J. F. Murdoch	11-14-64 ANR 70	Waived By J. F. Marrogonis 11-14-64	ANR 70
						VERIFIED BY USAF	DATE
						[illegible] McNamee 11/16/64	

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

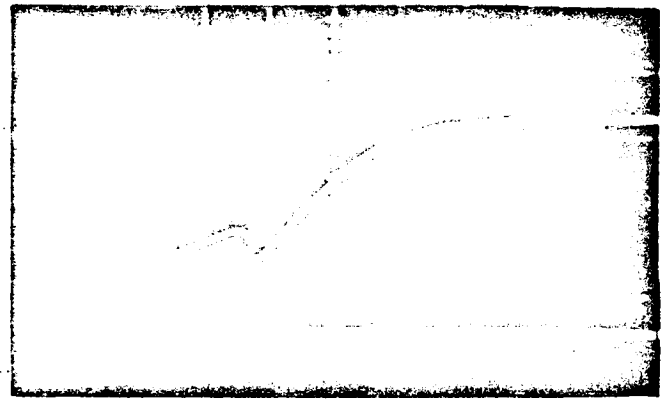
PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F. Pope	595397	ENV.LAB.	2061	11-14-64

PART	PART NO.	TYPE OF TEST
100# OAMS TCA UNIT #1A	207540-21 S/N 4058965	POST MECHANICAL SHOCK FUNCTIONAL

OXIDIZER VALVE

P/N 407561 S/N 4056529

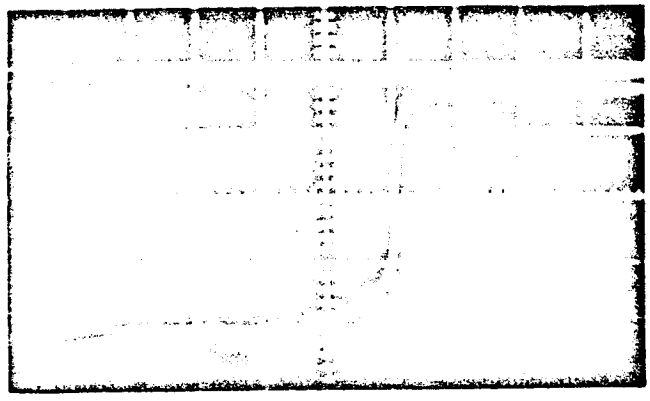
CURRENT TRACE
(OPENING TIME)



Horizontal = 5 ms/cm
Vertical = 20 mv/cm

Requirement = 0.021 sec/max
Actual = 0.019 sec

VOLTAGE TRACE
(CLOSING TIME)



Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = 0.075 sec/max
Actual = 0.064 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	595397	ENV.LAB.	2061	11-14-64

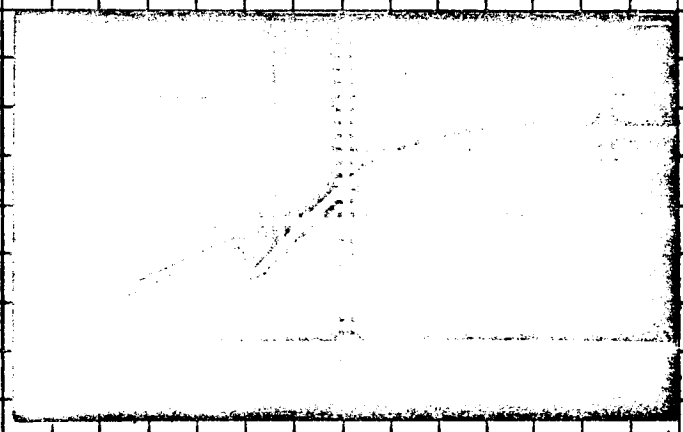
PART	PART NO.	TYPE OF TEST
100# OAMS TCA UNIT #1A S/N 4058965	207540-21	POST MECHANICAL SHOCK FUNCTIONAL

FUEL VALVE

P/N 407662 S/N 9183314

CURRENT TRACE

(OPENING TIME)



Horizontal = 5 ms/cm

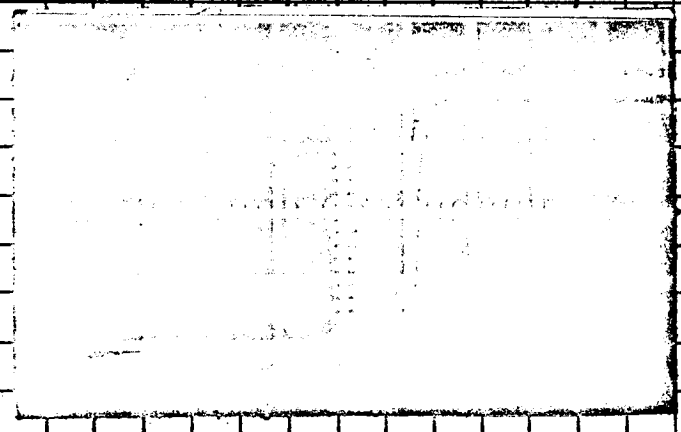
Vertical = 20 mv/cm

Requirement = 0.021 sec/max

Actual = 0.018 sec

VOLTAGE TRACE

(CLOSING TIME)



Horizontal = 20 ms/cm

Vertical = 200 mv/cm

Requirement = 0.075 sec/max

Actual = 0.065 sec

Form 600-W-67 New 10-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST MECHANICAL SHOCK TEST NO. 207540-401 SHEET 72 OF 180

7.1.3.2.7 Propellant Valve Functional test (reference paragraph 6.5)

	Oxidizer Valve	Fuel Valve
Response Time		
Ambient Temperature (70±10)	72° F	72° F
Energizing Voltage (26±0.5)	26 VDC	26 VDC
Inlet Pressure (300±10 for "pull-in")	300 psig	300 psig
Opening Time (0.021 maximum)	0.019 seconds	0.018 seconds
Inlet Pressure (zero for "drop-out")	Zero psig	Zero psig
Closing Time (0.075 maximum)	0.064 seconds	0.065 seconds
Low Voltage Operation		
Ambient Temperature (70±10)	72° F	72° F
Inlet Pressure (300±10 for "pull-in")	300 psig	300 psig
Opening Voltage (16 maximum)	12.2 VDC	12.25 VDC
Inlet Pressure (zero for "drop-out")	Zero psig	Zero psig
Closing Voltage (1.0 minimum)	1.4 VDC	1.5 VDC

Inspection Remarks

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64 7-10-64	L Cracraft	11-14-64	J Murchison	11-14-64	Waived by J Mavrogenis 11-14-64	
						VERIFIED BY USAF	DATE
						R L McManus	11/16/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST TEMPERATURE SHOCK TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5367

Deviation Request:

The Post Temperature Shock Functional Test of paragraph 6.2 was delayed pending the arrival of a replacement throat plug from CTL III. Authorization to continue functional testing was obtained from MAC Engineering.

Recopied from original request dated 4 November 1964.

James D. Mavrogenis
MAC Engineering
12-8-64

E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

31.

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST TEMPERATURE SHOCK TEST NO. 207540-401 SHEET 73 OF 180

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.2.3.7

7.1.4 Temperature Shock - TCA #1

7.1.4.1 Test Procedure

7.1.4.1.1 Place the TCA unit in a temperature chamber maintained at a temperature of 185 ±5F.

7.1.4.1.2 Expose the TCA to 185 ±5F for a continuous period of four hours minimum.

7.1.4.1.3 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.

7.1.4.1.4 Expose the TCA unit to -40 ±5F for a continuous period of four hours minimum.

7.1.4.1.5 Repeat paragraphs 7.1.4.1.1 through 7.1.4.1.4 two more times.

7.1.4.1.6 Allow the TCA unit to return to room ambient temperature.

7.1.4.1.7 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.

7.1.4.1.7.1 Perform Propellant Valve Proof Pressure and Leakage Test per paragraph 6.1.

7.1.4.1.7.2 Perform Thrust Chamber Proof Pressure and Leakage Test per paragraph 6.2.

PREPARED BY: T. G. Kniffin 7-10-64	DATE 4/14/64	APPROVED FOR NAA: R. F. Eide 7-22-64	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: [signature]	DATE 4/16				

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST TEMPERATURE SHOCK TEST NO. 207540-401 SHEET 74 OF 180

7.1.4.1.7.3 Perform Propellant Valve Electrical Resistance Test per paragraph 6.3.

7.1.4.1.7.4 Perform Propellant Valve Diclectric Strength Test per paragraph 6.4.

7.1.4.1.7.5 Perform Propellant Valve Functional Test per paragraph 6.5.

303

PREPARED BY: T. G. Kniffin 7-10-64	DATE 4/14/64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 4/16	7-22-64			

FORM 608-B-38 NEW 6-63

R-15019-2

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST: TEMPERATURE SHOCK TEST NO. 207540-401 SHEET 75 OF 180

7.1.4.2 Test Data - TCA # 1 A

7.1.4.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52701-277

Rocketdyne Part No. 207540-21

Component Serial No. 4058958

7.1.4.2.2. Temperature Shock test (reference paragraph 7.1.4.1)
START TIME 10:00 AM. 11/2/64

7.1.4.2.2.1 The TCA was placed in a temperature chamber where it was exposed to a temperature of 185 (185 ±5F) for a time period of 4.25 (4 minimum) hours.

7.1.4.2.2.2 The TCA was transfered to a temperature chamber where it was exposed to a temperature of -40 (-40 ±5F) for a time period of FOUR (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No)

7.1.4.2.2.3 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 4.10 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No)
START TIME 6:30 PM 11-2-64

7.1.4.2.2.4 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 4.20 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No) A

* -49° REF. 14, DTD. 11/3/64

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64 7-10-64	[illegible]	11-2-64	[illegible]	11/3/64	WITNESSED BY R L FREE	11/3/64
						VERIFIED BY USAF	DATE
						[illegible]	11/3/64

FORM 608-B-39 NEW 6-63

REVISION A R. L. Free 11-2-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST TEMPERATURE SHOCK TEST NO. 207540-401 SHEET 76 OF 180

7.1.4.2.2.5 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 4.10 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No)

7.1.4.2.2.6 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 4.5 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No)

7.1.4.2.2.7 Inspection Remarks

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64 7-10-64	H. A. Lindwall	11/3/64	M. J. Fogarty	11/3/64	WAIVED BY T. MAUROGENIS	11/3/64
						VERIFIED BY USAF	DATE
						W. Ballenbach	11/3/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-211

NAME OF TEST: TEMPERATURE SHOCK TEST NO. 207540-401 SHEET 77 OF 180

7.1.4.2.3 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 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

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64	H. A. Lindvall	11/3/64	M. J. Fogarty	11/3/64	WAIVED BY J. MAUROGENIS	11/3/64
7-10-64						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST TEMPERATURE SHOCK TEST NO. 207540-401 SHEET 78 OF 180

71.4.2.4 Thrust Chamber Proof Pressure and Leakage test (reference paragraph 6.2)

	1st Application	2nd Application
Proof Pressure	392 psig	392 psig
Pressure (392+10)		
Time Duration (3+.25)	3.0 minutes	3.0 minutes
Voltage (12 ±2)	12.0 VDC	12.0 VDC

Inspection Remarks

* UNABLE TO LEAK CHECK ALL WELD JOINTS REF. 6.2 DUE TO TCA BODY & PROP. VALVE SUPPORT BRACKET REF. 1L DTD. 11/5/64

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64	H. A. Lindwall	11/5/64	M. J. Fogarty	11/5/64	WAIVED BY J. MAUROGENAS	11/5/64
7-10-64						VERIFIED BY USAF	11/5/64

FORM 608-B-39 NEW 6-63

7

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST TEMPERATURE SHOCK TEST NO. 207540-401 SHEET 79 OF 180

7.1.4.2.5 Propellant Valve Electrical Resistance test (reference paragraph 6.3)

Environmental Temperature 70 (70±10F).

Resistance A - B

Oxidizer Valve 40.60 ohms (Acceptable per Figure 11, yes or no YES).

Fuel Valve 40.10 ohms (Acceptable per Figure 11, yes or no YES).

Resistance C - D (1.0 maximum)

Oxidizer Valve 0.08 ohms

Fuel Valve 0.02 ohms

Inspection Remarks

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64	H.A. Lindwall	11/5/64	M. J. Fogarty	11/5/64	WAIVED BY J. MAUROGENES	11/5/64
7-10-64						VERIFIED BY USAF	11/5/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST TEMPERATURE SHOCK TEST NO. 207540-401 SHEET 80 OF 180

7.1.4.2.6 Propellant Valve Dielectric Strength test (reference paragraph 6.4)

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500±10	Current Microamps 500 max.	Voltage Volts 500±10	Current Microamps 500 max.
A to Ground	500	47	500	72
C to Ground	500	62	500	70
A to C	500	23	500	33

Inspection Remarks

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64	H. A. Lindvall	11/5/64	M. J. Fogarty	11/5/64	WAIVED BY J. MAUROGENI	11/5/64
7-10-64						VERIFIED BY USAF	11/5/64

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

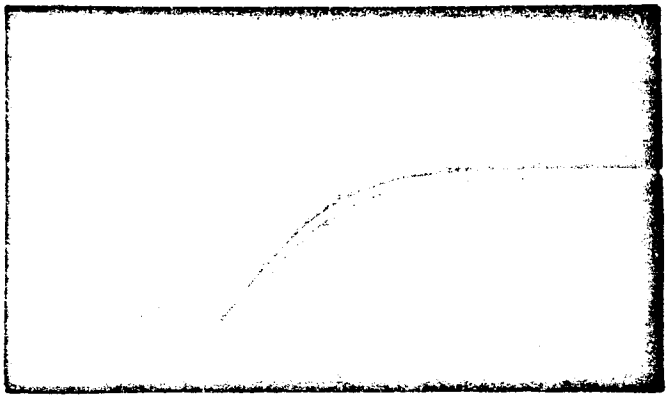
PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F. Pope	595397	ENV.LAB.	2061	11-5-64

PART	PART NO.	TYPE OF TEST
100# OAMS TCA UNIT #1	207540-21 S/N 4058958	POST TEMPERATURE SHOCK FUNCTIONAL

OXIDIZER VALVE

P/N 407561 S/N 9174970

CURRENT TRACE
(OPENING TIME)



Horizontal = 5 ms/cm
Vertical = 20 mv/cm

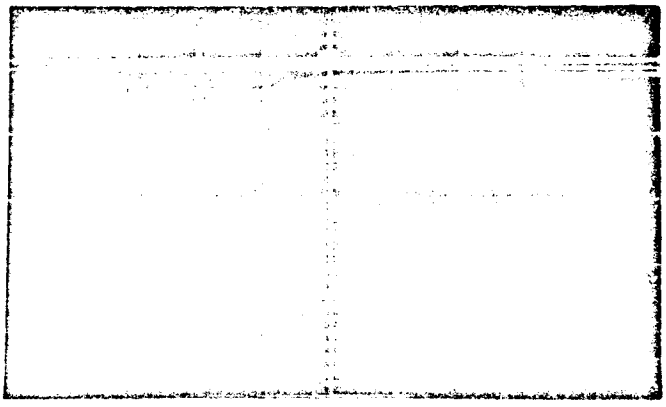
Requirement = 0.021 sec/max
Actual = 0.017 sec

VOLTAGE TRACE
(CLOSING TIME)
(WITH DIODE)

Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = 0.075 sec/max
Actual = 0.080 sec *

VOLTAGE TRACE
(CLOSING TIME)
(WITHOUT DIODE)



Horizontal = 1 ms/cm
Vertical = 50 v/cm
Deactuation

Requirement = 0.075 sec/max
Actual = 0.0041 sec

* REFERENCE DEVIATION

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE ____ OF ____

LAB TEST NO. ____

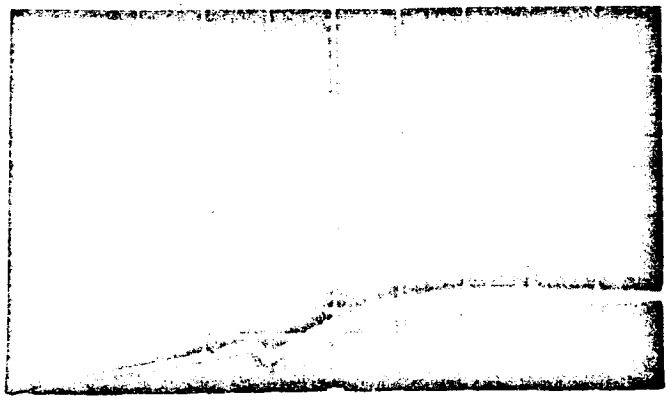
PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	595397	ENV.LAB.	2061	10-5-64

PART	PART NO.	TYPE OF TEST
100# TCA UNIT #1	207540-21 S/N 4058958	POST TEMPERATURE SHOCK FUNCTIONAL

FUEL VALVE

P/N 407662 S/N 9183330

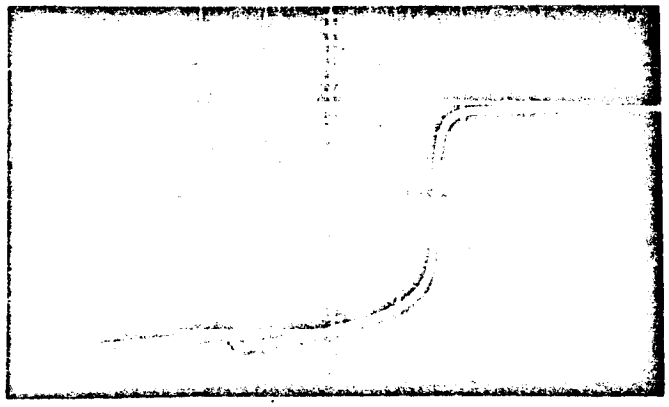
CURRENT TRACE
(OPENING TIME)



Horizontal = 5 ms/cm
Vertical = 20 mv/cm

Requirement = 0.021 sec/max
Actual = 0.019 sec

VOLTAGE TRACE
(CLOSING TIME)



Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = 0.075 sec/max
Actual = 0.068 sec

Form 600-V-67 Rev 10-63

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST: TEMPERATURE SHOCK TEST NO. 207540-401 SHEET 81 OF 180

7.1.4.2.7 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 (0.021 maximum)	0.017 seconds	0.019 seconds
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Time (0.075 maximum)	* 0.0041 seconds	0.068 seconds
	* WITHOUT DIODE REF IL. DTD 10/29/64	
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)	11.8 VDC	12.5 VDC
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Voltage (1.0 minimum)	1.12 VDC	1.32 VDC

Inspection Remarks

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64 7-10-64	H. A. Lindwall	11/5/64	Mt. J. Fogarty	11/5/64	WAIVED BY J. MAURO	11/5/64
						VERIFIED BY USAF	11/5/64

FORM 608-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST HOT-FIRE TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5368

Deviation Request:

The chamber pressure requirements outlined in Table I shall be deleted. The reason being that the vibration "FIX" prevents the installation of the pressure transducer.

Recopied from original request dated 11 November 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-8-64

John A. Ganger
John A. Ganger
Genini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

R-15019-2

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 1CO# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST: DAT DUTY CYCLE TO FAILURE TEST NO. 207540-401 SHEET 82 OF 180

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

7.1.5 DAT Duty Cycle to Failure — TCA #1

7.1.5.1 Test Procedure

7.1.5.1.1 Perform Cape Cycle Firing Test per paragraph 6.7.

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

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

7.1.5.1.1.3 Repeat paragraph 7.1.5.1.1.2.

7.1.5.1.2 Wait for TCA skin temperature to return to ambient temperature (70 ±20 F) and perform the DAT Duty Cycle Firing Test of paragraph 6.7 and table II. The TCA shall be fired until catastrophic failure occurs. Catastrophic failure is defined in Table II, Note 4.

7.1.5.1.2.1 The TCA shall not exceed a maximum skin temperature of 650 F at the end of the 220 seconds total burn time ("in spec" performance).

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole	9-20-64				
CHECKED BY:	DATE				
E Adams	11-4-64		11-4-64		

FORM 608-B-38 NEW 6-63

JAS 7/15/65

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 207540-401 SHEET 82.1 OF 180

7.1.5.1.2.2	The TCA shall not exceed a maximum skin temperature of 700F at 300 seconds total burn time. (guaranteed life).
7.1.5.1.3	Perform decontamination per paragraph 6.8.
7.1.5.1.4	Reduce data per RA0220-232.
7.1.5.1.4.1	The results of significant data shall include but not be limited to the following:
7.1.5.1.4.1.1	Graphical presentation of temperature versus time for all TCA thermocouple locations.
7.1.5.1.4.1.2	Graphical presentation of thrust versus time.
7.1.5.1.4.1.3	Graphical presentation of chamber pressure versus time.
7.1.5.1.4.1.4	Graphical presentation of oxidizer flowrate versus time.
7.1.5.1.4.1.5	Graphical presentation of fuel flowrate versus time.
7.1.5.1.5	Perform weight determination per paragraph 6.6.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
E. Adams	9-16-64				
CHECKED BY:	DATE				
	11-4-64		11-4-64		

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 207540-401 SHEET 83 OF 180

7.1.5.2 Test Data - TCA #1

7.1.5.2.1 Component Identification

Component Name SE-7 100# TCA

McDonnell Part No. 52-52701-277

Rocketdyne Part No. 207540-21

Component Serial No. 4058958

Accumulated Acceptance Test Firing Time, seconds 3.0

	Pre-Test	Post Test
Throat Diameter, inches (Average of four measurements)	7086	Ref Dep #16
Nozzle Exit Diameter, inches (Average of four measurements)	4.871	

7.1.5.2.2 Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	11/9/64	11/9/64
Sample Batch Number	11-105	11-106
Sample Temperature, F	60°	1.462
Sample Specific Gravity	77°	0.872
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	7-10-64 4/14/64	S. E. Hombrase / D. Kelly	11/14/64	Mel Moore		J. D. Mavrogenis	11/14/64
						VERIFIED BY USAF	DATE
						M. P. Beaton	11/14

FORM 608-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 207540-401 SHEET ___ OF ___

IL 5388-6245

Deviation Request:

It is hereby authorized to accept the following deviation from the DAT Specification 207540-401 for 100# TCA Unit #1.

1. The Cape Cycle pulse duration (1.04 seconds) exceeded the specification limit of 1.00 ±02 seconds.

John A. Ganger
John A. Ganger
Gemini DAT-RAT Unit

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
2-23-65

FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DUTY CYCLE TO FAILURE TEST NO. 207540-401 SHEET 83.1 OF 180

7.1.5.2.3 Cape Cycle Test (reference paragraph 7.1.51)

Test Cell Location C.T.L. III

Test Cell Number 39K

Test Number 094

Test Date 11/11/64

	Pulse Duration (sec) (1.000 ±.020 sec)	Time between Pulses, (minutes)
1st Pulse	1.04	5 (5)
2nd Pulse	↓	10 (10)
3rd Pulse	↓	5 (5)
4th Pulse	↓	10 (10)
5th Pulse	↓	5 (5)
6th Pulse	↓	(10)

Accumulated Firing Time, seconds 6.24

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	9-3-64	H. Robinson	1-21-65	W. C. Williams	3 March 1965	James D. Marrocco	2/23/65
						VERIFIED BY USAF	DATE
						[signature]	3/4/65

FORM 608-B-39 NEW 6-63

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R-15019-2

Revision [illegible]

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 207540-401 SHEET 85 OF 180

7.1.5.2.4 Duty Cycle Test (reference paragraph 7.1.5.1)

Test Cell Location CTL III

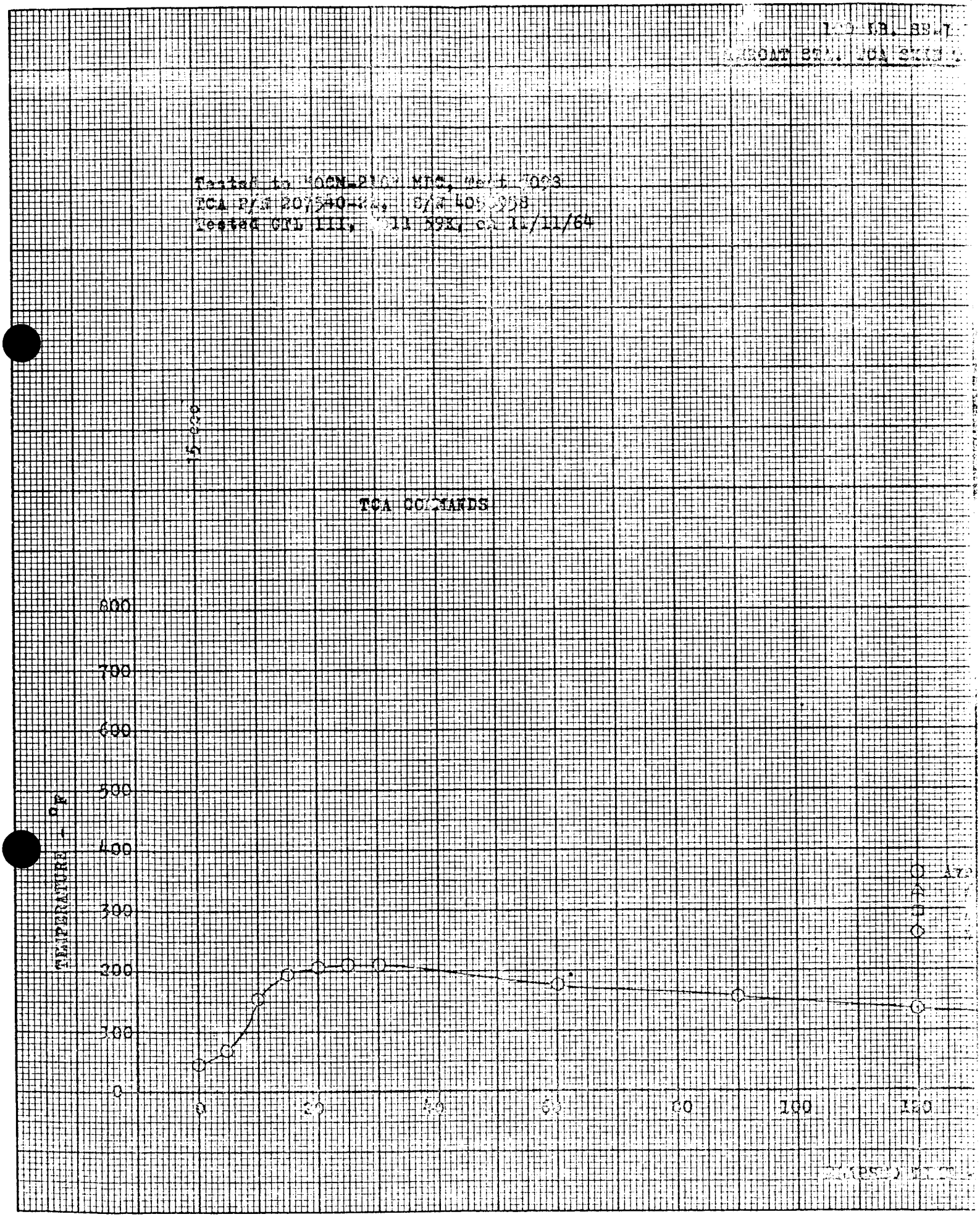
Test Cell Number 34K

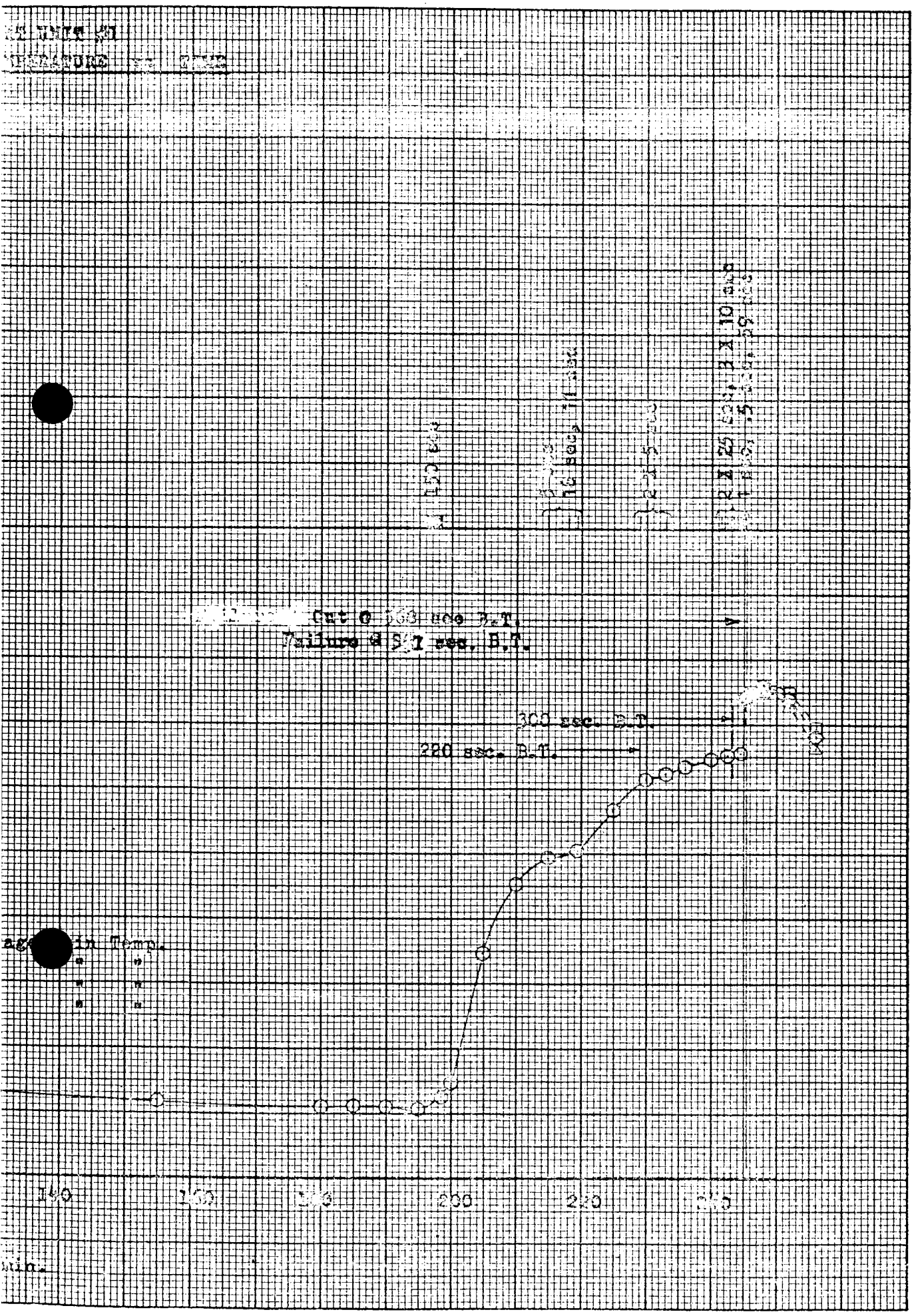
Test Number C98

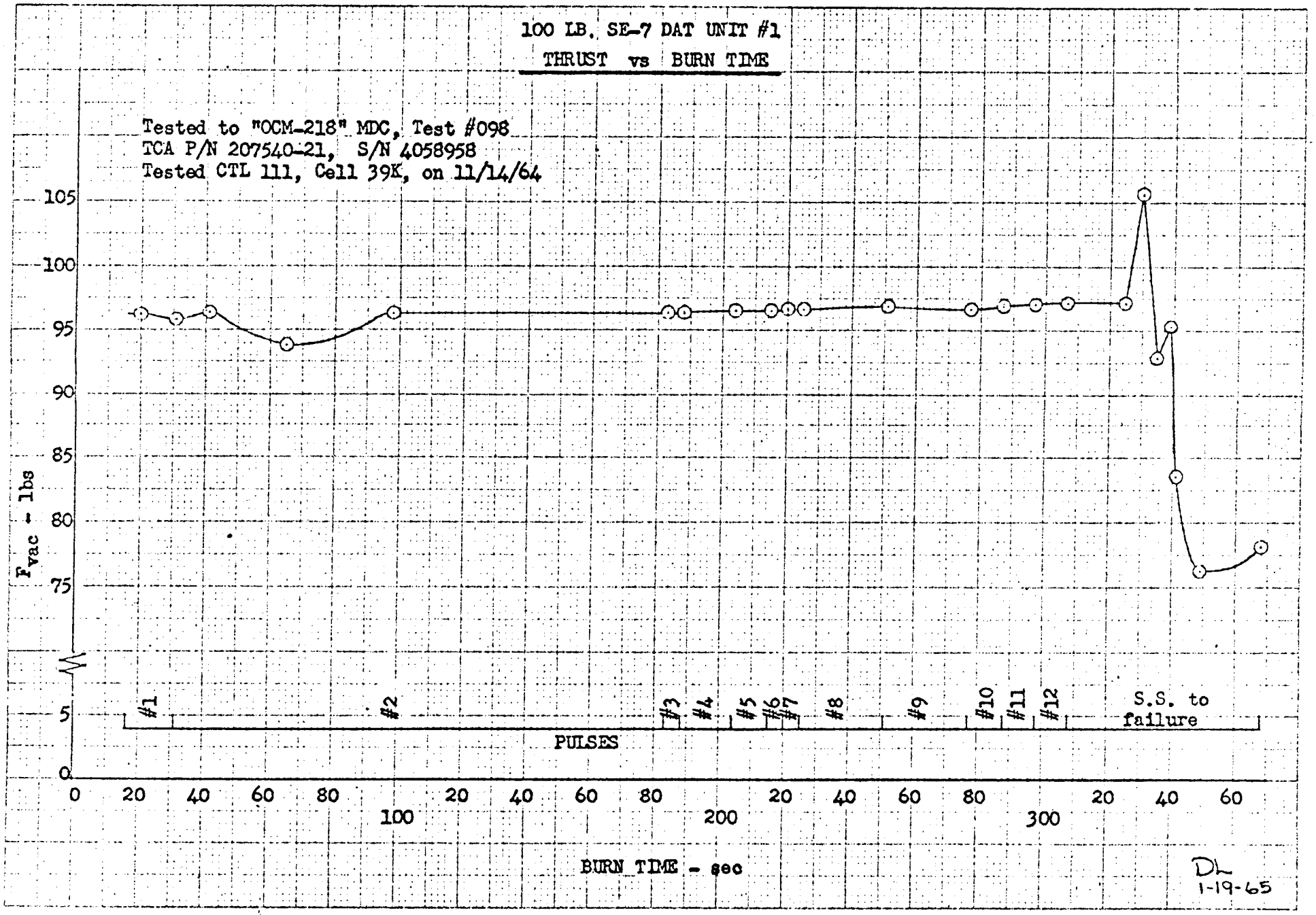
Test Date 11-14-64

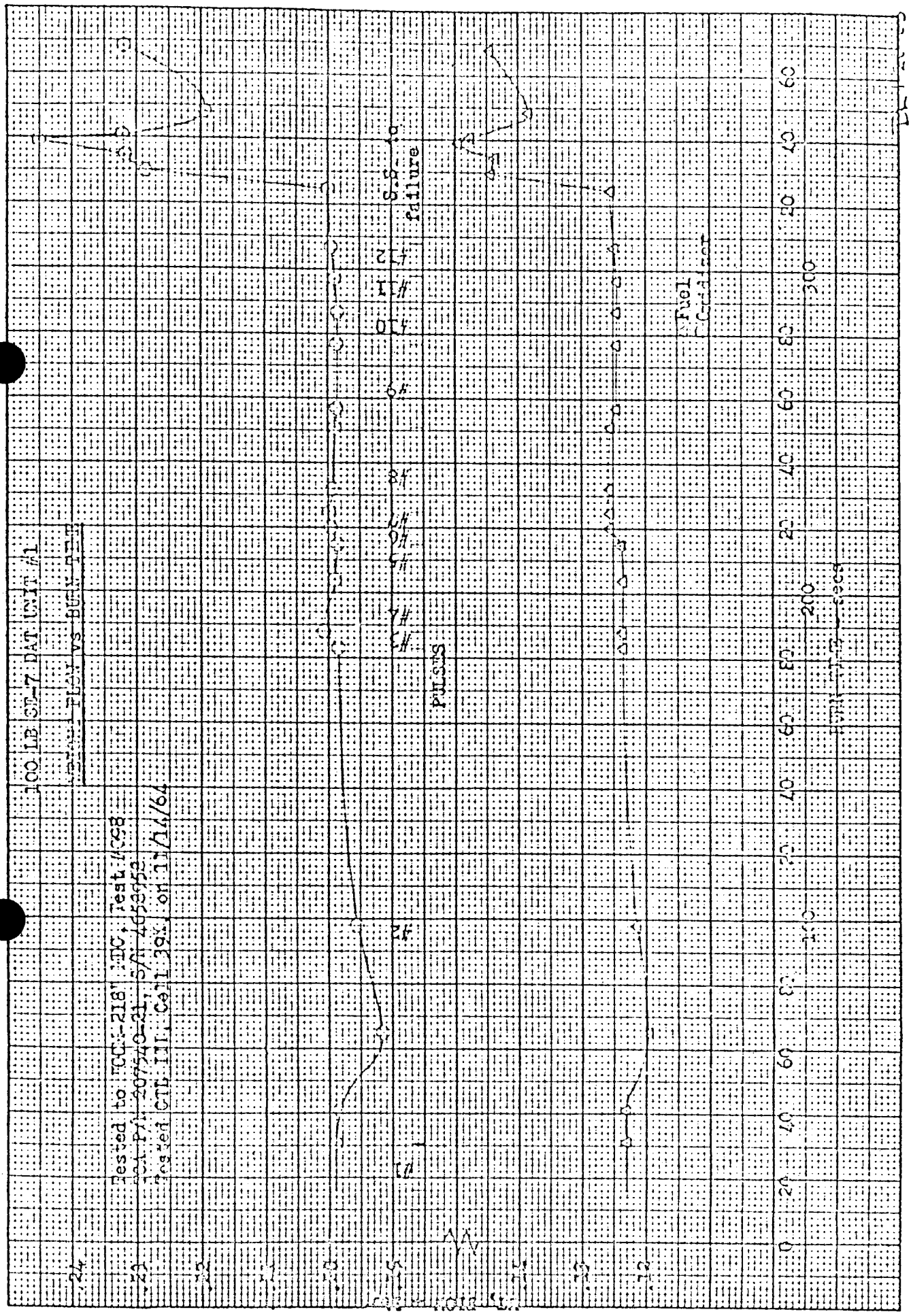
PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R. Cole		F. E. Hamlin	NOV 14 '64	Mel Moore	NOV 14 '64	waived via tele-con Mel Moore	
						VERIFIED BY USAF H. P. Braatz	DATE 11/14/64

