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5 General Dynamics/ Astronautics, San Diego, Calif.

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MISSILE 9C FAILURE

24 September 1959 [U]

9 FINAL REPORT.

FTA 6182, REVISION A, 22 October 1959

AMR RANGE TEST NUMBER 2944

CONVAIR TEST NUMBER P2-301-00-09

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CONVAIR - ASTRONAUTICS

Convair Division of

GENERAL DYNAMICS CORPORATION

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MT-59-79508

FOREWORD

Subsequent to the loss of Missile 9C during a Flight Readiness Firing at Complex 12, AMR, a committee was formed by Convair per DSP-1-29 to investigate the cause of the mishap and assess the damage. The action of this committee in instituting procedures for failure investigation has resulted in (a) the determination of the probable cause, and (b) the compilation of data and facts relating to the failure and the damage which was sustained.

This report resulted from the full cooperation and assistance from all AMR personnel and Convair Astronautics personnel in San Diego associated with the Atlas Program.

This report has been prepared to present significant information gathered by the committee.

T. L. Maloy, Chairman
for Base Manager, AMR

R. J. Close
for Chief of Industrial Security

W. R. Jackson
for Chief Project Engineer

J. E. Ransom
for Manager of Contracts

J. W. Swigart
for Assistant Chief Engineer - Test

W. Borden
for Chief Safety Engineer

C. R. Jackman
for Manager of Operations

C. B. Sherwin
for Manager, Plant Engineering

R. H. Nicholson
for Manager of Quality Control

A. S. Gossi
for Chief of Reliability

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SECTION III. DAMAGE (Cont)

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SUMMARY

Atlas Missile 9C, assigned as the first stage of the four-stage Atlas/Able IV lunar satellite project, was destroyed by fire and explosion during an attempted Flight Readiness Firing on 24 September 1959. The test was conducted at Complex 12, AMR, at 1012 EST. This was the last of the Series "C" flight test articles. Installed on the missile for the test was the Aerojet second stage of the Able IV.

An investigation was conducted by Convair engineering to determine the cause of the failure. After analysis of test data and recovered missile hardware, the investigation revealed the cause and established the sequence of events which resulted in the failure.

The loss of the missile followed a premature cutoff of the engine after 2.136 seconds of a planned 20-second cluster firing. The automatic cutoff was preceded by unloading of the sustainer engine turbine and subsequent sustainer pump overspeed, followed by rupture of a bellows joint in the sustainer LO_2 pump inlet ducting. A LO_2-fed fire resulted which destroyed the missile.

It was determined that the sustainer engine fuel pump cavitated due to the entrainment of helium in the fuel flowing to the pump. The helium entered the system when the vernier fuel tank vented into the main missile tank in the vicinity of the sustainer fuel outlet. The missile configuration in this respect was unique to Missile 9C, the result of weight-saving modifications.

A similar modification performed earlier on Missiles 10B and 13B resulted in satisfactory performance. The extension of the modification to Missile 9C was unsatisfactory due to a change in configuration between the Series "B" and Series "C" missiles.

The bellows joint ruptured due to excessive LO_2 hammer developed during the abnormal shutdown. Liquid oxygen entering the engine compartment started a fire of such intensity that normal firex facilities were incapable of extinguishing the flame.

Extensive damage of the test stand and facility equipment resulted. Estimated damage totaled two million, six-hundred thousand dollars; and approximately four and one-half months will be required to rebuild the complex and effect Series "D" modifications.

There were no personnel errors or unsafe acts which contributed to the failure, and no personnel were injured.

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CONCLUSIONS

The following conclusions are made based on the overall findings of Convair Astronautics:

1. Available data and hardware tend to indicate the missile 9C failure was initiated by venting helium from the vernier fuel start tank into the thrust cone and thence into the sustainer fuel outlet. Apparent fuel pump unloading occurred followed by a sustainer turbine overspeed.

2. The LO2 fed fire initiated during shutdown may be due to one of the following two considerations:

   a. The bellows joint in the sustainer LO2 pump inlet ducting may have ruptured due to the hydraulic hammer and subsequent high pressure transient experienced as a result of the abnormal shutdown or

   b. Metal-to-metal rubbing and resulting ignition in the sustainer LO2 pump inducer-adapter area. This action could occur because of the unloading of the fuel pump followed by an overspeed condition, and consequent bending or whipping of the common fuel and LO2 pump shaft.

3. The factory accomplished change in configuration for 9C regarding installation of the 5-second vernier fuel tank was a result of poor engineering judgement.

4. The failure of 9C was unique in that it resulted from the special configuration of the missile.

5. All evidence obtained points to the proper conduct of the test operation.

T. L. Maloy

T. L. Maloy, Chairman
Convair AMF Investigating Committee

M. Rosenbaum
Chief Engineer

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SUMMARY

Atlas Missile 9C, assigned as the first stage of the four-stage Atlas/Able IV lunar satellite project, was destroyed by fire and explosion during an attempted Flight Readiness Firing on 24 September 1959. The test was conducted at Complex 12, AMR, at 1012 EST. This was the last of the Series "C" flight test articles. Installed on the missile for the test was the Aerojet second stage of the Able IV.

An investigation was conducted by Convair engineering to determine the cause of the failure. After analysis of test data and recovered missile hardware, the investigation revealed the probable causeand established the sequence of events which resulted in the failure.

The loss of the missile followed a premature cutoff of the engine after 2.136 seconds of a planned 20 second cluster firing. The automatic cutoff was preceded by apparent unloading of the sustainer fuel pump and subsequent turbine overspeed. Two possibilities have been advanced as to the probable cause of the ensuing failure leading to a LO2 fed fire:

1. A high pressure transient causing failure of the sustainer LO2 pump inlet ducting due to abnormally fast closure of the sustainer head suppression valve in combination with the overspeed condition or

2. Rubbing and ignition occurring in the sustainer LO2 pump inducer-adapter area possibly due to unloading of the fuel pump with subsequent shaft bending or whipping could have resulted in a failure in the sustainer LO2 low pressure system.

In either case, liquid oxygen entering the engine compartment started a fire of such intensity that normal fire facilities were incapable of extinguishing the flame.

It appears probable that the sustainer engine fuel pump cavitated due to the entrainment of helium in the fuel flowing to the pump. The helium apparently entered the system when the vernier fuel tank vented into the main missile tank in the vicinity of the sustainer fuel outlet. The missile configuration in this respect was unique to Missile 9C, the result of weight-saving modifications.

A similar modification performed earlier on Missiles 10B and 13B resulted in satisfactory performance. The extension of the modification to Missiles 9C was unsatisfactory due to a change in configuration between the Series "B" and Series "C" missiles.

Extensive damage to the test stand and facility equipment resulted. Estimated damage totaled two million, six-hundred thousand dollars; and approximately twenty-one weeks will be required to rebuild the Complex and effect Series "D" modifications.

During test operations there were no personnel errors or unsafe acts which contributed to the failure, and no personnel were injured.

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INTRODUCTION

Atlas Missile 9C, the first stage of the four stage Atlas/Able IV lunar satellite project, was destroyed during a static test at the Atlantic Missile Range on 24 September 1959.

Project Atlas/Able IV was part of the program directed by the Air Force Ballistic Missile Division sponsored by the National Aeronautics and Space Administration, representing the contributions of a num··r of cooperating agencies.

The Atlas/Able IV lunar satellite was scheduled to be launched on 3, 4, 5, or 6 October 1959, its primary purpose to explore space between the moon and earth and to obtain data near the moon.

The Atlas/Able IV was to carry a payload of 368 pounds. The first stage was to be a modified Atlas Series "C" missile, the second stage an Aerojet rocket, the third stage an Allegheny Ballistics Laboratories 248-A4 solid propellant rocket, the fourth stage a Space Technology Laboratories payload.

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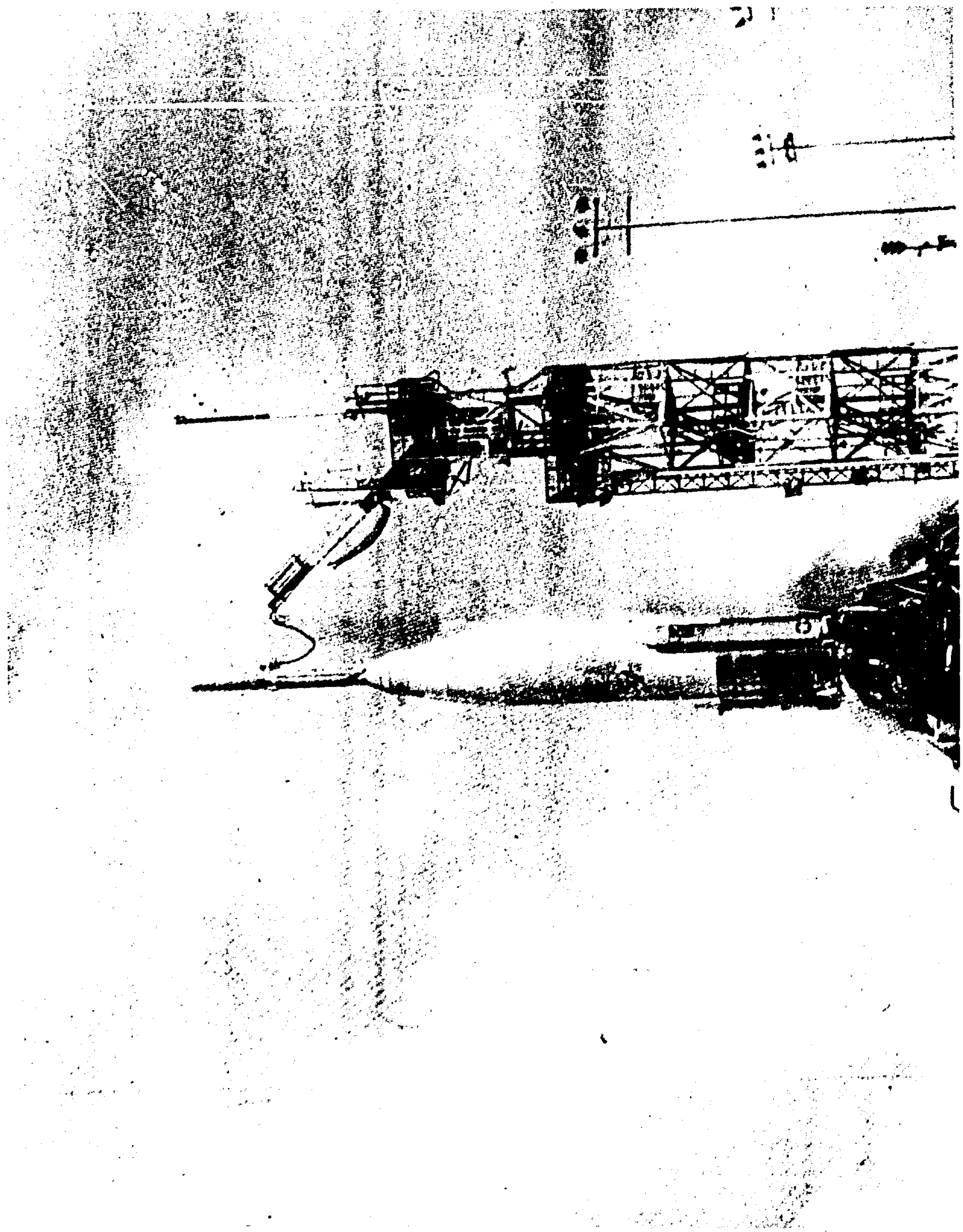

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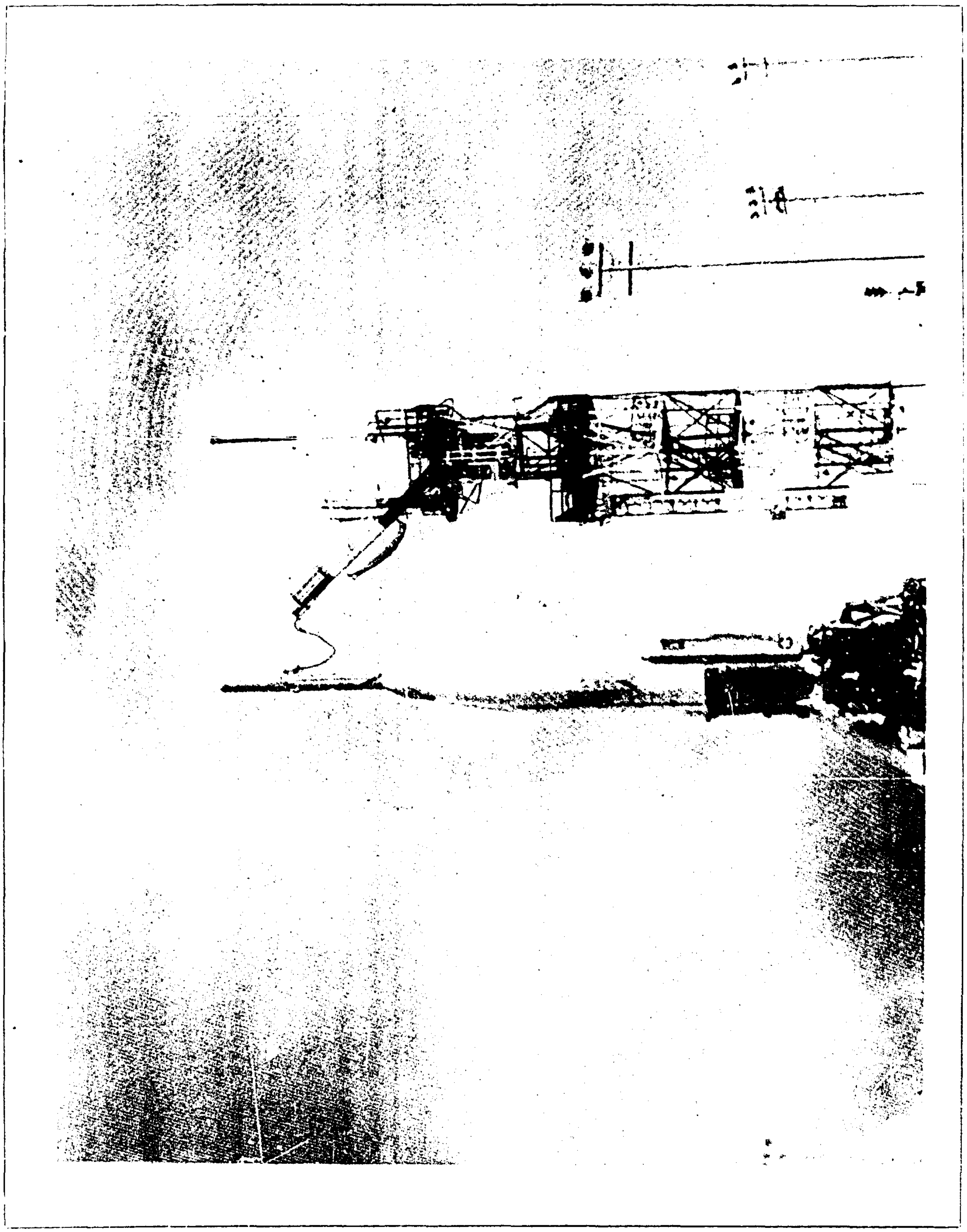

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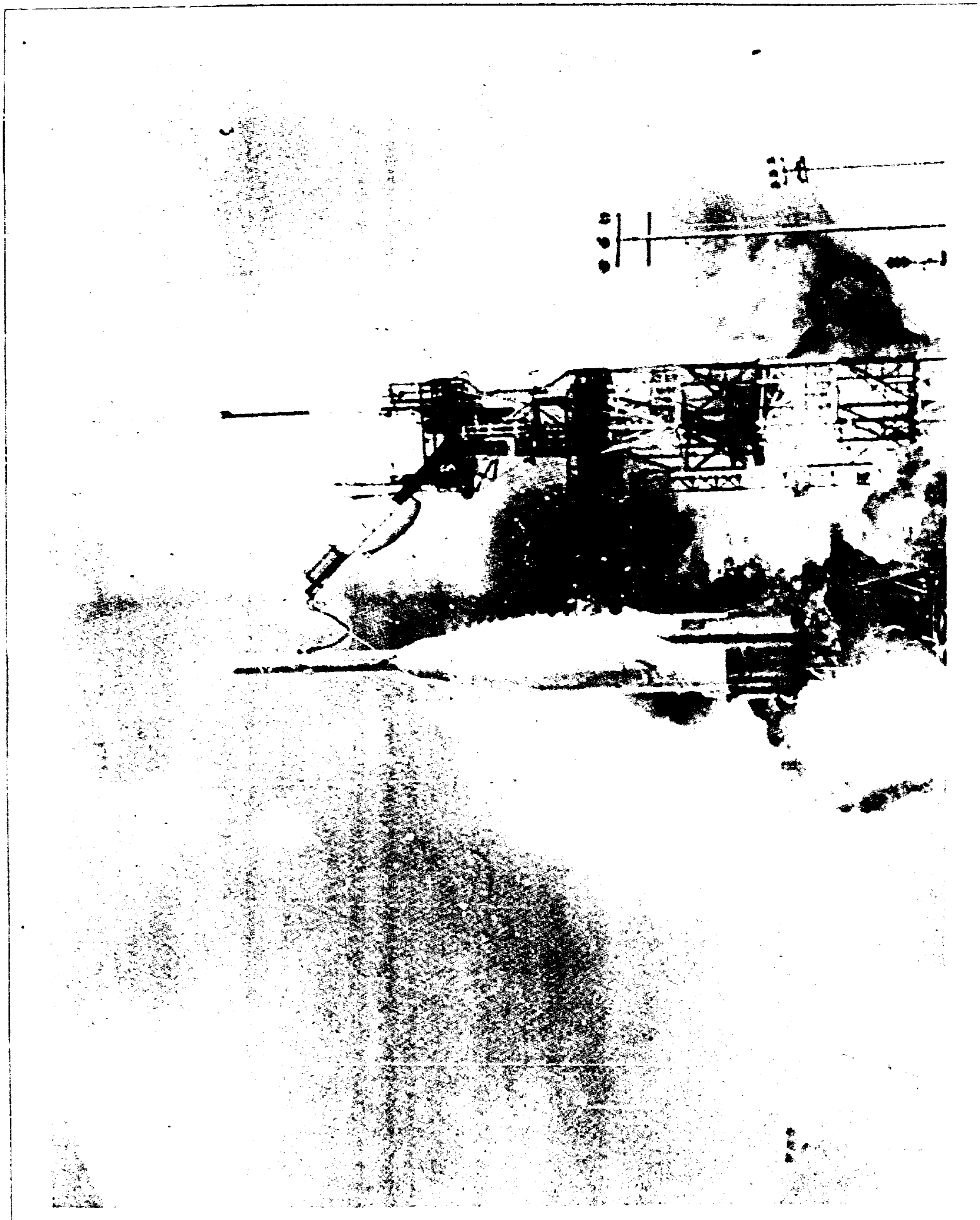

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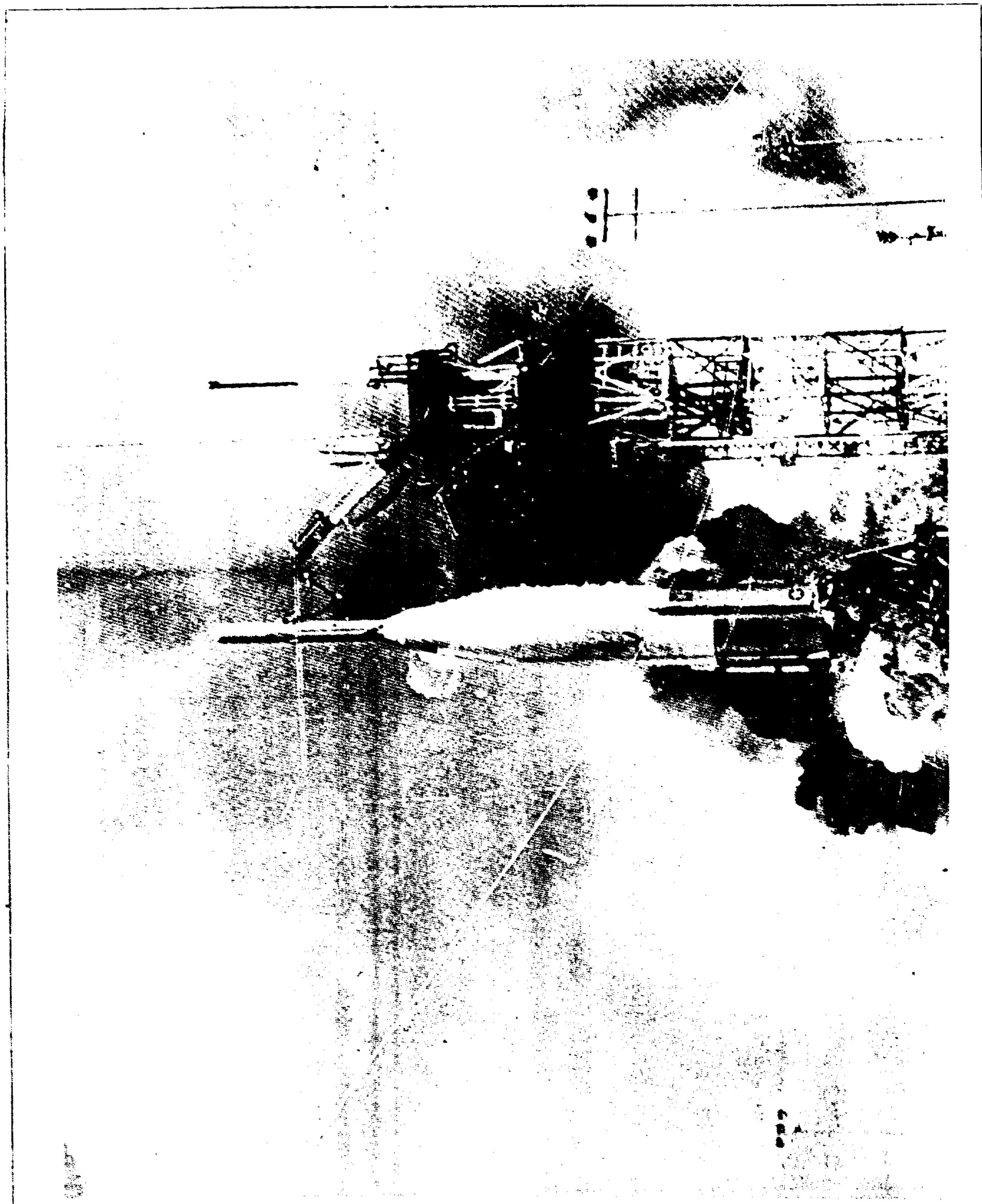

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SECTION I

FAILURE INVESTIGATION

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TECHNICAL ANALYSIS

An investigation was conducted to determine the cause of the Missile 9C failure. A complete analysis was made of all test data, and recovered missile hardware was thoroughly examined. The ivestigation revealed the probable cause and established the sequence of events which resulted in an engine compartment fire and subsequent loss of the missile.

It was determined that the sustainer engine system was subjected to abnormal operating conditions due to the apperent entrainment of helium in the fuel flowing to the sustainer engine fuel pump when the vernier fuel start tank vented into the main tank in the vicinity of the sustainer fuel outlet. The missile configuration which permitted this condition was unique to 9C, and resulted from modifications to the missile performed in the interest of weight saving.

The sequence of events which occurred after the fuel tank vented are briefly as follows:

1. The sustainer fuel pump cavitated, unloading the turbine, allowing the pump to overspeed.

2. The engine shutdown as the result of an overspeed cutoff signal.

3. Failure occurred in the sustainer LO2 low pressure system due to one of the following:

   a) A high pressure transient causing failure of the sustainer LO2 pump inlet ducting due to abnormally fast closure of the sustainer head suppression valve in combination with the overspeed condition or

   b) Rubbing and ignition occurring in the sustainer LO2 pump inducer-adapter area possibly due to unloading of the fuel pump with subsequent shaft bending or whipping could have resulted in a failure in the sustainer LO2 low pressure system.

4. LO2 was introduced into the engine compartment, starting a LO2 supported fire of such intensity that normal engine compartment firex facilities were incapable of extinguishing the flame.

The following information supports the conclusion relative to the initiation of the LO2 fed fire.

   1. A positive conclusion to define the inducer-adapter rubbing or duct failure as the primary contributor to the LO2 fed fire cannot be drawn based on recorded data.

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2. A similar incident occurred during MSTS Test 14-406 (24 March 1959). In this test, fuel pump unloading, sustainer overspeed and abnormal sustainer engine shutdown occurred. The sustainer LO2 inlet ducting and the inlet portion of the sustainer LO2 pump were damaged.

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PROPULSION SYSTEM

Operation of the propulsion system prior to venting of the start tanks was satisfactory. Start and thrust buildup characteristics of the entire engine appeared normal. Sustainer operation was normal until the sustainer turbopump unloaded. Vernier operation did not appear normal since LO_2 pressures and flow during mainstage were below the expected value. Booster system operation was normal with satisfactory start and shutdown characteristics.

Sustainer Engine

Sustainer engine operation prior to 1.96 seconds was normal. All valve opening times were within specifications and the transition to mainstage was satisfactorily effected.

At 1.62 seconds the start tanks were vented and the PU and HS valves were commanded to enter servo control. Venting of the vernier start tanks and of the booster-sustainer LO2 and ground fuel start tanks appeared normal and the valves began moving toward their control positions properly.

Deviations from normal were observed after 1.96 seconds as follows:

1. Pump speed increased from a recorded valve of 10,500 rpm at 2.03 seconds to 11,450 rpm at cutoff and peaked at 11,600 rpm at 2.20 seconds. EA sequence recorder data indicate that a sustainer overspeed cutoff was initiated. The overspeed circuitry was set to initiate cutoff at a pump speed of 11,200 rpm. Booster cutoff occurred at 2.136 seconds as evidenced by the "blip" superimposed on continuous rate gyro telemetered data.

2. LO2 pump discharge pressure reached the transducer upper limit of 1000 psia between 1.96 and 2.06 seconds and remained there until after cutoff.

3. Fuel injection pressure decreased from 805 psia at 1.97 seconds to 735 psia at 2.07 seconds. At 2.17 seconds the pressure was 400 psia.

4. Thrust chamber pressure dropped from 680 psia at 2.03 seconds to 580 psia at 2.13 seconds.

5. Vernier and SGG fuel flow decreased significantly during this period. Although flowmeters were installed in the sustainer LO2 and fuel ducts, these measurements were not made since one telemetry package had been removed for weight reducing purposes.

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The PU valve was closing toward a control position normally during this period and was at 72 degrees from closed at 2.18 seconds. The HS valve was responding normally to changes in fuel pump discharge and LO2 injection pressures and was moving toward the closed position throughout this period. At cutoff the valve was about 20 degrees from full closed.

There was no rough combustion count recorded which indicates that the engine mixture ratio did not become excessively fuel rich.

During shutdown the PU and gas generator blade valve closed normally, but the HS valve closed faster than expected. This appeared due to the fact that the valve was moving toward the closed position when cutoff was commanded and that the valve was only 20 degrees from closed when the cutoff occurred. When the valve closed, the LO2 pump inlet pressure surged beyond the transducer limit of 150 psia and then dropped to ambient pressure.

Shortly after cutoff, engine compartment temperatures decreased and then increased and the sustainer LO2 pump inlet temperature began to rise. The first indication of change was in P 530 T, sustainer LO2 pump inlet temperature. A change occurred between 2.22 and 2.42 seconds when the data went from -288.5 DGF to beyond the telemetry upper limit of -270 DGF. Due to the nature of the instrumentation, it cannot be determined if the temperature went beyond -270 DGF or if the instrumentation circuitry opened. Engine compartment temperature, P 14T, showed a drop from 90 to 20 DGF between 2.12 and 2.32 at 500 DGF at 4.37 seconds. The preceeding measurements were recorded as follows: P 1673 T, B1 igniter fuel valve ambient, rose from 52 to 70 DGF between 2.4 and 2.6 seconds then dropped to 5 DGF at 2.9 seconds. The trace reached the recorder lower limit (0 DGF) at 3.5 seconds. P 1675 T, booster pneumatic control manifold, started to decrease from 65 DGF at 3.0 seconds to 0 DGF (recorder lower limit) at 6.45 seconds. P 1674 T, B2 igniter fuel valve ambient was at the upper instrumentation limit of 400 DGF after 3.5 seconds. No data were available prior to that time due to failure of the recorder pen to ink properly.

Vernier Engine

Vernier start and tank-fed operation was satisfactory. Chamber pressures were 292 psia for V1 and 295 psia for V2 while tank fed. LO2 and fuel flow were normal at 5.2 and 2.9 pounds per seconds, respectively, Mixture ratio was 1.79 O/F.

Vernier operation was abnormal after transition of the sustainer engine to mainstage in that LO2 was supplied to the engines in less than normal quantities. After the sustainer engine bootstrapped and prior to venting of the start tanks, V1 and V2 LO2 inlet pressures showed rises of only 30 psi to 565 and 535 psia, respectively. Nominal pump-fed inlet pressures are 630 psia. LO2 flow increased slightly to 5.4 lb/sec. Fuel inlet pressures rose normally to 595 and 615 psia, respectively, Fuel flow rose to 3.5 lb/sec., and mixture ratio decreased to 1.54 O/F. Chamber pressures rose to 313 and 325 psig for V1 and V2 respectively, whereas nominal pressures are 355 psia.

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Slight changes in operating level occurred when the start tanks were vented. LO2 and fuel flow rates and inlet pressures showed decreases of less than four percent. Little change was observed in chamber pressures.

These data indicate that although bootstrapping of the vernier engines took place, it was not entirely normal in the LO2 system. No explanation for this behavior has been formulated.

When the sustainer turbopump unloaded, all vernier data reflected this condition. Fuel inlet pressures and fuel flow decreased due to the decrease in pump discharge pressure and LO2 inlet pressures and LO2 flow increased due to the increase in pump speed and discharge pressure. Chamber pressures decreased only slightly during this period.

Shutdown of the vernier engines was normal at cutoff.

Booster Engine

Booster engine operation was normal throughout the firing period. Start and shutdown characteristics were satisfactory and all valve operating times were within specifications. B1 and B2 chamber pressures were at satisfactory levels at cutoff of 500 and 520 psia, respectively. Corresponding pump speeds were 6180 and 6250 rpm at that time. Booster gas generator LO2 reference pressure was stable at 512 psia. Gas generator LO2 flow was 6.1 lbs/sec and gas generator and igniters fuel flow was 18.2 lb/sec. Assuming 1.5 lb/sec. igniter fuel flow to each booster chamber, resultant mixture ratio to the gas generator was 0.401 O/F. B1 turbine inlet temperature, as measured by landline instrumentation, had stabilized at 1240 DGF when cutoff occurred. B2 turbine inlet temperature, as measured by telemetry instrumentation, was at 1325 DGF at cutoff.

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ANALYSES OF POSSIBLE CAUSES OF FAILURE

In the course of the investigation, consideration was given all areas of the sustainer engine system which might have failed and produced conditions observed in the test data. A discussion of each of these individual analyses follows:

Sustainer Fuel Flow

The decrease in sustainer fuel injection pressure prompted a study of various aspects of the sustainer fuel system. This study revealed the initial cause of the failure.

A re-examination of the recovered hardware was performed and it was determined that on Missile 9C, the vernier fuel start tank bleed line was connected to the sustainer thrust cone below the anti-vortexing baffle (Station 1198). Examination of Missile 2C revealed the vernier fuel start tank bleed line was also connected to the sustainer thrust cone below the anti-vortex baffle (Station 1198).

When the 25 second tanks are vented, the pressurizing gas is vented directly to the atmosphere. Only fuel flows into the main tank during refilling through the open vernier fuel bleed valve and bleed line connected to the main tank apex. As the 5 second start tank does not contain a bladder, the TVA which incorporated the plumbing for this tank provided for venting directly into themain fuel tank. This was done to prevent loss of fuel overboard during tanking and refill and utilized the 25 second bleed line connection on the main tank.

Per sheet 1 of drawing 7-22236 (-805 installation for Series "B", effectivity 7-32-3 and on) the vernier fuel start tank bleed line (7-22236-23 tube) was attached above the sustainer baffle. This caused no trouble when the 5 second tank was vented through this fitting on 10-B and 13-B. Sheet 2 of this same drawing (-809 installation for Series "C" effectivity 7-54-1 and on) provides for the 25 second start tank bleed line (7-22236-115 tube) to be plumbed to a fitting on the sustainer thrust cone, below the baffle. The difference between the Series "B" and the Series "C" configuration in respect to the location of the vernier fuel start tank bleed line resulted in the tank vent line being connected below the sustainer cone baffle when the effectivity of TVA 56582 was extended to 9C.

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VERNIER FUEL TANK VENT LINE

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ANTI-VORTEXING BAFFLE ABOVE
SUSTAINER THRUST CONE

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Other considerations of difficulty in the sustainer fuel system were:

Loss of sustainer pump fuel outlet pressure might have been attributed to vortexing of the fuel tank. Vortexing usually occurs only at the lower fuel levels but could be aggravated by large holes in the anti-vortex membranes. The site-installed TVA 94369 against 7-70005 body assembly was initially suspected. This TVA covered installation of a plug into the bottom of the Acoustica stillwell to eliminate helium gas flow from the stillwell to the sustainer engine similar to vortexing. After removing the sustainer fuel pre-valve, a mechanic worked with hands inside the fuel tank to install the plug and crimp the lower end of the stillwell tube. Examination of the hardware found the TVA plug securely installed in the stillwell tube. The sustainer anti-vortex membrane has holes approximately 1.25 inches in diameter and thus any pieces or contamination of sufficient size to cause plugging of the tank outlet would either have to flow into the fuel pump or be contained in the tank cone. Examination of the tank cone revealed no such pieces.

Decrease of sustainer fuel flow was indicated by decreased fuel injection pressure and decreased chamber pressure, even though pump speed and oxygen pump discharge pressure increased. Partial closure of the sustainer fuel pre-valve was investigated and discounted as an initial cause of failure. The sustainer fuel pre-valve butterfly was found closed and the booster fuel pre-valve butterfly was opened. Both the sustainer and booster pre-valve actuators were found open and locked. The booster pre-valve actuator was nearly intact except at the mount where it was broken off of the butterfly portion. The sustainer pre-valve actuator was broken on the opening pressure end and was detached from the actuator housing. The sustainer fuel pre-valve position switches were not found.

The position switches on EA records showed that both valves remained open until after cutoff. The sustainer pre-valve probably closed at the same time the actuator was blown off, during one of the explosions that occurred after cutoff.

The sustainer fuel low pressure inlet duct was considered from many aspects as the prime cause of failure. Collapse of the duct from low internal pressure, rupture of the line from excessive internal pressure, or stoppage of fuel flow by the line being plugged or from the flowmeter restriction might have been possible. The duct was torn circumferentially just aft of the pre-valve flange. The tear did not appear to be caused from any stress risers or from poor welding. At the pump inlet end a tear, partially along a weld and partially around the duct on the forward side of the duct, appeared to have resulted after the missile exploded, from an impact on the upper elbow directed in an aft direction. The same impact may have buckled the upper elbow.

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The fact that the fuel pump discharge pressure would increase with a fuel line restriction in or downstream of the PU valve tends to eliminate this possibility as the initial cause of damage.

A malfunction of the head suppression valve servo could have caused the head suppression valve to close from the nominal position. This would increase LO2 pump discharge pressure, decrease the chamber pressure by reducing LO2 flow, decrease the fuel injection pressure by reducing back pressure on the pump and correspondingly reduce fuel flow to the sustainer gas generator and vernier engines.

However, one item which tends to demonstrate that the head suppression valve was operating correctly and that the servo valve was not stuck, is the fact that the rate of travel of the head suppression valve definitely changed slope when it reached 40 degrees and maintained this slope until cutoff occurred. This would tend to support the idea that the valve was controlling and closing, because the fuel pump discharge pressure was dropping and the LO2 pump discharge pressure was increasing. The head suppression valve was attempting to maintain proper differential between the LO2 dome pressure and fuel pump discharge pressure.

The possibility of this causing the pump to overspeed would have to be analyzed more carefully, using the individual curves of pump characteristics and considering the power change due to variations in SGG mixture ratio, head rise across both pumps, and flow rates.

The head suppression servo has been disassembled by Rocketdyne and no deficiencies were noted.

Sustainer Fuel Discharge Plumbing

The abnormal reduction in flows and pressures downstream of the fuel pump prior to cutoff prompted an investigation of the plumbing circuits to see if a plumbing rupture was allowing fuel discharge from the pump to be dumped overboard. This would reduce the pressure available for normal usage. The plumbing downstream of the fuel pump to the chamber inlet was intact. The regenerative tubes of the chamber through which the fuel passes were, for the most part, still complete. In the cases of the few tubes which had been severed, there was no evidence of pressure failures but rather, the breaks appeared to be a result of one or more of the explosions. The injector was in normal condition. The vernier fuel feed line, the fuel bootstrap line, and the fuel start line which also connect to the discharge line of the fuel pump, suffered considerable damage.