FORM 608-B-39 NEW 6-63


TCA COMMANDS
TEMPERATURE - °F
800
700
600
500
400
300
200
100
0
0
20
40
60
80
100
120


Failure @ 5.1 sec. B.T.
300 sec. B.T.
220 sec. B.T.
200
220


100 LB. SE-7 DAT UNIT #1
THRUST vs BURN TIME
Tested to "OCM-218" MDC, Test #098
TCA P/N 207540-21, S/N 4058958
Tested CTL 111, Cell 39K, on 11/14/64
F_{vac} - lbs
105
100
95
90
85
80
75
5
0
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10
#11
#12
S.S. to failure
PULSES
0
20
40
60
80
100
20
40
60
80
200
20
40
60
80
300
20
40
60
BURN TIME - sec
DL
1-19-65


100 LB SE-7 DAT UNIT #1
Tested to TCCM-218" MDC, Test #058
Tested CTL III, Cell 39%, on 11/14/64
S.S. failure
Fuel Oxidizer
PULSES
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10
#11
#12
0
20
40
60
80
100
200
300

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 207540-401 SHEET 86 OF 180

7.1.5.2.4.1 Pulse No. 1 15 seconds on-time followed by 183.75 min. off-time	Site Data	Standard Vacuum	
Firing Duration, sec	15		
Accumulated Firing Time, sec	30.7		
Data Slice Number	1		
Time of Data Slice	14.5		
Ambient Pressure, in. Hg	27.96		
Ambient Temperature, F	41.0		
Environmental Pressure, psia	.018	0	
Environmental Temperature, F	65°		
Oxidizer Temperature, F	44.0	70.00	
Fuel Temperature, F	39.0	70.00	
Oxidizer Inlet Pressure, psia	277.7	283.00	
Fuel Inlet Pressure, psia	284.7	285.00	
Chamber Pressure, psia	dubbed in		
Oxidizer Flowrate, lbs/sec	.2011	.2020	
Fuel Flowrate, lbs/sec	.1235	.1229	
Mixture Ratio, O/F	1.63	1.64	1.60 ±0.09
Main Thrust, lbs.	97.0	97.4	94.5 ±4.7
Specific Impulse, sec.	299	300	(280) min.
Electrical Power, Watts	32.2		
Oxidizer Valve Voltage, Volts	25.3		
Fuel Valve Voltage, Volts	24.4		
Oxidizer Valve Current, Amps	.664		
Fuel Valve Current, Amps.	.630		
Start Time, Millisec.	35		70 max.
Shutdown Time, Millisec.	87		25 max.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R. Cole J. Ganger		[signature]	1-19-65	W. C. Williams	3 March 1965	James D. [signature]	2/23/65
						VERIFIED BY USAF	DATE
						[signature]	3/4/65

DOWNGRADED FORM 608-B-39 NEW 6-63 R-15019-2 323

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DOD DIR 5200.10

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CONTAINS INFORMATION AFFECTI[illegible] THE NATIONAL [illegible] OF THE UNITED STA[illegible] WITHIN THE MEANING OF THE ESPIONAGE LAWS, TI[illegible] 18 U. S. C. [illegible] AND 794. ITS TRANSMISSIO[illegible] OR THE REVELATION OF ITS CONTENTS IN ANY [illegible] TO AN [illegible]

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A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 207540-401 SHEET 87 OF 180

7.1.5.2.4.2 Pulse No.2 150 seconds on-time followed by 165 minutes off-time	Site Data	Standard Vacuum	
Firing Duration, sec	151.8		
Accumulated Firing Time, sec	181.2		
Data Slice Number	2		
Time of Data Slice	150		
Ambient Pressure, in. Hg	27.96		
Ambient Temperature, F	41.0		
Environmental Pressure, psia	.018	0	
Environmental Temperature, F	97°		
Oxidizer Temperature, F	46.	70.00	
Fuel Temperature, F	43.	70.00	
Oxidizer Inlet Pressure, psia	273.2	283.00	
Fuel Inlet Pressure, psia	281.7	286.00	
Chamber Pressure, psia	dubbed in		
Oxidizer Flowrate, lbs/sec	.2010	.2044	
Fuel Flowrate, lbs/sec	.1248	.12495	
Mixture Ratio, O/F	1.61	1.64	1.60 ±0.09
Main Thrust, lbs.	97.6	99.1	94.5 ±4.7
Specific Impulse, sec.	300	301	(280) min.
Electrical Power, Watts	29.4		
Oxidizer Valve Voltage, Volts	25.5		
Fuel Valve Voltage, Volts	24.6		
Oxidizer Valve Current, Amps	.596		
Fuel Valve Current, Amps.	.580		
Start Time, Millisec.	30		50 max.
Shutdown Time, Millisec.	75		125 max.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R. Cole J. Ganger		H. Robinson	1-19-65	W. C. Watkins	3 March 1965	James D. Mercer	2/23/65
						VERIFIED BY USAF	DATE
						[signature]	3/4/65

FORM 608-B-39 NEW 6-63 324 R-15019-2

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

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A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY 1001 PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 207540-401 SHEET 88 OF 180

7.1.5.2.4.3 Pulse No.4 16 seconds on-time followed by 59 seconds off-time

	Site Data	Standard Vacuum	
Firing Duration, sec	16.4		
Accumulated Firing Time, sec	204.1		
Data Slice Number	1		
Time of Data Slice	16.0		
Ambient Pressure, in. Hg	27.96		
Ambient Temperature, F	41.0		
Environmental Pressure, psia	.018	0	
Environmental Temperature, F	71		
Oxidizer Temperature, F	470	70.00	
Fuel Temperature, F	450	70.00	
Oxidizer Inlet Pressure, psia	273.7	283.00	
Fuel Inlet Pressure, psia	284.2	285.00	
Chamber Pressure, psia	dubbed in		
Oxidizer Flowrate, lbs/sec	.2014	.2047	
Fuel Flowrate, lbs/sec	.1249	.1242	
Mixture Ratio, O/F	1.61	1.65	1.60 ±0.09
Main Thrust, lbs.	96.4	97.6	94.5 ±4.7
Specific Impulse, sec.	295	297	(280) min.
Electrical Power, Watts	27.3		
Oxidizer Valve Voltage, Volts	25.3		
Fuel Valve Voltage, Volts	21.6		
Oxidizer Valve Current, Amps	.558		
Fuel Valve Current, Amps.	.535		
Start Time, Millisec.	35		50 max.
Shutdown Time, Millisec.	85		125 max.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R. Cole J. Ganger		H. Robinson	1-19-65	W. C. Williams	3 March 1965	James D. Harris	2/23/65
						VERIFIED BY USAF	3/4/65

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

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DOD DIR 5200.10

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

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A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 207540-401 SHEET 89 OF 180

7.1.5.2.4.4 Pulse No. 7 5.0 seconds on-time followed by 979 seconds off-time

	Site Data	Standard Vacuum	
Firing Duration, sec	5.1		
Accumulated Firing Time, sec	225.3		
Data Slice Number	1		
Time of Data Slice	4.5		
Ambient Pressure, in. Hg	27.96		
Ambient Temperature, F	41.0		
Environmental Pressure, psia	.018	0	
Environmental Temperature, F	68°		
Oxidizer Temperature, F	48.0	70.00	
Fuel Temperature, F	45.0	70.00	
Oxidizer Inlet Pressure, psia	274.2	283.00	
Fuel Inlet Pressure, psia	285.7	286.00	
Chamber Pressure, psia	dubbed in		
Oxidizer Flowrate, lbs/sec	.2016	.2047	
Fuel Flowrate, lbs/sec	.1268	.1255	
Mixture Ratio, O/F	1.59	1.63	1.60 ±0.09
Main Thrust, lbs.	96.8	97.8	94.5 ±4.7
Specific Impulse, sec.	295	296	(280) min.
Electrical Power, Watts	25.7		
Oxidizer Valve Voltage, Volts	25.3		
Fuel Valve Voltage, Volts	24.6		
Oxidizer Valve Current, Amps	.527		
Fuel Valve Current, Amps.	.505		
Start Time, Millisec.	30		50 max.
Shutdown Time, Millisec.	100		125 max.

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
R. Cole J. Ganger	W. DeCamson 1-19-65	W. C. Williams 3 March 1965	Louis D. Martinelli 2/23/65 VERIFIED BY USAF / DATE 3/4/65

FORM 608-B-39 NEW 6-63

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DOD DIR 5200.10

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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.

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

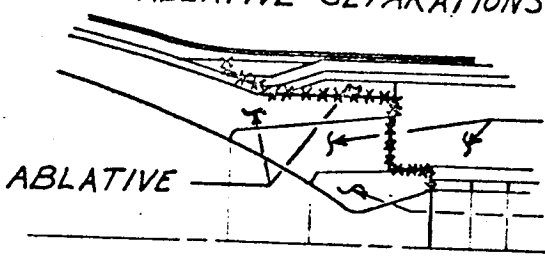
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO 207540-401 SHEET 90 OF 180

7.1.5.2.5 Failure Data

Accumulated Firing Time, sec. 331.3

Description of Failure Mode:

AFTER 330 SEC. OF TOTAL ACCUMULATED BURN TIME (B.T.), 30 SEC. BEYOND GUARANTEED LIFE, THE ABLATIVE PORTION OF THE MAC NOZZLE EXTENSION WAS EJECTED FROM THE TCA EXIT. THIS WAS FOLLOWED BY A GRADUAL EXTRUSION OF THE NOZZLE AS A RESULT OF ABLATIVE SEPARATIONS AS SHOWN:



A HOT GAS LEAK THEN DEVELOPED THROUGH THE DELAMINATIONS AND DISCHARGED AT THE EXIT BETWEEN THE TCA SHELL AND THE NOZZLE SEGMENT. THE FIRST INDICATION OF A SHELL TEMPERATURE ABOVE 700 F WAS OBTAINED BY PHOTOGRAPHIC INSTRUMENTATION AT 331.3 SEC. B.T. AND IS DEFINED AS THE FAILURE POINT. A HOT GAS LEAK DEVELOPED THROUGH THE SHELL AT 339.7 SEC. B.T. AND WAS FOLLOWED BY THE EJECTION OF THE NOZZLE/THROAT SEGMENT, AND FIVE OF THE SEVEN COMBUSTION ZONE LINERS. THE TEST WAS TERMINATED AT 368.0 SEC. B.T.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G.Kniffin	7/14/65	J A Sanger	7/14/65			R L Fee	7/15/65
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207540-401 SHEET 91 OF 180

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.2.3.20

7.1.6 Disassembly and Inspection

7.1.6.1 Test Procedure

7.1.6.1.1 Prior to sectioning the TCA perform a visual inspection and record the post test condition of the TCA.

7.1.6.1.2 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

7.1.6.1.3 Separate the propellant valves from the mounting bracket. C

7.1.6.1.4 Section the TCA by cutting along line C-D-E as depicted in Figure 16.

7.1.6.1.5 Perform visual inspection of all detailed parts for evidence of damage, distortion, fluid incompatability, corrosion, broken parts and impending failure.

7.1.6.1.6 After test completion identify the sectioned TCA and detailed parts and package and store for reference (except for propellant valves). C

7.1.6.1.7 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 407661 (Fuel Seat Assembly P/N 407660) shall not be removed at this time.

7.1.6.1.8 Machine the filter assembly to solenoid weld to loosen the filter. Only the minimum amount of material to accomplish C

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA: R. Cole	DATE 11-18-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY: [signature]	DATE 11-18-64				

FORM 608-B-38 NEW 6-63

Rev. C J. D. Mavrogenes Date 11/18/64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207540-401 SHEET 91.1 OF 180

(cont'd)	this shall be removed. The filter assembly P/N 5-28139-T1 shall not be removed at this time.
7.1.6.1.9	Remove, bag and identify the seat assembly.
7.1.6.1.10	Remove, bag and identify the armature P/N 407564.
7.1.6.1.11	Remove, bag and identify the spring P/N 406816.
7.1.6.1.12	Remove, bag and identify the filter assembly.
7.1.6.1.13	Bag and identify the solenoid assembly.
7.1.6.1.14	Repeat 7.1.6.1.7 thru 7.1.6.1.13 for the fuel propellant valve.

NOTE: Only authorized personnel shall have access to stored DAT hardware.

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA: R. H. Eide	DATE 11-18-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY: J. L. Sanger	DATE 11-18-64				

FORM 608-B-38 NEW 6-63

Rev. C J. D. Marrezeni Date 11/18/64

R-15019-2

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207540-401 SHEET 92 OF 180

7.1.6.2 Post Test Inspection Data - TCA #1

7.1.6.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52701-277

Rocketdyne Part No. 207540-21

Component Serial No. 4058958

7.1.6.2.1.1 Preliminary Inspection (Reference Paragraph 7.1.6.1.1)

The TCA was visually inspected prior to sectioning and the TCA condition was as follows: INJ. SPLASH PLATE BURNED THRU AT ALL IMPINGMENT AREAS, EXCEPT BETWEEN 2 O'CLOCK TO 5 O'CLOCK. OF THE (7) T/C LINERS ONLY (2) ARE VISIBLE AND THEY ARE BURNED AND BROKEN. LOWER PORTION OF NOZZLE SEGMENT BROKEN AWAY FROM CHAMBER SEGMENT AT APPROX. 1/2" ABOVE SMALL I.D.

7.1.6.2.1.2 Disassembly and Inspection (Reference Paragraph 7.1.6.1.3) (CON'T AT BOTTOM OF PAGE)

The TCA was sectioned along line C-D-E and visually inspected. The results of the inspection were as follows:

Results of Paragraph 7.1.6.2.1.2 shell have been neatly cut along Lines C, D, and E. Noted that the potting compound is badly deteriorated between the shell and the Thrust Chamber body; also that the throat liners are badly burned and deteriorated all the way around the ID of the can. Everything is the same as written in Paragraph 7.1.6.2.1.1.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. Kniffin	7-16-64			PARA. 7.1.6.2.1.1	4/13/5	WAIVED BY K.L. FREE TO R.F. SAVAGE	7/8/5
				PARA. 7.1.6.2.1.2	4/13/5	VERIFIED BY USAF	7/13/5

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OF THROAT INSERT. ABLATIVE LINER BURNED IN ALL AREAS MORE EXCESSIVELY AT 10 O'CLOCK. A 5/8" DIA. HOLE BURNED THRU SHELL AT 12 O'CLOCK, 3" FROM EXIT END, AREA OF HOLE BUCKLED. THROAT INSERT BROKEN ACROSS DIA. AT APPROX. 1/4" ABOVE SMALL I.D. A BAND OF HEAT DISCOLORATION ON SHELL AROUND CIRCUMFERENCE, APPROX 4" FROM EXIT END. HEAVY CONTAMINATION OF AN OILY SUBSTANCE AROUND ALL AREAS OF BOTH VALVES. ALL CLOCKING CALLOUTS ARE USING THE SHORT END OF ASS'Y AS 12 O'CLOCK LOOKING AT THE I.D. OF EXIT END.

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207540-401 SHEET 92.1 OF 180

7.1.6.2.4 Disassembly of Propellant Valves (Reference Paragraphs 7.1.6.1.7 thru 7.1.6.1.13). C

The propellant valves were disassembled and all parts called for were bagged and identified YES (yes or no).

PART SEPERATLY BAGGED, AND EACH PART TAGGED FOR IDENTIFICATION (PROP) VALVES, ONLY

R-15019-2

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
D, Cole D.C	11-20-64			R. HANSEN 7.1.6.2.4	4/8/65	WAIVED BY R.C.F. TO R. HANSEN	4/28/65
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

Rev. C J. D. Mangogna Date 11-20-64

UNIT #2

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4054757

Dwg. No. 207540

Model S.E.-

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
		ENVIRONMENTAL TEST LAB. D596/1116 C/P			
1	3/11/64 (ANR 22)	PART NO. PARA 7.2.1.2.3 Weight determination test. waived by McDonnell Rep (J.D. Marrogenis) per phone conversation.			
ACTION TAKEN		CLFC ONLY NO ACTION REQ			
2	8/18/64 (ANR 70)	PART NO. PARA 7.2.2.2.3 Proof & Leakage Test Ref Para 6.1 Was Run in Environmental Chamber Para. 6.1.1 States This Test to be Run in Hazardous Test Cell.			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					

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R-15019-2

UNIT #2

GEMINI ~~R~~ HARDWARE TEST RECORD

Date: 10-22-64 Cell 39 "K" Thrust Level 100# Inspector: Moore

HARDWARE IDENTIFICATION:

Test Objective:

100# DAT

Name	P/N	S/N	Verified
TCA	907540-21	4054757	
Injector	207543	4058099	
Ablative Liner		UNK	
Oxid. Valve	407561	4050856	
Fuel Valve	407662	4056547	

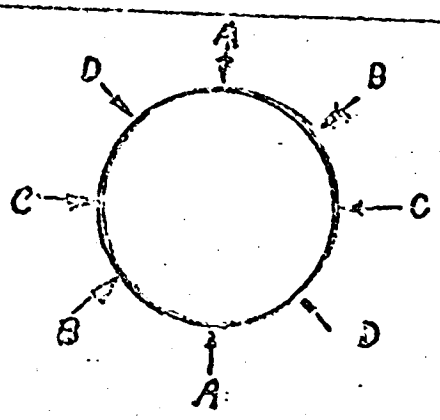
Test No.	Time	Duration	Altitude	Test Remarks
.088	start 1402	6 sec	Amb	CAPE cycle.
	stop 1457			
089	start 1750	223.0 sec	145,000	Duty cycle
	Stop 2131			
090	start 2145	3.0 sec	145,000	Burst Press.
	Stop 2145			

TCA Leak Check Performed ___ System Leak Check Performed ___

Oxid. Valve Opening Verified ___ Fuel Valve Opening Verified ___

Pre Test Injector Inspection. Remarks: OK

Pre Test Throat Insert Inspection. Remarks: OK



THROAT AND EXIT DIMENSIONS

	Pre - Test		Post - Test
A.A.	7083	A.A.	7081
B.B.	7083	B.B.	7083
C.C.	7082	C.C.	7151
D.D.	7084	D.D.	7081
Exit	4.461	Exit	4.458
Weight	4.10	Weight	

Cox NTO F/N S/N 2927 Cox MMH F/N S/N 2860

Ramapo NTO F/N S/N ___ Ramapo MMH F/N S/N ___

Remarks: Cox NTO S/N 3005 Cox MMH S/N 3151 — Bleed sys.
Post test: ① Circumferential crack in throat insert on convergent side Allso Three Longitudinal insert cracks.

R-15019-2

*ENTERED IN ERROR

UNIT 112

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4054757

Dwg. No. 207540

Model SE7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
		S/S CTL III Cell 39-K			
1	OCT 22 54	PART NO. General: H/F Tests Waived By McDonald Rep. J.D. Mayrogenis per. Tele-con - 1645 OCT 22			
		ACTION TAKEN: INFORMATION ONLY	OCT 22 54	OCT 22 54	OCT 22 54
2	OCT 22 54	PART NO. 207540-21 S/N 4054757 Post Test 089 Chamber Press. Recorder indication was irratic during Duty cycle 15 sec & 150 sec. H/F test.			
		ACTION TAKEN: TRANSFERRED TO SHORTAGE	OCT 23 54	OCT 23 54	OCT 23 54
3	OCT 22 54	PART NO. 207540-21 S/N 4054757 Post Test 089 Skin Temp Exceeded 650° Prior To 220 sec Total Burn Time - Ref Para 7.2.3.1.6.			
		ACTION TAKEN: TRANSFERRED TO SHORTAGE	OCT 23 54	OCT 23 54	OCT 23 54
4	OCT 22 54	PART NO. 207540-21 S/N 4054757 Post Test 090 MMH Sys. Δp indicated a Low MMH Flow Rate during 3 sec Burst Pressure H/F.			
		ACTION TAKEN: TRANSFERRED TO SHORTAGE	OCT 23 54	OCT 23 54	OCT 23 54
5	OCT 22 54	PART NO. 207540-21 S/N 4054757 Post Test Decontamination Performed up to Para 6.8.35			
		ACTION TAKEN: 334 DECONTAMINATION COMPLETE	OCT 23 54	OCT 23 54	OCT 23 54

Form R 25-L Rev. 12-57

R-15019-2

UNIT #2

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4054757

Dwg. No. 207540

Model SE-7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
		S/S CTL III Cell 39K			
		PART NO.			
		Insp. Complete at C.T.L. 3			
		[illegible]			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					

Form R 25-[illegible] Rev. 12-57 R-15019-2

UNIT #2

SHORTAGE REPORT

☑ ELEC. ☑ MECH. ☐ ORIG. ☐ DUP.

ASSEMBLY NAME	ASSEMBLY NO.	L.H.	R.H.	UPPER	LOWER
SET 100# TCA	207540				

DEPARTMENT NO.	SHIP OR UNIT NO.	CONTRACT NO.	SERIAL NO.	DATE
056		5246	4054757	10-22-64

SHORTAGES CHECK ONE ACTUAL	HELD UP	INSP. VERIF.	QUAN.	PART NUMBER	COMPLETE PART NAME	DATE	MECH.	L.H.	INSP.
✓			1	207540-21	S/N 4054757 POST TEST C59 CHAMBER				
					PRESS. RECORDER INDICATION WAS IRRATIC				
					DURING DUTY CYCLE 15 SEC & 150 SEC H/F				
					TEST REF. DCP #2 10/23/64				
✓			1	207540-21	S/N 4054757 POST TEST C59 SKIN TEMP				
					EXCEEDED 650° PRIOR TO 220 SEC TOTAL				
					BURN TIME - REF. PARA 7.2.3.1.6.				
					REF. DCP #3 10/23/64				
✓			1	207540-21	S/N 4054757 POST TEST C70 MAIN SYS.				
					ΔP INDICATED A LOW MAIN FLOW RATE				
					DURING 3 SEC BURST PRESSURE H/F.				
					REF. DCP #4 10/23/64				
					Insp. Complete on C.T.L. 3				
					OK TO SHIP J. Wilson 10/24/64				

This sheet is to be prepared in duplicate by the production department. All entries will be made with pen, indelible pencil or with a typewriter. Responsible production personnel will place a check mark (✓) in the applicable column to indicate whether the shortage is actual or held up. Inspection will add the original and/or the duplicate shortage sheets to the sign-off book and verify correct entries by placing an inspection stamp impression in the applicable block.

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST ENVIRONMENT AND SERVICE LIFE TEST TEST NO. 207540-401 SHEET 93 OF 180.

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

7.2 Thrust Chamber Assembly Number Two

This subsection specified those environment and service life tests which are to be performed on Thrust Chamber Assembly Number Two.

PREPARED BY: T. G. Kniffin	DATE 4/14/64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 4/16		7-22-64		

FORM 608-B-38 NEW 6-63

R-15019-2

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100#
PART NO. MAC 52-52701-277 / NAA 207540-21
NAME OF TEST: PRE-TEST INSPECTION
TEST NO. 207540-401 SHEET 94 OF 180

Reference: MAC SCD 52-52701, Revision F, 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 RA0220-349. 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. See Figure 12.

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	4/14/64	[illegible]	7-22-64		
CHECKED BY: [illegible]	DATE 4/16				

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207540-401 SHEET 95 OF 180

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.	52-52701-277		
Rocketdyne Part No.	207540-21	407561	407662
Component Serial No.	4054757	4050856	4056547

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 RA0220-349. YES (ANR 718) (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 (ANR 838) (Yes or No)

7.2.1.2.2.3 Inspection Remarks: NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64	H S Kubo	8/12/64	P. N. Liston	8/12/64	R. L. Tree	8-19-64
						VERIFIED BY USAF WAIVED BY M. PINTO	DATE 8/12/64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207540-401 SHEET 96 OF 180

7.2.1.2.3 Weight Determination Test (reference paragraph 6.6)

All protective closures were removed from the TCA.

YES (Yes or No) ANR 224

The TCA dry weight was 8.95 pounds. ANR 224
(Record to the nearest one-hundredth pound)

Inspection Remarks NONE. ANR 224

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	7/14/64	F. E. Pope	8-14-64	[illegible] ANR 224	8-14-64	R. L. Jones	8-19-64
						VERIFIED BY USAF	DATE 8/14/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST: PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 207540-401 SHEET 97 OF 180

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.3.1.3.2.2

7.2.2 Propellant Valve Continuous Duty - TCA #2

7.2.2.1 Test Procedure

7.2.2.1.1 Install the TCA test setup as shown in Figure 10.

7.2.2.1.2 Activate the temperature recorder and thermocouple.

7.2.2.1.3 Adjust the DC power supply to 26 ±4 VDC and energize the oxidizer 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.

7.2.2.1.4 Remove the TCA from the test setup.

7.2.2.1.5 Perform Propellant Valve Proof Pressure and Leakage per paragraph 6.1.

7.2.2.1.6 Perform Propellant Valve Electrical Resistance per paragraph 6.3.

7.2.2.1.7 Perform Propellant Valve Dielectric Strength per paragraph 6.4.

7.2.2.1.8 Perform Propellant Valve Functional per paragraph 6.5.

PREPARED BY: T. G. Kniffin 7-15-64	DATE 4/14/64	APPROVED FOR NAA:	DATE 7-22-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 4/16				

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 207540-401 SHEET 98 OF 180

7.2.2.2 Test Data - TCA #2

7.2.2.2.1 Component Identification

Component Name	TCA	Propellant Valve
McDonnell Part No.	52-52701-277	
Rocketdyne Part No.	207540-21	407561
Component Serial No.	4054757	4050856

7.2.2.2.2 Propellant Valve Continuous Duty test (reference paragraph 7.2.2.1)

Start of energize (date and time) 8-17-64 @ 10:00 AM.

Initial energize voltage (26 ±4) 26 VDC

Reduce energize voltage (10 ±2) 10 VDC

End of energize (date and time) 8-18-64 10:00 AM.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64 7/15/64	Frank Valpe	8/18/64	L. Johnson	8-18-64	R. L. Free	8/19/64
						VERIFIED BY USAF R. M. Ayers	8/18/64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 207540-401 SHEET 99 OF 180

7.2.2.2.2 (cont'd) Valve body temperature

Hour	Temp.	Hour	Temp.	Hour	Temp.
0	79 F	9	130 F	18	113 F
1	119 F	10	130 F	19	110 F
2	126 F	11	128 F	20	114 F
3	130	12	121 F	21	111 F
4	130	13	118 F	22	112 F
1500 5	136 F	14	117 F	23	119 F
6	137	15	112 F	24	122 F
7	136 F	16	114 F		
8	134 F	17	112 F		

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T. G. Kniffin 4/14/64 7-10-64	8/18/64	8-18-64	8/19/64
			VERIFIED BY USAF DATE 8/18/64

FORM 608-B-39 NEW 6-63

R-15019-2

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-211

NAME OF TEST: PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 207540-401 SHEET 100 OF 180

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	DNA psig
Time Duration (3 minimum	3 minutes	DNA minutes
Leakage Voltage (26 ±0.5)	26 VDC	DNA VDC
Inlet Pressure (500±10)	500 psig	DNA psig
Time Duration (5 minimum)	5 minutes	DNA minutes
Leakage Rate (2.23 maximum)	-0- scc He / 5 min	DNA scc He / min

Inspection Remarks

DNA OK PER MC DONNEL 8-19-64

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64 7-10-64	[illegible]	8/18/64	[illegible]	8-19-64	R. L. [illegible]	8/19/64
						VERIFIED BY USAF	DATE
						[illegible]	8/19/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 207540-401 SHEET 101 OF 180

7.2.2.2.4 Propellant Valve Electrical Resistance test (reference paragraph 6.3)

Environmental Temperature 75 (70±10°F).

Resistance A - B

Oxidizer Valve 41.4 ohms (Acceptable per Figure 11, yes or no yes).

Fuel Valve DNA ohms (Acceptable per Figure 11, yes or no DNA).

Resistance C - D (1.0 maximum)

Oxidizer Valve .05 ohms

Fuel Valve DNA ohms

Inspection Remarks

SEE PAGE 100

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64 7/10/64	[illegible]	8/18/64	[illegible]	8-19-64	[illegible]	8/18/64
						VERIFIED BY USAF	DATE
						[illegible]	[illegible]

FORM 608-B-39 NEW 6-63.