Finally, the complete fuel discharge system was eliminated as an initial source of failure because an increase in fuel flow due to a rupture anywhere downstream of the pump would promote a reduction in pump speed rather than an increase as was the case.

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A large crease and tear in the tank outlet elbow of the duct adjacent to the flex joint may have been caused by an explosion in the Quad I area. Of particular interest is the vernier LO2 tank which was shattered and had been located in Quad I; however, vernier LO2 tank pressures did not indicate an explosion prior to cutoff.

The flowmeter was inspected by disassembly of the duct. There was no evidence of contamination and the flowmeter appeared to have been operating properly.

A high pressure surge causing rupture was ruled out since the weakest portion of the fuel inlet duct is the flex joint which would distort and break at much lower pressure than the basic duct. None of the flex joints were damaged in the manner typical of their failure.

Sustainer Turbopump

An investigation was made of the sustainer turbopump to determine if there were any restrictions which might obstruct the fuel flow, causing the decrease in fuel injection pressure and corresponding loss in flow to the sustainer gas generator and verniers which was apparent just prior to cutoff. The pump was completely torn down on Monday, 28 September. There were no obstructions in the impellers and the only foreign material found in the pumps was slag from the LO2 eroded inducer or from connecting tubing. The turbine showed that an excessively high gas generator discharge temperature was encountered during the run. The first stage turbine blades were eroded away and the second stage blades showed signs of excessive heat. The hot gas line was burned through. The drive shaft of the turbine appeared to have no uneven loading or radial displacement. Outside of the signs of high temperature environment and burned hot gas line the pump appeared normal.

The condition of the pump is covered in more detail in the report of sustainer turbopump and thrust chamber inspection presented elsewhere in this report.

Head Suppression and PU Valve Behavior

The drop in fuel injection pressure would have occurred if there had been a malfunction in the PU system, causing the PU valve to close down. This was discounted for two reasons. First, the fuel pump discharge pressure would have increased, thereby causing an increase in flow to the verniers and the sustainer gas generator opposite to that shown in the data. Second, the PU valve operation was normal and was moving into control when cutoff occurred. Post-run inspection of the PU valve showed it partially open but the actuator was badly damaged in the blast which had apparently caused the valve to crack open.

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Gas Generator Performance

Examination of the sustainer turbine revealed that the first stage blades had been burned off. Also, the gas generator temperature rose abnormally prior to cutoff. The rise in temperature shown on the strip chart was only a few degrees, but the actual rise was greater than indicated prior to cutoff because of the time lag inherent in the sensor. The increase in gas generator temperature was due to a rise in mixture ratio as a result of reduced fuel flow. Fuel flow to the gas generator began dropping off approximately 120 milliseconds prior to cutoff as indicated by the sustainer gas generator fuel flowmeter. The performance of the sustainer LO2 regulator was completely normal throughout the run. The abnormal performance of the sustainer gas generator was a result of the drop in fuel pump discharge pressure; it was not the cause of the incident.

LO2 Pump Inlet Ducting

Examination of the sustainer LO2 pump inlet ducting and data eliminated the duct as the primary cause of missile failure.

The duct was found to be broken in two places, just aft of the LO2 staging valve and at the flex joint adjacent to the sustainer pump. The duct showed very little heat damage except for the elbow which attached to the pump inlet. The elbow was badly burned and the pump inlet and inducer were melted and eroded.

Events leading to the possible failure in the sustainer LO2 low pressure system started at the same time the head suppression valve went into servo control. The head suppression valve started closing at approximately the proper rate. When cutoff occurred the valve continued to close, and moved from approximately 20 degrees to full closed in 55 to 60 milliseconds. At the same time the sustainer LO2 pump inlet pressure pegged at the 150 psia limit of the transducer.

The pressure remained pegged for about 100 milliseconds and then dropped rapidly to ambient pressure. Before the sustainer LO2 pump inlet pressure began to decrease to ambient the pump inlet temperature measurement indicated a temperature exceeding the transducer range of minus 270 DGF or a loss of instrumentation.

The sustainer LO2 duct was possibly ruptured during a pressure surge. This pressure surge could possibly be due to ignition of LO2 in the inducer-adapter area or an excessive hydraulic hammer resulting in a liquid oxygen supported fire across the sustainer engine into the Quad 3 and 2 area where the majority of the fire damage occurred.

Sustainer LO2 Dome and Injector

The condition of the LO2 dome and fuel manifold was also under suspicion. It was disassembled and no obstructions were found. There was some water in the LO2 dome, apparently from rain which occurred when the engine was lying in the open for four days after the test. The injector appeared to

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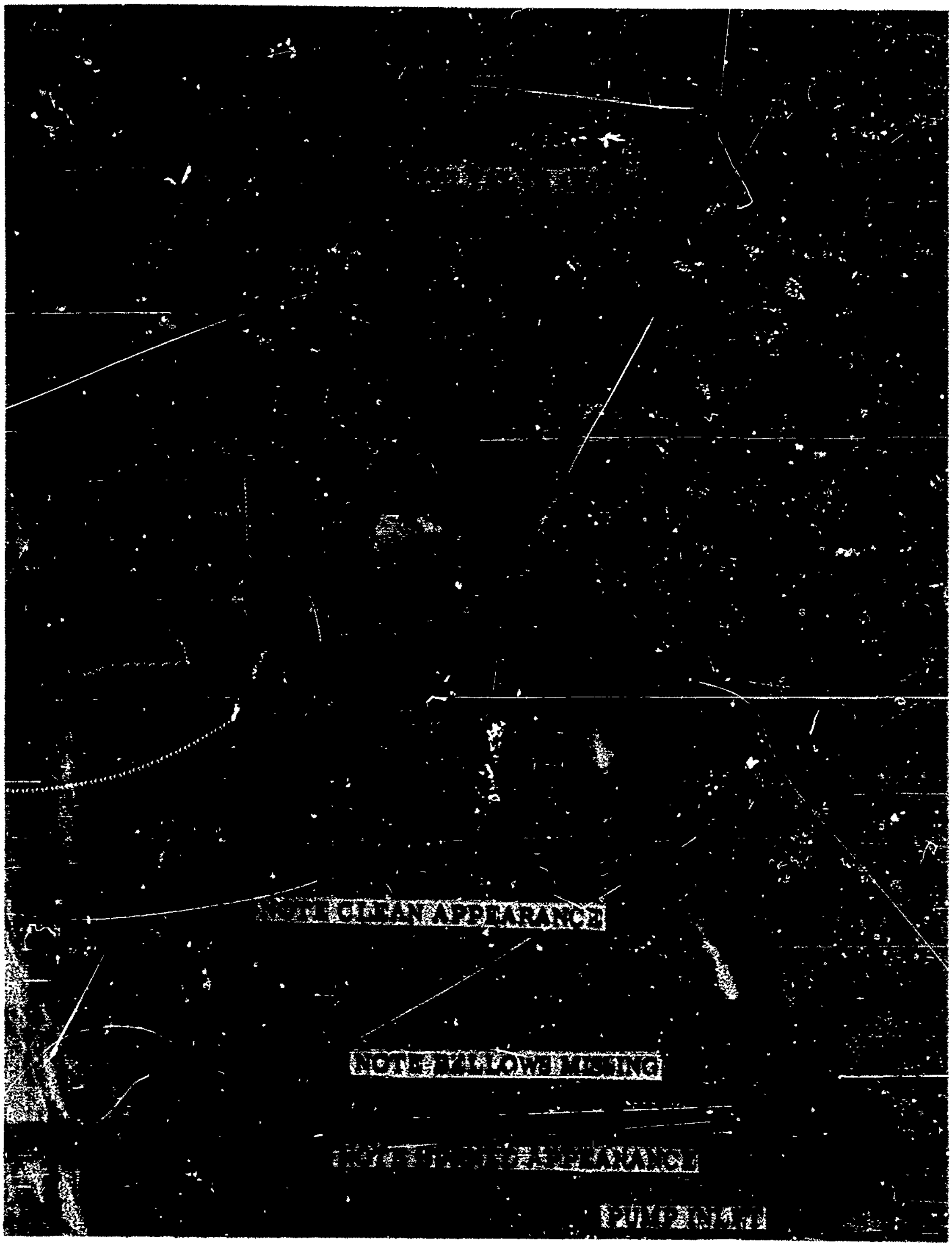
SUSTAINER LO2 PUMP INLET DUCTING



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be in good condition with no burned spots or obstructions in the orifices. This section of the hardware indicated no cause for failure.

Vernier Engine Start Tank Explosion

Examination of the vernier LO2 start tank fragments revealed that it had been torn apart by internal forces. Since this was the only high pressure tank which exhibited these characteristics, the tank was examined. The data were studied to determine if the tank explosion was the initial cause of the failure. It was not apparent whether the tank failed as a result of excessive pressure and temperature or as a result of being struck by fragments. Previously, the five-second vernier LO2 tanks have been found to be contaminated with aluminum chips as a result of a machining operation. To remedy this situation, A rocketdyne Field Service Bulletin was originated, and performed on all existing five-second vernier LO2 start tanks. This Field Service Bulletin was performed twice on this tank. Had the vernier tank exploded prior to engine cutoff, it is likely that some pieces would have pierced the thrust structure. None of these pieces were visible on the films. The LO2 start tank pressure transducer connection was sheared from the tank. The tank pressure data was normal to cutoff and exhibited normal venting. The vernier LO2 regulator output pressure also showed no irregularity before cutoff. Since pressure data does not support the hypothesis of a tank explosion before cutoff, it is concluded that the vernier LO2 tank explosion was not a primary cause of the failure.

Ground Fuel Start Tank System

A routine survey was conducted of the ground fuel start tank system with negative results. All data substantiated normal operation. The engines bootstrapped prior to any evidence of problems. The hardware showed no indications of failure which might have occurred prior to the sequence of explosions.

Pneumatic System

The pneumatic system was studied to determine if a failure in that system could have caused other failures which led to loss of the missiles, such as a severed line whipping into other components. The pneumatic system pressures were normal in all instances through cutoff. At 0.15 seconds after cutoff, the sustainer helium control bottle began to drop rapidly, but the cause of this drop is considered secondary.

Hydraulic System

The hydraulic system appeared to have operated normally prior to cutoff. There is no reason to suspect that this system could have been the cause of trouble. A hardware investigation uncovered nothing that looked unusual. The sustainer reservoir had a hole burned in one end, apparently caused by a LO2 supported fire. The only hydraulic parts missing were those associated with V1 engine.

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SUSTAINER TURBOPUMP AND THRUST CHAMBER INSPECTION

As part of the Atlas Missile 9C accident survey, the sustainer turbopump and thrust chamber disassembly and inspection was conducted in the Rocketdyne modification area in Hangar J, on 28 and 29 September 1959.

General Failure Summary

Review of sustainer turbopump hardware gives a conclusive indication that the fuel pump was completely operable at all times during the test. Fire and damage in the LO2 pump was possibly caused by rubbing of the inducer on the adapter when the fuel pump unloaded and the overspeed occurred. It is concluded that the turbine blades and nozzles were eroded and burned during the abnormal cutoff transient.

Teardown Inspection of the Missile 9C Sustainer Turbopump

The following is a sequential teardown and visual inspection of the various parts of the turbopump assembly. The discussion in general will follow the condition of the parts and any conclusions related to whether or not the particular discrepancy involved may have been the cause of a malfunction, or was the effect of a malfunction.

HS Valve and Bellows

The downstream side of the HS valve showed no evidence of fire or burning, nor was there any film of brown powder as is usually evidenced by a LO2 fire.

The outside of the bellows was blackened from an external fire.

The torque on the bolts holding the HS valve to the LO2 volute flange was high and the connection solid.

A brown powdery coating similar in color to rust was deposited on the upstream side of the gate of the HS valve. The deposite was rather heavy and tended to flake off. A small amount of scale was also found on the upstream side of the gate. A small amount of the same scale was adhered to the Flexitallic gasket which is located between the HS valve flange and LO2 volute discharge flange.

The Flexitallic gasket on the discharge side of the HS valve was clean and in good condition.

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The plastic lip seal of the valve gate was in good condition, with no indication of burn or damage.

Conclusion

The heavy deposit of the brown powder on the upstream side of the gate indicated that a fire had occurred upstream, and that the HS valve was closed at the time of this fire. The deposit of scale on the Flexitallic gasket only indicates that the scale was loose and had been deposited into the area of the gasket during the removal of the HS valve from the LO_2 volute.

LO_2 Volute

The discharge cone portion of the LO_2 volute was coated with a thin film of brown powder. Pieces of slag and a globule of molten aluminum were also in the same area.

The outside of the LO_2 volute was blackened by an external fire.

The helicoil was backed out of its threaded hole in the discharge flange.

The general condition of the LO_2 volute, other than the comments noted above, was excellent with no indications of a direct fire within the volute itself.

Conclusion

The presence of the brown powdery film, pieces of slag, and molten aluminum, indicated that there had been a LO_2 type of fire somewhere upstream of the LO_2 volute itself. The helicoil had partially backed out when one of the bolts holding the HS valve was removed. Inspection of the surfaces of both parts showed that they were free of any scratches or deformations which would further indicate that the helicoil could only back out during disassembly. The blackened condition of the exterior of the LO_2 volute indicated an external fire.

Inlet Adapter

The inlet adapter had two large holes burned through the side walls in a nine o'clock and six o'clock position. This is referenced to the discharge flange of the volute at a six o'clock position.

The direction of flow of material, burning and apparent fire appeared to have emanated from a position immediately upstream of the wear ring in the sleeve

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of the inlet adapter. The flow direction was generally toward the upstream side of the inlet adapter and radially through the wall of the adapter.

The diverter lip of the wear ring was eroded approximately 360°. The metal from the wear ring was sprayed in the direction towards the upstream side of the inlet adapter.

An inner half gasket was used between the inlet adapter and LO2 volute. This gasket was in excellent shape and the torque on the bolts holding the inlet to the LO2 volute was high, indicating that a good and adequate seal existed.

Conclusion

The burning of the inlet adapter took place in the area of the inducer and the flow tended to move upstream which indicates that some type of rubbing occurred in this area. The cause of the rubbing will be discussed later. The erosion of the diverter lip was also caused by burning but its flow path indicates that this burning in all probability resulted from its close proximity to the burned area of the aluminum inlet adapter rather than from a rubbing or a fire starting at the wear ring itself.

Inducer

The inducer was burned and eroded on the periphery and underside of the blades. The erosion of the aluminum was evenly distributed. There was a rather heavy deposit of slag on the underside portion of the blades.

Conclusion

Unloading of the fuel pump with the overspeed condition may have caused shaft bending or whipping with resultant rubbing and ignition in the inducer-adapter area.

Impeller

The chamfer of the impeller eye was coated with a thick deposit of slag which appeared to have been applied in a spray form. This slag was readily removable. In these areas from which the slag was removed, there was no indication of erosion of the aluminum metal of the chamfer.

The inlet eye in general was blackened but relatively cleared of deposits of slag or molten material.

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The smallest land of the step labyrinth had indications of a rub and a blackening of the surface but was very minor in nature.

The two smaller lands of the step labyrinth were blackened.

The balance of the lands were coated with a brown substance.

The back and discharge areas of the impeller were coated with a very light deposit of brown film.

Conclusion

The fact that the chamfer of the inlet eye was not eroded indicates that no rubbing existed between the diverter lip of the wear ring and this chamfer, and that the deposit of slag of this chamfer occurred as a result of the burning of the wear ring. The rub mark on the small land of the step labyrinth was occasioned by a buildup of slag on the adjacent surfaces of the wear ring. This buildup was caused by the general burning condition in the area. It can be ascertained that no rubbing existed between any portion of the impeller and wear ring prior to the fire or that it may have contributed to the fire.

LO_2 Slinger

The LO_2 slinger was in good condition and showed no signs of rubbing of any type.

LO_2 Seal Manifold

Pieces of molten aluminum metal were found within the seal manifold in the area of the discharge line. The general condition of this manifold was good. The drain line fitting was dented by impact of some type.

Conclusion

The deposit of molten metal in the manifold and its relative position indicated that the metal in its molten form had entered the discharge line and fitting of this manifold and was sprayed into it from an external source.

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Heater Housing "O" Ring

The "O" ring which effects an oil seal between the heater housing and the fuel volute was partially extruded into the No. 1 bearing cavity.

Conclusion

The extrusion of the "O" ring took place after the fire which enveloped the pump, as indicated by its direction and characteristic of extrusion as well as the fact that no oil existed on the ambient or downstream side of the O'ring. This "O" ring effected a good seal prior to this fire.

Oil Seal and Intermediate Seal

The oil seal and intermediate seals were in excellent shape showing no indications of failure or damage.

Fuel Impeller

The inlet of the fuel impeller was coated with a black film in an area of approximately 180°. The other 180° of the inlet and vanes did not have any appreciable discoloration.

Conclusion

This black film was caused by an external fire which burned or charred residual fuels which were in the pump and took place after the pump had ceased to rotate.

Fuel Inlet

The fuel inlet was coated with a dark black film approximately 180° in the area of the inlet cone and diminishing in intensity as it progressed inwardly into the fuel impeller. In this area it matched the discoloration of the fuel impeller and its relative position.

Conclusion

With a more intense indication of a black film and its diminishing color starting from the inlet cone of the fuel inlet, it is indicated that the fire that caused this discoloration was from an external source or origin. There was no apparent erosion of any of these parts which would tend to indicate that the burning of possible residual fuels took place at relatively low temperatures and for a short period of time.

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SUSTAINER LO2 PUMP SHOWING
DAMAGE TO INDUCER AND HOUSING

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PAGE NO.
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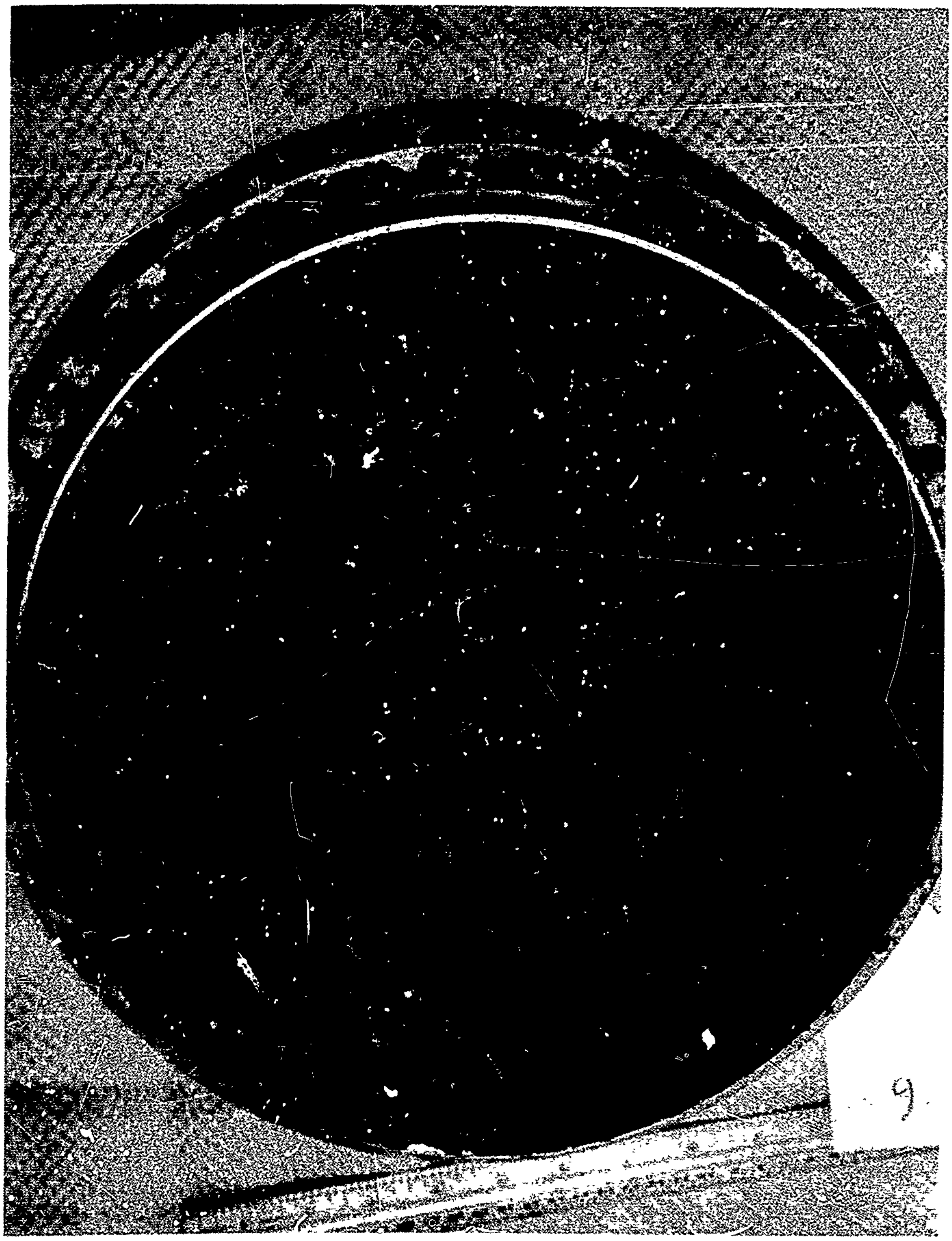
SUSTAINER INJECTOR



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WORK ACCOMPLISHED ON VERNIER FUEL AND LO_2 SYSTEMS AT AMR

All work accomplished at AMR on the 9C vernier fuel system, and vernier LO_2 system, is documented below for reference. Configuration changes which resulted cannot be associated with the conditions which initiated the failure.

DATE	IR NO.	DESCRIPTION
4/6/59	401174	V1 and V2 LO_2 dome seals replaced after contamination check of domes. Ref. BOI No. 06469
4/7/59	401175	Vernier LO_2 flowmeter pickup replaced because of open reading
4/7/59	401193	Bend in 9529-43391-65 V1 LO_2 link too close to AN 819 sleeve. Replaced link with GMA 0761 link.
4/8/59	401167	Vernier LO2 Flowmeter pickup replaced because of open reading
4/10/59	401526	Orifice in V1 fuel inlet pressure instrumentation link installed backwards and without an O-ring. Orifice was removed and installed per blueprint.
4/13/59	401525	Orifice in V2 fuel inlet pressure instrumentation link installed backwards. Orifice was removed and installed per blueprint.
8/27/59	421236	GMA 0761 V2 LO_2 line interfered with fairing. Material was trimmed from fairing to provide clearance
8/27/59	421234	GMA 0761 V1 LO_2 link interferred with fairing. Material was trimmed from fairing to provide clearance.
8/27/59	421233	7-20441-242 V1 LO_2 purge link scratched. Okayed for use.
8/27/59	421232	7-20441-245 V1 fuel purge link scratched. Okayed for use

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DATE	IR NO.	DESCRIPTION
8/31/59	413924	V1 and V2 LO_2 dome seals replaced after contamination check of domes. Ref. BOI No. 08864
9/3/59	413776	20120-5 vernier LO_2 start tank pressurizing valve replaced because of suspected internal leakage.
9/4/59	413778	9512-59052 vernier LO_2 start tank pressure regulator replaced because of internal leakage.
9/10/59	413817	7-20441-245 V2 LO_2 purge link dinged. Okayed for use.
9/15/59	421939	9529-43391-57 V1 fuel link dented. Okayed for use after leak check at 535 psig
9/17/59	421891	9512-45094 B Vernier LO_2 start tank low pressure relief valve replaced because of leakage past poppet
9/18/59	421948	9512-43006 V2 LO_2 bulkhead valve replaced because of internal leakage.
9/23/59	421895	V1 fuel inlet pressure transducer replaced because of short
9/23/59	421812	9512-59052 vernier LO_2 start tank pressure regulator replaced because of internal leakage.

DATE	BOI NO.	DESCRIPTION
4/6/59	06469	V1 and V2 LO_2 domes removed for contamination check
4/10/59	06645	Vernier LO_2 start tank vent link removed for cleaning
4/20/59	11361	TVA 56579-7 vernier LO_2 link removed in order to install B1 pitch actuator. Interference existed between these parts
6/15/59	11087	7-22237-45 vernier LO_2 link removed for contamination check

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DATE	BOI NO.	DESCRIPTION
8/6/59	12567	TVA 89228-9 and -11 PU purge supply links disconnected to work TVA 93633
8/21/59	08009	TVA 56582-7 and -11 tubes disconnected during leak check
8/25/59	08022	TVA 81190-9 and -11 tubes removed to work TVA 93641
8/29/59	08855	TVA 56582-11 tube disconnected during leak checks
8/31/59	08864	Vernier LO_2 domes removed for contamination check
9/3/59	08933	20120-5 vernier LO_2 start tank pressurizing valve removed per IR No. 413776
9/4/59	08942	9512-59052 vernier LO_2 start tank pressure regulator removed per IR No. 413778
9/14/59	09000	Disconnected 7-02319 vernier LO_2 flex line and 7-02322 vernier fuel flex line for access to fuel RMI valve. Ref. TVA 8709
9/17/59	08778	9512-45094B vernier LO_2 start tank low pressure relief valve removed per IR No. 421891
9/18/59	09047	9512-43006 V2 LO_2 bulkhead valve removed per IR No. 421948
9/23/59	08804	V1 fuel inlet pressure transducer removed per IR No. 421895
9/23/59	08811	9512-59052 vernier LO_2 start tank pressure regulator removed per IR No. 421812

COMPLETION DATE	TVA/GMA NO.	DWG. NO.	DESCRIPTION
4/10/59	GMA 0761	7-22107	Replaced 9529-43391-47 vernier LO_2 line with GMA 0761-7 line because of interference with fire shield

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COMPLETION DATE	TVA/GMA NO.	DWG. NO	DESCRIPTION
4/14/59	TVA 93620	7-16911	Relocated vernier fuel start tank transducer due to removal of sustainer tank bottle
8/5/59	GMA 10802	7-20204	Remocked pigtails on vernier LO_2 vents to keep LO_2 from hitting launcher
8/10/59	TVA 93633	7-43028	Provided connection for external supply for PU purge
8/27/59	TVA 93641	7-16911	Provided bulkhead valve to allow vernier fuel tank to fill.

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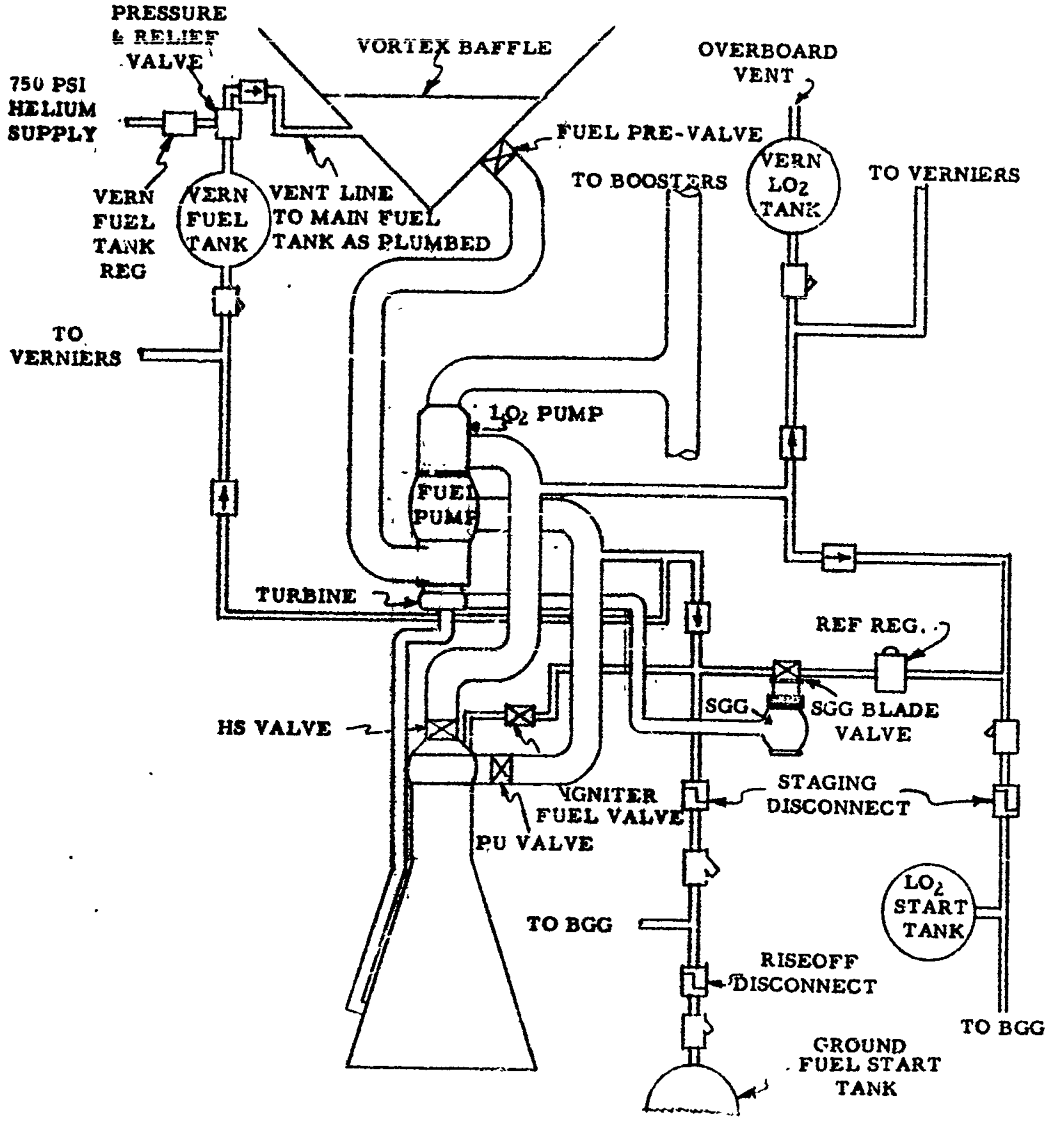
SUSTAINER ENGINE SYSTEM



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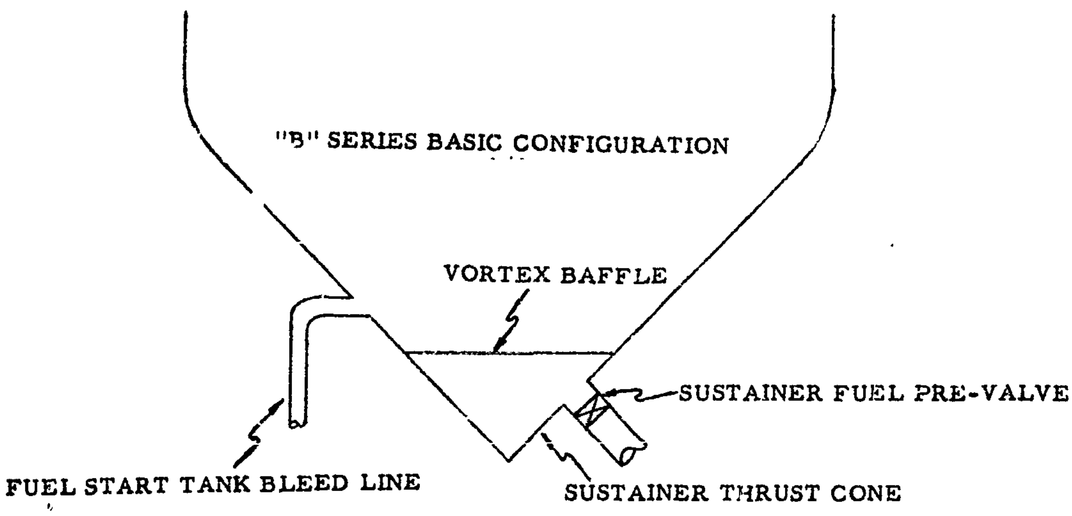
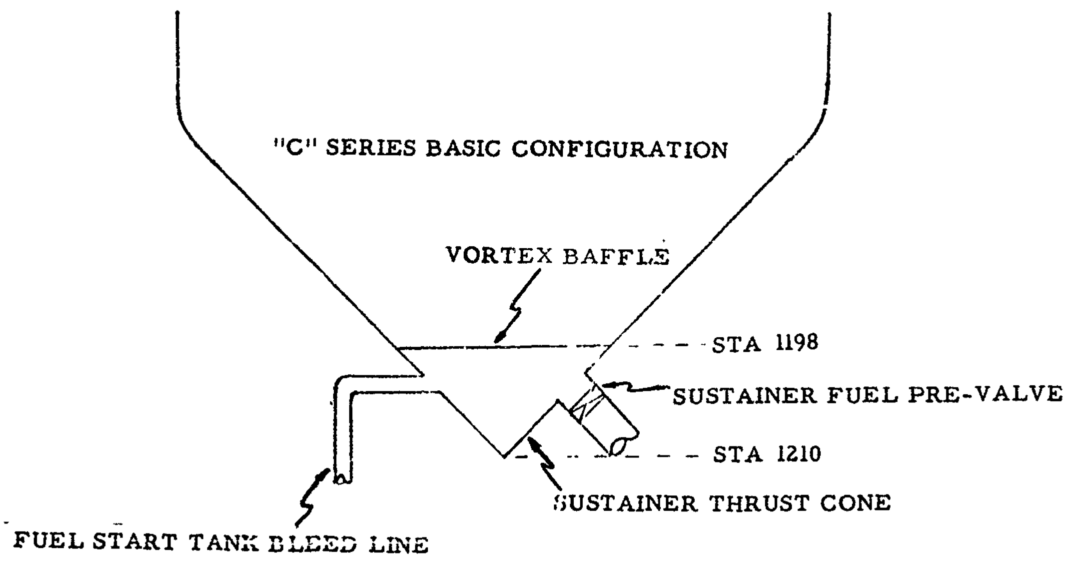
DIFFERENCE BETWEEN "B SERIES AND "C" SERIES
FUEL START TANK BLEED LINE ATTACH POINT





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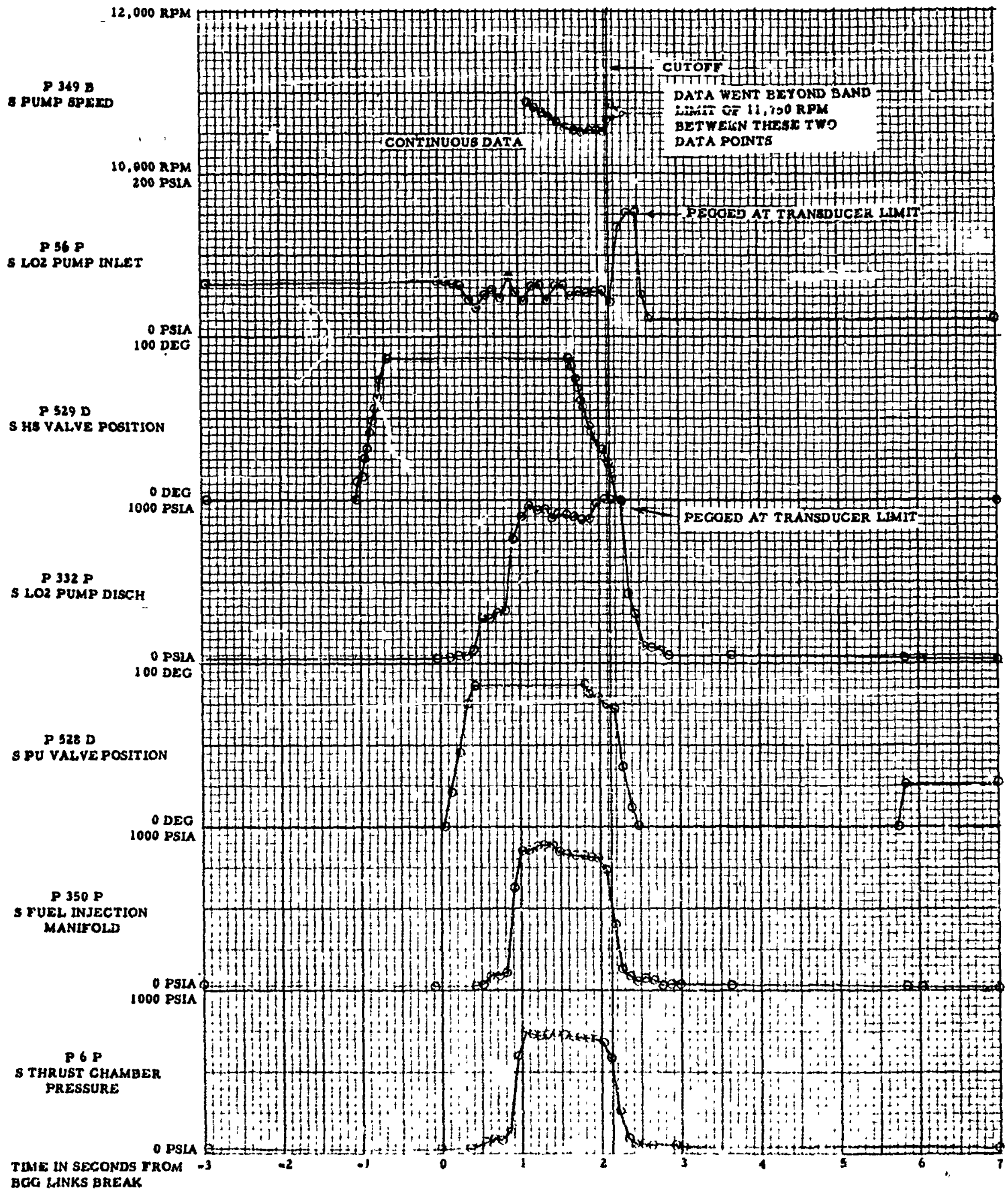
PROPULSION SYSTEM
COMMUTATED TELEMETRY DATA