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 207540-401 SHEET 102 OF 180

7.2.2.2.5 **Propellant Valve Dielectric Strength test (reference paragraph 6.4)**

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500±10	Current Microamps 500 max.	Voltage Volts 500±10	Current Microamps 500 max.
A to Ground	500	52	DNA	DNA
C to Ground	500	91	DNA	DNA
A to C	500	6	DNA	DNA

Inspection Remarks

SEE PAGE 100

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64 7-10-64	[signature]	8/18/64	[signature]	8-19-64	R. L. Free	8/19/64
						VERIFIED BY USAF	DATE
						[signature]	8/19/64

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE ____ OF ____

LAB TEST NO. ____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
L.Cracraft	595397	ENV.LAB.	2061	8-19-64

PART	PART NO.	TYPE OF TEST
100# OAMS TCA UNIT #2	207540-21 S/n 4054757	POST P.V.CONTINUOUS DUTY FUNCTIONAL

OXIDIZER VALVE

P/N 407561 S/N 4050856

CURRENT TRACE
(OPENING TIME)

Horizontal = 5 ms/cm
Vertical = 50 mv/cm

Requirement = 0.021 sec/max
Actual = 0.016 sec

VOLTAGE TRACE
(CLOSING TIME)

Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = 0.075 sec/max
Actual = 0.065 sec

R-15019-2

Form 600-V-67 Nov 10-63

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST: PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 207540-401 SHEET 103 OF 180

7.2.2.2.6 Propellant Valve Functional test (reference paragraph 6.5)

	Oxidizer Valve	Fuel Valve
Response Time		
Ambient Temperature (70±10)	70° F	DNA F
Energizing Voltage (26±0.5)	26 VDC	DNA VDC
Inlet Pressure (300±10 for "pull-in")	300 psig	DNA psig
Opening Time (0.021 maximum)	.016 seconds	DNA seconds
Inlet Pressure (zero for "drop-out")	ZERO psig	DNA psig
Closing Time (0.075 maximum)	.065 seconds	DNA seconds
Low Voltage Operation		
Ambient Temperature (70±10)	71 F	DNA F
Inlet Pressure (300±10 for "pull-in")	300 psig	DNA psig
Opening Voltage (16 maximum)	11.6 VDC	DNA VDC
Inlet Pressure (zero for "drop-out")	ZERO psig	DNA psig
Closing Voltage (1.0 minimum)	1.8 VDC	DNA VDC

Inspection Remarks SEE PAGE 100

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
T. G. Kniffin 4/14/64 7/10/64	Floyd Cracraft 8-19-64	L. Johnson 8-19-64	R. L. Lee 8-19-64
			VERIFIED BY USAF / DATE: R. M. Lewis 8/19/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21 }

NAME OF TEST DAT DUTY CYCLE TO MINIMUM DURATION TEST NO. 207540-401 SHEET 104 OF 180

Reference:	MAC SCD 52-52701, Revision F, Paragraph 6.3.1.3.2.2
7.2.3	DAT Duty Cycle to Minimum Duration - TCA #2
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 adapters (99-106726 & 99-106727) 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 ranges 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 five minutes later.
7.2.3.1.5.2	Wait ten minutes and make a one second firing followed by another one second firing five minutes later.
7.2.3.1.5.3	Repeat paragraph 7.2.3.1.5.2.
7.2.3.1.6	Wait for TCA skin temperature to return to ambient temperature (70 ±20F) and perform duty cycle firing test per paragraph 6.7 and Table II. The firing test shall be terminated upon completion of pulse number 7. The TCA shall not exceed a maximum skin temperature of 650 F at the end of 220 seconds total burn time.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
E. Adams	9-16-64	[illegible]	9-30-64		
CHECKED BY:	DATE				
[illegible]	9-30-64				

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO MINIMUM DURATION TEST NO. 207540-401 SHEET 104.1 OF 180

7.2.3.1.6 (cont'd) 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.

7.2.3.1.7 Reduce data per RA0220-232.

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 including soakout.

7.2.3.1.7.1.2 Graphical presentation of thrust versus time.

7.2.3.1.7.1.3 Graphical presentation of chamber pressure versus time.

7.2.3.1.7.1.4 Graphical presentation of oxidizer flowrate versus time.

7.2.3.1.7.1.5 Graphical presentation of fuel flowrate versus time.

[illegible]

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
E. Adams	10-15-64	R. Heide	10-15-64		
CHECKED BY:	DATE				
[illegible]	10-15-64				

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST DAT DUTY CYLE TO MINIMUM DURATION TEST NO. 207540-401 SHEET 105 OF 180

7.2.3.2 Test Data - TCA #2

7.2.3.2.1 Component Identification

Component Name SE-7 100# TCA

McDonnell Part No. 52-52701-277

Rocketdyne Part No. 207540-21

Component Serial No. 4654757

Accumulated Acceptance Test Firing Time, seconds 3.0

	Pre-Test	Post Test
Throat Diameter, inches (Average of four measurements)	.7083	7099
Nozzle Exit Diameter, inches	4.461	4.488

7.2.3.2.2 Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	10/19/64	10/19/64
Sample Batch Number	10-297	10-298
Sample Temperature, F	60	77
Sample Specific Gravity	1.460	0.871
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	4/14/64 7/10/64	[signature] 2554	2 2 64	[signature]	2 2 64	Waived per Tele-Con J.D. Maverogenis	2 2 64
						VERIFIED BY USAF H.P. Braaten	10/23/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21 401

NAME OF TEST DAT DUTY CYCLE TO MINIMUM DURATION TEST NO. 207540- SHEET ___ OF ___

IL 5388-6246

Deviation Request:

It is hereby authorized to accept the following deviations from the DAT Specification 207540-401 for 100# TCA Unit #2.

1. The Cape Cycle pulse duration (1.04 seconds) exceeded the specification limit of 1.00 ±.02 seconds.

2. The MIC pulse "Start Time" (TCA start signal to 90 percent thrust) cannot be established for pulse number 7: the data for pulse number 7 indicates a thrust above 90 percent of the steady state level prior to the maximum start time value. The thrust trace for pulse numbers 1, 2 and 4 was satisfactory for an accurate reduction of the start time.

John A. Ganger
John A. Ganger
Gemini DAT-RAT Unit

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering

2-23-65

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO MINIMUM DURATION TEST NO. 207540-401 SHEET 106 OF 180

7.2.3.2.3 Caps Cycle Test (reference paragraph 7.2.3.1)

Test Cell Location C'tL III

Test Cell Number Cell 39-K

Test Number 088

Test Date 10-22-64

The fuel and oxidizer propellant valve orifices were removed from the TCA per paragraph 6.11 YES (yes or no)

The fuel and oxidizer propellant valve orifice adapters were installed in the facility feed system. YES (yes or no)

The fuel and oxidizer propellant valve metering orifices were installed in the facility mounted orifice adapters. YES (yes or no)

	Pulse Duration (sec) (1.000 ±.020 sec)	Time Between Pulses, (minutes)
1st Pulse	1.04	5 (5)
2nd Pulse	1.04	10 (10)
3rd Pulse	1.04	5 (5)
4th Pulse	1.04	10 (10)
5th Pulse	1.04	5 (5)
6th Pulse	1.04	
Accumulated Firing Time, seconds	6.24	

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	9-15-64	W. Robinson	1-13-65	W. C. Williams	3/3/65	James D. Marron	3/2/65
						VERIFIED BY U.S.A.F.	DATE 3/4/65

FORM 608-B-39 NEW 6-63

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A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO MINIMUM DURATION TEST NO. 207540-401 SHEET 107 OF 180

7.2.3.2.4 Duty Cycle Test (reference paragraph 7.2.3.1)

Test Cell Location CTL III

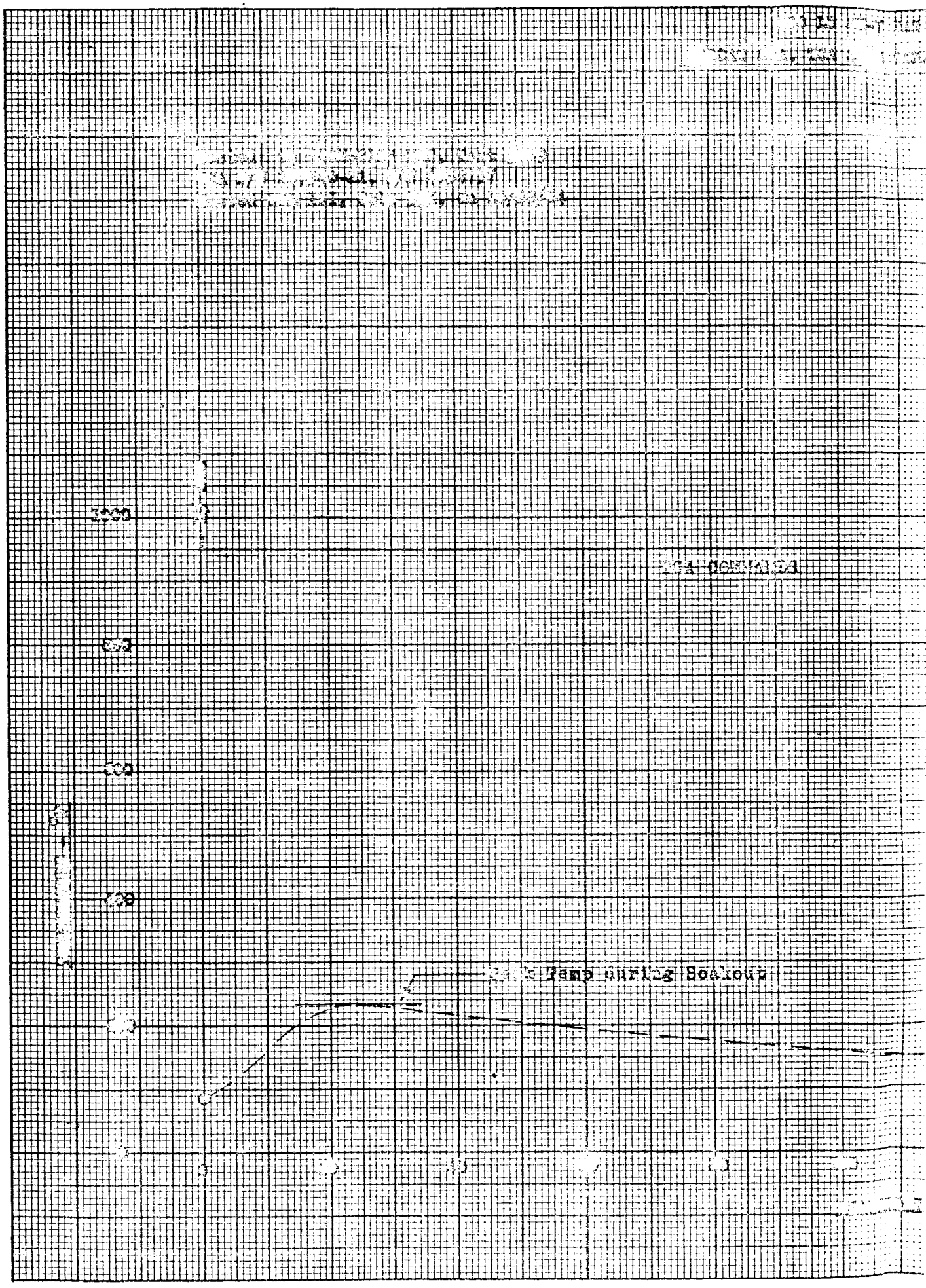
Test Cell Number Cell 39-K

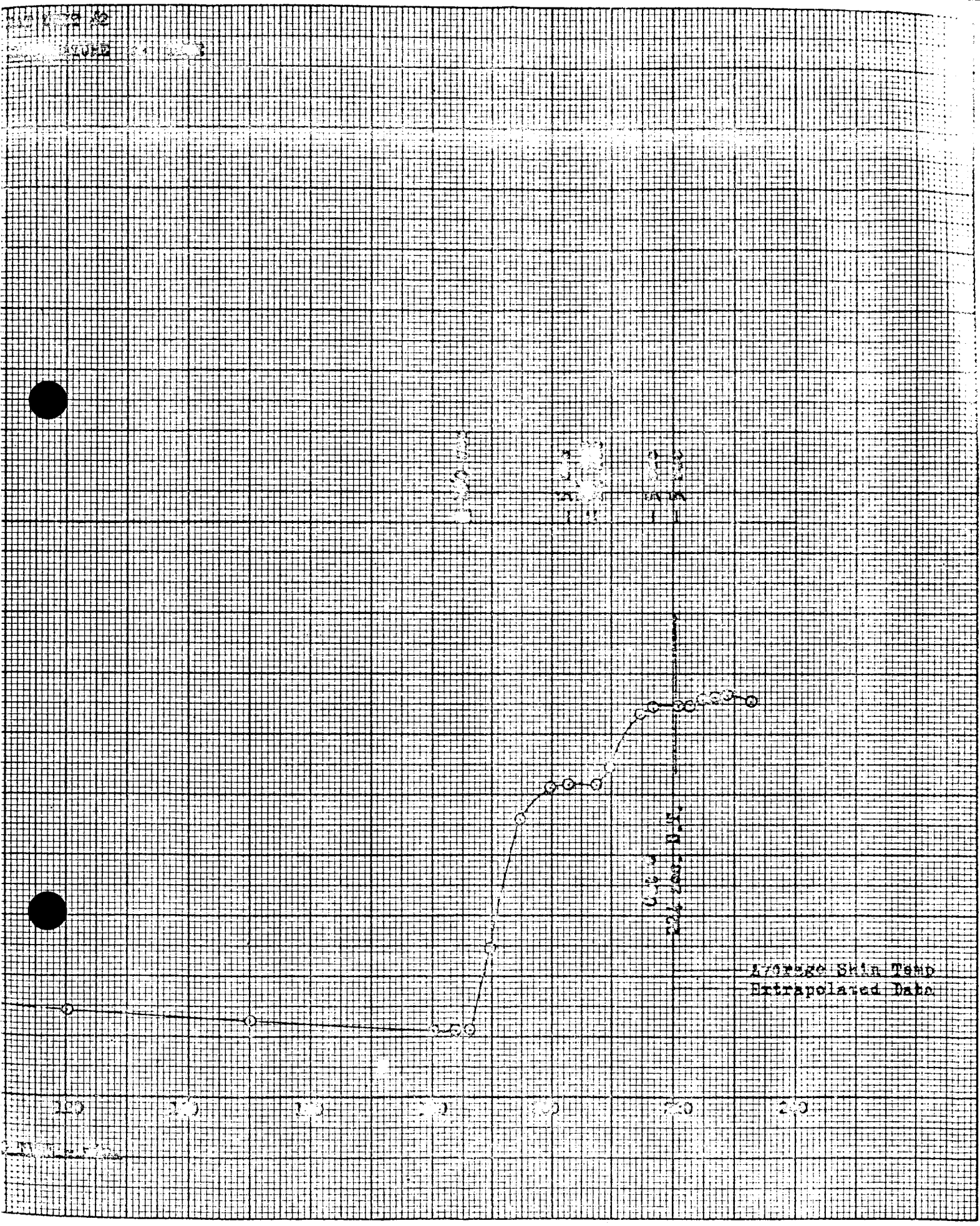
Test Number 089

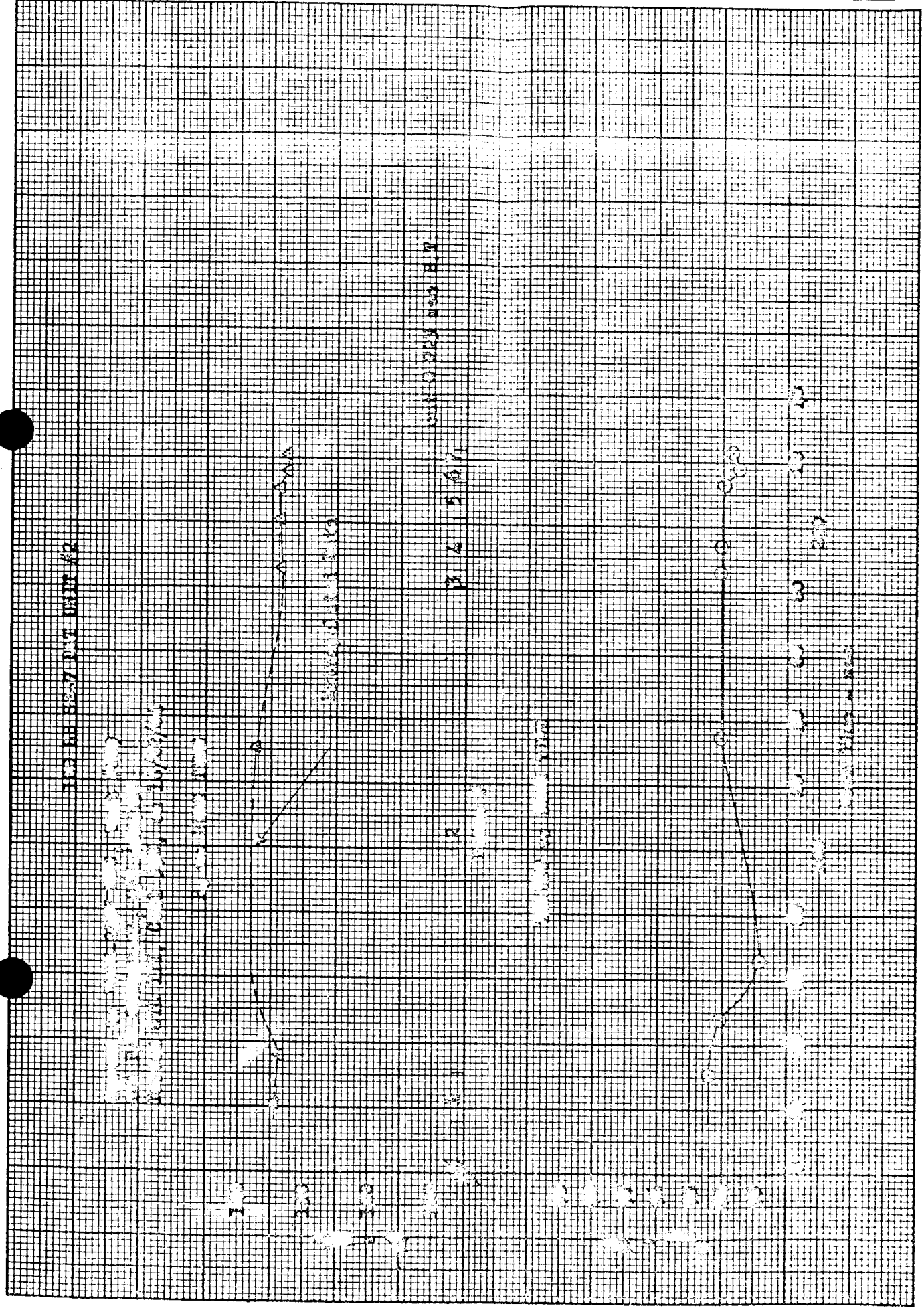
Test Date 10-22-64

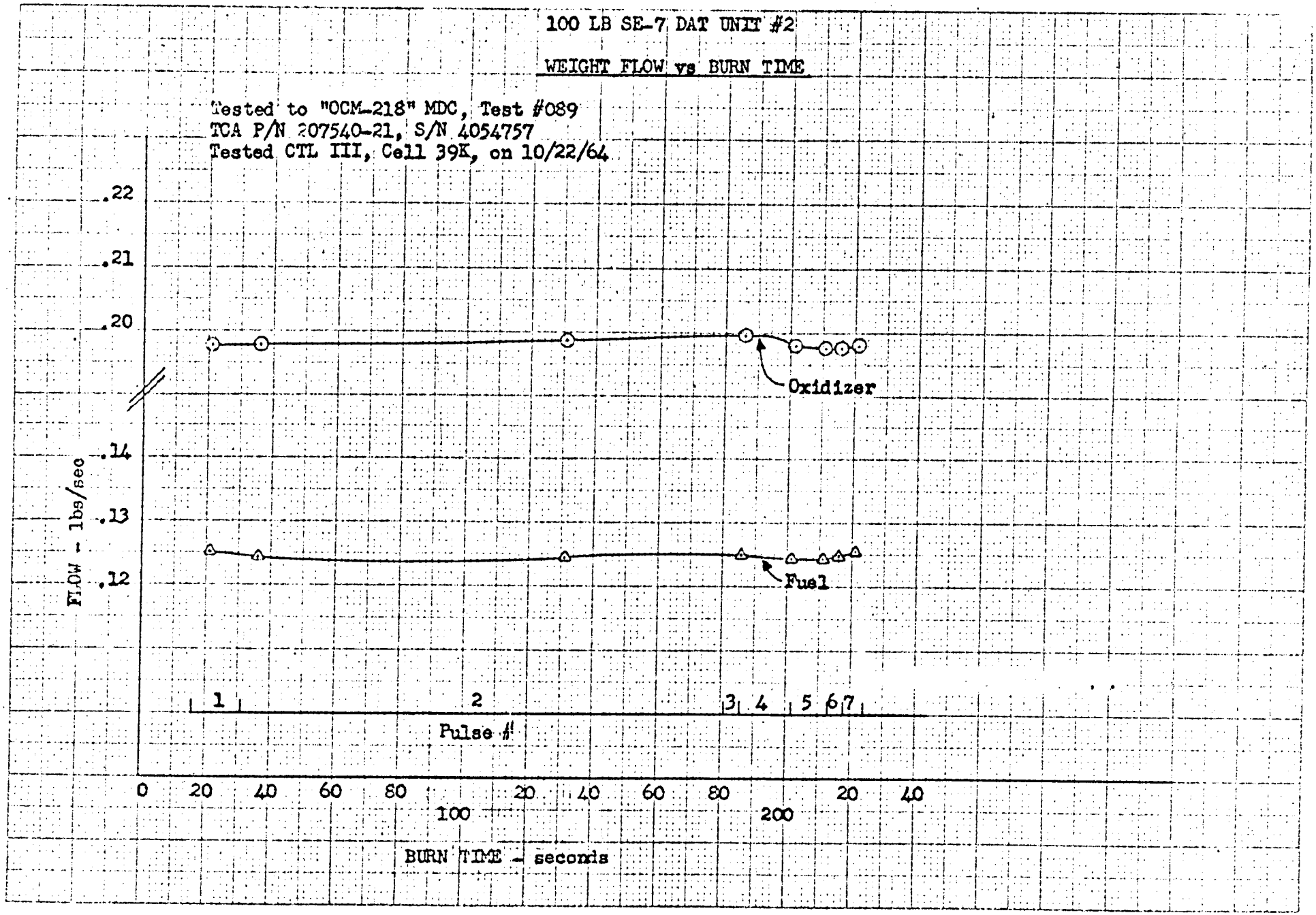
PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R Cole R. Cole		[signature] 2554	22	Mel Moore	22	Waived per tele-con J.P. Mavrogenis	8 20
						VERIFIED BY USAF H. P. Brantan	DATE 10/26/64

FORM 608-B-39 NEW 6-63


Temp during Soakout


Average Skin Temp
Extrapolated Data




100 LB SE-7 DAT UNIT #2
WEIGHT FLOW vs BURN TIME
Tested to "OCM-218" MDC, Test #089
TCA P/N 207540-21, S/N 4054757
Tested CTL III, Cell 39K, on 10/22/64
.22
.21
.20
.14
.13
.12
FLOW - lbs/sec
Oxidizer
Fuel
1
2
3
4
5
6
7
Pulse #
0
20
40
60
80
100
20
40
60
80
200
20
40
BURN TIME - seconds

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO MINIMUM DURATION TEST NO. 207540-401 SHEET 108 OF 180

7.2.3.2.4.1 Pulse No. 1 15 seconds on-time followed by 183.75 min. off-time	Site Data	Standard Vacuum	
Firing Duration, sec	15		
Accumulated Firing Time, sec	20		
Data Slice Number	1		
Time of Data Slice	4		
Ambient Pressure, in. Hg	28.055		
Ambient Temperature, F	58		
Environmental Pressure, psia	.015	0	
Environmental Temperature, F	80°		
Oxidizer Temperature, F	74°	70.00	
Fuel Temperature, F	74°	70.00	
Oxidizer Inlet Pressure, psia	288	283.00	
Fuel Inlet Pressure, psia	293	286.00	
Chamber Pressure, psia	133.8	132.1	
Oxidizer Flowrate, lbs/sec	.1993	.1970	
Fuel Flowrate, lbs/sec	.1248	.1229	
Mixture Ratio, O/F	1.60	1.60	1.60 ±0.09
Main Thrust, lbs.	94.2	93.2	94.5 ±4.7
Specific Impulse, sec.	291	291	(280) min.
Electrical Power, Watts	42.1		
Oxidizer Valve Voltage, Volts	29.8		
Fuel Valve Voltage, Volts	28.1		
Oxidizer Valve Current, Amps	.730		
Fuel Valve Current, Amps.	.697		
Start Time, Millisec.	22		50 max.
Shutdown Time, Millisec.	70		125 max.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R. Cole J. Ganger		H. Robinson	1-13-65	W. C. Williams	3/3/65	James D. Mavrogenis	2/23/65
						VERIFIED BY USAF	DATE
						[signature]	3/4/65

FORM 608-B-39 NEW 6-63

358 R-I 5019-2

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DECLASSIFIED AFTER ~~12 YEARS~~
DOD DIR 5200.10

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

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO MINIMUM DURATION TEST NO. 207540-401 SHEET 109 OF 180

7.2.3.2.4.2 Pulse No. 2 150 seconds on-time followed by 16.5 min. off-time	Site Data	Standard Vacuum	
Firing Duration, sec	150		
Accumulated Firing Time, sec	134		
Data Slice Number	2		
Time of Data Slice	103		
Ambient Pressure, in. Hg	28.055		
Ambient Temperature, F	58		
Environmental Pressure, psia	.015	0	
Environmental Temperature, F	74		
Oxidizer Temperature, F	65°	70.00	
Fuel Temperature, F	63°	70.00	
Oxidizer Inlet Pressure, psia	238	283.00	
Fuel Inlet Pressure, psia	292	286.00	
Chamber Pressure, psia	137.3	135.3	
Oxidizer Flowrate, lbs/sec	.1995	.1966	
Fuel Flowrate, lbs/sec	.1244	.1226	
Mixture Ratio, O/F	1.60	1.60	1.60 ±0.09
Main Thrust, lbs.	93.6	92.5	94.5 ±4.7
Specific Impulse, sec.	289	290	(280) min.
Electrical Power, Watts	41.7		
Oxidizer Valve Voltage, Volts	29.8		
Fuel Valve Voltage, Volts	28.9		
Oxidizer Valve Current, Amps	.726		
Fuel Valve Current, Amps.	.697		
Start Time, Millisec.	28		50 max.
Shutdown Time, Millisec.	95		125 max.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R. Cole J. Ganger		H Robinson	1-13-65	W. C. Wallace	3/3/65	James D. Morrison	2/23/65
						VERIFIED BY USAF	DATE
						[signature]	3/4/65

FORM 608-B-39 NEW 6-63 R-15019-2 359

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DOWNGRADED AT 3 YEARS
DECLASSIFIED AFTER 12 YEARS
DOD DIR 5200.10

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

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO MINIMUM DURATION TEST NO. 207540-401 SHEET 110 OF 180

7.2.3.2.4.3 Pulse No.4 16 seconds on-time followed by 59 seconds off-time

	Site Data	Standard Vacuum	
Firing Duration, sec	16		
Accumulated Firing Time, sec	193		
Data Slice Number	3		
Time of Data Slice	7		
Ambient Pressure, in. Hg	28.055		
Ambient Temperature, F	58		
Environmental Pressure, psia	.015	0	
Environmental Temperature, F	87°		
Oxidizer Temperature, F	70°	70.00	
Fuel Temperature, F	69°	70.00	
Oxidizer Inlet Pressure, psia	293	283.00	
Fuel Inlet Pressure, psia	293	286.00	
Chamber Pressure, psia	133.8	130.9	
Oxidizer Flowrate, lbs/sec	.2011	.1960	
Fuel Flowrate, lbs/sec	.1254	.1239	
Mixture Ratio, O/F	1.60	1.58	1.60 ±0.09
Main Thrust, lbs.	93.9	92.2	94.5 ±4.7
Specific Impulse, sec.	288	287	(280) min.
Electrical Power, Watts	39.5		
Oxidizer Valve Voltage, Volts	29.5		
Fuel Valve Voltage, Volts	29.1		
Oxidizer Valve Current, Amps	.692		
Fuel Valve Current, Amps.	.655		
Start Time, Millisec.	27		50 max.
Shutdown Time, Millisec.	100		125 max.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R. Cole J. Ganger		H. Robinson	1-13-65	W. C. Williams	3/3/65	James D. Thompson	2/23/65
						VERIFIED BY USAF	DATE
						[illegible]	3/4/65

FORM 608-B-39 NEW 6-63 360 R-15019-2

DOWNGRADED
DECLASSIFIED AFTER 12 YEARS
DOD DIR 5200.10

~~CONFIDENTIAL~~

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.

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO MINIMUM DURATION TEST NO. 207540-401 SHEET 111 OF 180

7.2.3.2.44 Pulse No. 7 5.0seconds on-time followed by 479 seconds off-time

	Site Data	Standard Vacuum
Firing Duration, sec	5	
Accumulated Firing Time, sec	221	
Data Slice Number	4	
Time of Data Slice	3	
Ambient Pressure, in. Hg	28.055	
Ambient Temperature, F	58	
Environmental Pressure, psia	.015	0
Environmental Temperature, F	85°	
Oxidizer Temperature, F	73°	70.00
Fuel Temperature, F	70°	70.00
Oxidizer Inlet Pressure, psia	288	283.00
Fuel Inlet Pressure, psia	292	286.00
Chamber Pressure, psia	132.8	131.1
Oxidizer Flowrate, lbs/sec	.2001	.1977
Fuel Flowrate, lbs/sec	.1256	.1240
Mixture Ratio, O/F	1.59	1.59 1.60 ±0.09
Main Thrust, lbs.	93.2	92.3 94.5 ±4.7
Specific Impulse, sec.	286	287 (280) min.
Electrical Power, Watts	38.8	
Oxidizer Valve Voltage, Volts	29.8	
Fuel Valve Voltage, Volts	29.0	
Oxidizer Valve Current, Amps	.675	
Fuel Valve Current, Amps.	.645	F @ 90% within Limit.
Start Time, Millisec.		50 max.
Shutdown Time, Millisec.	100	125 max.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R. Cole J. Ganger		W. Robinson	1-13-65	W. C. Williams	3/3/65	James D. Thompson	2/23/65
						VERIFIED BY USAF	DATE 3/4/65

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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.

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC: 52-52701-277 / NAA 207540-21

NAME OF TEST BURST PRESSURE TEST NO 207540-401 SHEET ___ OF ___

IL 4388-5369

Deviation Request:

The Burst Pressure Test Data of paragraph 7.2.4.2 on page 113 will be completed when data is made available. Proceed with the Weight Determination of paragraph 6.6 and 7.2.4.2.3.

Recopied from original request dated 12 November 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-8-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21 }

NAME OF TEST BURST PRESSURE TEST NO. 207540-401 SHEET 112 OF 180

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

7.2.4 Burst Pressure - TCA #2

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.

11-15-64

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
J.A. Ganger	10-6-64	R.H. Eide	10-8-64		
CHECKED BY: R Cole	DATE 10-8-64				

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST BURST PRESSURE TEST NO. 207540-401 SHEET 113 OF 180

7.2.4.2 Test Data - TCA #2

7.2.4.2.1 Component Identification

Component Name SET-100# TCA

McDonnell Part No. 52-52701-277

Rocketdyne Part No. 207540-21

Component Serial No. 4054759

7.2.4.2.2 Site Data

Facility oxidizer tank pressure (psig) 743 (750^{+0}_{-20})

Facility fuel tank pressure (psig) 749 (750^{+0}_{-20})

Oxidizer inlet pressure (psia) 344

Fuel inlet pressure (psia) 723

Combustion chamber pressure (psia) 221.8

Combustion chamber exterior wall temperature (F) 650° (700F max)

Inspection Remarks

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. G. Kniffin	4/14/64 7-10-64	H. Robinson	1-13-65	W. C. Williams	3/3/65	James D. Montgomery	2/23/65
						VERIFIED BY USAF	3/9/65

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

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NAME OF TEST BURST PRESSURE TEST NO. 207540-401 SHEET 114 OF 180

7.2.4.2.3 Weight Determination Test (reference paragraph 6.6)

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

The TCA dry weight was 8.60 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
T.G. Kniffin	4/14/64 7-10-64	D. Fowler	11-13-64	E.C. Jones	11-13-64		11/14/64
						VERIFIED BY USAF	DATE 11/13/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207540-401 SHEET 115 OF 180

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 of all 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 407661 (Fuel Seat Assembly P/N 407660) 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 C

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA: [signature]	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: [signature]	DATE 11-18-64		11-18-64		

FORM 608-B-38 NEW 6-63

Rev. C J. D. Mavrogenis Date 11/18/64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207540-401 SHEET 115 OF 180

(cont'd) this shall be removed. The filter assembly P/N 5-28139-T1 shall not be removed at this time.

7.2.5.1.9 Remove, bag and identify the seat assembly.

7.2.5.1.10 Remove, bag and identify the armature P/N 407564.

7.2.5.1.11 Remove, bag and identify the spring P/N 406816.

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.

PREPARED BY: DATE	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
R. Cole	R. Heide 11-18-64	
CHECKED BY: DATE L. Berger 11-18-64		

FORM 608-B-38 NEW 6-63

Rev. C J. D. Marrogen Date 11/18/64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207540-401 SHEET 116 OF 180

7.2.5.2 Post Test Inspection Data - TCA #1

7.2.5.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-5270

Rocketdyne Part No. 207540-21

Component Serial No. 4054757

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: Exit end of nozzle has ablative separations; Throat and Liners are coated with a substance build up; ding on OD of shell at approx. 2.000 inches from top of injector on oxid side; weld splash at 4.000 inches from top of injector and at center of fuel & oxid valves; Top of valves & top of injector has rust & dirt on them; Throat insert is cracked. (Longitudial thruout & circumferential 360°)

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:

3/25/65

1. Cut along C-D in ablative is up to 3/8 in. wide, (multiple cut).
2. Numerous variationsfom saw line & several "break-offs" at ends ofcut
3. C-D cut near Pc boss is overcut 5/8 in.
4. Throat insert is broken into twenty pcs.
5. One throat liner is missing
6. Three throat liners cut in two pcs. along D-E.
7. Throat liner retainer not completely cut to upstream ends of D-E and are broken off.

J. Powell
OK to Section MAC-GA

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. Kniffin	7-16-64	PARA. 7.2.5.2.1 PARA. 7.2.5.2.2		PARA 7.2.5.2.1 PAR A 7.2.5.2.2		VERIFIED BY USAF PARA 7.2.5.2.2 / 7.2.5.2.3	DATE 3-24-65

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277
NAA 207540-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207540-401 SHEET 116 OF 130

7.2.5.2.2 (Cont.) Preliminary Inspection (Cont'd)

1. P/N 99-106126-19 tube on fuel side dented approx. .050 deep X .300 length.

2. P/N 99-106126-19 tube on oxid side bent up approx. .030

OWOK 1-4-65

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207540-401 SHEET 161 OF 180

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).