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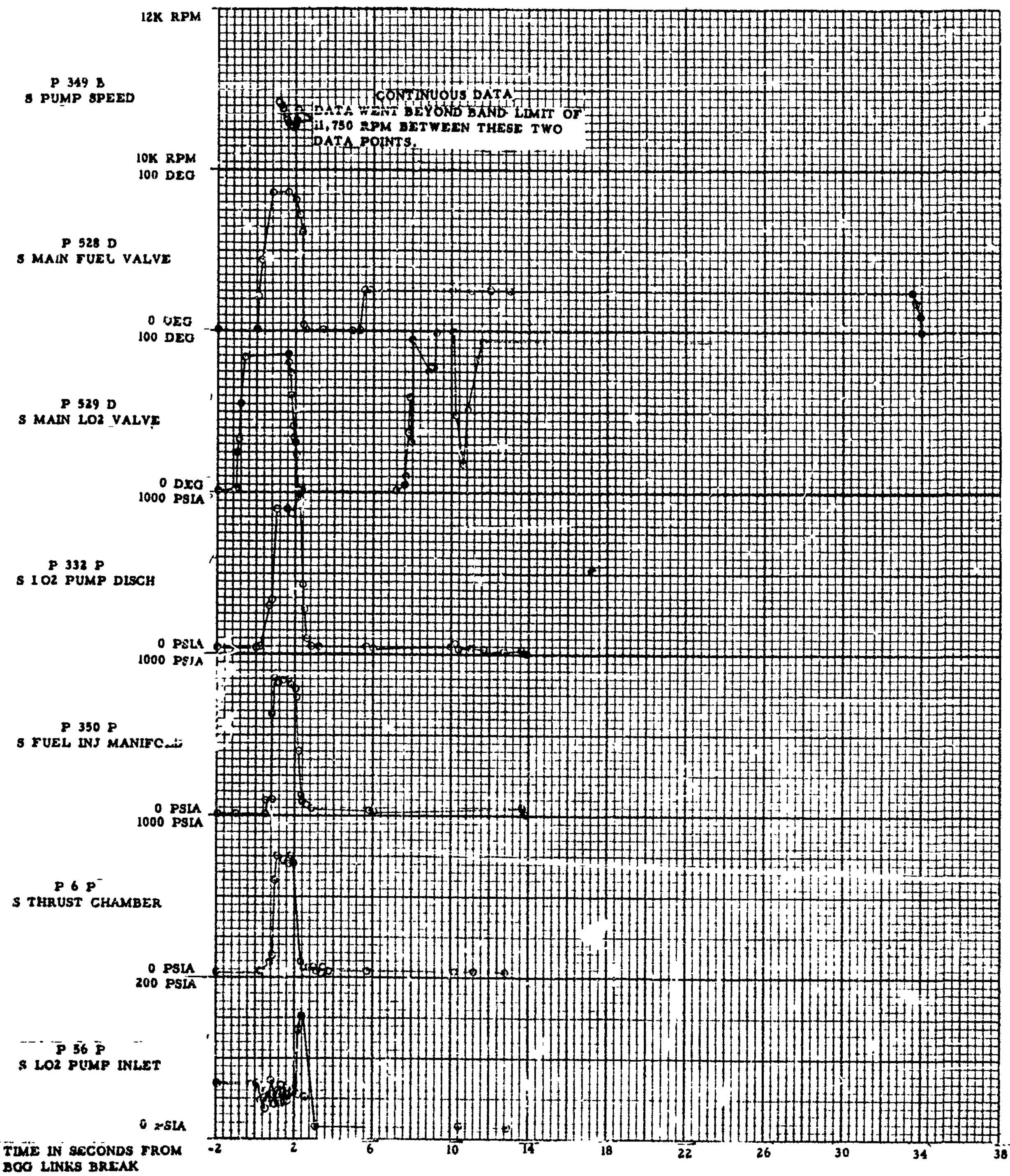
PROPULSION SYSTEM
COMMUTATED TELEMETRY DATA



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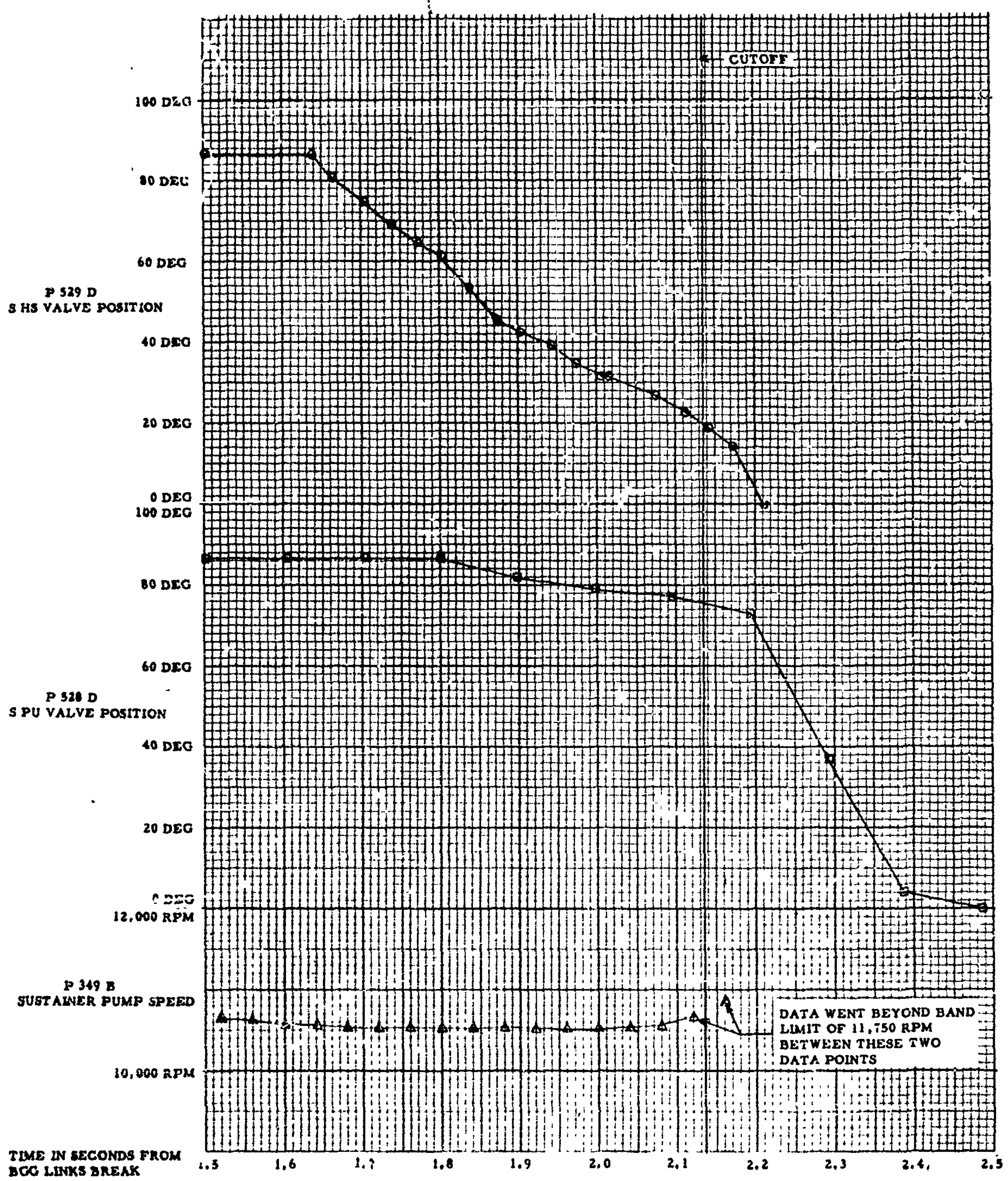
EXPANDED SCALE PRESENTATION OF MISSILE 9C FRF
PROPULSION SYSTEM COMMUTATED TELEMETRY DATA



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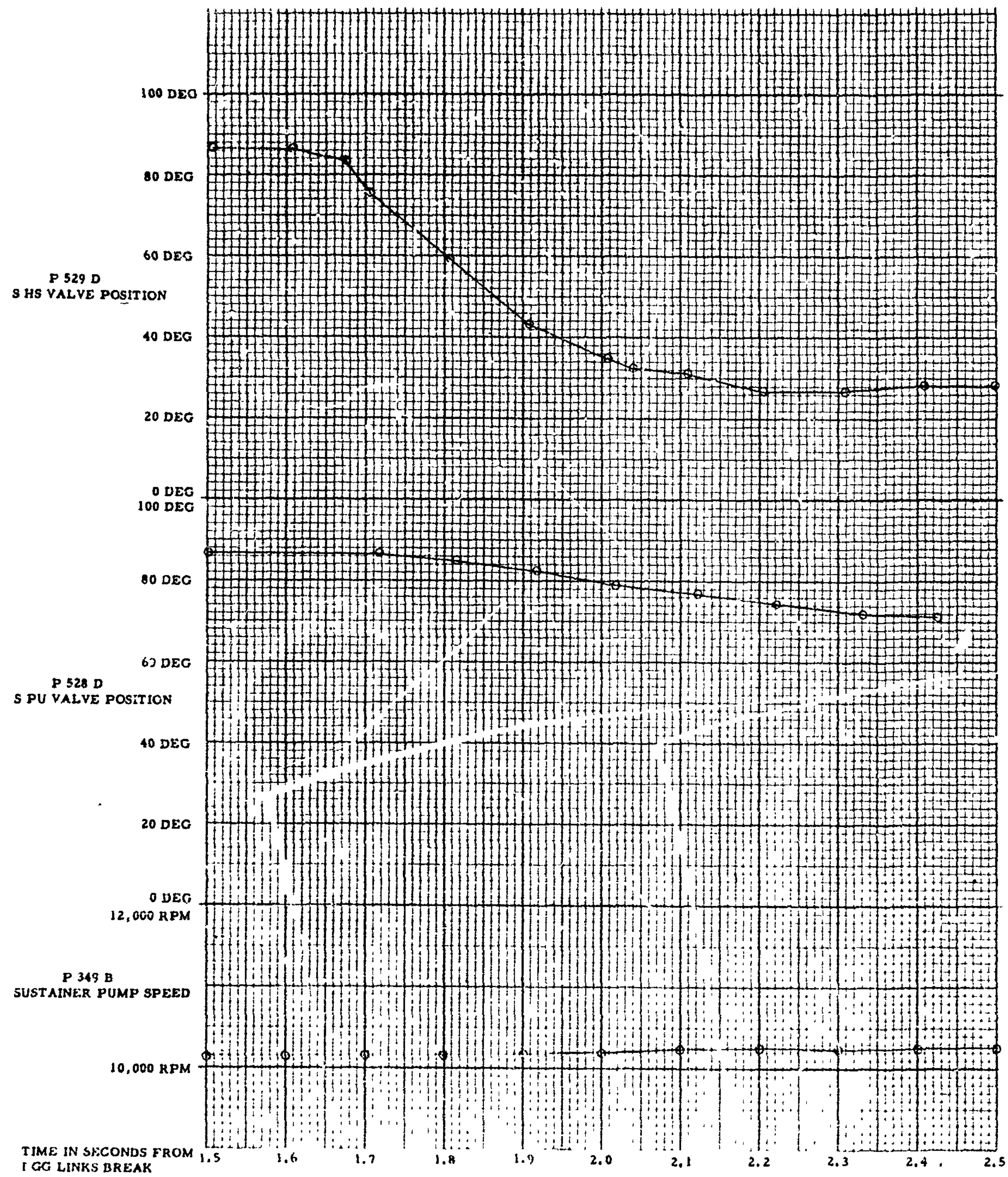
EXPANDED SCALE PRESENTATION OF MISSILE 8C FRF PROPULSION SYSTEM COMMUTATED TELEMETRY DATA



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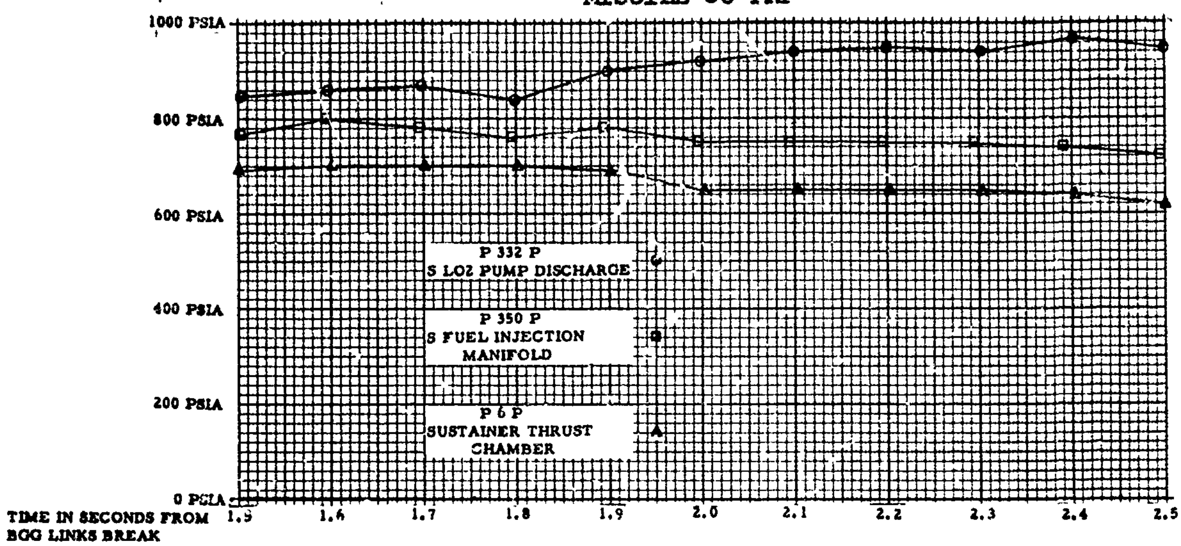
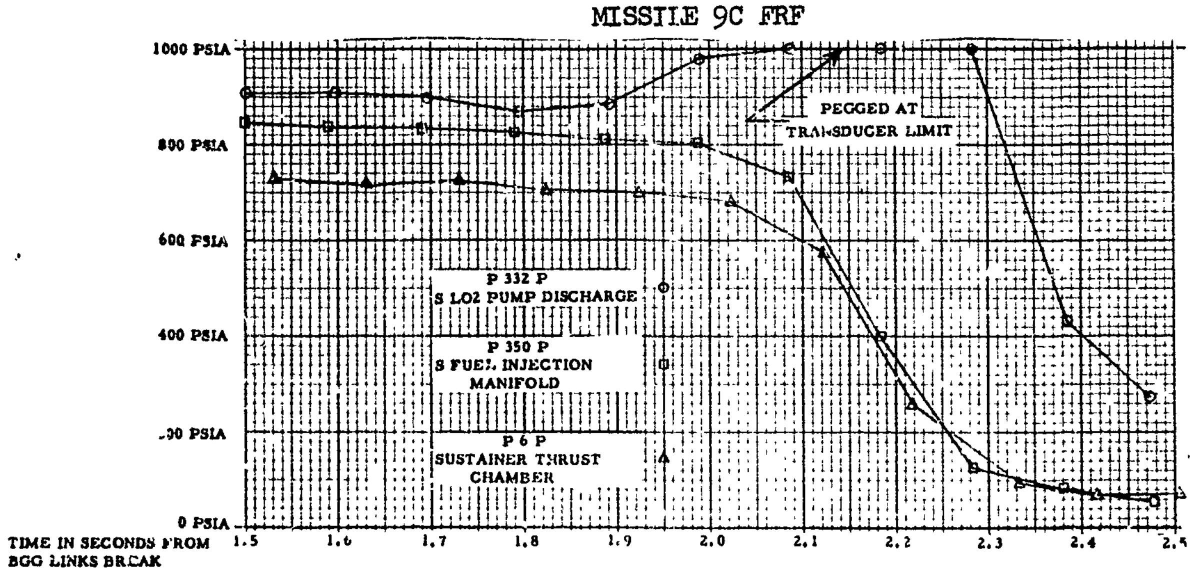
EXPANDED SCALE PRESENTATION OF PROPULSION SYSTEM COMMUTATED TELE[illegible] DATA FROM MISSILE 8C FRF AND MISSILE 9C FRF

MISSILE 8C FRF



MISSILE 9C FRF



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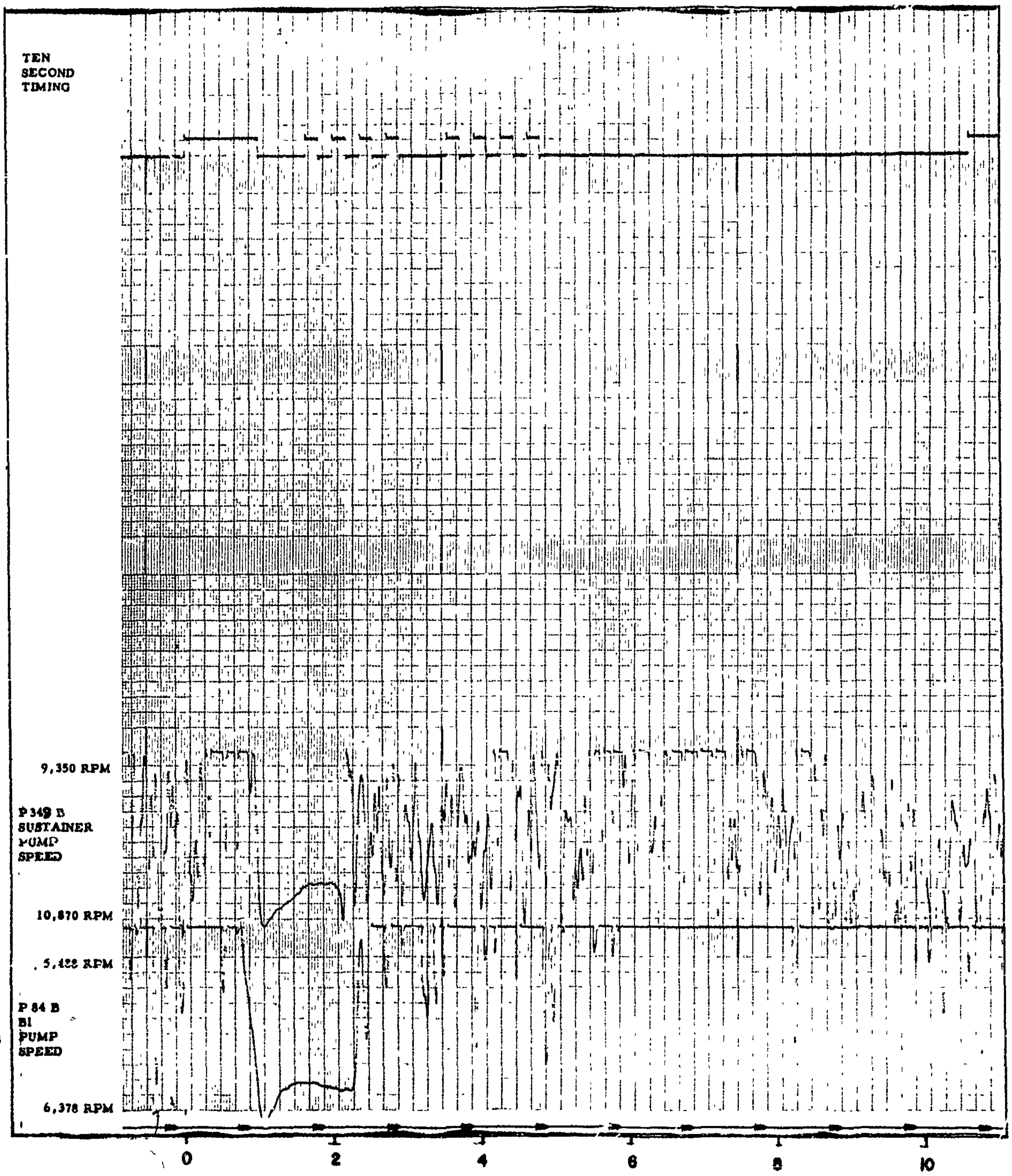
PROPULSION SYSTEM
CONTINUOUS TELEMETRY DATA



TIME IN SECONDS FROM B.G.G. LINKS BREAK

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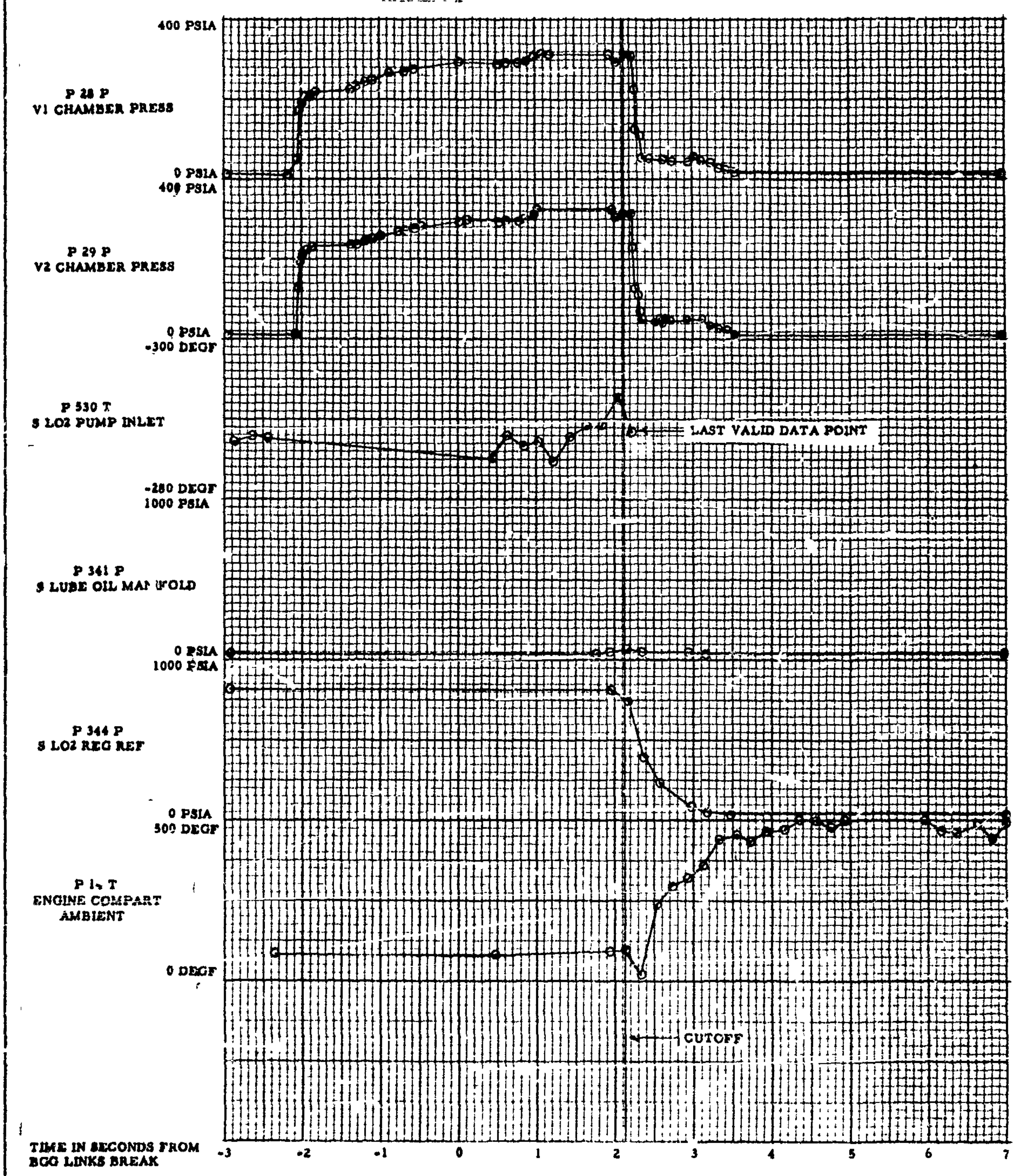
PROPULSION SYSTEM
COMMUTATED TELEMETRY DATA



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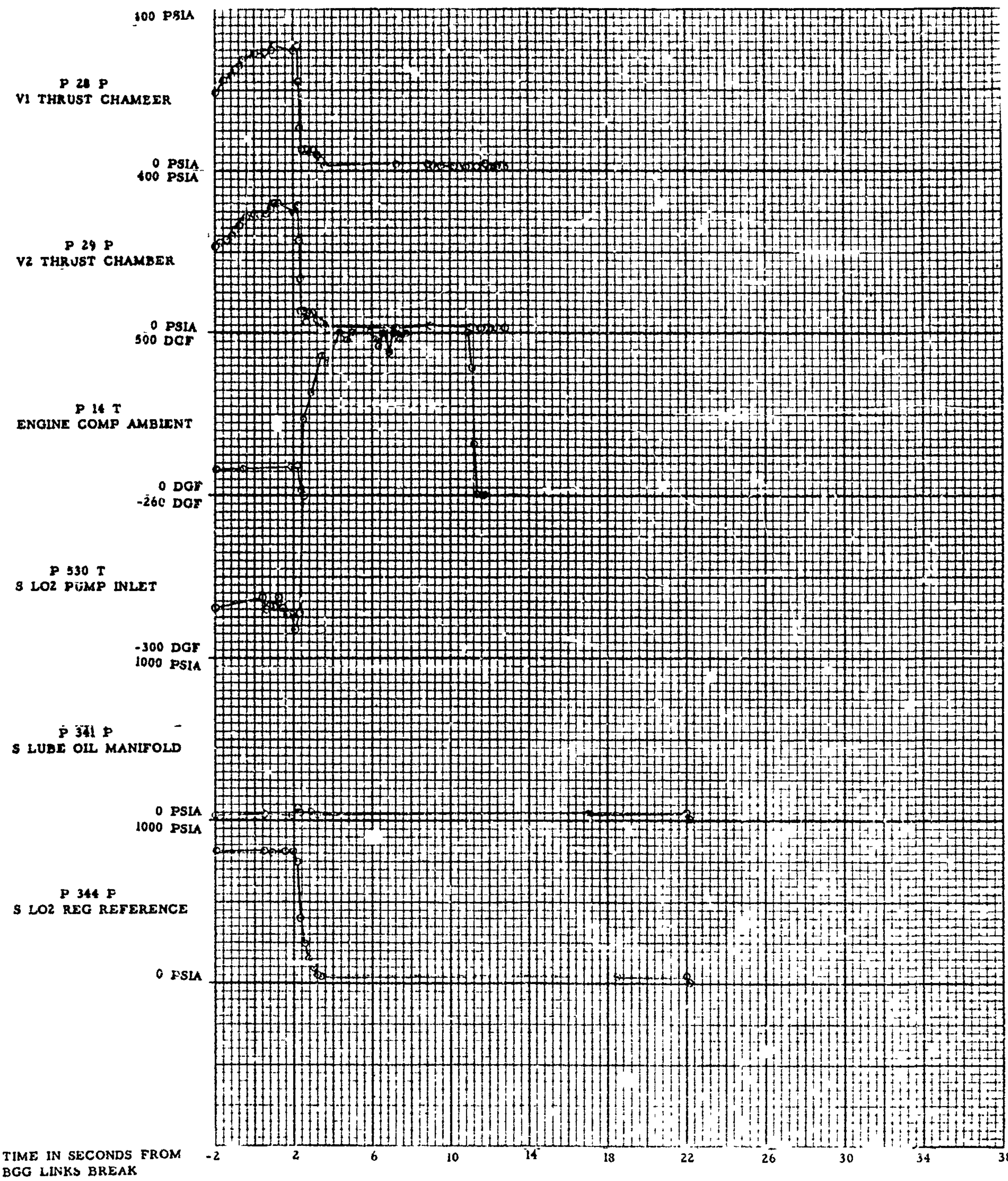
PROPULSION SYSTEM
COMMUTATED TELEMETRY DATA



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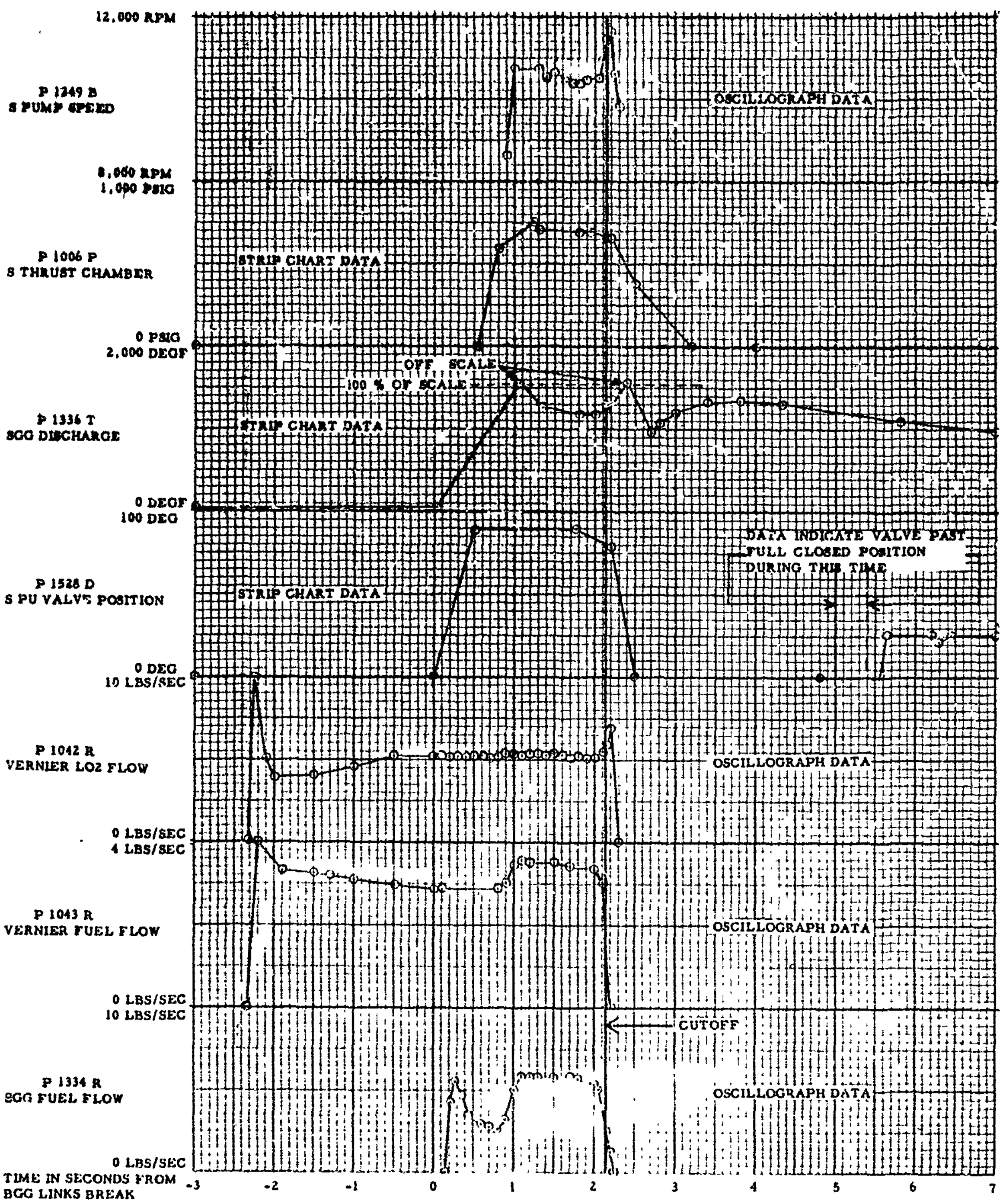
PROPULSION SYSTEM LANDLINE DATA



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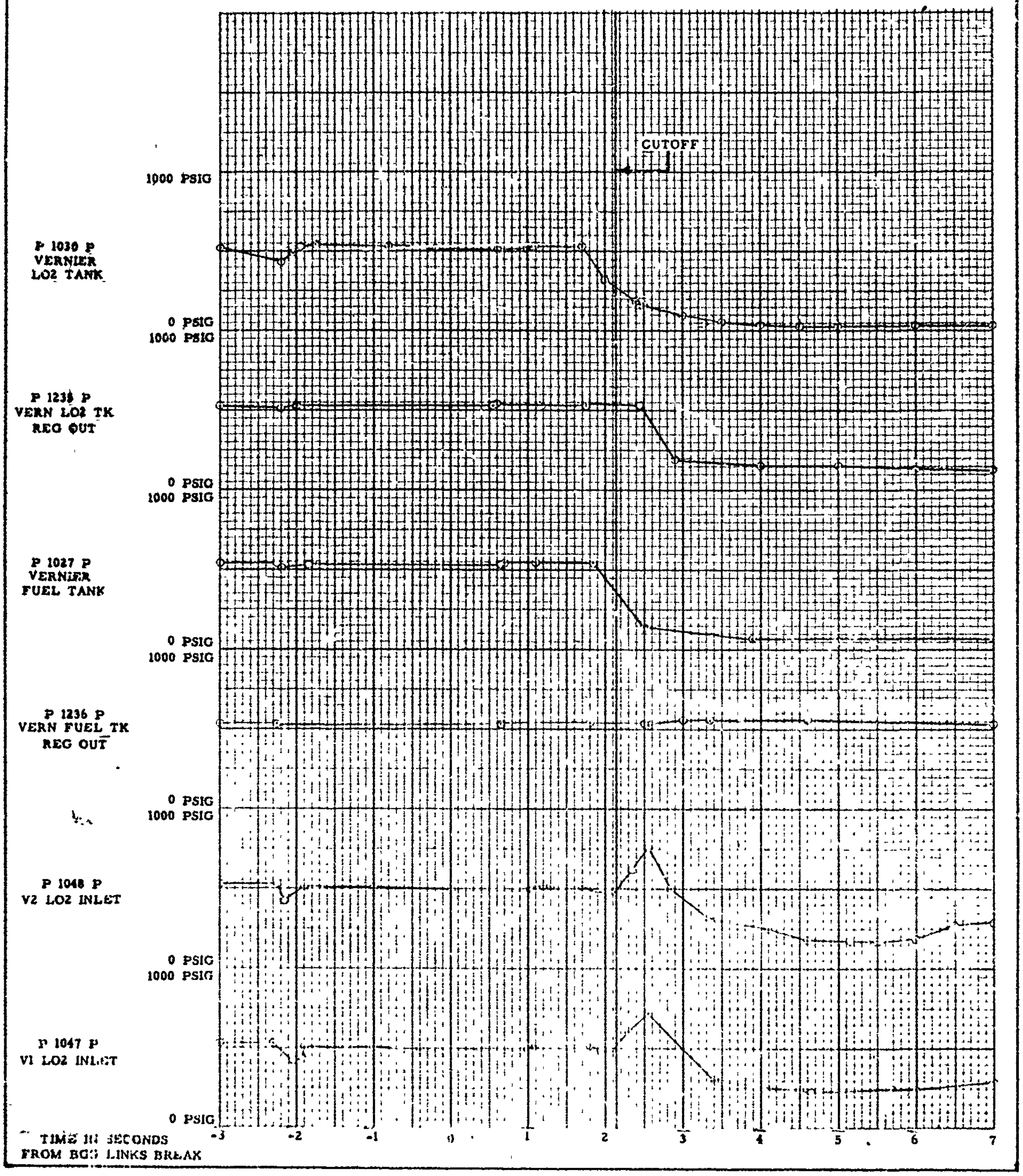
PROPULSION SYSTEM LANDLINE DATA