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
D. Cole DC	11-20-64	[illegible]	4/7/65	[illegible]	4/7/65	WAIVED BY [illegible] JOHN ERICKSON	4/7/65
						VERIFIED BY USAF	DATE 4/7/65

FORM 608-B-39 NEW 6-63

Rev C J. D. Mavrogordato Date 11-20-64

UNIT #3

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4054759

Dwg. No. 207540-21

Model SB-7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
		Customer			
#1	9/11/64	PART NO. ITEMS # 6.8.31 THRU 6.8.32 NO THROAT PLUG AVAILABLE, VACUUM OVEN USED TO DE-CONTAMINATE T/C/A UNIT #3.			
ACTION TAKEN		BOUGHT MAC ENGINEERING: I.L. ISSUED TO AIR FORCE COVERING ABOVE SQUAWK			9-11-64
2	9/18/64	PART NO. Para. 7331.2 + 7331.9 Thier is no wall temp Thermo couple or recorder available. Wall Temp within 20F of 100±5F would be impractical to obtain.			
ACTION TAKEN		Wall temp on the test chamber will not have to be monitored for this explosive atmosphere test. Per I.L. Sept 18-1964 R Cole 896/[illegible] [illegible]			9/18/64
3	9/29/64	PART NO. OVID VALVE P/N 407561 & 3722092 FILLED WITH N.T.O NOT TO SPEC MIL-P-26539 STARTING 00:15 HOURS WOULD TRANSFERRED to [illegible] Squawk sheet			
ACTION TAKEN					9/29/64
		PART NO.			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					

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Unit #3

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4054759

Dwg. No. 207540-21

Model S87

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
		CTL #III Cell 39-K			
#1	9/11/64	PART NO. 207540-21 S/N 4054759 TCA. Information For Pages 123 Thru 126 to Be Completed When Data is Recieved From Data Reduction:			
ACTION TAKEN		Transferred to Shortage	9/11/64		
#2	9/11/64	PART NO. 207540-21 S/N 4054759 TCA. Decontamination Completed From Para 6.8.1 Thru 6.8.30			
ACTION TAKEN		Operation 6.8.31. Thru 6.8.34 Complete Ref. Customer D.R. #1	9/11/64		
#3	9/11/64	PART NO. 207540-21 S/N 4054759 TCA Post Test Inspection Revealed Heavy Glassing down stream of Throat insert Also in Combustion Zone.			
ACTION TAKEN		Information Only	9/11/64		
#4	9/11/64	PART NO. 207540-21 S/N 4054759 TCA. Post Test Recorded First Two Combustion Zone Segments upstream of Throat insert Missing.			
ACTION TAKEN		Information Only	9/11/64		
#5	9/11/64	PART NO. 207540-21 S/N 4054759 TCA. Post Test, Two small parts of Throat insert Broken off on Combustion Zone Side of insert			
ACTION TAKEN		Information Only	9/11/64		

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UNIT #3

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4054759

Dwg. No. 207540-21

Model SE-7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
		C.T.L. #III Cell 39-K			
#6	9/11/64	PART NO. 207540-21 S/N 4054759 T.C.R. Post-Test Several Blisters & 1st Ply Ruptures in Nozzle Exit Area.			
ACTION TAKEN		Information Only		9/11/64	
#7	9/11/64	PART NO. 207540-21 S/N 4054759 T.C.R. Post Test Fuel Inlet Line Bent & Distorted.			
ACTION TAKEN		Transferred to Shop 42	9/11/64	9/11/64	
8	9/15/64	PART NO. 207540-21 S/N 207540-21 COMPLETED PARA 7.3.3.2.5 PROPELLANT VALVE ELECTRICAL TESTS UNIT TRANSFERRED TO SANTA SUSANA FROM D596/146 C/C			
ACTION TAKEN		No Action Req. Information Only		9-15-64	
9	9/18/64	PART NO. 207540-21 S/N 207540-21 UNIT RECEIVED IN D596/146 C/C FROM SANTA SUSANA			
ACTION TAKEN		No Action Req Info. Only.		9-18-64	
10	9/19/64	PART NO. 207540-21 S/N 207540-21 COMPLETED PARA 7.3.3.2.10. UNIT TRANSFERED TO D896/388 S/N 2			
ACTION TAKEN		No Action Req Info Only		9-19-64	

Form R 25-U Rev. 12-57 R-15019-2

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UNIT #3

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4054759

Dwg. No. 207504-21

Model Se 1

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
11	10/11/64	PART NO. 40766-S/N 9183322 fuel valve unable to test valve power off 07:08 to 07:42 OK PER IL DATED 10-12-64			
ACTION TAKEN					10/13/64
12	10/11/64	PART NO. 407662 S/N 9183322 fuel valve and P/N 407561 S/N 3722902 oxidizer valve no power on valves 07:08 to 07:42 and from 11:00 to 12:00 total time 64 min - 10-12-64 OK PER IL DATED			
ACTION TAKEN					10/13/64
13	10/12/64	PART NO. Deviation 1.3.4.1.6 test conducted before 10-9-64 on fuel valve and test on oxidizer valve before 10-7-64 are for information only See PAGE - 147# Information only			
ACTION TAKEN					10/13/64
14	10/12/64	PART NO. No pressure on oxidizer valve from 11:00 AT 08:00 OK PER IL - Dated Oct 16, 1964			
ACTION TAKEN				10/16/64	10/16/64
15	10/12/64	PART NO. Unable to conform to spec 207540-409 PARA - 7.3.4.1.9. H_2 Flash was performed 10 min at 40 PSIG at 83°F, 20 min at 75 PSIG at 80°F. 150 proof alcohol at 35 PSIG was flushed for 20 min followed by H_2 at 75 PSIG at 80°F for 40 min OK PER IL Dated 10-16-64			
ACTION TAKEN					10/16/64

Form R 25-u Rev. 12-57 ENTERED IN ERROR 37½

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UNIT #3

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4054759

Dwg. No. 207504-21

Model Se-1

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. & Date	Lead-man & Date	Insp. & Date
16	10/14/64	PART NO. PRESSURE GAGE 14209 REMOVED AND REPLACED BY GAGE 14244 DURING test. M-#4244 calib - 9-4-64 OK FOR TEST			
ACTION TAKEN		- Information only -		10/14/64	10/14/64
17	10/15/64	PART NO. 207540-21 - STOP 7.3 4.1.9 [illegible] @ 115° F [illegible] 8 min This is not [illegible] 10/15/64			
ACTION TAKEN		OK PER ITL Dated 16 1964			10/16/64
		PART NO.			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					

R-15019-2

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UNIT #3

SHORTAGE REPORT

☑ ELEC. ☑ MECH. ☑ ORIG. ☐ DUP.

ASSEMBLY NAME	ASSEMBLY NO.	L.H.	R.H.	UPPER	LOWER
100# Gimini TCA.	207540-21	✓	✓		

DEPARTMENT NO.	SHIP OR UNIT NO.	CONTRACT NO.	SERIAL NO.	DATE
056		5246	4054759	9/12/64

SHORTAGES CHECK ONE ACTUAL	HELD UP	INSP. VERI.	QUAN.	PART NUMBER	COMPLETE PART NAME	DATE	MECH.	L.H.	INSP.
✓		[illegible]	1	207540-21	S/N 4054759 General:				
					information for pages 123 thru				
					126 to be completed when				
					data is Recieved from				
					Data Reduction 9/11/64 [illegible]				
✓		[illegible]	1	207540-21	S/N 4054759 TCA Post test				
					Fuel inlet Line Dent				
					& Distorted 9/11/64 [illegible]				
					OK for Explosive act. test				
					9/12/64 J. [illegible] [illegible]				

This sheet is to be prepared in duplicate by the production department. All entries will be made with pen, indelible pencil or with a typewriter. Responsible production personnel will place a check mark (✓) in the applicable column to indicate whether the shortage is actual or held up. Inspection will add the original and/or the duplicate shortage sheets to the sign-off book and verify correct entries by placing an inspection stamp impression in the applicable block.

Form 61-Y, Rev. 3-58 376 [illegible] R-15019-2 Page No. 1 of 1 Pages

UNIT #3

GEMINI R & D HARDWARE TEST RECORD

Date 9/11/64 Cell # K Thrust Level 100# Inspector Moore-Kelly

HARDWARE IDENTIFICATION

Test Objective	Name	P/N	S/N	Verified
	TCA	207540-21	4054759	
	Injector	207543	4060040	
	Ablative Liner	UNK		
	Oxid. Valve	UNK	3722092	
	Fuel Valve	407662 D	9183322	

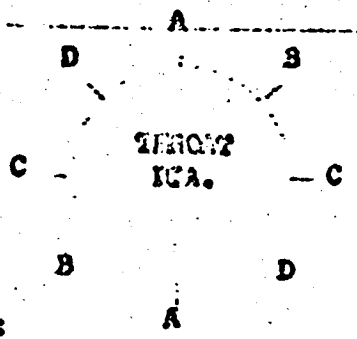
Test No.	Time	Duration	Altitude	Test Remarks
070	START 1640	Cape-cycle	Amb	
	Fini. 1915			
071	START 2010			
	Fini. 2357	MDC.	Alt.	

TCA Leak check performed ✓ System leak check performed ✓

Oxid. valve opening verified ✓ Fuel valve opening verified ✓

Pre-test Injector Inspection. Remarks: OK

Pre-test Throat Insert Inspection. Remarks: good



THROAT AND EXIT DIMENSIONS

Pre-test		Post-test	
A.A.	.7095	A.A.	.8124
B.B.	.7095	B.B.	.8301
C.C.	.7095	C.C.	.8722
D.D.	.7095	D.D.	.8362
Exit	4.487	Exit	4.202
Weight		Weight	

REMARKS:

~~RAMPO P/N~~ Cox
NTO 3147
MMH 3146

SPG
NTO 1450 @ 55° °F
MMH .873 @ 74° °F

ACCT	CONT	TTRR
3721	5246	0920

R-15019-2

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 207540-401 SHEET 117 OF 180

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

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: T. G. Kniffin DATE 4/14/64	APPROVED FOR NAA: DATE 7-22-64	APPROVED FOR McDONNELL: DATE
CHECKED BY: DATE 4/14		

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207540-401 SHEET 118 OF 180

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.2.2.1

7.3.1 Pre-Test Inspection - TCA #3

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 RA0220-349. 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. See Figure 12.

7.3.1.1.3 Perform Weight Determination per paragraph 6.6.

PREPARED BY: T. G. Kniffin	DATE 4/14/64	APPROVED FOR NAA:	DATE 7-22-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 4/14				

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST: PRE-TEST INSPECTION TEST NO. 207540-401 SHEET 119 OF 180

7.3.1.2 Test Data - TCA #3

7.3.1.2.1 Component Identification

Component Name	TCA	Oxidizer Valve	Fuel Valve
McDonnell Part No.	52-52701-277		
Rocketdyne Part No.	207540-21	407561	407662
Component Serial No.	4054759	8722092	9183322

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 RA0220-349. 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. NO (Yes or No)
PER PARA 7.3.1.2.2.3

7.3.1.2.2.3 Inspection Remarks
4/3/64
DIMS FROM END OF PROPELLANT VALVE INLET ADAPTERS TO CENTER LINE OF PROPELLANT VALVE INLET TUBE STUBS ARE APPROX 2.92, SHOULD BE 3.20 ±.02 REF FIGURE 12 SHEET 175 OF 180
OK as is R Cole 896/388

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T. G. Kniffin 4/14/64	4/3/64	Eugene Fri... 4/3/64	A. D. Mangiamis 4-4-64
			VERIFIED BY USAF 4/4/64 DATE
			W. Bollenbacher

FORM 608-B-39 NEW 6-63

105

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207540-401 SHEET 120 OF 180

7.3.1.2.3 Weight Determination Test (reference paragraph 6.6)

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

The TCA dry weight was 8.91 pounds.
(Record to the nearest one-hundredth pound)

Inspection Remarks NONE W

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	4/14/64	2622	9/3/64	L Johnson	9-3-64	J.D. Mavrosenis	9-4-64
						VERIFIED BY USAF	DATE
						W Bollenbach	9/4/64

FORM 608-B-39 NEW 6-63

W

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST HOT-FIRE TEST NO 207540-401 SHEET ___ OF ___

IL 4388-5370

Deviation Request:

(1) One thermocouple for each propellant may be used to obtain the flowmeter and the inlet temperature for each respective propellant.

(2) Instrumentation requirements not required for oxidizer flowrate for the DIGR., fuel flowrate for the DIGR., and (1) environmental pressure (fine).

Recopied from original request dated 10 September 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-7-64

John A. Ganger
John A. Ganger
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 207540-401 SHEET 121 OF 180

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

7.3.2 DAT Duty Cycle to Guaranteed Life - TCA #3 A

7.3.2.1 Test Procedure

7.3.2.1.1 Perform Cape Cycle Firing Test per paragraph 6.7.

7.3.2.1.1.1 Make a one second firing followed by another one second firing ten minutes later.

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

7.3.2.1.1.3 Repeat paragraph 7.3.2.1.1.2.

7.3.2.1.2 Wait for TCA skin temperature to return to ambient temperature (70 ±20F) and perform the DAT duty cycle Firing Test of paragraph 6.7 and Table II. The Firing Test shall be terminated upon completion of pulse 12.

7.3.2.1.2.1 The TCA shall not exceed a maximum skin temperature of 650F at the end of the 220 seconds total burn time ("in spec" performance).

7.3.2.1.2.2 The TCA shall not exceed a maximum skin temperature of 700F at 300 seconds total burn time. (guaranteed life).

7.3.2.1.3 Perform decontamination per paragraph 6.8.

7.3.2.1.4 Reduce data per RA0220-232. NOTE: ONE COARSE AND ONLY ONE FINE ALTITUDE PRESSURE IS REQUIRED FOR THESE TESTS. ALSO, THE DIGR FLOWRATE ANALYSIS IS NOT REQUIRED FOR THESE TESTS. B

7.3.2.1.4.1 The results of significant data shall include but not be limited to the following:

7.3.2.1.4.1.1 Graphical presentation of temperature versus time for all TCA thermocouple locations.

7.3.2.1.4.1.2 Graphical presentation of thrust versus time.

7.3.2.1.4.1.3 Graphical presentation of chamber pressure versus time.

7.3.2.1.4.1.4 Graphical presentation of oxidizer flowrate versus time.

7.3.2.1.4.1.5 Graphical presentation of fuel flowrate versus time.

7.3.2.1.5 Perform weight determination per paragraph 6.6.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
E. Adams	9-3-64	[illegible]	9-3-64		
CHECKED BY:	DATE	[illegible]	9-10-64		

FORM 608-B-38 NEW 6-63

Revision A J. D. Mangum Dated 9-3-64

REVISION B J. D. Mangum DATED 9-10-64

-8

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 207540-401 SHEET 122 OF 180

7.3.2.2 Test Data - TCA #3

7.3.2.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52701-277

Rocketdyne Part No. 207540-21

Component Serial No. 4054759

Accumulated Acceptance Test Firing Time, seconds 3.0

	Pre-Test	Post Test
Throat Diameter, inches (Average of four measurements)	7095	.8377
Nozzle Exit Diameter, inches	4.487	4.202

7.3.2.2.2 Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	9/4/64	9/10/64
Sample Batch Number	9-81	9-116
Sample Temperature, F	55°	74°
Sample Specific Gravity	1.450	.873
Met Mil Spec. Requirements (Yes or No)	yes	yes

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
7/10/64 T. G. Kniffin 4/14/64			[signature] 7/15/65
			VERIFIED BY USAF DATE

FORM 608-B-39 NEW 6-63

Approved as to Jr. James P. Mavrogenis MAC Engrg 9-9-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO 207540-401 SHEET ___ OF ___

IL 5388-6247

Deviation Request:

It is hereby authorized to accept the following deviations from the DAT Specification 207540-401 for 100# TCA Unit 3:

1. The Cape Cycle pulse duration of 1.03 seconds exceeded the specification limit of 1.00 ±.02 seconds.

2. The Cape Cycle duty cycle off period was not recorded. The Cape Cycle pulse periods were nominal as prescribed in MAC SCD 52-52701.

3. The MDC pulse "Shutdown Time" (TCA cutoff signal to 2 percent thrust) cannot be determined for pulse number 2. The supply of Oscillograph Recording Paper was exhausted prior to the termination of pulse number 2. No difficulty was experienced in the recording of the remaining prescribed pulses.

4. The instrumentation accuracy during the MDC cannot be established for the TCA thrust measurement because of the gross difference between pre-test and post-test thrust calibrations.

5. Problems encountered with the NTO valve current sensing transducer prevent satisfactory data reduction. The erratic signal was not observed until the Oscillograph Recording Paper was photographically developed after the MDC. The TCA operating characteristics and the normal NTO voltage signal indicate satisfactory TCA valve operation.

John A. Ganger
John A. Ganger
Gemini DAT Unit

R L Free
R.L. Free
MAC Resident
Engineering Rep.

FORM 608-B-37 NEW 6-63

The Mission Duty Cycle Test conducted on TCA Unit 3 was to demonstrate satisfactory TCA operation through the guaranteed life portion of Mission Duty Cycle (MDC) OCM-218. After this test, a review of the IBM reduced and derived data revealed discrepancies between the TCA acceptance test data and the MDC data. Two apparent discrepancies were: (1) a bias in the MMH flows vs TCA pressure drop between the acceptance test and the MDC test; and (2) a difference in TCA performance (I_{sp}) between the acceptance test and the MDC test.

Each discrepant condition is composed of two or more TCA parameters. An error in the measurement of any one of these parameters or a combination of several parameters could contribute toward the discrepancy. If several parameters are only slightly in error to produce the discrepancy, then the solution (i.e., the estimation of the correct values for the erroneous parameters) becomes incalculable. If, however, a reasonable manipulation of one parameter corrects the discrepancy and all the other suspect parameters can be exonerated by the interplay of additional non-suspect data then that manipulation may be assumed to be valid.

The three basic test parameters that contribute toward the determination of the MMH flows vs TCA pressure drop are MMH inlet pressure, TCA chamber pressure, and MMH flow rate. The TCA chamber pressure and the MMH flowrate were vindicated by the close agreement between the acceptance and the MDC tests of NTO flow, TCA ΔP, and the characteristic velocity. Therefore, the MMH inlet pressure was in error during either the acceptance test or the MDC test. The conclusion of which test was in error is based on data that could be defined as circumstantial. This conclusion will be described together with a similar conclusion, related to the TCA performance discrepancy, following a discussion of the second discrepancy.

The observed difference in the TCA I_{sp} performance between the acceptance and MDC tests can be attributed to the propellant flowrates and/or the TCA thrust. The vindication of the propellant flowrates in the discussion of the first discrepancy is still valid. Therefore, the TCA thrust may be considered to be in error during the acceptance test or the MDC test.

No absolute statement as to which test was in error can be made for either discrepancy since there are no interlocking parameters which reflect the error. However, the IBM standard performance mixture ratio (M/R) would suggest which test contains the erroneous MMH inlet pressure if a discrepant pattern could be established between the two types of tests. Such a pattern was found. All 85 and 100 lb thrust TCA's successfully hot-fire acceptance calibrated at Nevada Field Lab Position "1-A" between the dates 30 April 1964 and 13 September 1964 without a TCA orifice change prior to delivery to the Gemini Component DAT program, exhibited standard vacuum mixture ratios within 0.7 percent of the mean value The repeatibility of the hot-fire acceptance tests indicate that the Freon cold-flow calibrations of the TCA injectors were repeatable also. Since the inlet pressure transducers were changed at least once during the 4.5 month period discussed, any irregularities in the MMH inlet pressure transducer due to an erroneous transducer calibration or a poor standardization of the recording instrumentation would have been reflected by a discrepancy in the standard vacuum M/R. The lack of any irregular standard vacuum M/R's indicates that the inlet pressures were measured correctly during the hot-fire acceptance test. Because of the small number of DAT TCA's tested without orifice removal, no pattern can be established from which to sort any discrepant test parameters. However, if the MMH inlet pressure is assumed to be discrepant during the MDC and the data is corrected accordingly, then the data agrees with the hot-fire acceptance test data, with the acceptance performance

history of preceding and succeeding TCA's, and with the test data of the only other TCA subjected to a DAT MDC without prior hardware modifications.

Only a statement of probability can be made stating whether the hot-fire acceptance test or the DAT MDC test contained the thrust measurement error which produced the TCA performance discrepancy. The only TCA performance parameter which displays a compliance of one test to the nominal performance with a corresponding disagreement in the remaining test is that of thrust coefficient efficiency (C_f EFF.). The nominal C_f EFF. established from the history of acceptance test is 99.0 percent. The hot-fire acceptance C_f EFF. value of 99.2 percent agrees quite well with the established nominal while the MDC test performance exhibited an unusual C_f EFF. of 96.6 percent. From the preceding paragraphs the following observations may be established. During the DAT MDC test the MMH inlet pressure could have been thirteen (13) psi greater than the test data indicated. The recorded thrust during the DAT MDC could have been two (2) pounds lower than the actual TCA thrust during the test. These observations cannot be verified, however, if these observations are assumed valid and the test data is adjusted accordingly the TCA performance during the initial portion of MDC agrees with the hot-fire acceptance test data. No unusual deviations between the hot-fire acceptance test data of this TCA and other production TCA's of identical configuration were observed. If these conclusions are valid, the TCA would have exhibited satisfactory specification performance during the initial pulses of the MDC and exceeded the specification performance tolerance on thrust prior to the completion of the "in spec." life.

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DUTY CYCLE TO GUARANTEED LIFE TEST NO. 207540-401 SHEET 123 OF 180

7.3.2.2.3 Cape Cycle Test (reference paragraph 7.3.2.1) A

Test Cell Location CTL III

Test Cell Number 39-K

Test Number 070

Test Date 9/11/64

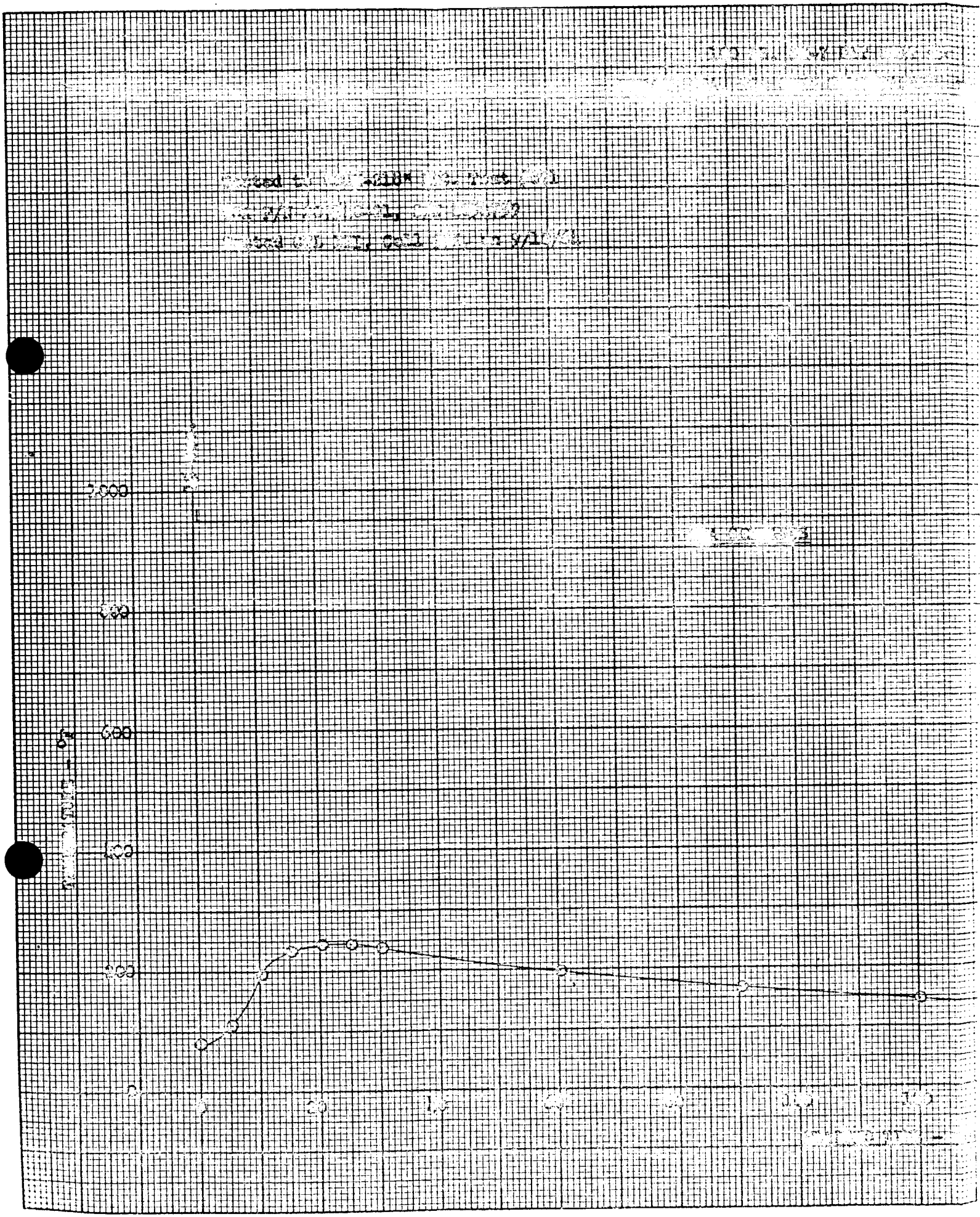
	Pulse Duration (sec) (1.000 ±.020 sec)	Time between Pulses, (minutes)
1st Pulse	1.03	*
2nd Pulse		(10)
3rd Pulse		(5)
4th Pulse		(10)
5th Pulse		(5)
6th Pulse		(10)
Accumulated Firing Time, seconds 6.18		

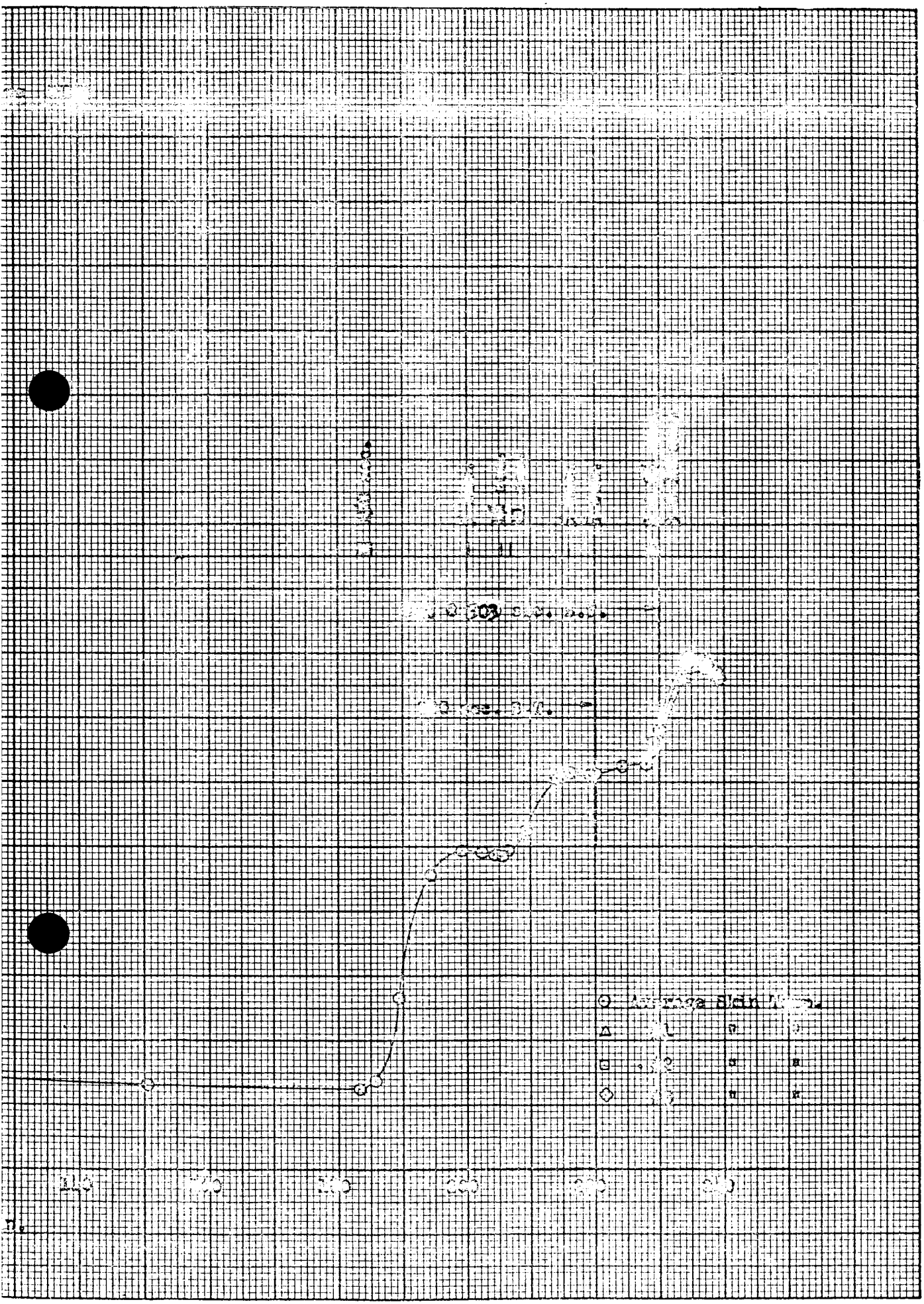
* Time between pulses not continuously recorded.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	9-3-64	H. Robinson	1-21-65			R. L. Free	7/15/65
						VERIFIED BY USAF	DATE

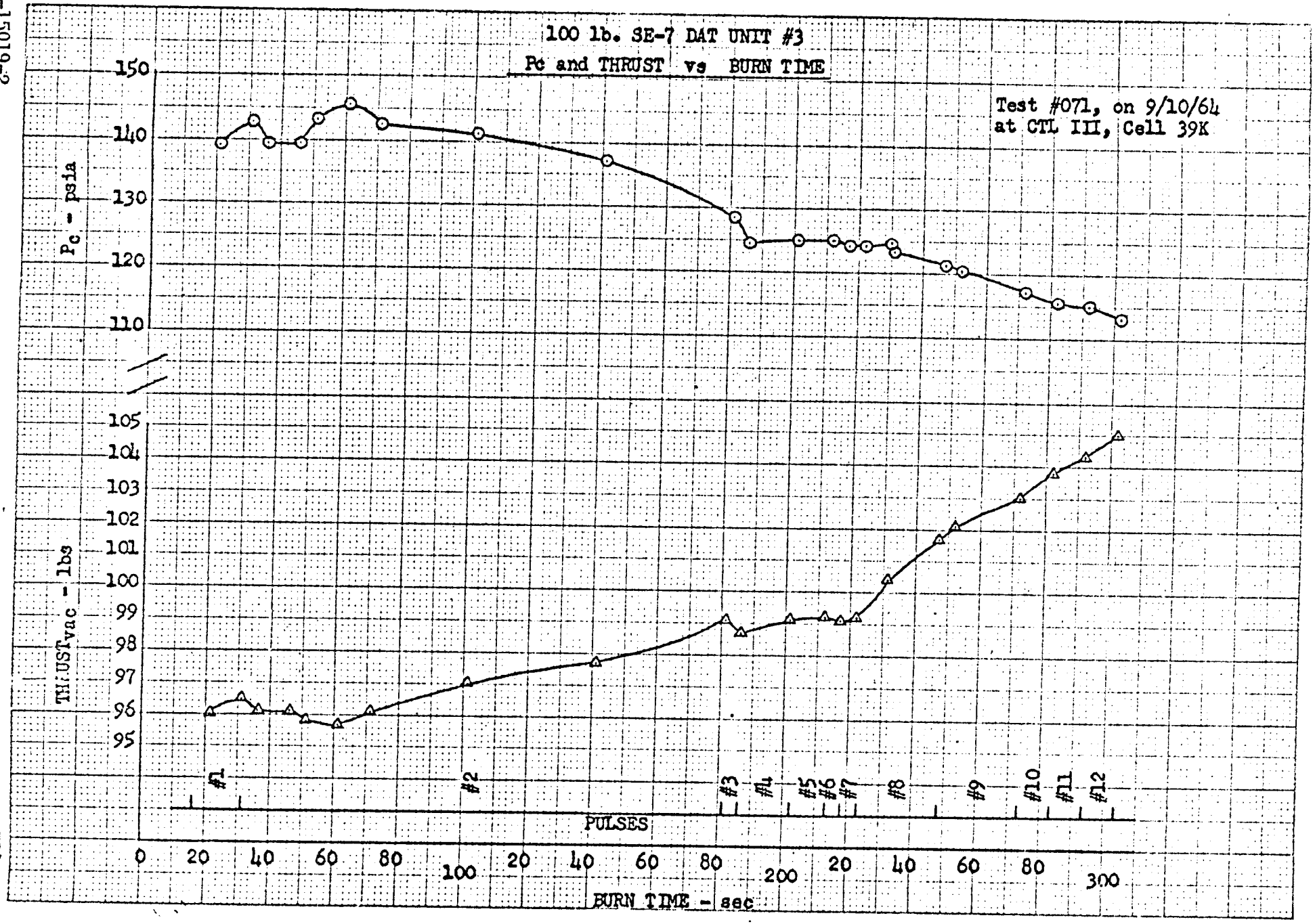
FORM 608-B-39 NEW 6-63

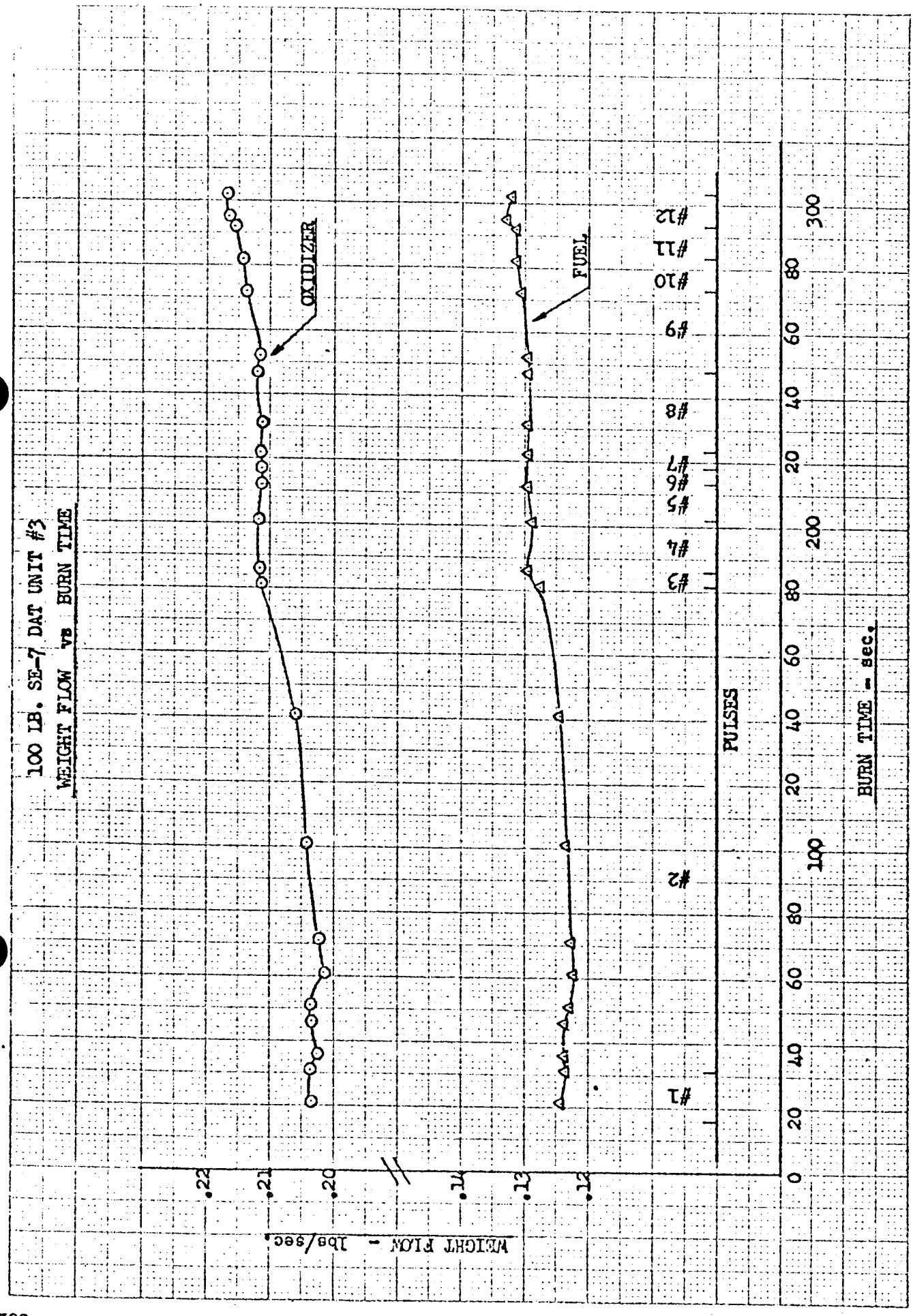
Revision A J.D. Mangeman dated 9-3-64


2000
600
400
0



R-15019-2


100 lb. SE-7 DAT UNIT #3
Pc and THRUST vs BURN TIME
Test #071, on 9/10/64
at CTL III, Cell 39K
Pc - psia
150
140
130
120
110
THRUSTvac - lbs
105
104
103
102
101
100
99
98
97
96
95
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10
#11
#12
PULSES
0
20
40
60
80
100
20
40
60
80
200
20
40
60
80
300
BURN TIME - sec