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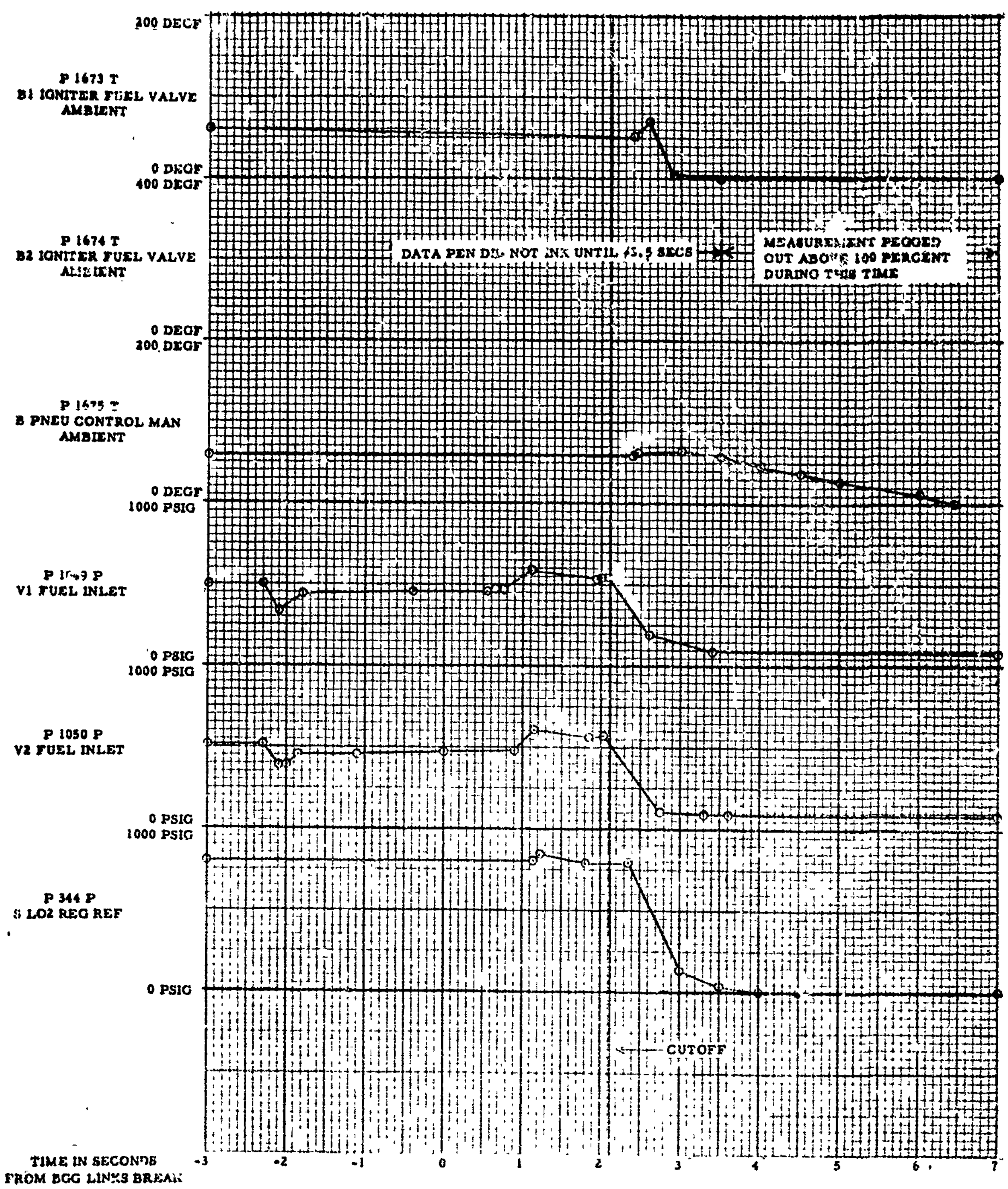
PROPULSION SYSTEM
LANDLINE STRIP CHART DATA



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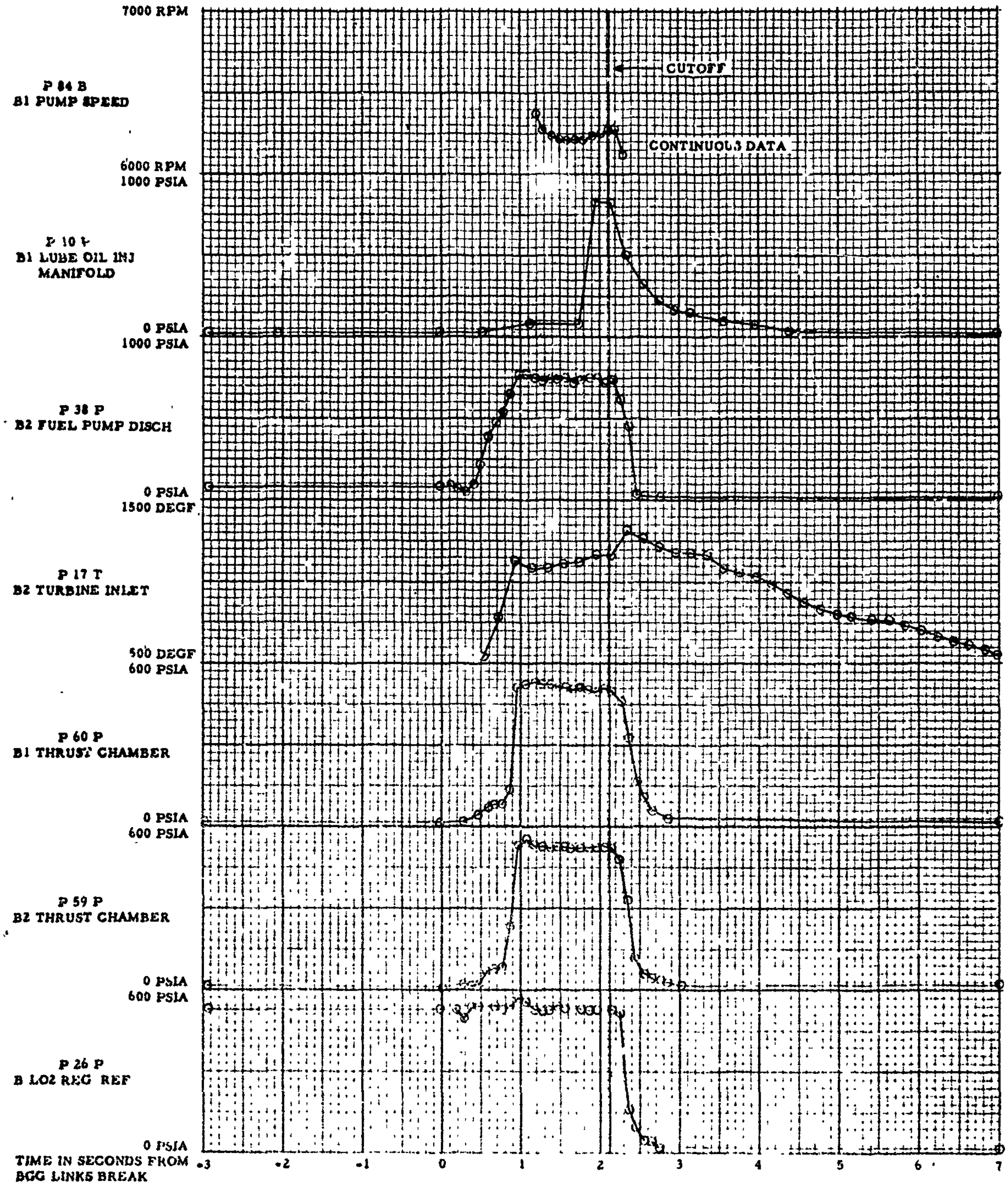
PROPULSION SYSTEM
COMMUTATED TELEMETRY DATA



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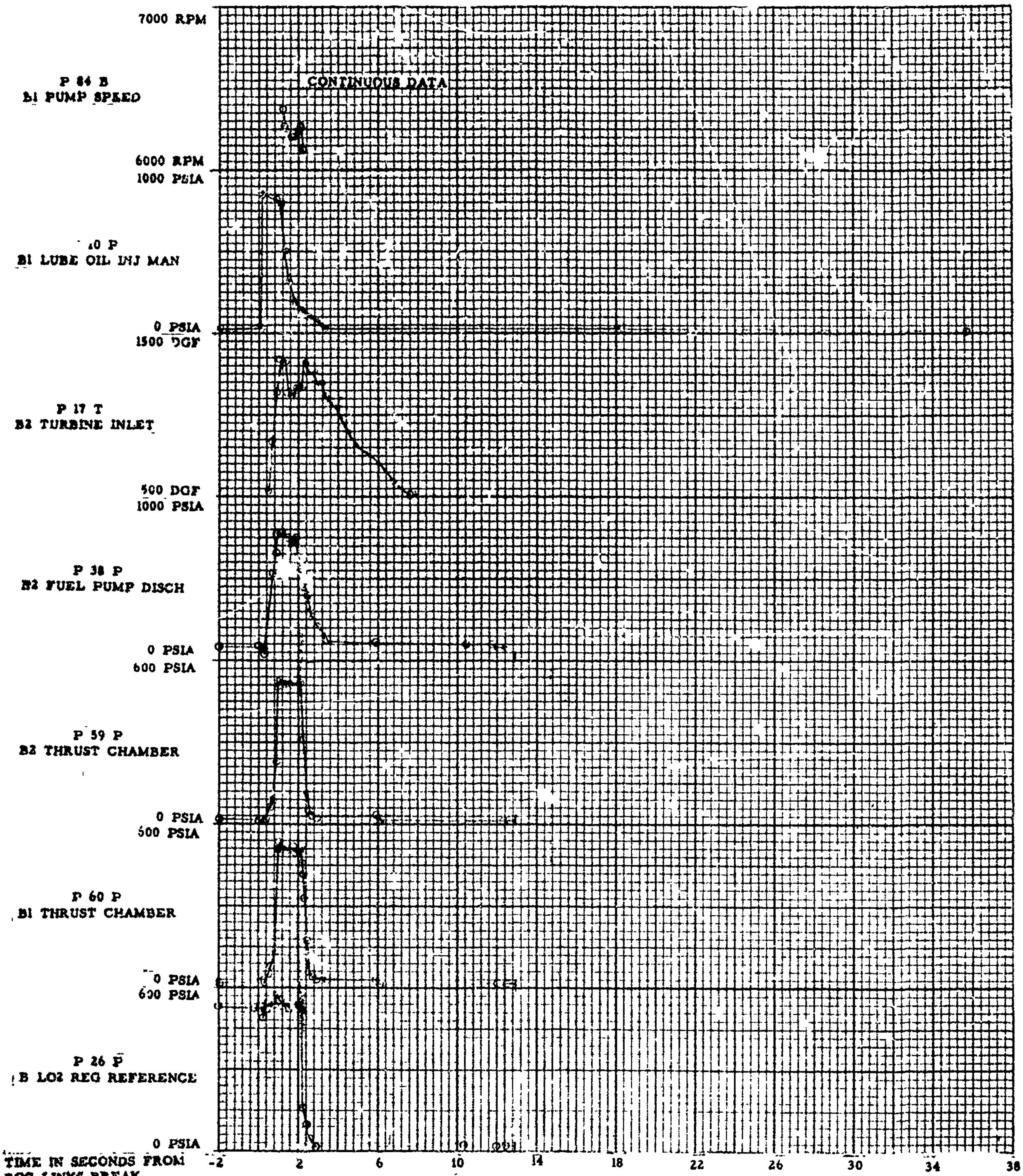
PROPULSION SYSTEM
COMMUTATED TELEMETRY DATA



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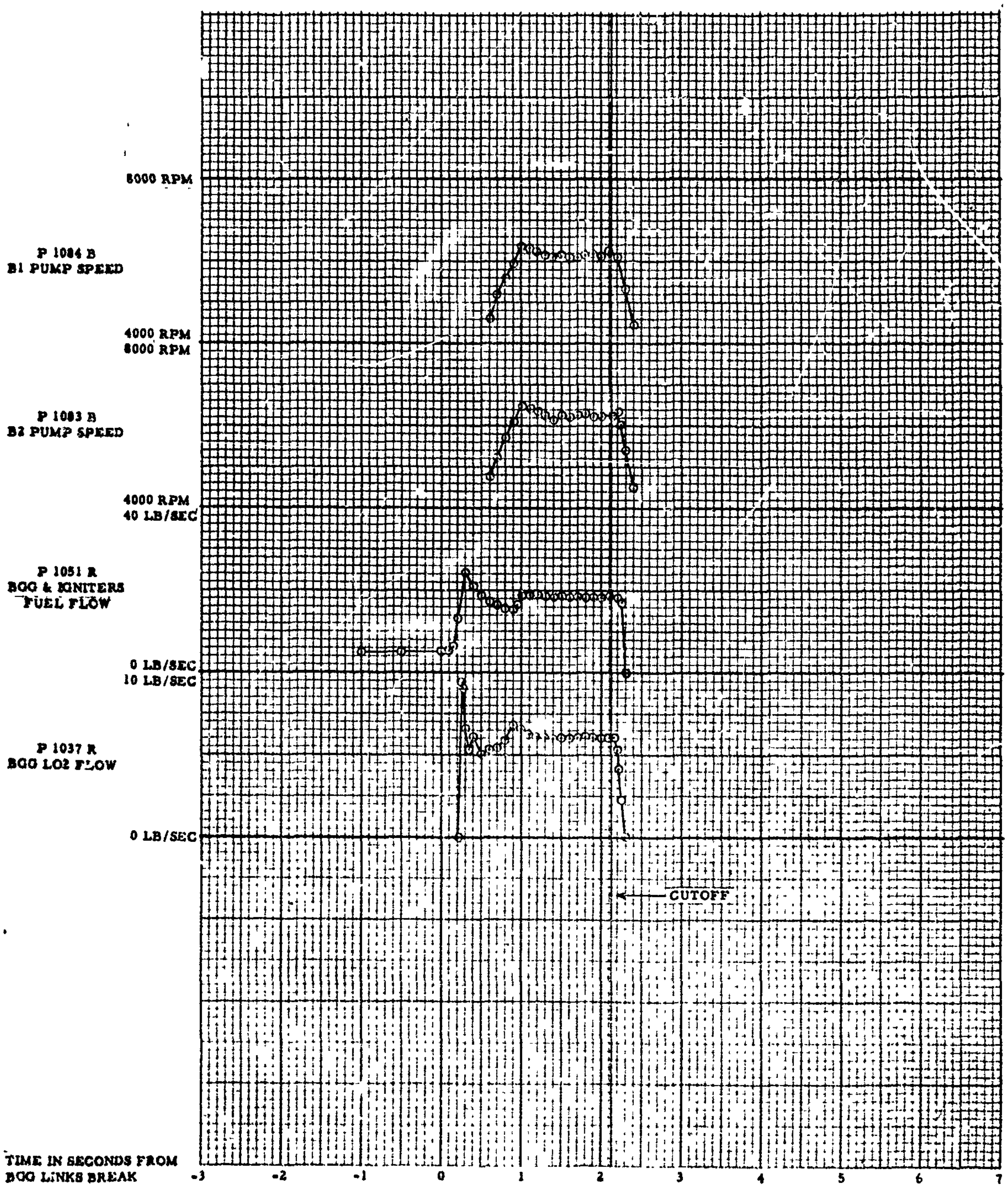
PROPULSION SYSTEM
LANDLINE OSCILLOGRAPH DATA



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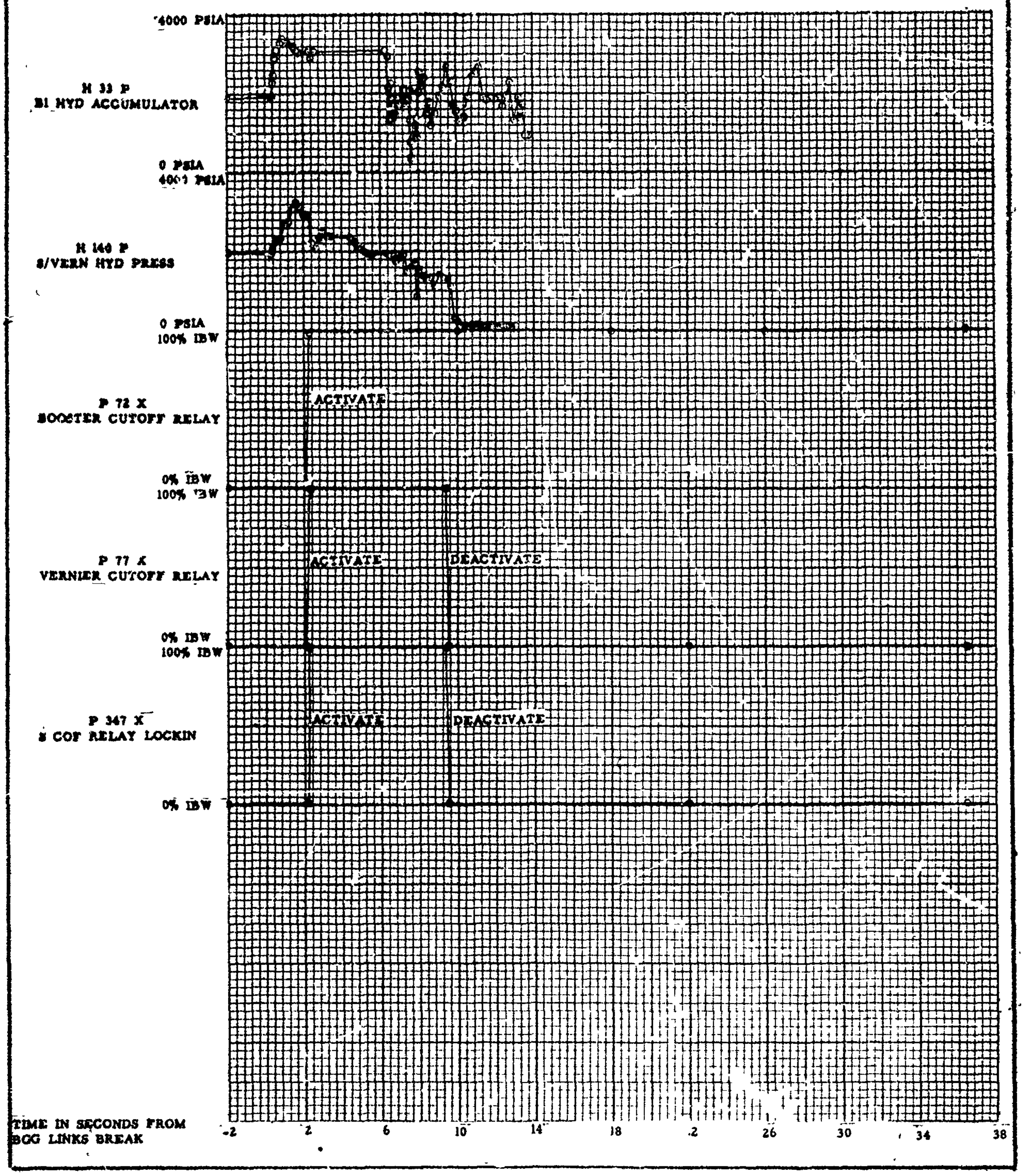
PROPULSION SYSTEM
COMMUTATED TELEMETRY DATA