100 LB. SE-7 DAT UNIT #3
WEIGHT FLOW vs BURN TIME
OXIDIZER
FUEL
WEIGHT FLOW - lbs/sec.
.22
.21
.20
.14
.13
.12
PULSES
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10
#11
#12
BURN TIME - sec.
0
20
40
60
80
100
200
300

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 207540-401 SHEET 124 OF 180

7.3.2.2.4 Duty Cycle Test (reference paragraph 7.3.2.1) A

Test Cell Location CTL III

Test Cell Number 39-K

Test Number 071

Test Date 9-11-64

7.3.2.2.4.1

Pulse No. 1 (15 seconds on time followed by 183.75 minutes off time)	Site Data	Standard Vacuum
Firing Duration, sec	15.2	
Accumulated Firing Time, sec	23.	
Data Slice Number	1	
Time of Data Slice	7.0	
Ambient Pressure, in.Hg.	27.98	
Ambient Temperature, F	74.	
Environmental Pressure, psia	.0134	0
Environmental Temperature, F	74.	
Oxidizer Temperature, F	70.	70.00
Fuel Temperature, F	75.	70.00

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T. G. Kniffin 4/14/64 7-10-64	H. Robinson 1-21-65		R L Dree 7/15/65
			VERIFIED BY USAF DATE

FORM 608-B-39 NEW 6-63

R-15019-REVISION A [signature] Dated 9-3-64

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

CONFIDENTIAL

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 207540-401 SHEET 125 OF 180

7.3.2.2.4.1 Pulse No. 1 15 seconds on-time followed by 183.75 minutes off-time	Site Data	Standard Vacuum	
Firing Duration, sec	15.2		
Accumulated Firing Time, sec	23.0		
Data Slice Number	1		
Time of Data Slice	7.0		
Ambient Pressure, in. Hg	27.98		
Ambient Temperature, F	74°		
Environmental Pressure, psia	.0134	0	
Environmental Temperature, F	74°		
Oxidizer Temperature, F	70°	70.00	
Fuel Temperature, F	75°	70.00	
Oxidizer Inlet Pressure, psia	291.2	283.00	
Fuel Inlet Pressure, psia	288.7	286.00	
Chamber Pressure, psia	139.1	136.9	
Oxidizer Flowrate, lbs/sec	.2009	.1962	
Fuel Flowrate, lbs/sec	.1254	.1254	
Mixture Ratio, O/F	1.60	1.57	1.60 ±0.09
Main Thrust, lbs.	96.	94.7	94.5 ±4.7
Specific Impulse, sec.	294	294	(280) min.
Electrical Power, Watts	—		
Oxidizer Valve Voltage, Volts	29.03		
Fuel Valve Voltage, Volts	29.33		
Oxidizer Valve Current, Amps	N.G		
Fuel Valve Current, Amps.	.679		
Start Time, Millisec.	32		50 max.
Shutdown Time, Millisec.	47		125 max.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R. Cole J. Ganger		W. Robinson	1-21-65			R. L. Tree	
						VERIFIED BY USAF	DATE

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

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

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

~~CONFIDENTIAL~~

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 207540-401 SHEET 126 OF 180

7.3.2.2.4.2 Pulse No. 2 150 seconds on-time followed by 165 minutes off-time

	Site Data	Standard Vacuum	
Firing Duration, sec	149.9		
Accumulated Firing Time, sec	40.4		
Data Slice Number	2		
Time of Data Slice	9.		
Ambient Pressure, in. Hg	28.005		
Ambient Temperature, F	73		
Environmental Pressure, psia	.014	0	
Environmental Temperature, F	78°		
Oxidizer Temperature, F	63°	70.00	
Fuel Temperature, F	75°	70.00	
Oxidizer Inlet Pressure, psia	292.8	283.00	
Fuel Inlet Pressure, psia	288.8	285.00	
Chamber Pressure, psia	139.6	136.8	
Oxidizer Flowrate, lbs/sec	.2004	.1945	
Fuel Flowrate, lbs/sec	.1248	.1250	
Mixture Ratio, O/F	1.61	1.56	1.60 ±0.09
Main Thrust, lbs.	95.9	94.2	94.5 ±4.7
Specific Impulse, sec.	295	295	(280) min.
Electrical Power, Watts	—		
Oxidizer Valve Voltage, Volts	29.03		
Fuel Valve Voltage, Volts	29.33		
Oxidizer Valve Current, Amps	N.G		c/o not recorded; osc. roll exhausted @ 148 sec
Fuel Valve Current, Amps.	.635		
Start Time, Millisec.	35		50 max.
Shutdown Time, Millisec.			125 max.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R. Cole J. Ganger		W. Robinson	1-21-65			R. L. Dye	7/16/65
						VERIFIED BY USAF	DATE

15019-2

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 207540-401 SHEET 127 OF 180

7.3.2.2.4.3 Pulse No. 4 16 seconds on-time followed by 59 seconds off-time

	Site Data	Standard Vacuum	
Firing Duration, sec	16.		
Accumulated Firing Time, sec	196.3		
Data Slice Number	3		
Time of Data Slice	10.		
Ambient Pressure, in. Hg	28.005		
Ambient Temperature, F	73		
Environmental Pressure, psia	.017	0	
Environmental Temperature, F	90°		
Oxidizer Temperature, F	68°	70.00	
Fuel Temperature, F	75°	70.00	
Oxidizer Inlet Pressure, psia	291.3	283.00	
Fuel Inlet Pressure, psia	288.8	286.00	
Chamber Pressure, psia	125.	122.9	
Oxidizer Flowrate, lbs/sec	.2081	.2034	
Fuel Flowrate, lbs/sec	.1307	.1306	
Mixture Ratio, O/F	1.59	1.56	1.60 ±0.09
Main Thrust, lbs.	99.2	97.8	94.5 ±4.7
Specific Impulse, sec.	293	293	(280) min.
Electrical Power, Watts	—		
Oxidizer Valve Voltage, Volts	29.17		
Fuel Valve Voltage, Volts	29.33		
Oxidizer Valve Current, Amps	.6		
Fuel Valve Current, Amps.	.595		
Start Time, Millisec.	50		50 max.
Shutdown Time, Millisec.	40		125 max.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R. Cole J. Ganger		W. Robinson	1-21-65			R L Fan	1/16/65
						VERIFIED BY USAF	DATE

DOWNGRADED AT 3 YEARS
DECLASSIFIED AFTER 12 YEARS
DOD DIR 5200.10

~~CONFIDENTIAL~~

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A DIVISION OF NORTH AMERICAN AVIATION, INC

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 207540-401 SHEET 128 OF 180

7.3.2.2.4.4 Pulse No. 7 50 seconds on-time followed by 479 seconds off-time

	Site Data	Standard Vacuum	
Firing Duration, sec	5.		
Accumulated Firing Time, sec	221.		
Data Slice Number	4		
Time of Data Slice	2.5		
Ambient Pressure, in. Hg	28.005		
Ambient Temperature, F	73		
Environmental Pressure, psia	.017	0	
Environmental Temperature, F	89°		
Oxidizer Temperature, F	70°	70.00	
Fuel Temperature, F	75°	70.00	
Oxidizer Inlet Pressure, psia	291.8	283.00	
Fuel Inlet Pressure, psia	288.8	286.00	
Chamber Pressure, psia	123.8	121.7	
Oxidizer Flowrate, lbs/sec	.2086	.2037	
Fuel Flowrate, lbs/sec	.1317	.1316	
Mixture Ratio, O/F	1.58	1.55	1.60 ±0.09
Main Thrust, lbs.	99.1	97.7	94.5 ±4.7
Specific Impulse, sec.	291	292	(280) min.
Electrical Power, Watts	—		
Oxidizer Valve Voltage, Volts	29.45		
Fuel Valve Voltage, Volts	29.33		
Oxidizer Valve Current, Amps	N.G		
Fuel Valve Current, Amps.	.586		
Start Time, Millisec.	50		50 max.
Shutdown Time, Millisec.	66		125 max.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
R. Cole J. Ganger		W. Robinson	1-21-65			R L Free	7/16/65
						VERIFIED BY USAF	DATE

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

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DECLASSIFIED AFTER 12 YEARS
DOD DIR 5200.10

~~CONFIDENTIAL~~

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.

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST DAT DUTY CYCLE TO GUARANTEED LIFE TEST NO. 207540-401 SHEET 129 OF 180

7.3.2.2.5 Weight Determination Test (reference paragraph 6.6) A

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

The TCA dry weight was 8.2 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	4/14/64 7-10-64	Fred Moeller	9/14/64	M. J. Fogarty	9/14/64	WAIVED BY MAC RE H. D. MAUROGENIS	9/14/64
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

REVISION A J. D. Mauroganis Dated 9-3-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5371

Deviation Request:

Paragraph 7.3.3 will be performed with the propellant valves attached to the TCA (Unit #3).

Recopied from original request dated 14 September 1964.

James D. Mavrogenis
James D.Mavrogenis
MAC Engineering
12-8-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

319

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - #100 PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5372

Deviation Request:

(Change second sentence of paragraph 7.3.3.1.10 to read)

-The desired test altitude for the first test is sea level.-

(Change first sentence of paragraph 7.3.3.1.20 to read)

Energize the spark igniter within the combustion sampling chamber of the test chamber, if combustion is demonstrated within the combustion sampling chamber proceed with paragraph 7.3.3.1.21 .

Recopied from original request dated 16 September 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-8-64

R. Cole
R.Cole
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO 207540-401 SHEET ___ OF ___

IL 4388-5373

Deviation Request:

Wall temperature on the test chamber (reference paragraph 7.3.3.1.7) will not have to be monitored for this explosive atmosphere test.

Recopied from orginal request dated 18 September 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-8-64

R. Cole
R. Cole
Gemini DAT-RAT Unit

401

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST: EXPLOSIVE ATMOSPHERE TEST NO. 207540-401 SHEET 130 OF 180

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.2.3.13

7.3.3 Explosive Atmosphere - TCA #3

7.3.3.1 Test Procedure

7.3.3.1.1 Perform Propellant Valve Removal per paragraph 6.10.

7.3.3.1.2 Perform Propellant Valve Proof Pressure and Leakage per paragraph 6.1.

7.3.3.1.3 Perform Propellant Valve Electrical Resistance per paragraph 6.3.

7.3.3.1.4 Perform Propellant Valve Dielectric Strength per paragraph 6.4.

7.3.3.1.5 Perform Propellant Valve Functional per paragraph 6.5.

7.3.3.1.6 (AIR 918) Install the propellant valves in an explosion test chamber in accordance with Figure 9.

TIME 0355 9-17-64

7.3.3.1.7 (AIR 918) Instrumentation shall be provided for monitoring propellant valve body temperature and the test chamber ambient air and wall temperatures. Ref. deviation as per IL

7.3.3.1.8 (AIR 918) Seal the explosion test chamber and raise the internal temperature to 160 ±5F.

7.3.3.1.9 (AIR 918) Allow the temperature of the propellant valves and the explosion chamber walls to rise within 20F of the temperature of paragraph 7.3.3.1.8.

7.3.3.1.10 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 this test is sea level.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
E. Adams	7-10-64 4/15/64				
CHECKED BY:	DATE				
	4/17		4-18-64		

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY -100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST: EXPLOSIVE ATMOSPHERE TEST NO. 207540-401 SHEET 131 OF 180

7.3.3.1.11 (ANA 916) Introduce into the test chamber, in proper quantity, commercial butane so that an explosive atmosphere is attained for the desired test altitude.

7.3.3.1.12 (ANA 916) Return the test chamber's pressure altitude to 5000 feet above the desired test altitude by admitting air to the chamber.

7.3.3.1.13 (ANA 916) Allow the test chamber's explosive mixture to circulate for a period of three minutes.

7.3.3.1.14 (ANA 916) Energize the spark exciter within the combustion sampling chamber of the test chamber.

7.3.3.1.15 (ANA 916) If combustion is demonstrated within the combustion sampling chamber of the test chamber proceed with paragraph 7.3.3.1.16. If not, vent and purge the test chamber and repeat paragraphs 7.3.3.1.8 through 7.3.3.1.15.

7.3.3.1.16 (ANA 916) 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.

7.3.3.1.17 (ANA 916) Energize the fuel valve for a period of 10 seconds. Then deenergize. Explosion generated by actuation of the fuel valve shall constitute a failure. See paragraph 3.6.

7.3.3.1.18 Repeat paragraphs 7.3.3.1.16 through 7.3.3.1.17 nine successive times.

7.3.3.1.19 (ANA 916) If explosion did not occur during performance of paragraphs 7.3.3.1.16 through 7.3.3.1.18, 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 7.3.3.1.16 and 7.3.3.1.17 once during each 1000 feet of drop.

PREPARED BY: E. Adams 7-16-64	DATE 4/15/64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 6/17	4-18-64			

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - [illegible] PART NO. MAC 52-52701-275 NAA 2075[illegible]-21

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 2075[illegible]-401 SHEET 132 OF 180

7.3.3.1.20 (AWR 918)	Repeat paragraph 7.3.3.1.15. If combustion is not demonstrated vent and purge test chamber and repeat paragraphs 7.3.3.1.8 through 7.3.3.1.20.
7.3.3.1.21 (AWR 918)	Vent and purge the test chamber.
7.3.3.1.22	Repeat paragraphs 7.3.3.1.8 through 7.3.3.1.21 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.
7.3.3.1.23 (AWR 918)	Remove all test equipment, pressurant and electrical connections from the propellant valves.
7.3.3.1.24	Perform Propellant Valve Proof Pressure and Leakage Test per paragraph 6.1.
7.3.3.1.25	Perform Propellant Valve Electrical Resistance Test per paragraph 6.3.
7.3.3.1.26	Perform Propellant Valve Dielectric Strength per paragraph 6.4.
7.3.3.1.27	Perform Propellant Valve Functional Test per paragraph 6.5.
7.3.3.1.28	Replace protective covers.

* NO SPACE ON DATA SHEET BUT TEST COMP. (AWR 918)

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
E. Adams EA 7-10-64	4/15/64	B G Eicke	4-18-64		
CHECKED BY: K Wote	4/17				

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 1007 PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 207540-401 SHEET 133 OF 180

7.3.3.2 Test Data - TCA #3

7.3.3.2.1 Component Identification

Component Name	TCA	Oxidizer Valve	Fuel Valve
McDonnell Part No.	52-52701-277		
Rocketdyne Part No.	207540-21	407561	407662
Component Serial No.	4054759	3722092	9183322

405

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	4/15/64	Trice / Moeller	9/15/64	G. Kaye	9-15-64	WAIVED BY R.B. FRGS	9-25-64
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 1C0# PART NO. MAC 52-52701-277 NAA 207540-21 -401

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 207540 SHEET 134 OF 180

7.3.3.2.2 Propellant Valve Proof Pressure and Leakage Test (reference paragraph 6.1)

Proof Pressure	Oxidizer Valve	Fuel Valve
Pressure (500 $^{+10}_{-0}$)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
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)	<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
E. Adams	4/15/64 7-10-64	Fred Mueller	9/15/64	J. Kuge	9-15-64	WAIVED BY R.L. FREE 9-15-64	
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 207540-401 SHEET 135 OF 180

7.3.3.2.3 Propellant Valve Electrical Resistance Test (reference paragraph 6.3)

Environmental Temperature 70 (70 ±10F).

Resistance A - B

Oxidizer Valve 42.66 ohms (Acceptable per Figure 11, yes or no YES).

Fuel Valve 41.16 ohms (Acceptable per Figure 11, yes or no YES).

Resistance C - D (1.0 maximum)

Oxidizer Valve .17 ohms

Fuel Valve .52 ohms

Inspection Remarks

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	4/15/64	Fred Moeller	9/15/64	S Kaye	9-15-64	WAIVED BY R.L. FREE 9-15-64	
						VERIFIED BY USAF	DATE
						RPM Nance	9/15/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 207540-401 SHEET 136 OF 180

7.3.3.2.4 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	81	500	64
C to Ground	500	16	500	15
A to C	500	19	500	16

Inspection Remarks

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams EA	4/15/64	Fred Moeller	9/15/64	G Kaye	9-15-64	WAIVED BY R L FREE 9-15-64	
						VERIFIED BY USAF	DATE
						[illegible]	9/15/64

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
L.Cracraft	595397	ENV.LAB	2061	9-15-64
PART	PART NO. 207540-21	TYPE OF TEST PRE-EXPLOSIVE ATMOSPHERE		
100# OAMS TCA UNIT #3	S/N 4054759	FUNCTIONAL		

OXIDIZER VALVE

P/N 407561 S/N 3722092

CURRENT TRACE

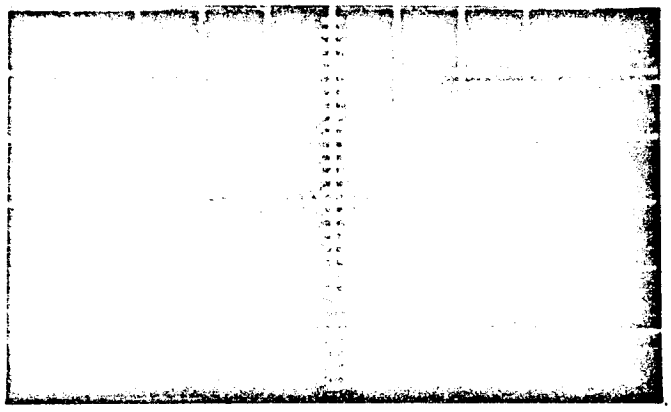
(OPENING TIME)

Horizontal = 5 ms/cm

Vertical = 20 mv/cm

Requirement = 0.021 sec/max

Actual = 0.0165 sec



VOLTAGE TRACE

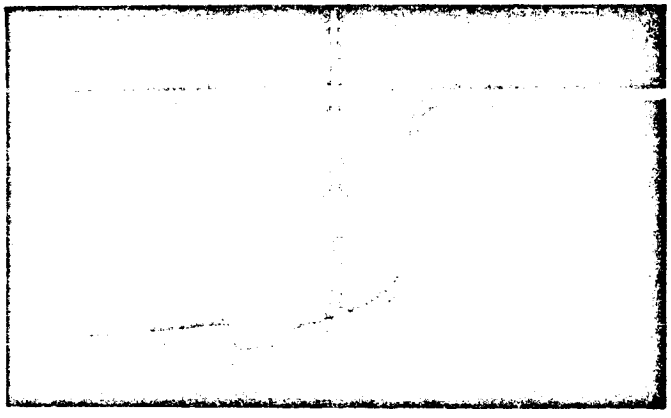
(CLOSING TIME)

Horizontal = 20 ms/cm

Vertical = 200 mv/cm

Requirement = 0.075 sec/max

Actual = 0.072 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
L.Cracraft	595397	ENV.LAB.	2061	9-15-64

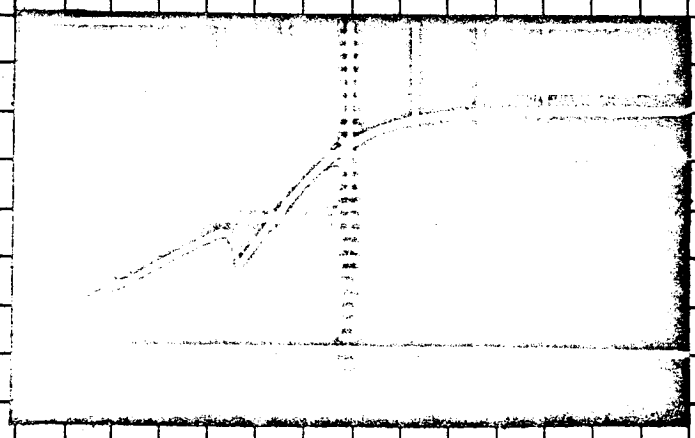
PART	PART NO.	TYPE OF TEST
100# OAMS TCA UNIT #3	207540-21 S/N 4054759	PRE-EXPLOSIVE ATMOSPHERE FUNCTIONAL

FUEL VALVE

P/N 407662 S/N 9183322

CURRENT TRACE

(OPENING TIME)



Horizontal = 5 ms/cm

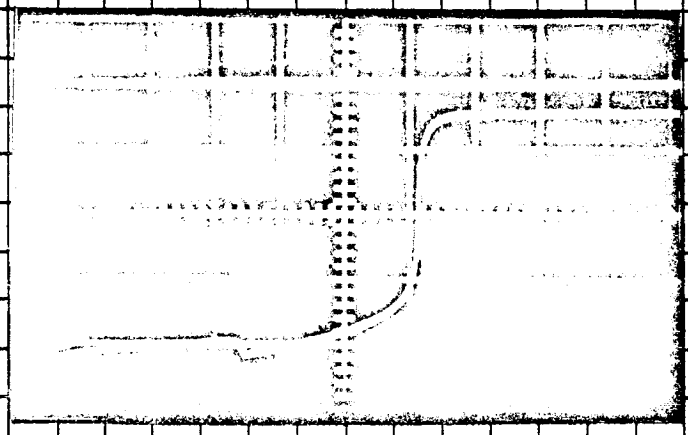
Vertical = 20 mv/cm

Requirement = 0.021 sec/max

Actual = 0.0168 sec

VOLTAGE TRACE

(CLOSING TIME)



Horizontal = 20 ms/cm

Vertical = 200 mv/cm

Requirement = 0.075 sec/max

Actual = 0.070 sec.

R-15019-2

Form 600-V-67 New 10-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 207540-401 SHEET 137 OF 180

7.3.3.2.5 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 (0.021 maximum)	0.0165 seconds	0.0168 seconds
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Time (0.075 maximum)	0.072 seconds	0.070 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)	11.5 VDC	11.6 VDC
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Voltage (1.0 minimum)	1.39 VDC	1.4 VDC

Inspection Remarks

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	4/15/64 7-10-64	Floyd Bancroft	9-15-64	J Kaye	9-15-64	WAIVED BY R.L. FREE	9-15-64
						VERIFIED BY USAF	DATE
						R.H. McNamee	9/15/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 207540-401 SHEET 138 OF 180

7.3.3.2.6 Explosive Atomosphere Test (reference paragraph 7.3.3.1)

The propellant valves were tested at the following pressure altitudes for explosion producing characteristics. YES (Yes or No)

Pressure Altitude (feet)	The Propellant valves passed the test (Yes or No)
Sea level to 5000	YES
5000 to 15000	YES
15000 to 25000	YES
25000 to 35000	YES
35000 to 45000	YES.
45000 to 55000	YES.

Inspection Remarks

REF PAGE 132 PAR. 7.3.3.1.7

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	4/15/64		9/14/64		9-18-64	R. L. Frue	9/19/65
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 207540-401 SHEET 139 OF 180

7.3.3.2.7 Propellant Valve Proof Pressure and Leakage Test (reference paragraph 6.1)

Proof Pressure	Oxidizer Valve	Fuel Valve
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

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PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	7-10-64	E. Jones	9/10/64	J. P. Murchison	9/19/64	R. L. Free	9/19/64
EA	4/15/64					VERIFIED BY USAF	DATE
						Robert M. Myers	9/19/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 207540-401 SHEET 140 OF 180

7.3.3.2.8 Propellant Valve Electrical Resistance Test (reference paragraph 6.3)

Environmental Temperature 70.5 (70 ±10F)

Resistance A - B

Oxidizer Valve 43.4 ohms (Acceptable per Figure 11, yes or no yes).

Fuel Valve 41.7 ohms (Acceptable per Figure 11, yes or no yes).

Resistance C - D (1.0 maximum)

Oxidizer Valve 0.14 ohms

Fuel Valve 0.10 ohms

Inspection Remarks

None

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams EA	4/15/64	DC Jones	9/19/65	J. Henderson	9/19/64	R. L. Free	9/16/64
						VERIFIED BY USAF	DATE
						Robert M Myers	9/14/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 207540-401 SHEET 141 OF 180

7.3.3.2.9 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	87	500	73
C to Ground	500	20	500	21
A to C	500	22	500	19

Inspection Remarks

None

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams EA	4/15/64	DC Jones	9/19/64	J.H. Murchison	9/19/64	R.L. Free	9/19/64
						VERIFIED BY USAF	DATE
						Robert M Ayers	9/19/64

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

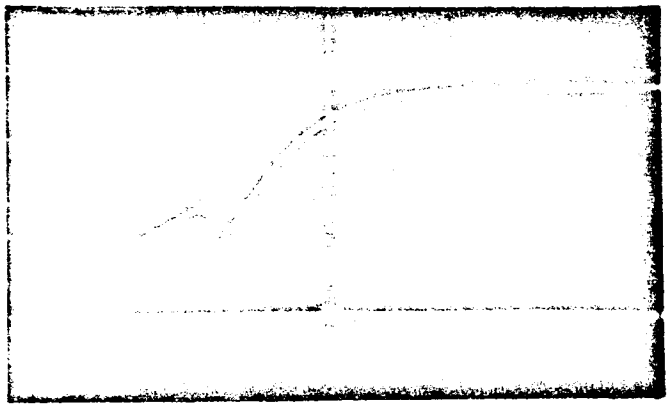
PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
J.Lally	595397	ENV.LAB.	2061	9-19-64

PART	PART NO	TYPE OF TEST
100# OAMS TCA UNIT #3	207540-21 S/N 4054759	POST EXPLOSIVE ATMOSPHERE FUNCTIONAL

OXIDIZER VALVE

P/N 407561 S/N 3722092

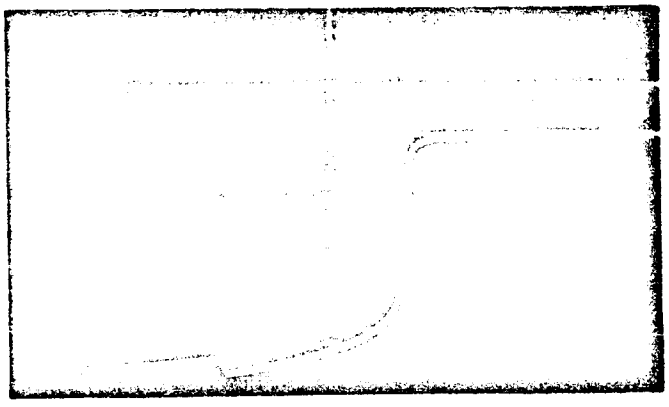
CURRENT TRACE
(OPENING TIME)



Horizontal = 5 ms/cm
Vertical = 20 mv/cm

Requirement = 0.021 sec/max
Actual = 0.016 sec

VOLTAGE TRACE
(CLOSING TIME)



Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = 0.075 sec/max
Actual = 0.069 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
J. Lally	595397	ENV.LAB.	2061	9-19-64

PART	PART NO.	TYPE OF TEST
100# OAMS TCA UNIT #3	207540-21 S/N 4054759	POST EXPLOSIVE ATMOSPHERE FUNCTIONAL

FUEL VALVE

P/N 407662 S/N 9183322

CURRENT TRACE
(OPENING TIME)

Horizontal = 5 ms/cm
Vertical = 200 mv/cm

Requirement = 0.021 sec/max
Actual = 0.017 sec

VOLTAGE TRACE
(CLOSING TIME)

Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = 0.075 sec/max
Actual = 0.066 sec

R-15019-2

Form 600-V-67 New 10-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 207540-401 SHEET 142 OF 180

7.3.3.2.10 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 (0.021 maximum)	0.016 seconds	0.017 seconds
Inlet Pressure (zero for "drop-out"	ZERO psig	ZERO psig
Closing Time (0.075 maximum)	.069 seconds	.066 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)	11.75 VDC	11.75 VDC
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Voltage (1.0 minimum)	1.3 VDC	1.46 VDC

Inspection Remarks

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams EA	4/15/64 7-10-64	D C Jones	9/19/64	J. H. Murdison	9/18/64	R. L. Tree	9/10/64
						VERIFIED BY USAF Robert M. Myers	9/14/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO 207540-401 SHEET ___ OF ___

IL 4388-5374

Deviation Request:

During the operation of paragraph 7.3.4.1.6, it will be necessary to record the current trace for the propellant valve opening response and the voltage trace for the propellant valve closing response. This will be accomplished by use of an oscillograph. These recordings will be monitored for the 8-hour cycles that occur during the first two working shifts. This will be incorporated in the remaining portion of the resistance testing as soon as possible.

Recopied from original request dated 2 October 1964.

James D. Mavrogenis
MAC Engineering

12-8-64

R. Cole
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5375

Deviation Request:

It is hereby authorized to extend the MMH Resistance test on the fuel propellant valve on additional 8 hours as a power failure on 11 October 1964 caused an 8 hour actuation to be missed and a loss of environmental temperature.

Recopied from Original request dated 12 October 1964.

James D. Mavrogenis
12-8-64

R. Cole

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-42701-277 / NAA 207540-21

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO 207540-401 SHEET ___ OF ___

IL 4388-5376

Deviation Request:

It is hereby authorized to extend the NTO Resistance testing on additional 16 hours. This was due as one 8 hour cycle had a loss of temperature (10-11-64) and another 8 hour cycle a system leak caused a loss of pressure (10-12-65).

Recopied from original request dated 16 October 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-8-64

R. Cole
R.Cole
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5377

Deviation Request:

It is hereby authorized to accept the decontamination procedure as done on the propellant valves for the resistance testing, any deviations on this procedure were due to equipment problems.

Recopied from original request dated 16 October 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-9-64

R. Cole
R. Cole
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 207540-401 SHEET ___ OF ___

IL 4388-5378

Deviation Request:

Post Functionals (paragraph 6.5.6.4.6.1) on the Oxidizer and Fuel Resistance test will be run straight through on each valve. This will expedite the high environmental temperature requirement.

Recopied from original request dated 19 October 1964.

James D. Mavrogenis
MAC Engineering

R. Cole
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST: FUEL AND OXIDIZER RESISTANCE TEST NO. 207540-401 SHEET 143 OF 180

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.2.3.18 & 19

7.3.4 Fuel and Oxidizer Resistance - TCA #3

7.3.4.1 Test Procedure

7.3.4.1.1 Install the oxidizer propellant valve as shown in Figure 14. Close Valve V_{10}.

7.3.4.1.2 Attach to the inlet of Valve V_{10} a Nitrogen Tetroxide propellant supply.

7.3.4.1.3 Adjust the propellant supply pressure to 150 ±15 psig.

7.3.4.1.4 Open Valve 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.

7.3.4.1.5 Adjust the environmental temperature to 160 ±5F. 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).

7.3.4.1.6 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).

7.3.4.1.7 Repeat paragraph 7.3.4.1.6 three times daily at equally spaced intervals during the two week exposure period.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
7-10-64 E. Adams	4/15/64		4-18-64		
CHECKED BY:	DATE				
	4/17				

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 207540-401 SHEET 144 OF 180

7.3.4.1.8 At the end of the two week period close Valve V_{10} and record the date and the time on the data sheet.

7.3.4.1.9 Attach a GN_2 supply to the inlet of Valve V_{10}. Open Valve 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 de-energize the propellant valve. Close Valve V_{10} and disconnect the GN_2 supply.

7.3.4.1.10 Attach a Freon TF supply to the inlet of Valve V_{10}. Open Valve 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 de-energize the propellant valve. Close Valve V_{10} and disconnect the Freon TF supply. Repeat paragraph 7.3.4.1.9.

7.3.4.1.11 Remove the propellant valve from the test setup.

7.3.4.1.12 Perform Propellant Valve Electrical Resistance per paragraph 6.3 on the oxidizer propellant valve.

7.3.4.1.13 Perform Propellant Valve Functional per paragraph 6.5 on the oxidizer propellant valve at the temperature of paragraph 7.3.4.1.5.

7.3.4.1.14 Perform Propellant Valve Dielectric Strength per paragraph 6.4 on the oxidizer propellant valve at the temperature of paragraph 7.3.4.1.5.

7.3.4.1.15 Perform Propellant Valve Proof Pressure and Leakage per paragraph 6.1 on the oxidizer propellant valve at the temperature of paragraph 7.3.4.1.5.

PREPARED BY: E. Adams	DATE 4/15/64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 4/17	4-18-64			

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 207540-401 SHEET 145 OF 180

7.3.4.1.16 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 7.3.4.1.5. Refer to Figure 15 for test setup.

7.3.4.1.17 Repeat paragraphs 7.3.4.1.12 through 7.3.4.1.15 except that the environmental temperature of paragraph 7.3.4.1.5 shall be changed to $15 \pm^{5}_{0}$ F.

7.3.4.1.18 Repeat paragraphs 7.3.4.1.1 through 7.3.4.1.17 on the fuel propellant valve except that the propellant as specified in paragraph 7.3.4.1.2 shall be Monomethyl Hydrazine and that the flushing fluid as specified in paragraph 7.3.4.1.10 shall be alcohol.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
E. Adams	7-22-64				
CHECKED BY:	DATE				
[illegible]	8-11-64	[illegible]	8-13-64		

FORM 608-B-38 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 207540-401 SHEET 146 OF 180

7.3.4.2 Test Data - TCA #3

7.3.4.2.1 Component Identification

Component Name	TCA	Oxidizer Valve	Fuel Valve
McDonnell Part No.	52-52701-277		
Rocketdyne Part No.	207540-21	407661	407662
Component Serial No.	4054759	3722092	9183322

7.3.4.2.2 Fuel and Oxidizer Resistance Test (reference paragraph 7.3.4.1)

	Oxidizer Valve	Fuel Valve	
Start of Exposure (date and time)	L Rogers 10/1/64 12 Noon	9-29-64	00.00
Environmental Temp. (160 ±5)	160 ±5 F	160 ±5 F	
Propellant Temp. (160 ±5)	160 ±5 F	160 ±5 F	
End of Exposure (date and time)	10-15-64 10:30 PM	10-13-64 - 08:30	

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PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	7-10-64	R H Maag	10/16/64	S B Green	10/10/64	waived by [illegible]	10/16/64
EA	4/15/64					VERIFIED BY USAF	DATE
						[illegible]	10/16/64

FORM 608-B-39 NEW 6-63

R-15019-2

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21-401

NAME OF TEST: FUEL AND OXIDIZER RESISTANCE TEST NO. 207540 SHEET 147 OF 180

7.3.4.2.2 (cont'd) Oxidizer valve actuation checkoff

Date	8AM	4PM	12PM	Oscillograph 8AM	Oscillograph 4PM
1 10/1 9-27-64				26811	26817
2 10-2-64				26821	26825
3 10-3-64				26829	26837
4 10-4-64				26842	26849
5 10-5-64				26853	26857
6 10-6-64				26863	26867
7 10-7-64				26876	26876
8 10-8-64				26880	26885
9 10/9/64					
10 10/10/64					
11 10/11/64					
12 10/12/64					
13 10/13/64					
14 10/14/64					
15 10/15/64					
16 10/16/64					

Fuel Valve actuation checkoff

Calb Oscillograph starts Record No NTO 26806

Calb Oscillograph starts Record No HMH 7559

Date	8AM	4PM	12PM	Oscillograph 8AM	Oscillograph 4PM
1 9-27-64					
2 9-30-64					
3 10-1-64					
4 10-2-64					
5 10-3-64					
6 10-4-64					
7 10-5-64					
8 10/6/64					3308
9 10/7/64				3312	3319-20
10 10/8/64				3325	3333
11 10/9/64				3337	7559
12 10/10/64				7563	7568
13 10/11/64				Recorder Line	7576
14 10/12/64				7581	7586
15 10/13/64				7590	

Inspection Remarks

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	7-10-64	RH Moy	10/16/64		10/10/64	Called by	
	4/15/64					VERIFIED BY USAF	DATE
							10/ 64

FORM 608-B-39 NEW 6-63

*void

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST: FUEL AND OXIDIZER RESISTANCE TEST NO. 207540-401 SHEET 148 OF 180

7.3.4.2.3 Propellant Valve Electrical Resistance Test (reference paragraph 6.3)

Environmental Temperature 72°F (70 ±10F).

Resistance A - B

Oxidizer Valve 44.02 ohms (Acceptable per Figure 11, yes or no YES).

Fuel Valve 41.82 ohms (Acceptable per Figure 11, yes or no YES).

Resistance C - D (1.0 maximum)

Oxidizer Valve .36 ohms

Fuel Valve .05 ohms

Inspection Remarks

NONE 19 Oct 64

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	7-10-64				19/Oct/64	R. L. FREE	19/Oct/64
	4-15-64					VERIFIED BY USAF	DATE 19/Oct/64

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
L. Cracraft	595397	ENV.LAB.	2061	10-19-64

PART	PART NO.	TYPE OF TEST
100# OAMS TCA UNIT #3	207540-21 S/N 4054759	FUNCTIONAL-POST OXID.RESISTANCE

ENVIRONMENTAL TEMPERATURE 160F

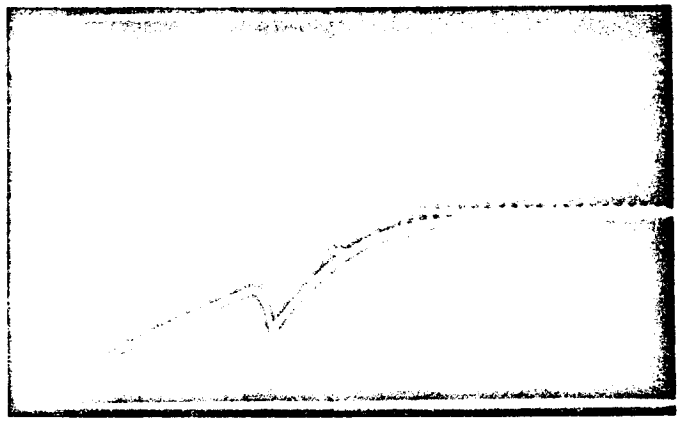
OXIDIZER VALVE

P/N 407561 S/N 3722092

CURRENT TRACE
(OPENING TIME)

Horizontal = 5 ms/cm
Vertical = 20 mv/cm

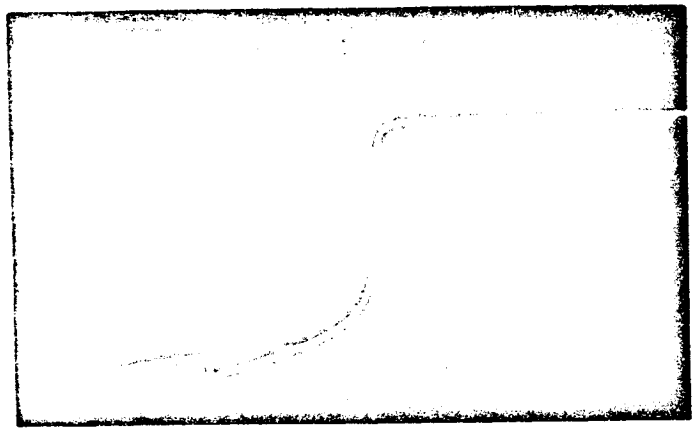
Requirement = 0.021 sec/max
Actual = 0.019 sec



VOLTAGE TRACE
(CLOSING TIME)

Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = 0.075 sec/max
Actual = 0.056 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
L.Cracraft	595397	ENV.LAB.	2061	10-19-64

PART	PART NO.	TYPE OF TEST
100# OAMS TCA UNIT #3	207540-21 S/N 4054759	FUNCTIONAL-POST FUEL RESISTANCE

ENVIRONMENTAL TEMPERATURE 160F

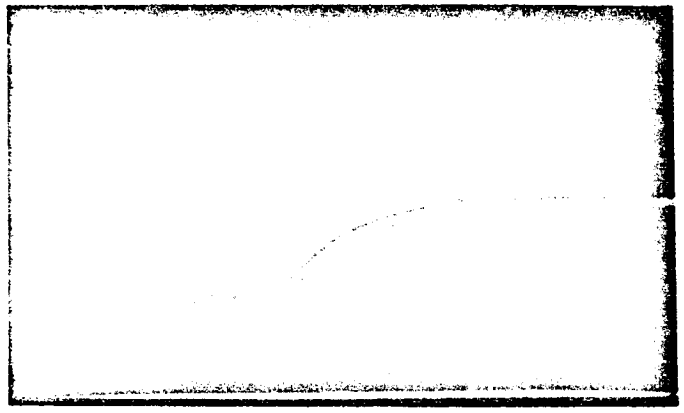
FUEL VALVE

P/N 407662 S/N 9183322

CURRENT TRACE
(OPENING TIME)

Horizontal = 5 ms/cm
Vertical = 20 mv/cm

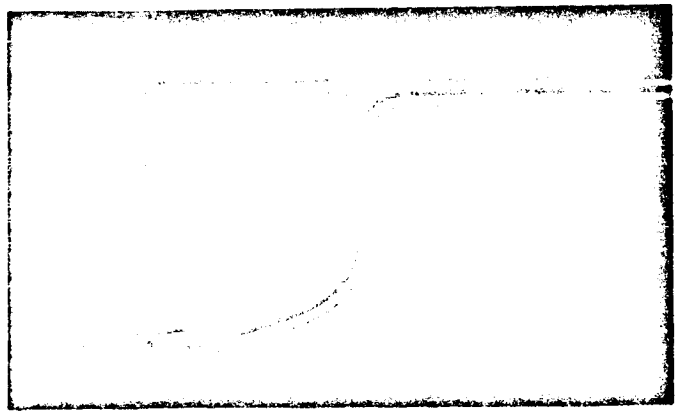
Requirement = 0.021 sec/max
Actual = 0.018 sec



VOLTAGE TRACE
(CLOSING TIME)

Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = 0.075 sec/max
Actual = 0.054 sec



Form 600-V-67 Rev 10-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 207540-401 SHEET 149 OF 180

7.3.4.2.4 Propellant Valve Functional Test (reference paragraph 6.5)

	Oxidizer Valve	Fuel Valve
Response Time		
High Temperature (160 ±5)	ANR 941 160° F	ANR 941 160° F
Energizing Voltage (26 ±0.5)	ANR 941 26.0 VDC	ANR 941 26.0 VDC
Inlet Pressure (300 ±10 "pull-in")	ANR 941 300 psig	ANR 941 300 psig
Opening Time (0.021 maximum)	ANR 941 0.019 seconds	ANR 941 0.018 seconds
Inlet Pressure (zero for "drop-out")	ANR 941 ZERO psig	ANR 941 ZERO psig
Closing Time (0.075 maximum)	ANR 941 0.056 seconds	ANR 941 0.054 seconds
Low Voltage Operation		
High Temperature (160 ±5)	ANR 941 160° F	ANR 941 160° F
Inlet Pressure (300 ±10 for "pull-in")	ANR 941 300 psig	ANR 941 300 psig
Opening Voltage (16 maximum)	ANR 941 14.8 VDC	ANR 941 13.5 VDC
Inlet Pressure (zero for "drop-out")	ANR 941 ZERO psig	ANR 941 ZERO psig
Closing Voltage (1.0 minimum)	ANR 941 1.70 VDC	ANR 941 1.75 VDC

Inspection Remarks

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
EA E. Adams	4/15/64 7-10-64	L Cracraft	10-19-64	[illegible] ANR 941	19/Oct/64	LEAVED BY ROGER FREE	19/Oct/64
						VERIFIED BY USAF	DATE 19/Oct/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 207540-401 SHEET 150 OF 180

7.3.4.2.5 Propellant Valve Dielectric Strength Test (reference paragraph 6.4)

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 $\pm^{10}_{0}$	Current Microamps 500 max.	Voltage Volts 500 $\pm^{10}_{0}$	Current Microamps 500 max.
A to Ground	ANR 941 500	ANR 941 96 ua	ANR 941 76 ua	ANR 941 500 V
C to Ground	ANR 941 500	ANR 941 18 ua	ANR 941 18 ua	ANR 941 500 V
A to C	ANR 941 500	ANR 941 17 ua	ANR 941 8 ua	ANR 941 500 V
High Temp. (160 ±5F)	ANR 941 160°F		ANR 941 160°F	

Inspection Remarks

NEW ANR 941 ABOVE READINGS FOR FUEL VALVE (VOLTAGES & CURRENTS) ARE TRANSPOSITIONED ANR 941

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams EA	4/15/64 7-10-64	[illegible]	10-19-64	[illegible] ANR 941	19/Oct/64	[illegible]	ANR 941
						VERIFIED BY USAF [illegible]	19/Oct/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 207540-401 SHEET 151 OF 180

7.3.4.2.6 Propellant Valve Proof Pressure and Leakage Test (reference paragraph 6.1)

	Oxidizer Valve	Fuel Valve
High Temperature (160 ±5F)	160° F	160° F
Proof Pressure		
Pressure (500 $^{+10}_{-0}$)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
Leakage Voltage (26±0.5)	26.0 VDC	26.0 VDC
Inlet Pressure (500 $^{+10}_{-0}$)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate	< 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
E. Adams	7-10-64	[illegible]		[illegible]	19/Oct/64	Roger Free	19/Oct/64
EA	4/15/64					VERIFIED BY USAF	DATE
						[illegible]	19/Oct/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 207540-401 SHEET 152 OF 180

7.3.4.2.7 Propellant Valve Load Analysis Test - Oxidizer Valve (reference paragraph 6.9) ANR 941

Oxidizer valve body temp. 160 (160±5) F.

GN_2 supply pressure 295 (~~290~~ 300 ±10) psig. ANR 941

Power consumption (steady state)

	Current	Voltage	Power	
20 VDC	.385	20.0	7.7	
22 VDC	.430	22.0	9.46	(20 watts maximum)
24 VDC	.460	24.0	11.04	(20 watts maximum)
26 VDC	.510	26.0	13.26	(20 watts maximum)
28 VDC	.560	28.0	15.68	(20 watts maximum)
30 VDC	.610	30.0	18.30	(20 watts maximum)
33 VDC	.650	33.0	21.45	

Inspection Remarks

NONE ANR 941

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	7-10-64	[illegible]	10-20-64	[illegible]	20/Oct/64	SAVED BY R. L. FREE	20/Oct/64
[illegible]	4/15/64					VERIFIED BY USAF	20/Oct/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 207540-401 SHEET 153 OF 180

7.3.4.2.8 Propellant Valve Load Analysis Test-Fuel Valve (reference paragraph 6.9)

Fuel valve body temp. 160 (160 ±5) F.

GN_2 supply pressure 295 (290 ±10) psig.

Power consumption (steady state)

	Current	Voltage	Power	
20 VDC	.382	20.0	7.64	
22 VDC	.430	22.0	9.41	(20 watts maximum)
24 VDC	.460	24.0	11.04	(20 watts maximum)
26 VDC	.500	26.0	13.00	(20 watts maximum)
28 VDC	.550	28.0	5.40	(20 watts maximum)
30 VDC	.600	30.0	8.00	(20 watts maximum)
33 VDC	.640	33.0	21.12	

Inspection Remarks

NONE

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	4/15/64 7-10-64	[illegible]		[illegible]	20/Oct/64	[illegible]	20/Oct/64
						VERIFIED BY USAF	20/Oct/64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 207540-401 SHEET 154 OF 180

7.3.4.2.9 Propellant Valve Electrical Resistance Test (reference paragraph 6.3)

Environmental Temperature 70 (70 ±10F).

Resistance A - B

Oxidizer Valve 40.82 ohms (Acceptable per Figure 1, yes or no YES)

Fuel Valve 41.42 ohms (Acceptable per Figure 1, yes or no YES)

Resistance C - D (1.0 maximum)

Oxidizer Valve .10 ohms

Fuel Valve .07 ohms

Inspection Remarks

NONE 10-21-64

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	7-10-64	F. E. Pope	10-21-64	G Kaye	10-21-64	WAIVED BY JIM MAVRUGENIT BY E ADAMS	
EA	4/15/64					VERIFIED BY USAF	DATE
						RL McNamee	10/21/64

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

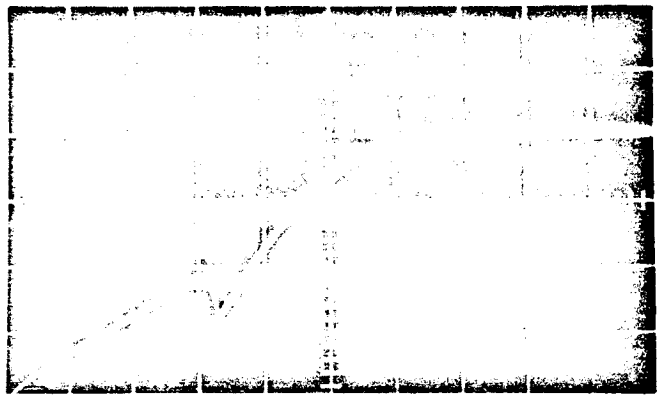
PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F. Pope	595397	ENV.LAB	2061	10-21-64
PART	**PART NO.**	**TYPE OF TEST**		
100# OAMS TCA UNIT #3	207540-21 S/N 4054759	FUNCTIONAL-POST OXID. RESISTANCE		

ENVIRONMENTAL TEMPERATURE 15F

OXIDIZER VALVE

P/N 407561 S/N 3722092

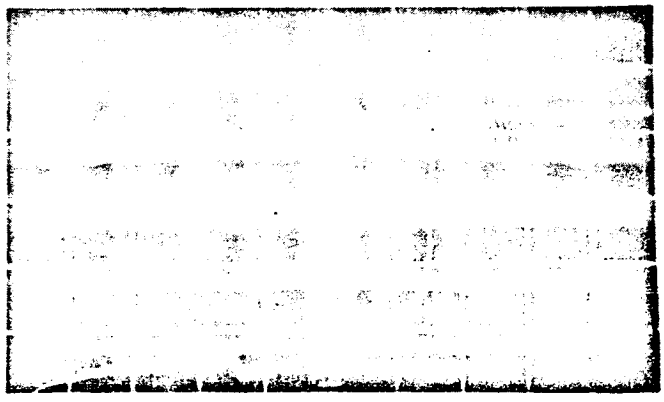
CURRENT TRACE
(OPENING TIME)



Horizontal = 5 ms/cm
Vertical = 20 mv/cm

Requirement = 0.021 sec/max
Actual = 0.0163 sec

VOLTAGE TRACE
(CLOSING TIME)



Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = 0.075 sec/max
Actual = 0.072 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	595397	ENV.LAB.	2061	10-21-64
PART	**PART NO.**	**TYPE OF TEST**		
100# OAMS TCA UNIT #3	207540-21 S/N 4054750	FUNCTIONAL-POST OXID.RESISTANCE		

ENVIRONMENTAL TEMPERATURE 15F

FUEL VALVE

P/N 407662 S/N 9183322

CURRENT TRACE
(OPENING TIME)

Horizontal = 5 ms/cm
Vertical = 20 mv/cm

Requirement = 0.021 sec/max
Actual = 0.0165 sec

VOLTAGE TRACE
(CLOSING TIME)

Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = 0.075 sec/max
Actual = 0.072 sec

Form 600-V-67 New 10-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - [illegible] PART NO. MAC 52-52701-277 / NAA 20754[illegible]

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 207540-40[illegible] SHEET [illegible] OF [illegible]80

7.3.4.2.10 Propellant Valve Functional Test (reference paragraph 6.5)

	Oxidizer Valve	Fuel Valve
Response Time		
Low Temperature (15 $^{+5}_{-0}$F)	18 F	15 F
Energizing Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Time (0.021 maximum)	.01625 seconds	.0165 seconds
Inlet Pressure (zero for "drop-out")	Zero psig	Zero psig
Closing Time (0.075 maximum)	0.072 seconds	.072 seconds
Low Voltage Operation		
Low Temperature (15 $^{+5}_{-0}$F)	15 F	15 F
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Voltage (16 maximum)	10.8 VDC	10.5 VDC
Inlet Pressure (zero for "drop-out)	Zero psig	Zero psig
Closing Voltage (1.0 minimum)	1.17 VDC	1.25 VDC

Inspection Remarks

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	7-10-64	L Cracraft	10-21-64	J. F. Murchison	10/21/64	Waved By J. Mavrogenius	10-21-64
Et	4/15/64					VERIFIED BY USAF	DATE
							21 Oct 64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. [illegible]-52701-277

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. [illegible] SHEET [illegible] OF 150

7.3.4.2.11 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	103	500	78
C to Ground	500	25	500	27
A to C	500	13	500	13
Low Temp. (15^{+5}_{-0} F)	15°		15°	

Inspection Remarks

None 10-21-64

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NA.	DATE	CERTIFIED FOR MCDONNELL
E. Adams	4/15/64	F. E. Pope	10-21-64	J. P. Murchison	10/21/64	Waived by J. Marrogenias 10/21/64
	7-[illegible]					VERIFIED BY USA 10-21-64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 207540-401 SHEET 157 OF 180

7.3.4.2.12 Propellant Valve Proof Pressure and Leakage Test (reference paragraph 6.1)

Low Temperature 15 $^{+5}_{-0}$ F 15 (ANR 70) 15 F (ANR 70)

Proof Pressure	Oxidizer Valve	Fuel Valve
Pressure (500 $^{+10}_{-0}$)	500 (ANR 70) psig	500 psig (ANR 70)
Time Duration (3 minimum)	3 (ANR 70) minutes	3 minutes (ANR 70)
Leakage Voltage (26±0.5)	26 (ANR 70) VDC	26 VDC (ANR 70)
Inlet Pressure (500 $^{+10}_{-0}$)	500 (ANR 70) psig	500 psig (ANR 70)
Time Duration (5 minimum)	5 (ANR 70) minutes	5 minutes (ANR 70)
Leakage Rate (2.23 maximum)	.3 (ANR 70) scc He/min	Zero scc He/min (ANR 70)

Inspection Remarks

None 10-21-64 (ANR 70)

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	7-10-64	F. E. Pope	10-21-64	J. P. Murchison (ANR 70)	10/21/64	Waived by J. Mavrogenes (ANR 70)	10-21-64
EA	4/15/64					VERIFIED BY USAF	DATE
						[illegible]	10-21-64

FORM 608-B-39 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207540-101 SHEET 158 OF 180

REFERENCE: MAC SCD 52-52701, Revision F, Paragraph 6.2.3.20

7.3.5 Disassembly and Inspection

7.3.5.1 Test Procedure

7.3.5.1.1 Prior to sectioning the TCA perform a visual inspection and record the post test condition of the TCA.

7.3.5.1.2 Section the TCA by cutting along line C-D-E as depicted in Figure 16.

7.3.5.1.3 Perform visual inspection of all detailed parts for evidence of damage, distortion, fluid incompatability, corrosion, broken parts and impending failure.

7.3.5.1.4 After test completion identify the sectioned TCA and detailed parts and package and store for reference.

7.3.5.1.5 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 407661 (Fuel Seat Assembly P/N 407660) shall not be removed at this time.

7.3.5.1.6 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 5-28139-T1 shall not be removed at this time.

7.3.5.1.7 Remove, bag and identify the seat assembly.

7.3.5.1.8 Remove, bag and identify the armature P/N 407564.

C

C

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
D. Cole					
CHECKED BY:	DATE				
	10-28-64		10-28-64		

FORM 608-B-38 NEW 6-63

Rev. C J.D. Morgan Date 11/9/64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207540-401 SHEET 158 OF 180

7.3.5.1.9 Remove, bag and identify the spring P/N 406816.

7.3.5.1.10 Remove, bag and identify the filter assembly.

7.3.5.1.11 Bag and identify the solenoid assembly.

7.3.5.1.12 Repeat 7.3.5.1.5 thru 7.3.5.1.11 for the fuel propellant valve.

NOTE: Only authorized personnel shall have access to stored DAT hardware.

PREPARED BY: D. Cole	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: [signature]	DATE 10-28-64	[signature]	10-28-64		

FORM 608-B-38 NEW 6-63

Rev. C J. D. [signature] Date 11/9/64

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ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

EWR 585995

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207540-401 SHEET 159 OF 180

7.3.5.2 Post Test Inspection Data - TCA #1

7.3.5.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-5270 1-277

Rocketdyne Part No. 20754-21

Component Serial No. 4054759

7.3.5.2.2 Preliminary Inspection (Reference Paragraph 7.3.5.1.1)

The TCA was visually inspected prior to sectioning and the TCA condition was as follows:

Nozzle ablative delaminated; throat cracked; Graphite Liner + Sleeve burnt away

7.3.5.2.3 Disassembly and Inspection (Reference Paragraph 7.3.5.1.3)

The TCA was sectioned along line C-D-E and visually inspected. The results of the inspection were as follows:

Ablative material burnt away behind throat.

Cracks thru chamber wall causing distruction of exterior wrappings.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
D. Colsfen	7-2-64	B. C. Reyes 816-1702	12-3-64	W W Ferrier	12-16-64	L.D. Morrisons	12/9/64
						VERIFIED BY USAF	DATE
						** A Chernak	12/17/64

FORM 608-B-39 NEW 6-63

** AFQA was not notifed for verification signatures until disassembly of the TCA was complete.

R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

Eu 2 585995

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207540-401 SHEET 159.1 OF 180

7.3.5.2.4 Disassembly of Propellant Valves (Reference Paragraphs 7.3.5.1.5 thru 7.3.5.1.11). C

The propellant valves were disassembled and all parts called for were bagged and identified. Yes (yes or no).

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
D. Colefin		B. C. Keyes 816-1702	12-3-64	W W Ferries	12-16-64	J. D. Mannerius	12/8/64
						VERIFIED BY USAF	DATE
						** C. Chenard	12/17/64

FORM 608-B-39 NEW 6-63

Rev. C J. D. Mannerius Date 11/9/64

** AFQA was not notifed for verification signatures until disassembly of the TCA was complete

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R-15019-2

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST MINIMUM INSTRUMENTATION REQUIREMENTS - HOT FIRE TESTS TEST NO. 207540-401 SHEET 160 OF 180

TABLE I

MEASUREMENT	RANGE	(3) PRECISION	(1) RESPONSE (SEC)	RECORDER
Main Thrust (5)(6)	0-120 lb	B(±0.5%)	1 ±.25	Null Balance
Main Thrust (2)(5)(6)	0-120 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
Chamber Pressure (4)	0-200 psig	B(±0.5%)	1 ±.25	Null Balance
Chamber Pressure (4)	0-200 psig	Y***	0.001	Oscillograph
Oxidizer Flowmeter Temperature (5)	0-300F	D(±5.0F)		Null Balance
Oxidizer Inlet Temperature (5)	0-300F	D(±5.0F)		Null Balance
Fuel Flowmeter Temperature (5)	0-300F	D(±5.0F)		Null Balance
Fuel Inlet Temperature (5)	0-300F	D(±5.0F)		Null Balance
Oxidizer Flowrate (5)	0.50-2.0 gpm	B(±0.5%)*	1 ±.25	Null Balance
Oxidizer Flowrate (5)	0.50-2.0 gpm	B(±0.5%)*	0.001	Oscillograph
Fuel Flowrate (5)	0.50-2.0 gpm	B(±0.5%)*	1 ±.25	Null Balance
Fuel Flowrate (5)	0.50-2.0 gpm	B(±0.5%)*	0.001	Oscillograph
Oxidizer Valve Current	0-1.0 amp	Y	0.001	Oscillograph
Fuel Valve Current	0-1.0 amp	Y	0.001	Oscillograph
Oxidizer Valve Voltage	0-40 volts	Y**	0.001	Oscillograph
Fuel Valve Voltage	0-40 volts	Y**	0.001	Oscillograph
Local Ambient Pressure	21-40 in Hg	Y		Barometer
Environmental Pressure (Fine)	0.02-0.20 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	0-300F	D(±5.0F)		Null Balance
TCA Wall Temperature (3 Places)	0-1000F	D(±20 F)		Null Balance

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PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
J. Ganger	10-22-64	[signature]	10-22-64		
CHECKED BY: [signature]	DATE 10-22-64				

FORM 608-B-38 NEW 6-63

REVISION C [signature] Dated 10-22-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST MINIMUM INSTRUMENTATION REQUIREMENTS - HOT FIRE TESTS TEST NO 207540-401 SHEET 161 OF 180

TABLE I
(cont'd)

MEASUREMENT	(1) RESPONSE (SEC)	RECORDER	
Start and Cutoff, Pip	0.001 1.0 Max.	Oscillograph and Time Sequence	D
Oscillograph Drive, Pip	1.0 Max.	Time Sequence	D
DIGR Drive, Pip	1.0 Max.	Time Sequence	D

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 except for time sequence. D

(3) Letters designate instrumentation precision category per RA0201-050.

(4) Ranges shall be increased a minimum of 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) Delete for cape cycle tests only. C

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
J. Ganger	10-22-64	[signature]	10-22-64		
CHECKED BY: [signature]	DATE 10-22-64				

FORM 608-B-38 NEW 6-63

REVISION C R. L. Free Dated 10-22-64

REVISION D R. L. Free Dated 11-6-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST MINIMUM INSTRUMENTATION REQUIREMENTS - HOT FIRE TESTS TEST NO. 207540-401 SHEET 161.1 OF 180

TABLE I
(cont'd)

C

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; 0.200, 0.160 and 0.125 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; 0,6,12,24,60,72,84,96,108, 120,108,96,84,72,60,24,12,6 and 0. This shall be followed by a pre and post test 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.

C

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
J. Ganger	10-22-64	[signature]	10-22-64		
CHECKED BY: [signature]	DATE 10-22-64				

FORM 608-B-38 NEW 6-63

Revision C [signature] Dated 10-22-64

R-15019-2

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

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 100#
PART NO. MAC 52-52701-277
NAA 207540-21
NAME OF TEST: DESIGN APPROVAL TEST DUTY CYCLE
TEST NO. 207540-401 SHEET 162 OF 180

TABLE II

PULSE NO.	ON TIME (SEC)	OFF TIME (SEC)	TOTAL ON (SEC) (1)	ELAPSED TIME (MINUTES)	
1	15	183.75 minutes	31	184	
2	150	16.5 minutes	181	203	
3	5	181	186	206.1	
4	16	59	202	207.35	
5	11	558	213	216.85	A
6	5	227	218	220.72	
7 (2)	5	479	223	228.79	A
8	25	10	248	229.37	
9	25	10	273	229.95	
10	10	10	283	230.28	
11	10	10	293	230.61	
12 (3)	10	51	303	231.62	A
13	1	7.5	304	231.76	
14	0.5	2.5	304.5	231.81	
15	95.5		400	233.41	
16 (4)	To catastrophic failure				

(1) Includes 10 seconds of calibration firing time and 6 seconds of simulated Cape Canaveral firing time.

(2) The TCA shall demonstrate specification performance for an accumulative firing time, including calibration and simulated Cape Canaveral firing time of 220. seconds minimum. A

(3) The TCA shall demonstrate operation without catastrophic chamber failure for an accumulative firing time of 300 seconds minimum. A

PREPARED BY: T. G. Kniffin	DATE 9/14/64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 9/16	9-3-64			

FORM 608-B-38 NEW 6-63

Revision A Dated 9-3-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DESIGN APPROVAL TEST DUTY CYCLE TEST NO. 207540-401 SHEET 163 OF 180

TABLE II
(cont'd)

(4) Pulse number 15 is extended, without pause, until catastrophic failure occurs. Catastrophic chamber failure is defined as a condition in which further operation would endanger the spacecraft or crew. Specifically it shall include:

(a) Lack of the capability to stop propellant flow,
(b) Any flow or leakage of propellants or products of combustion from locations other than the TCA exit,
(c) Temperature in excess of 700 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 700 F is not exceeded by the TCA.

PREPARED BY: 7-15-64 DATE	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
T.G. Kniffin 4/14/64	9-3-64	
CHECKED BY: DATE 4-18-64		

FORM 608/B-38 NEW 6-63

R-15019-2

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY-100# PART NO. { MAC 52-52701-277 / NAA 207540-21 }

NAME OF TEST PROPELLANT VALVE ELECTRICAL SCHEMATIC TEST NO. 207540-401 SHEET 164 OF 180

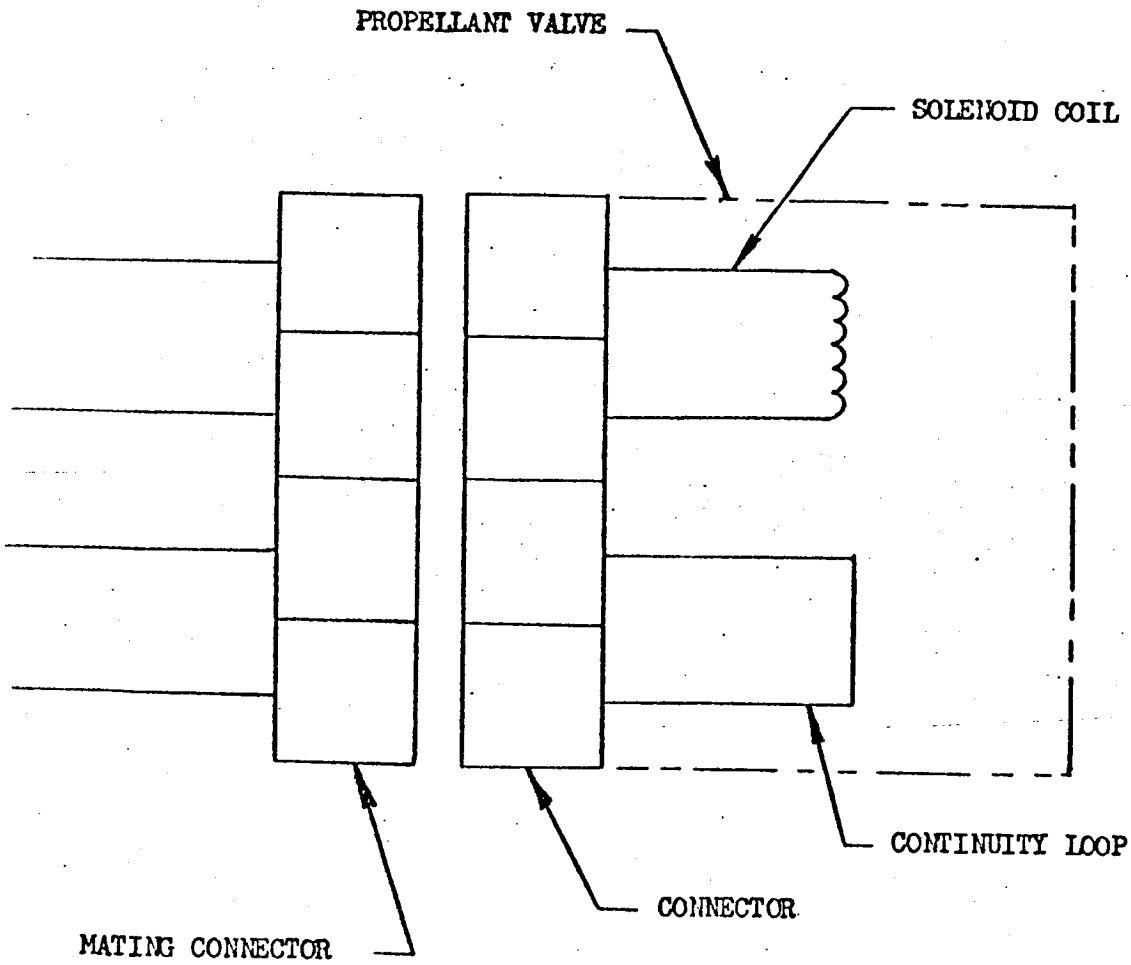

FIGURE 1

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY-100# PART NO. MAC 52-52701-277 / NAA 207540-21

NAME OF TEST PROPELLANT VALVE PROOF PRESSURE AND LEAKAGE TEST NO 207540-401 SHEET 165 OF 180

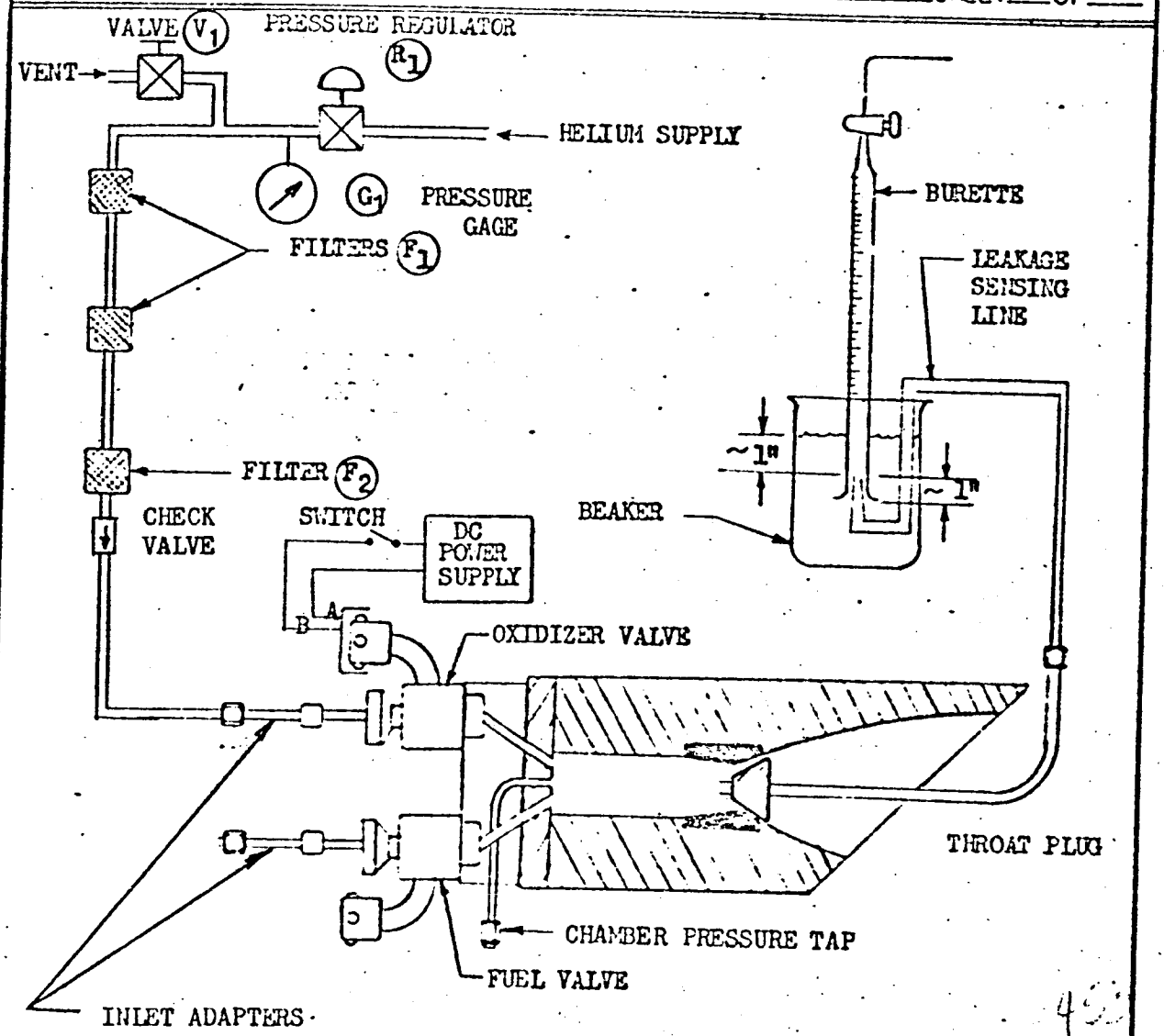


FIGURE 2

FORM 602-8-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY-100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST THRUST CHAMBER PROOF PRESSURE AND LEAKAGE TEST NO 207540-401 SHEET 166 OF 180

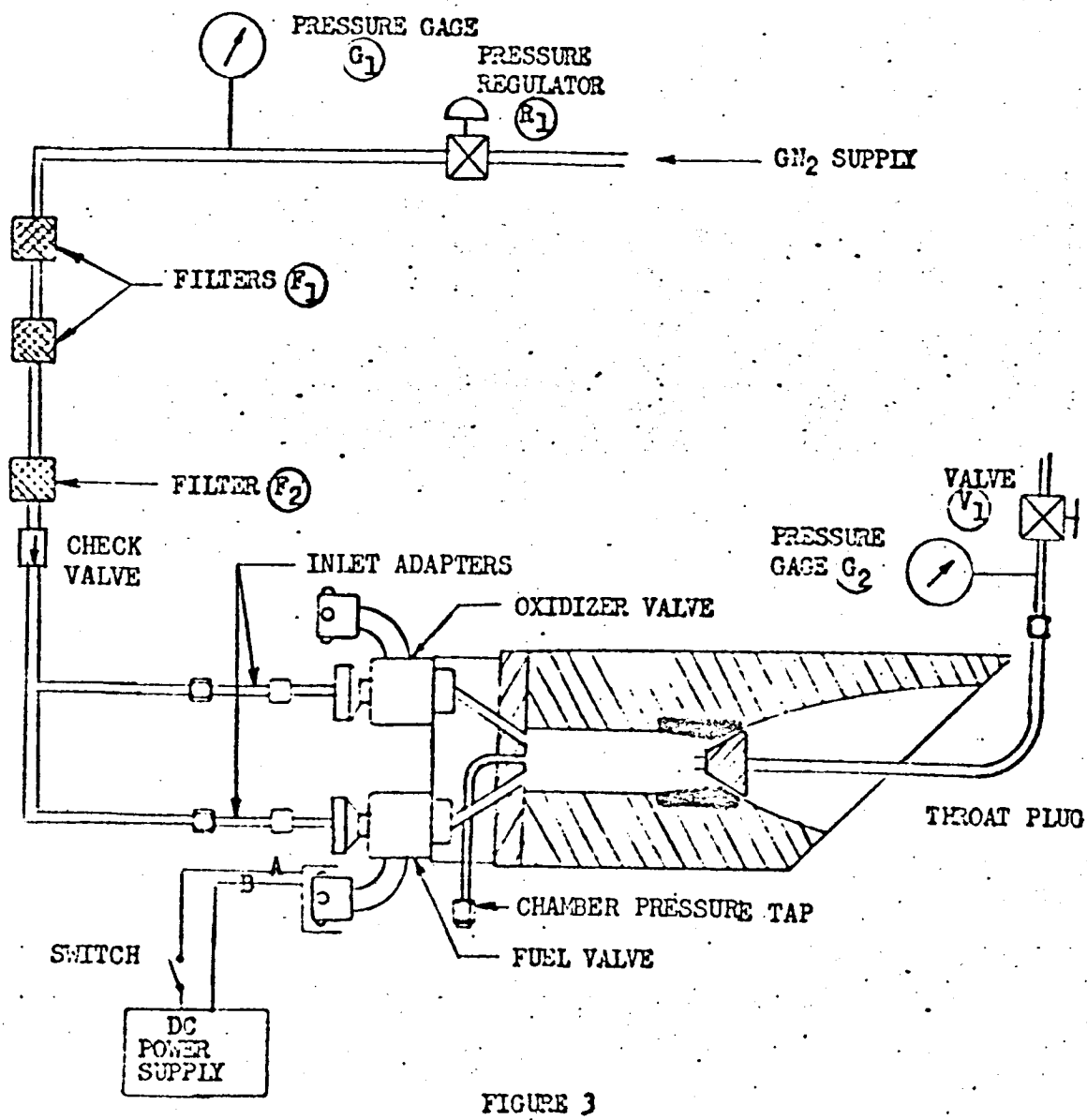


FIGURE 3

FORM 600-B-3, NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY-100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST PROPELLANT VALVE FUNCTIONAL TEST NO. 207540-401 SHEET 167 OF 180

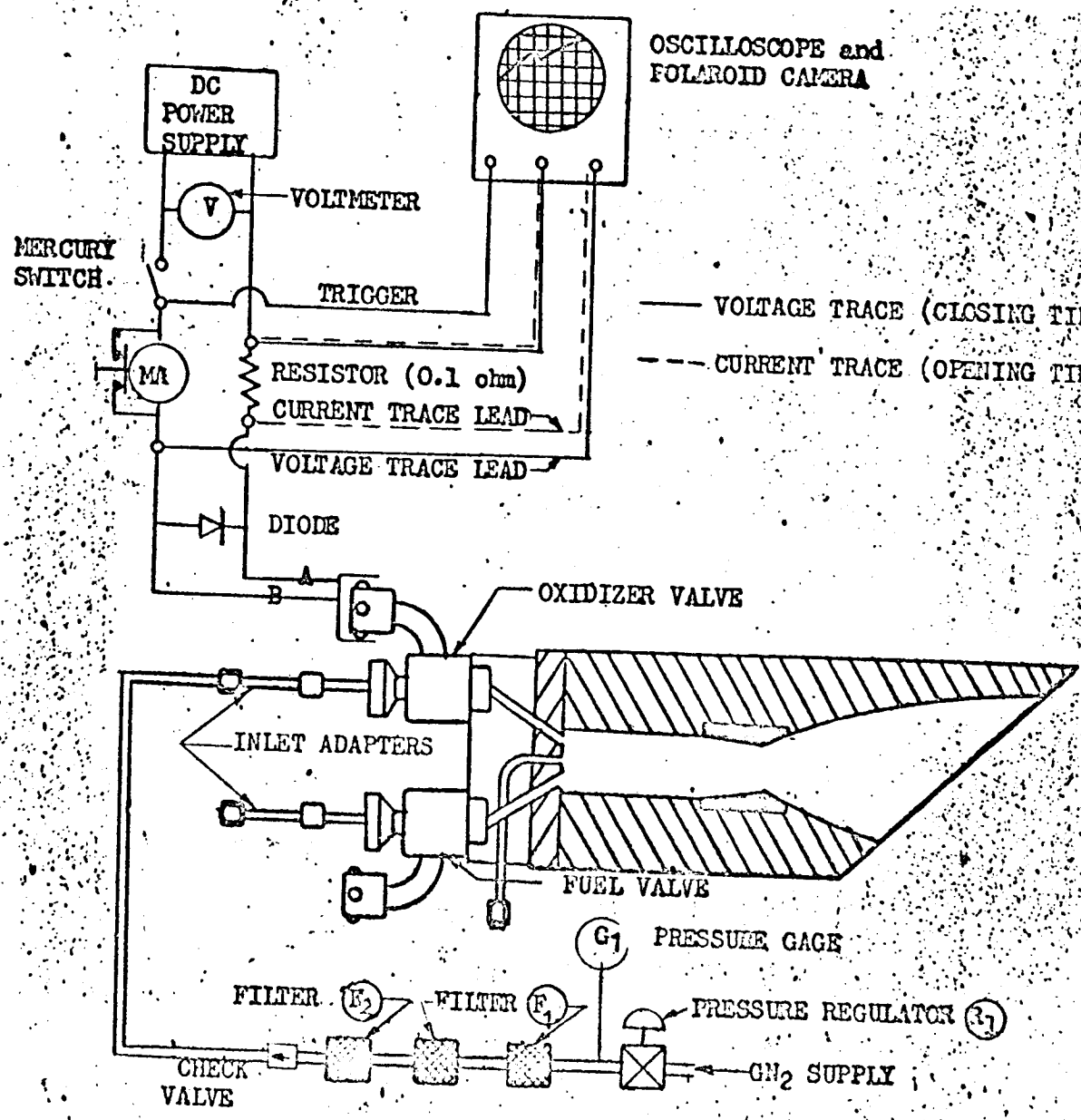


FIGURE 4

7

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST PROPELLANT VALVE VOLTAGE AND CURRENT TRACES TEST NO. 207540-401 SHEET 168 OF 180

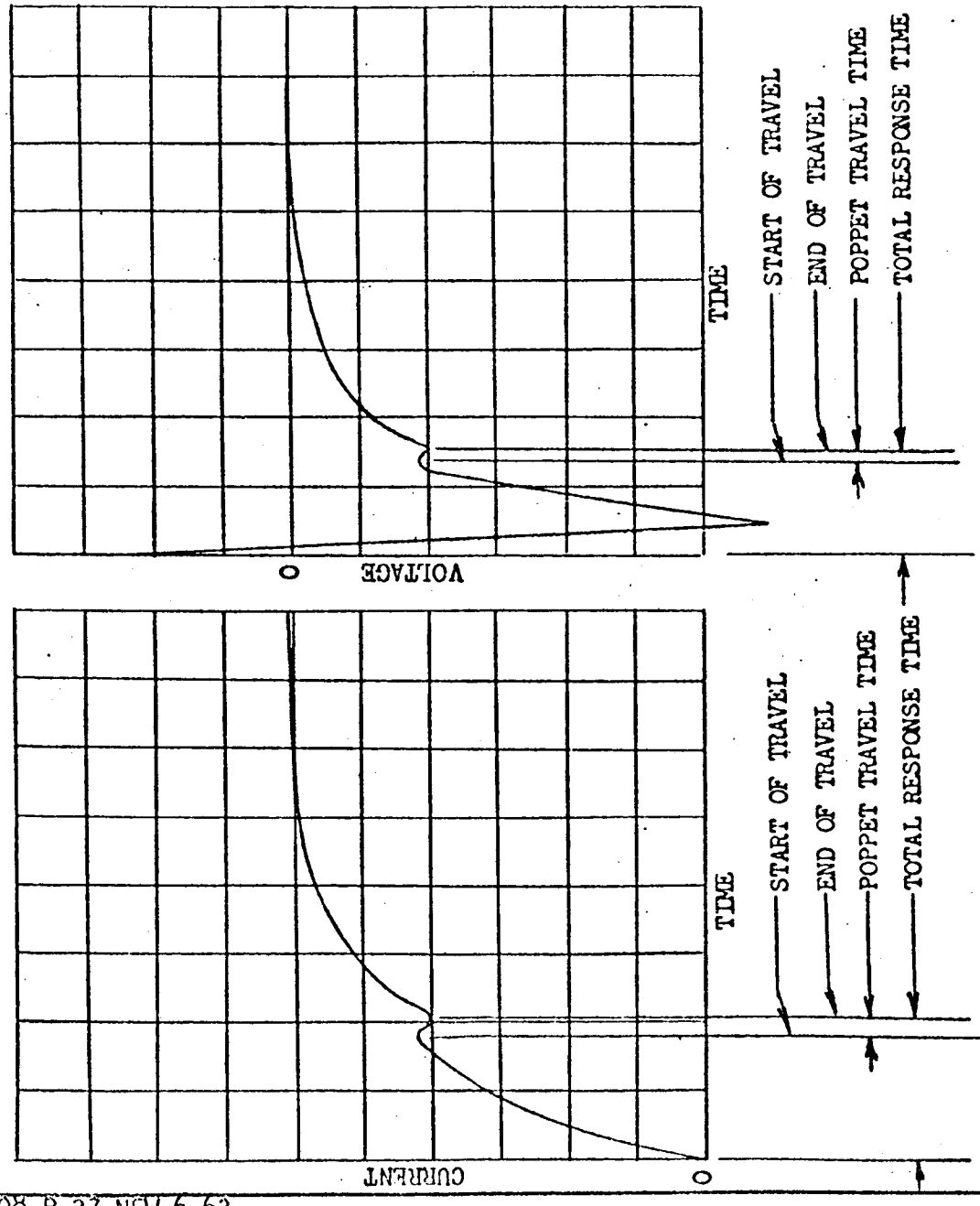


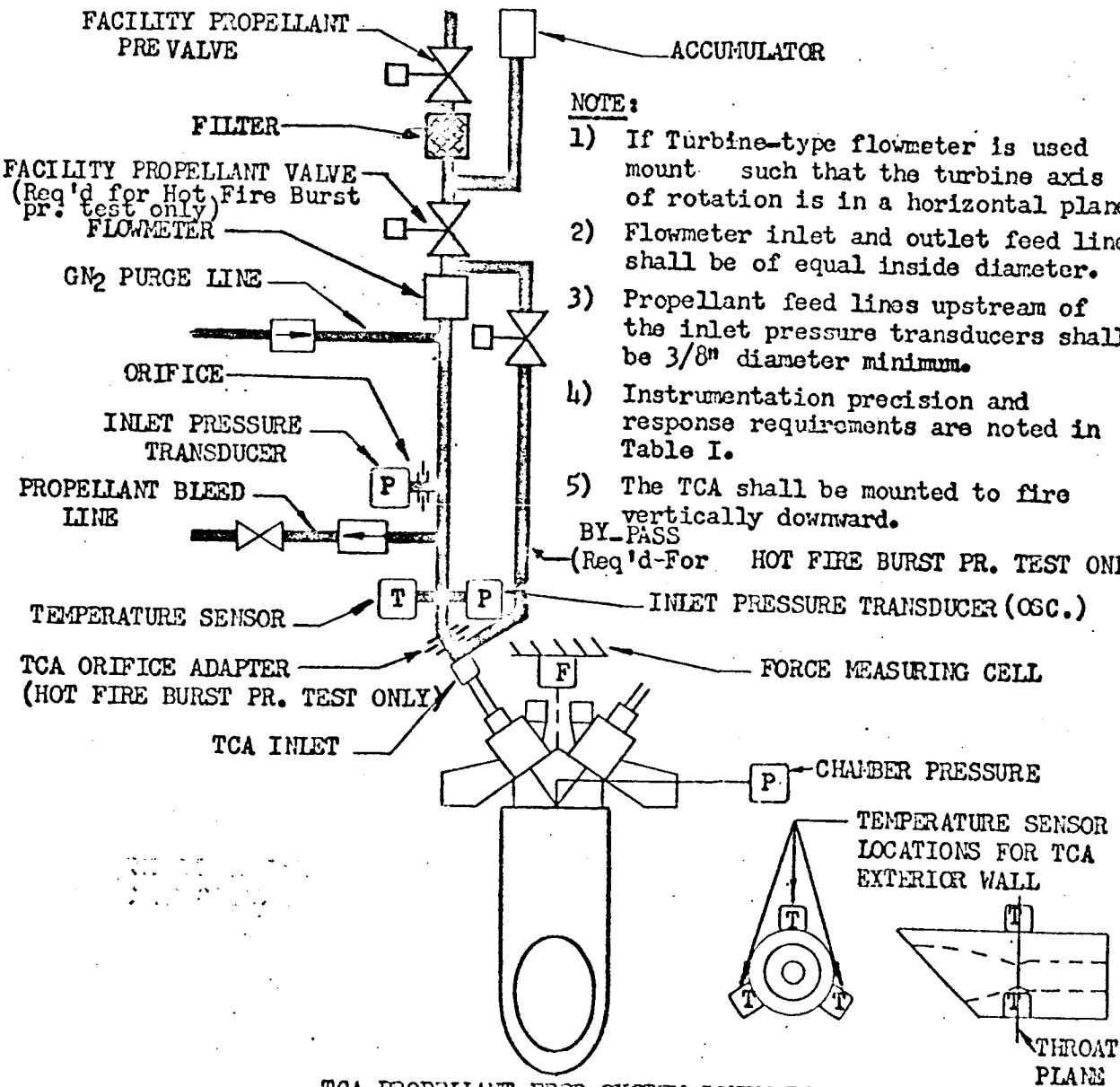
FIGURE 5

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST PROPELLANT FEED SYSTEM TEST NO. 207540-401 SHEET 169 OF 180



NOTE:

1) If Turbine-type flowmeter is used mount such that the turbine axis of rotation is in a horizontal plane. B
2) Flowmeter inlet and outlet feed lines shall be of equal inside diameter. C
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. A
5) The TCA shall be mounted to fire vertically downward. A

A
B
A
B

TCA PROPELLANT FEED SYSTEM SCHEMATIC

FIGURE 6

FORM 608-B-37 NEW 6-63

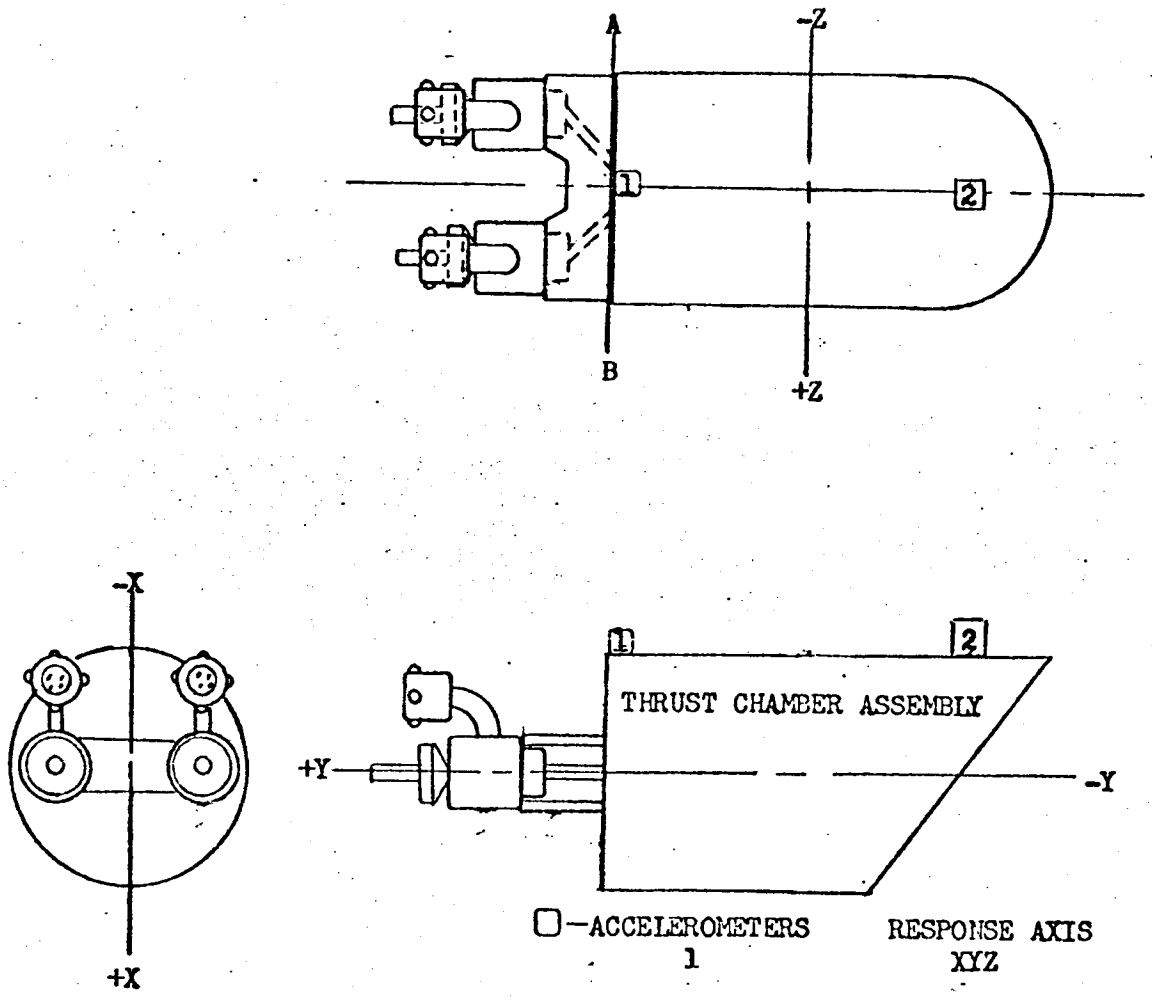
Revision C J.D. Manzione Dated 10/19/64

9

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY-100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST VIBRATION AND SHOCK TEST NO. 207540-401 SHEET 170 OF 180



A

A

□—ACCELEROMETERS	RESPONSE AXIS
1	XYZ
2	XYZ

A

NOTE:

The MAC TCA Modification, simulated Spacecraft Tubing and Mounting Brackets not shown: Refer to Applicable Drawings of Paragraphs 2.2 and 2.5.

FIGURE 7

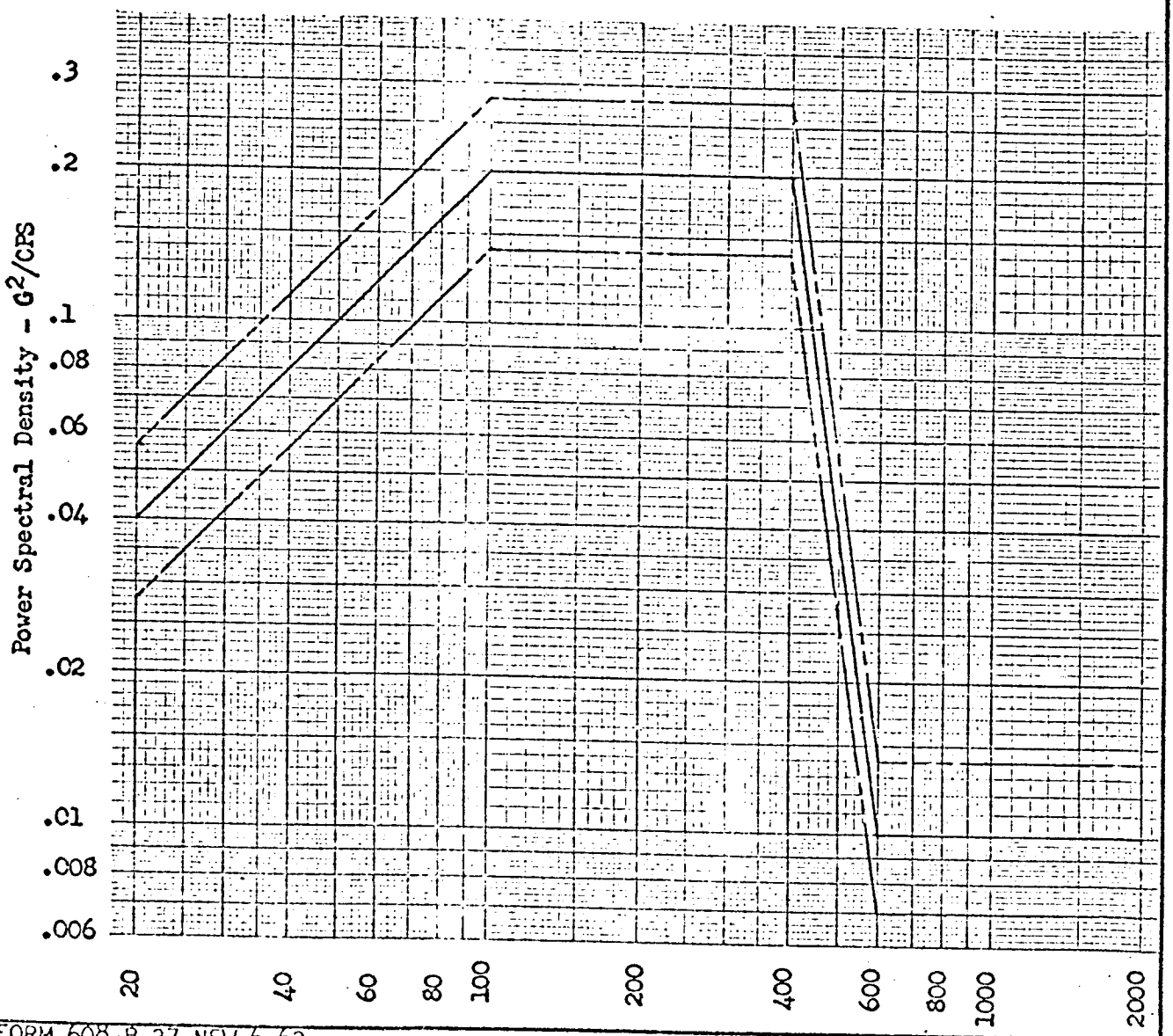
FORM 608-B-37 NEW 6-63

REVISION A J.D. Maringer Dated 9-31-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST RANDOM VIBRATION TEST NO. 207540-401 SHEET 171 OF 180



FORM 608-B-37 NEW 6-63

FREQUENCY - CPS

FIGURE 8

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY-100# PART NO. MAC 52-52701-272 NAA 207520-21

NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 207520-201 SHEET 172 OF 180

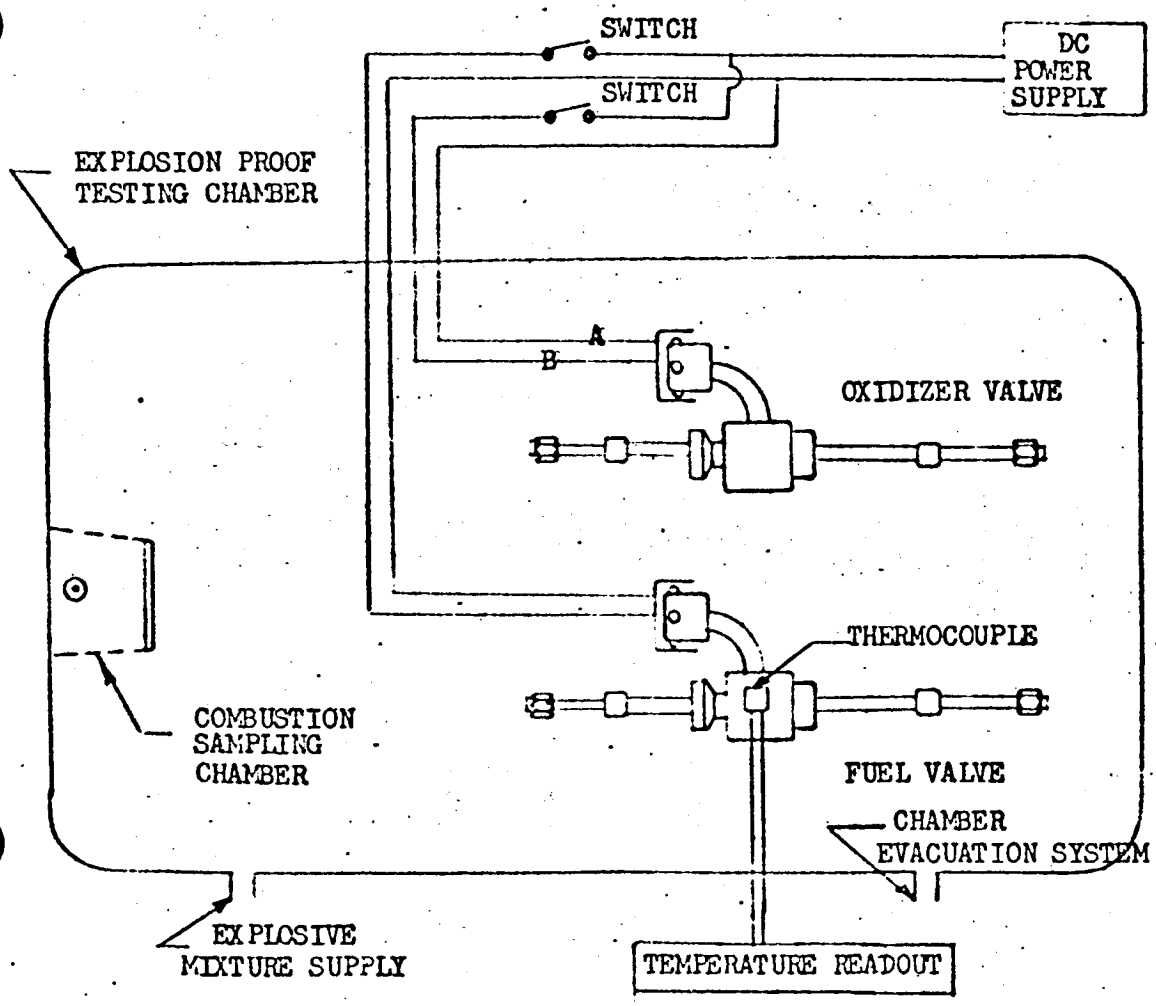


FIGURE 9

FORM 003-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 207540-401 SHEET 173 OF 180

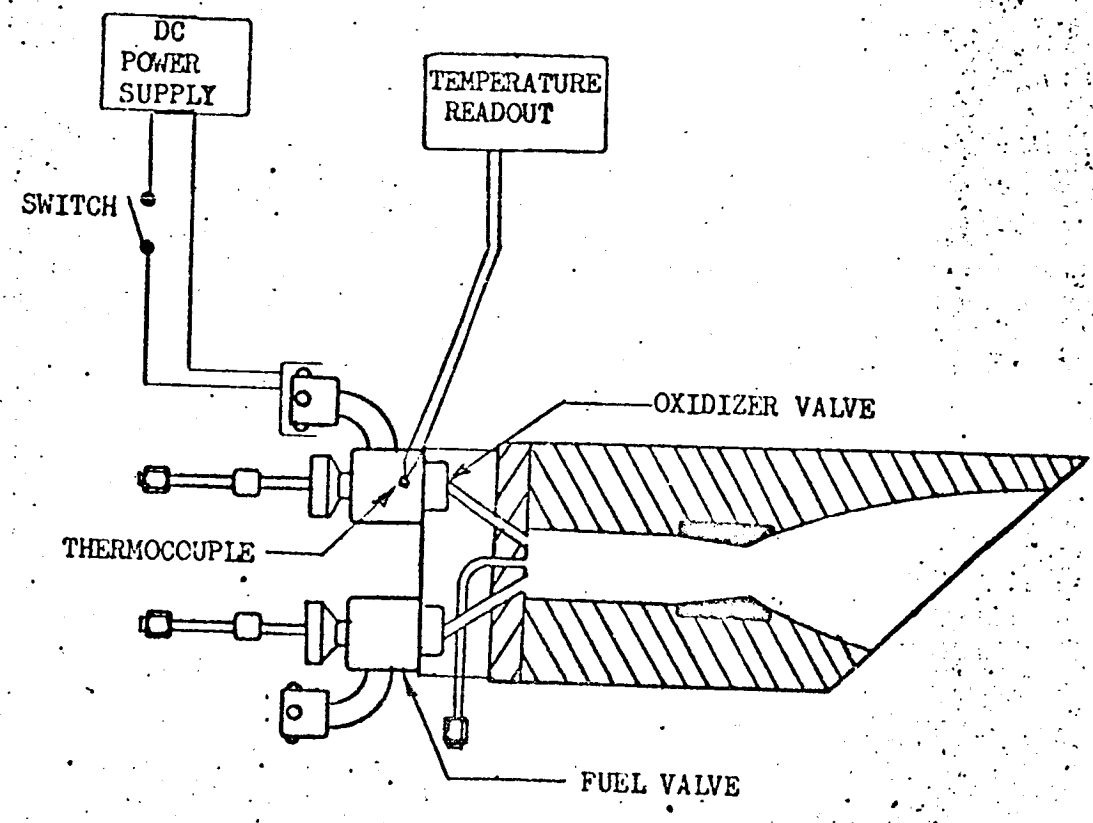


FIGURE 10

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST PROPELLANT VALVE CONTINUOUS DUTY TEST NO. 207540-401 SHEET 173 OF 180

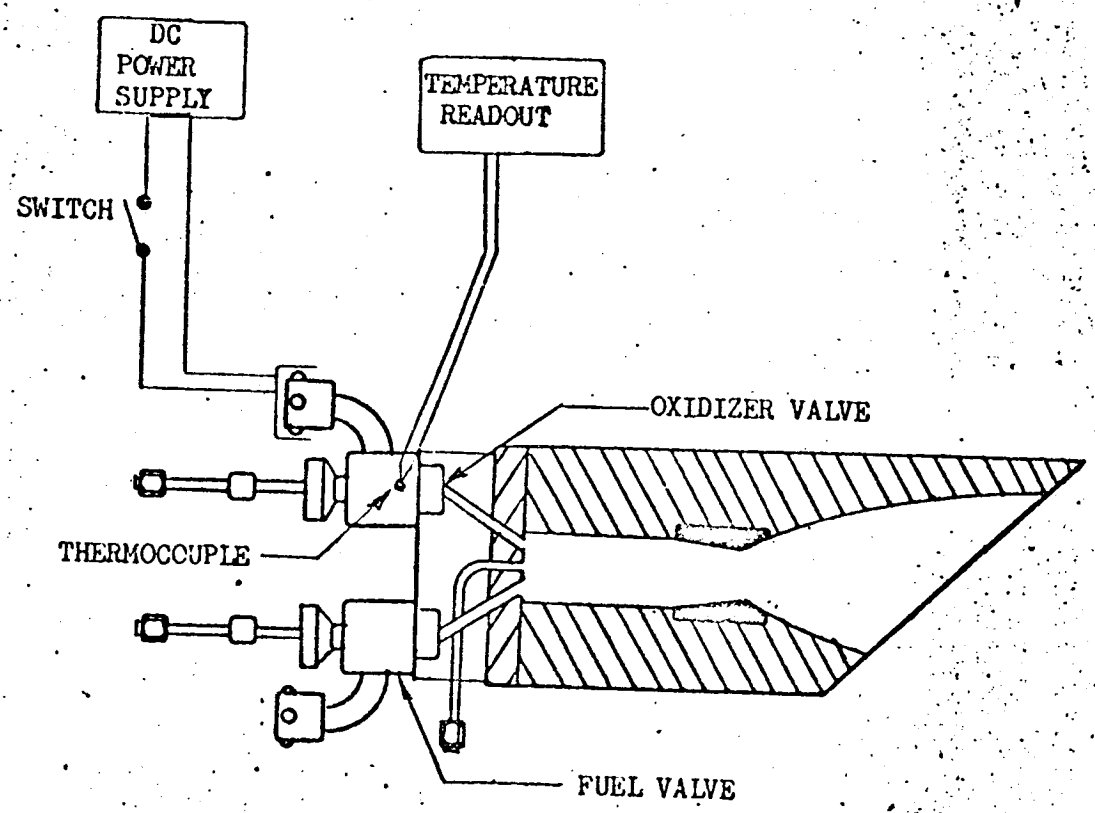


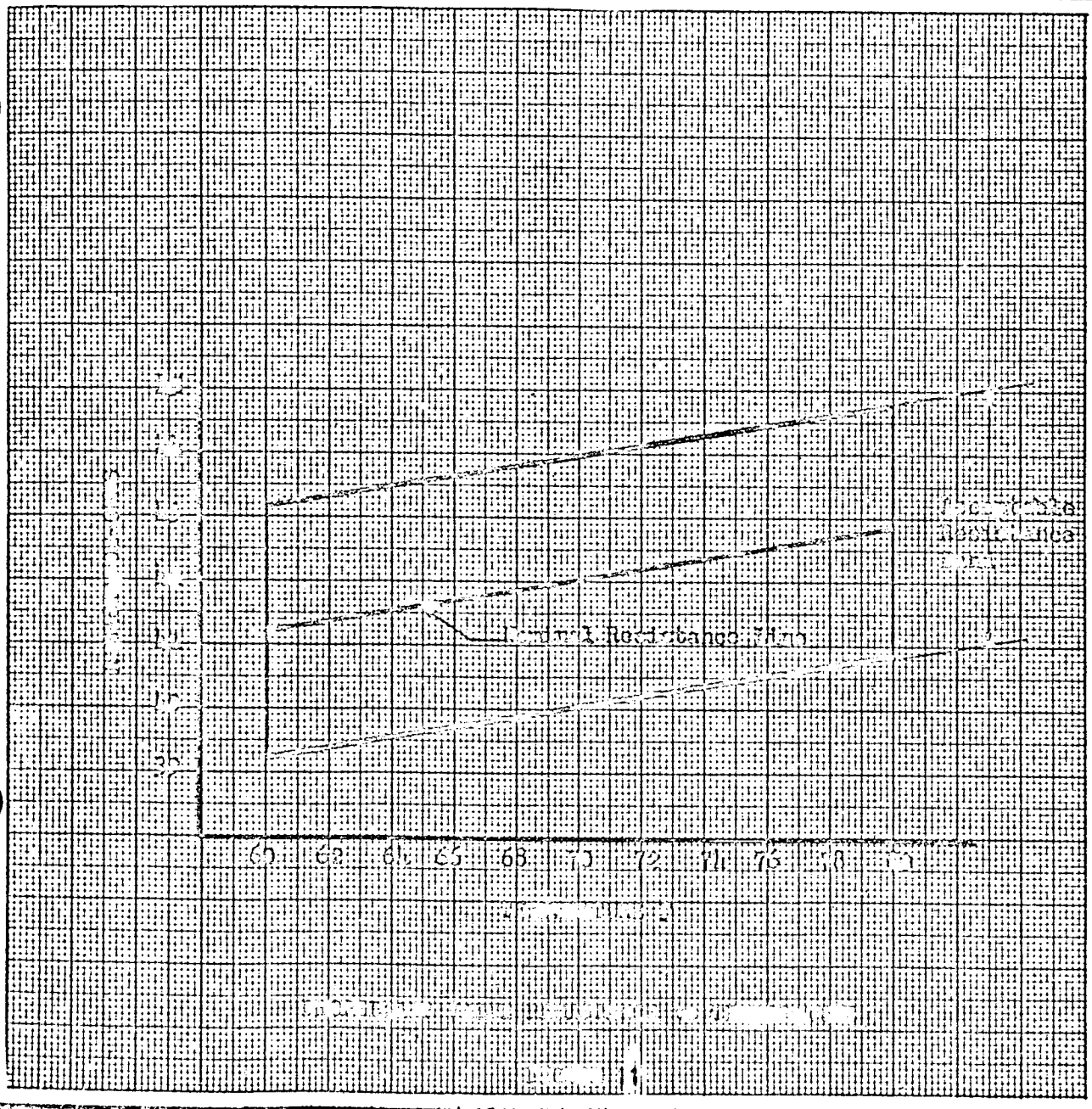
FIGURE 10

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY-100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST PROPELLANT VALVE ELECTRICAL RESISTANCE TEST NO. 207540-401 SHEET 174 OF 180

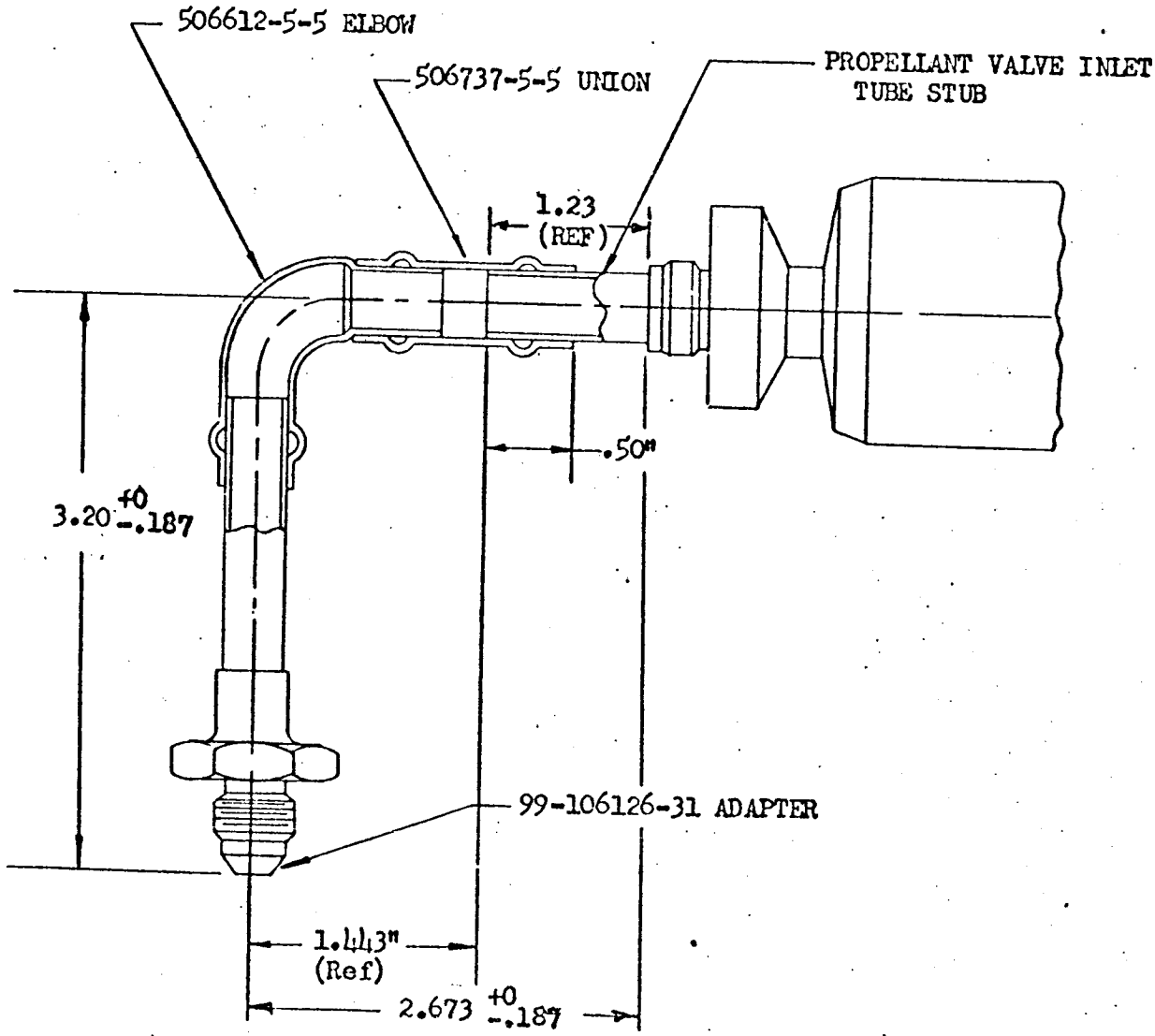


FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST COMPONENT TEST MODIFICATION TEST NO. 207540-101 SHEET 175 OF 180



PROPELLANT VALVE INLET ADAPTER

FIGURE 12

FORM 608-B-37 NEW 6-63

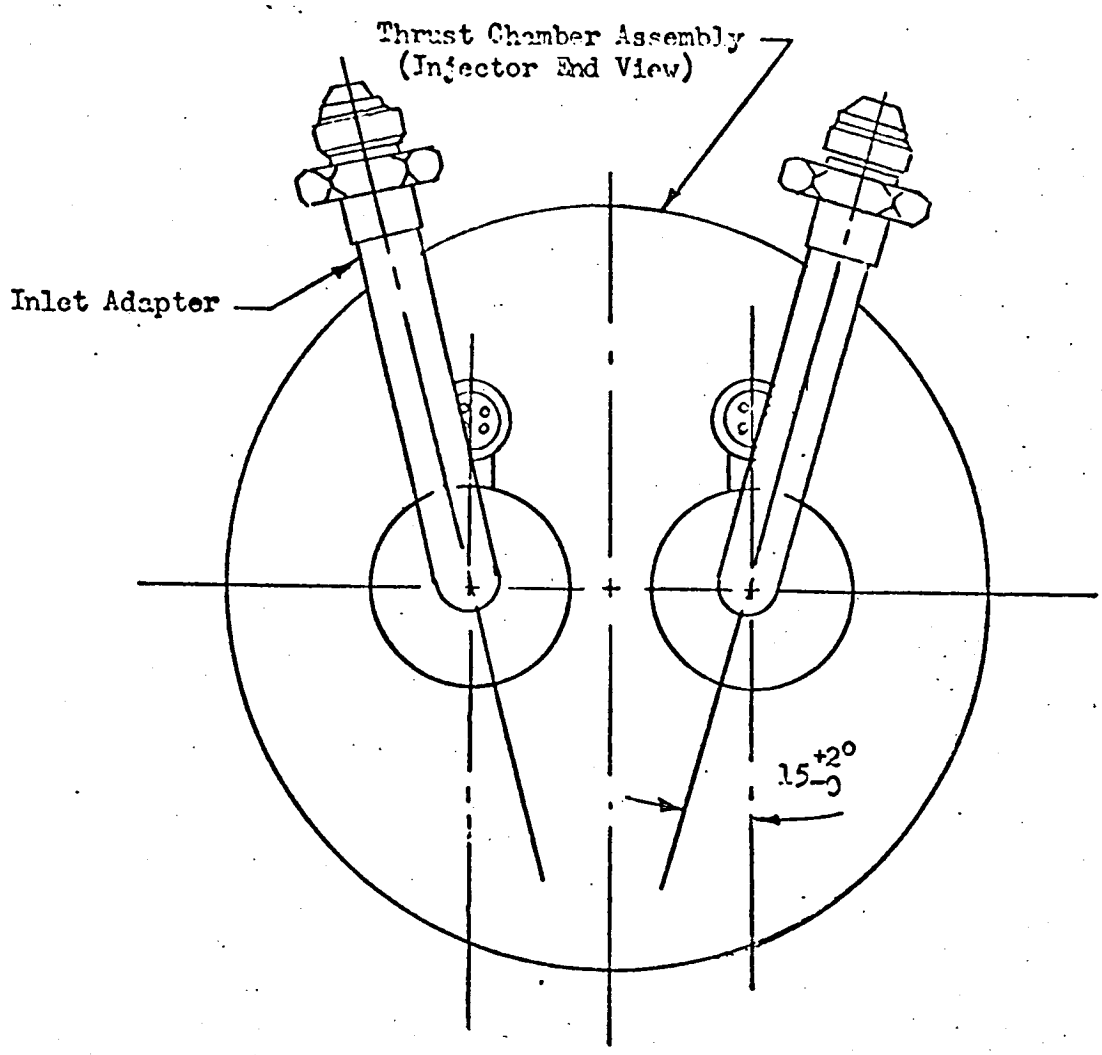
REVISION A Dated 9-1-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. MAC 52-52701-277 NAA 207540-21

NAME OF TEST COMPONENT TEST MODIFICATION TEST NO. 207540-401 SHEET 176 OF 180

A



PROPELLANT VALVE INLET ADAPTER ORIENTATION

FIGURE 12A

FORM 608-B-37 NEW 6-63

REVISION A J. D. Morrisgaine Dated 9-1-64

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST THRUST PULSE PARAMETERS TEST NO. 207540-401 SHEET 177 OF 180

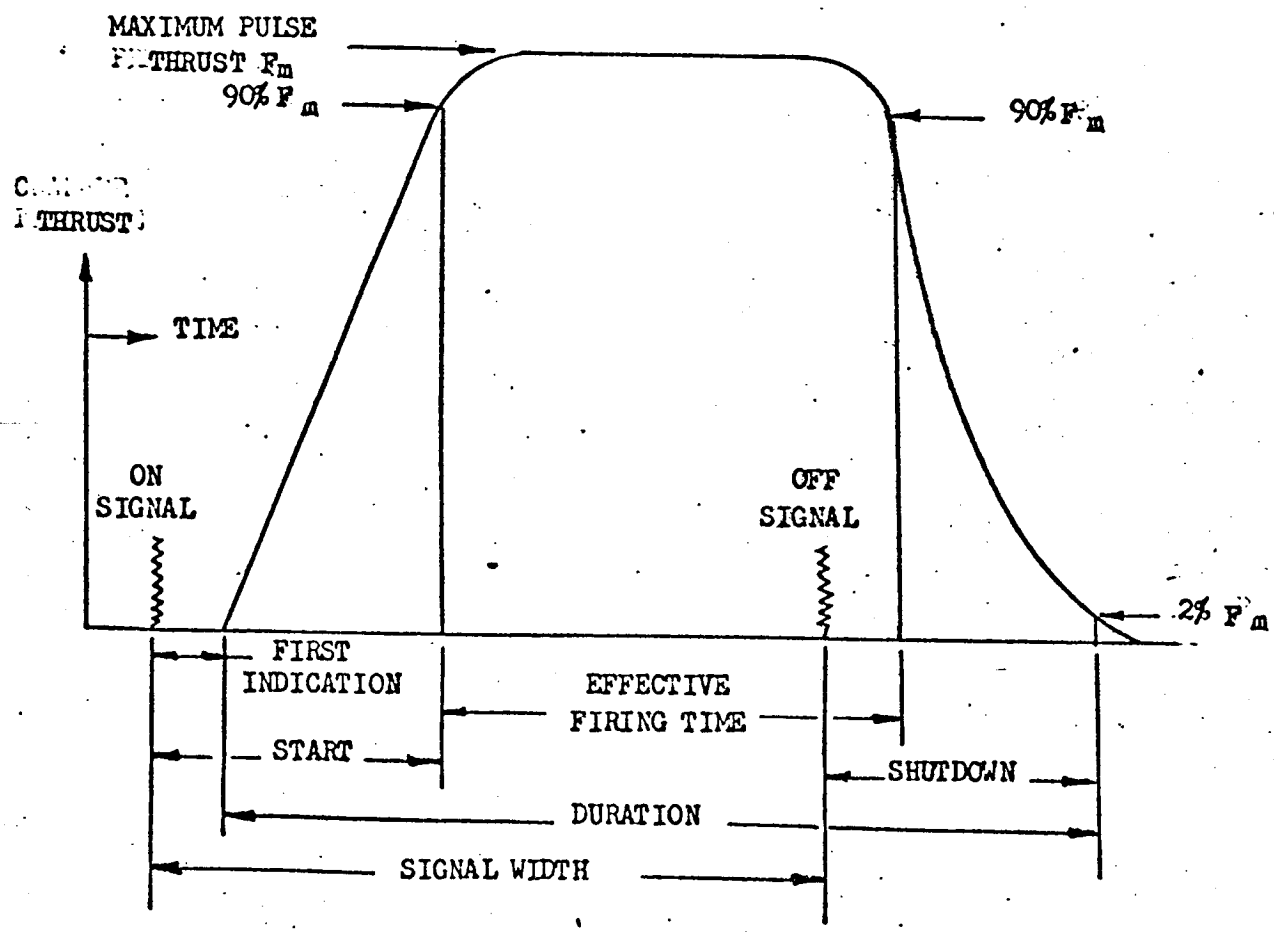


FIGURE 13

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY -100# PART NO. { MAC 52-52701-277 / NAA 2075/0-21

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 2075/0-40 SHEET 178 OF 180

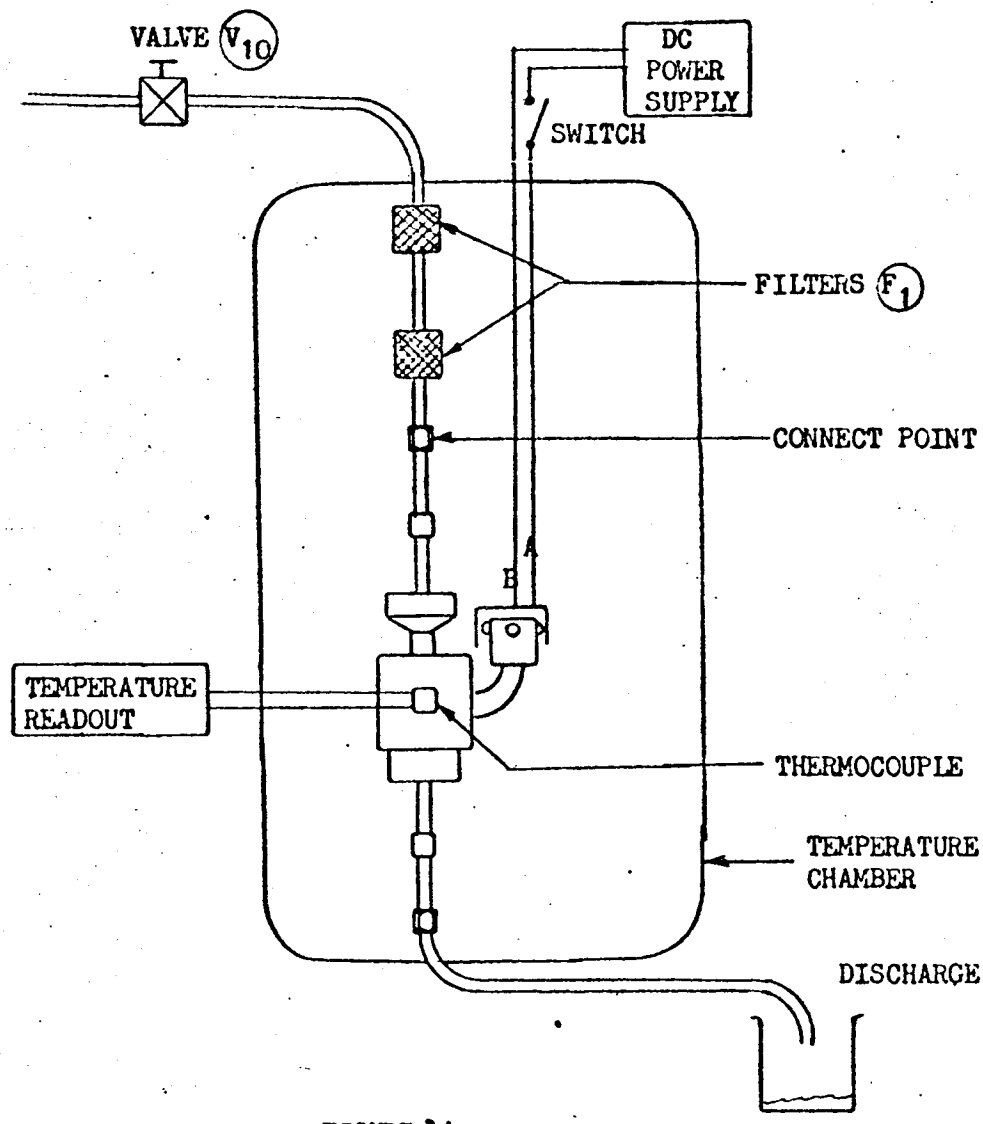


FIGURE 14

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. MAC 52-52701-277 / NA. 207520-21

NAME OF TEST PROPELLANT VALVE LOAD ANALYSIS TEST NO 207520-01 SHEET 179 OF 180

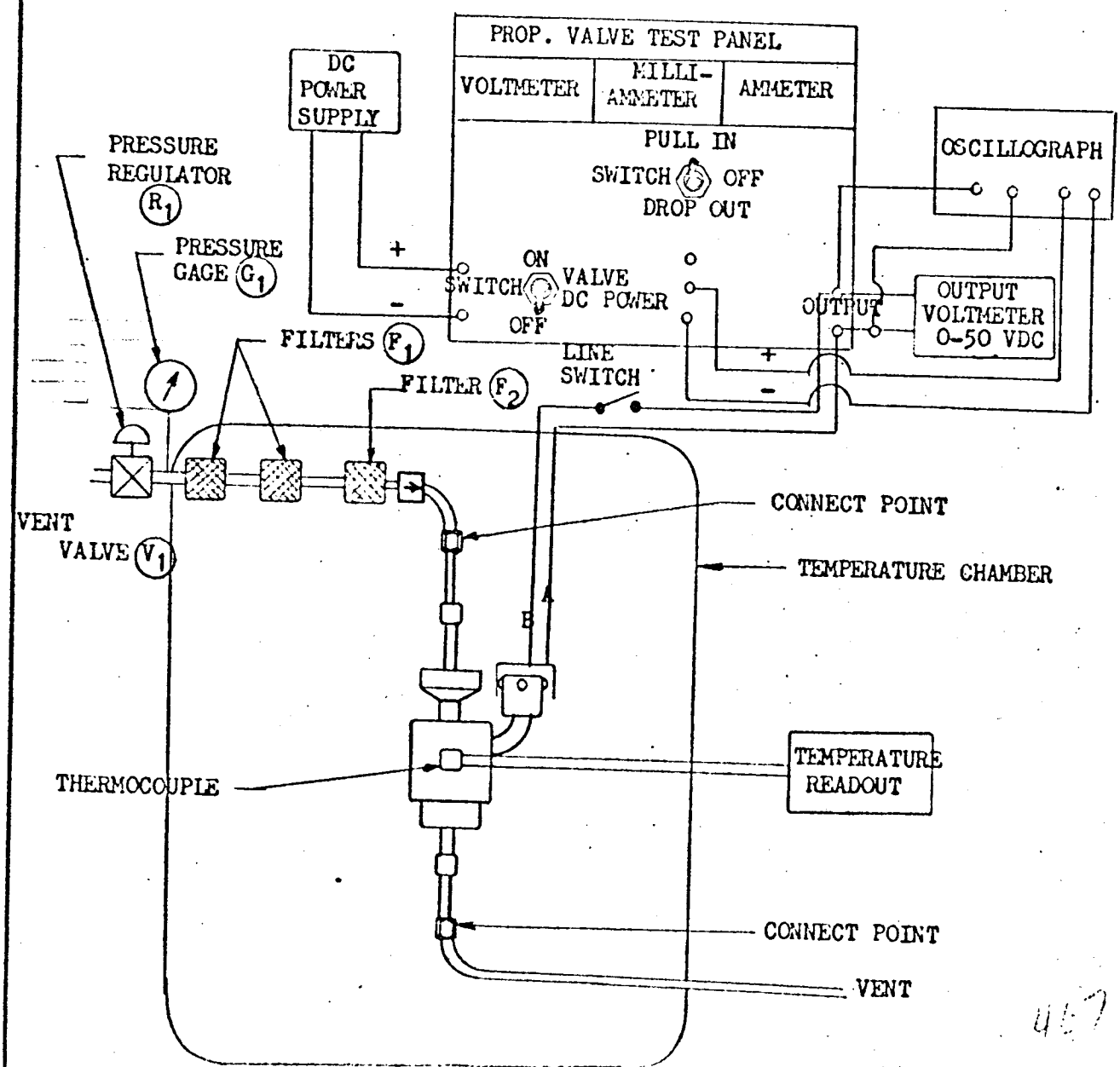


FIGURE 15

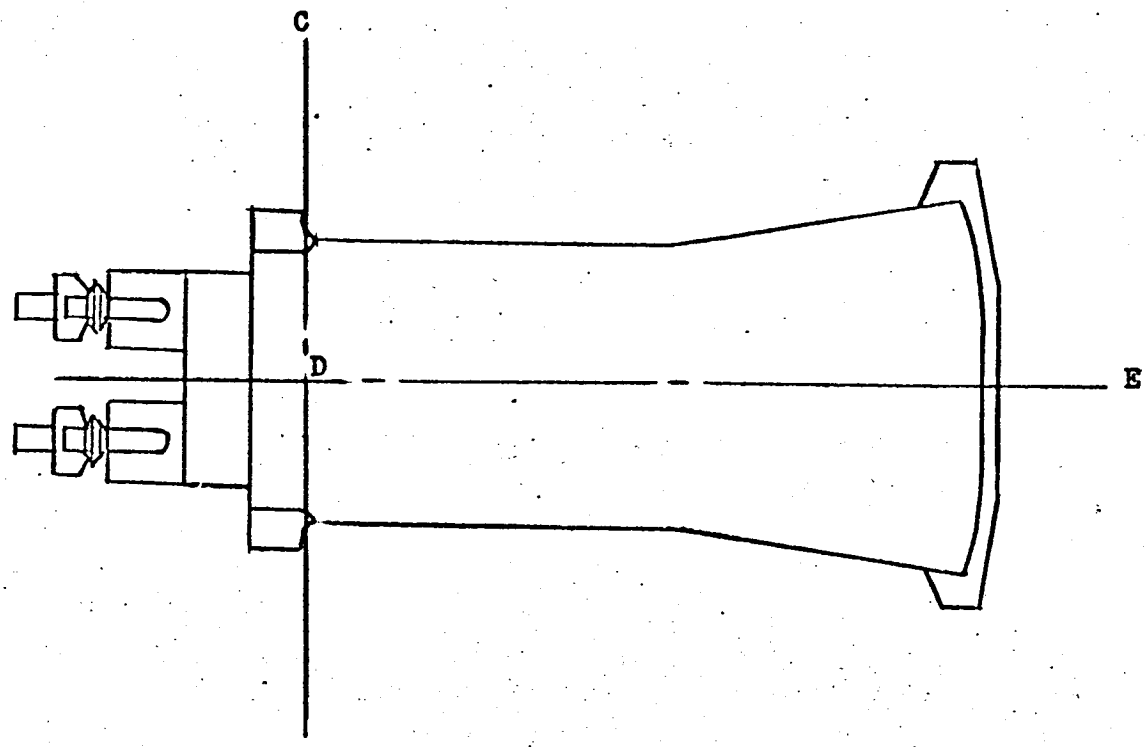
FORM 608-B-37 NEW 6-63

R-15019-2

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21 }

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207540-401 SHEET 180 OF 180



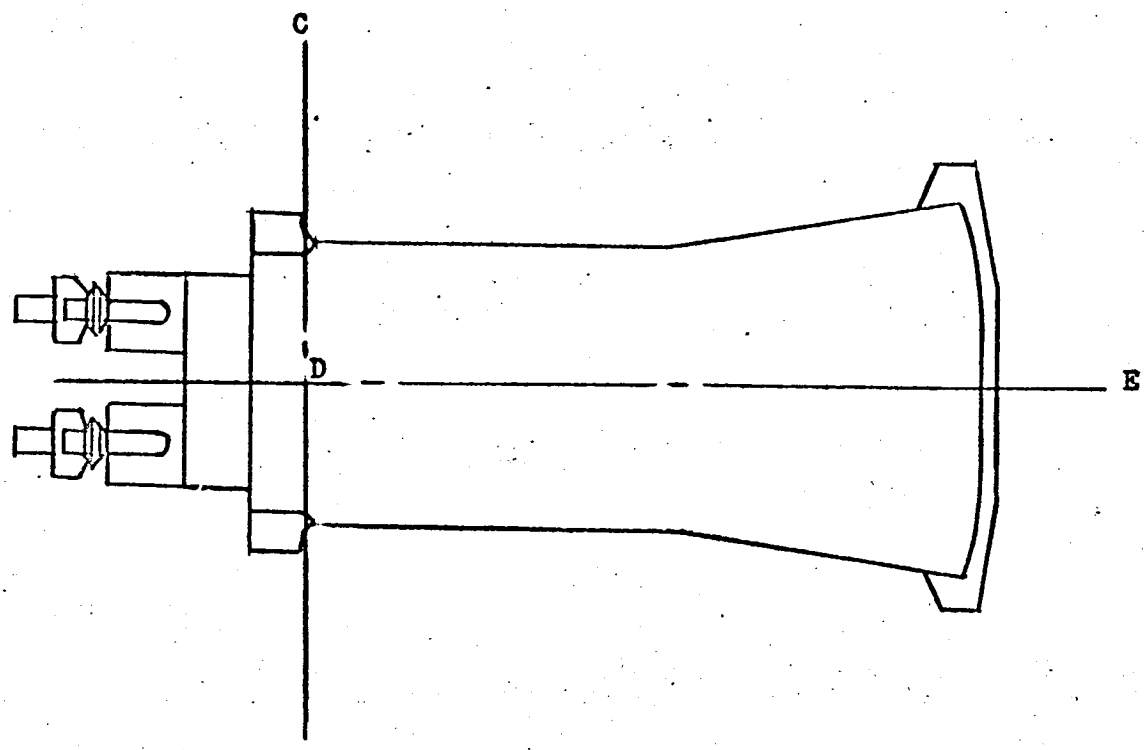
SECTIONING DIAGRAM
FIGURE 16

FORM 608-B-37 NEW 6-63

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

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 100# PART NO. { MAC 52-52701-277 / NAA 207540-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207540-401 SHEET 180 OF 180



SECTIONING DIAGRAM
FIGURE 16

FORM 608-B-37 NEW 6-63