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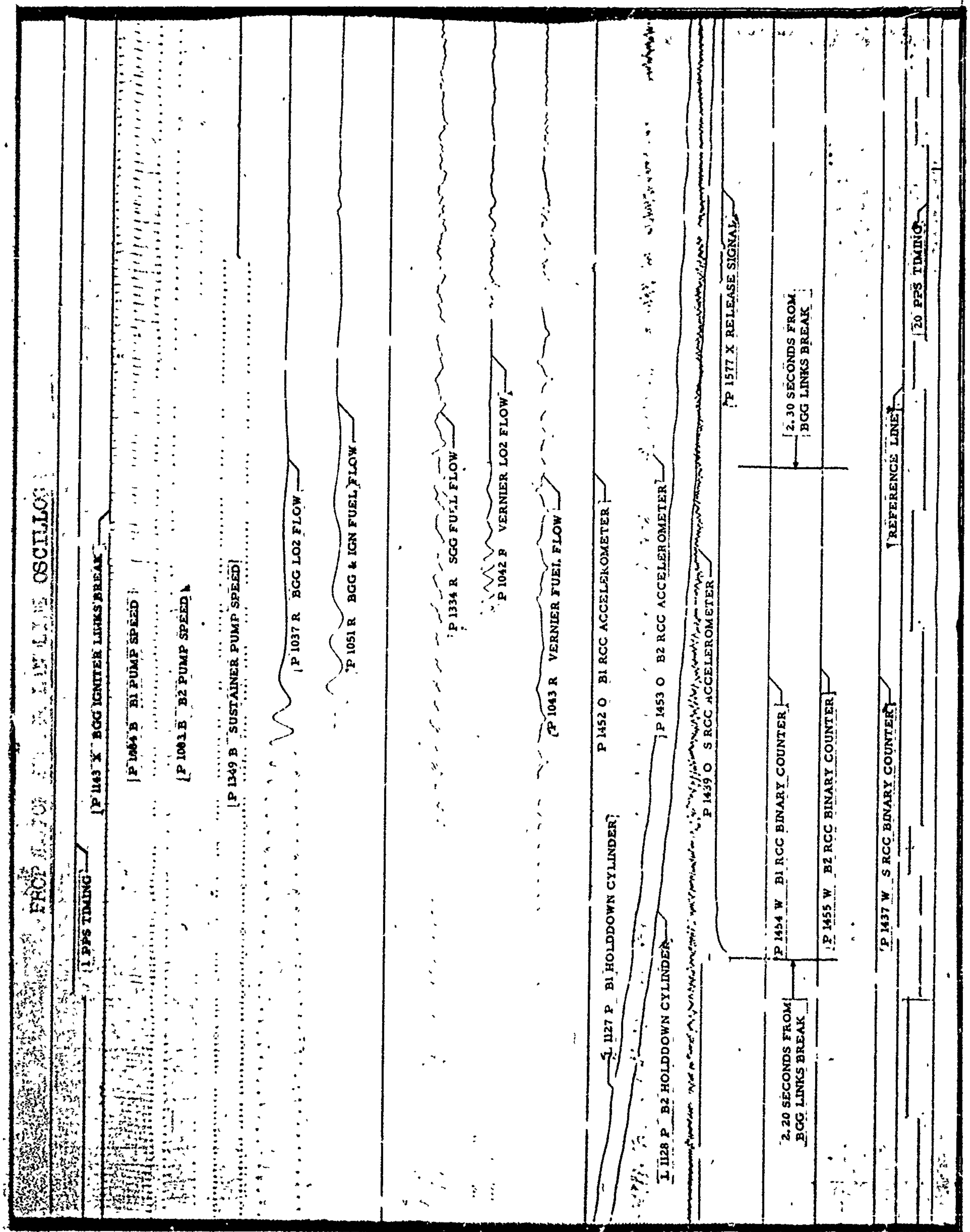

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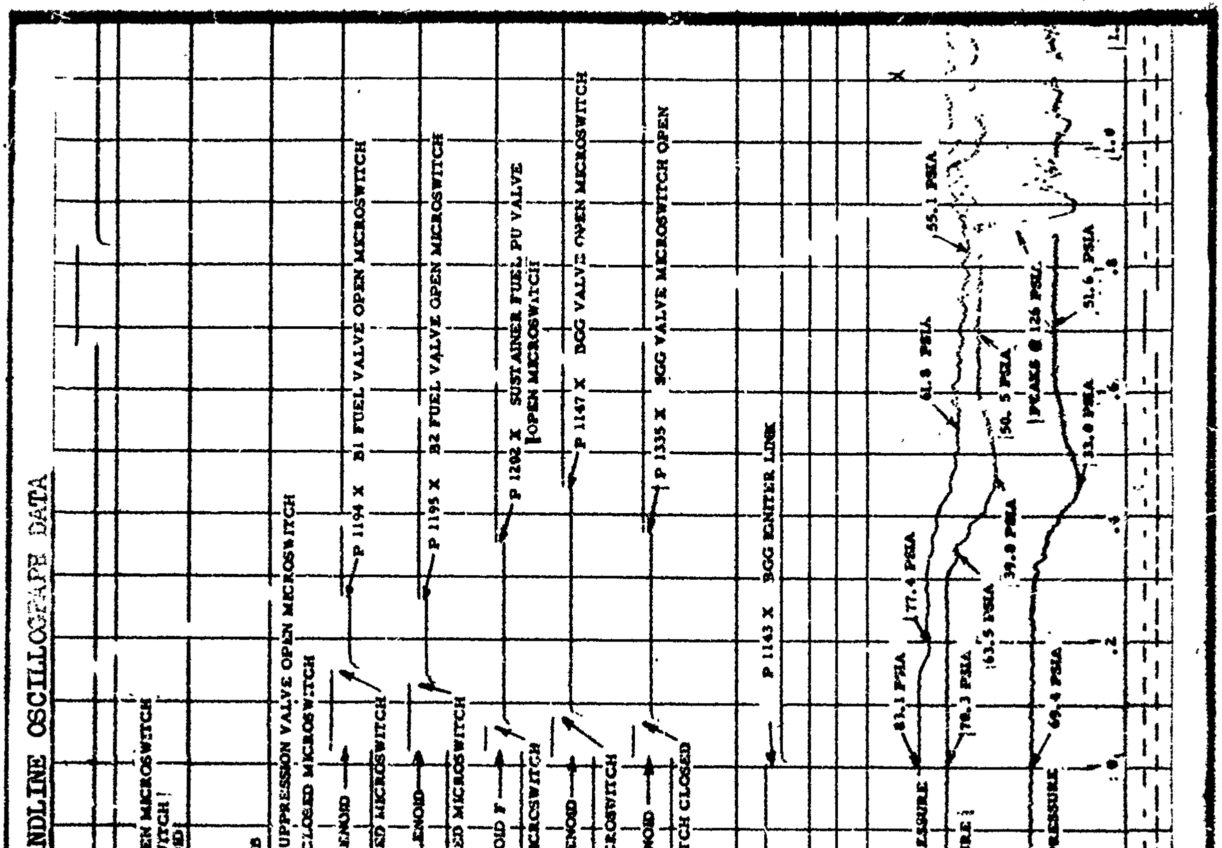

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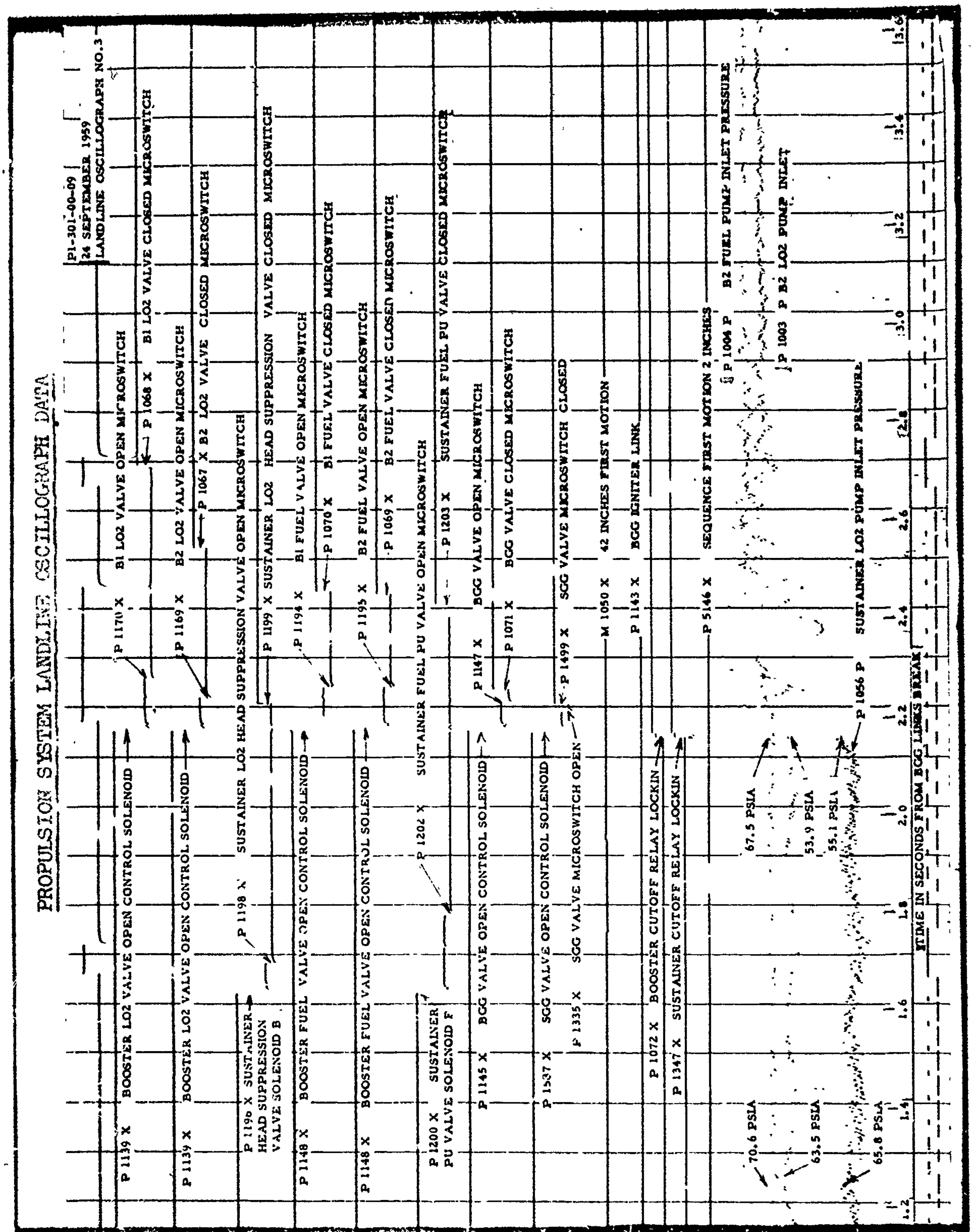

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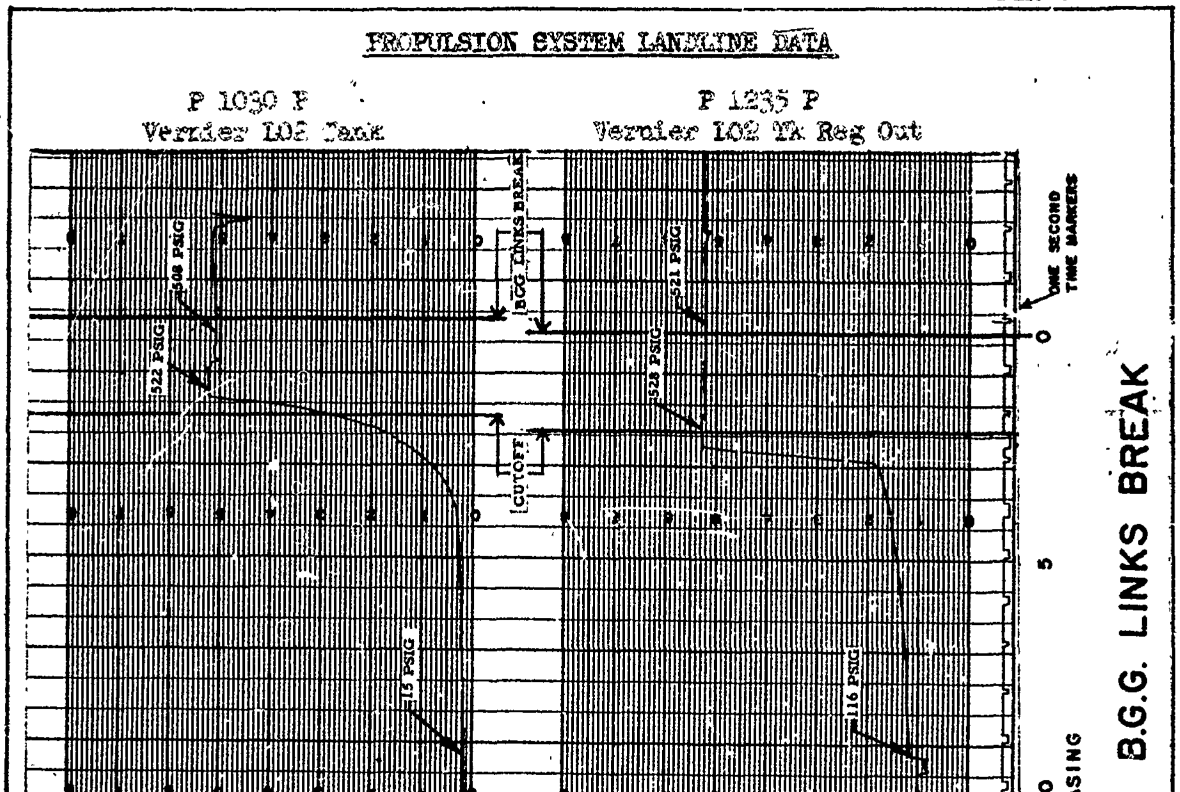

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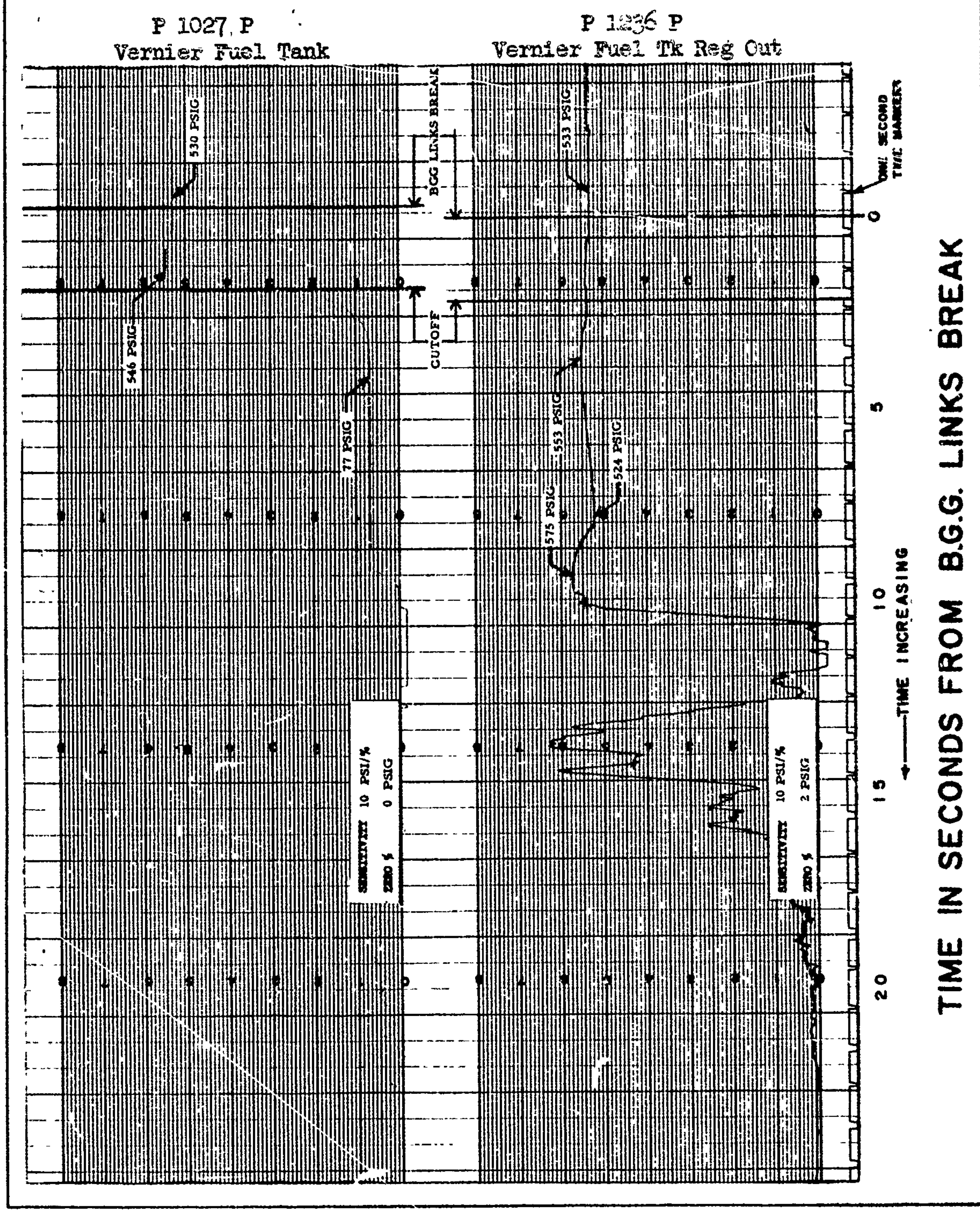
PROPULSION SYSTEM LANDLINE DATA



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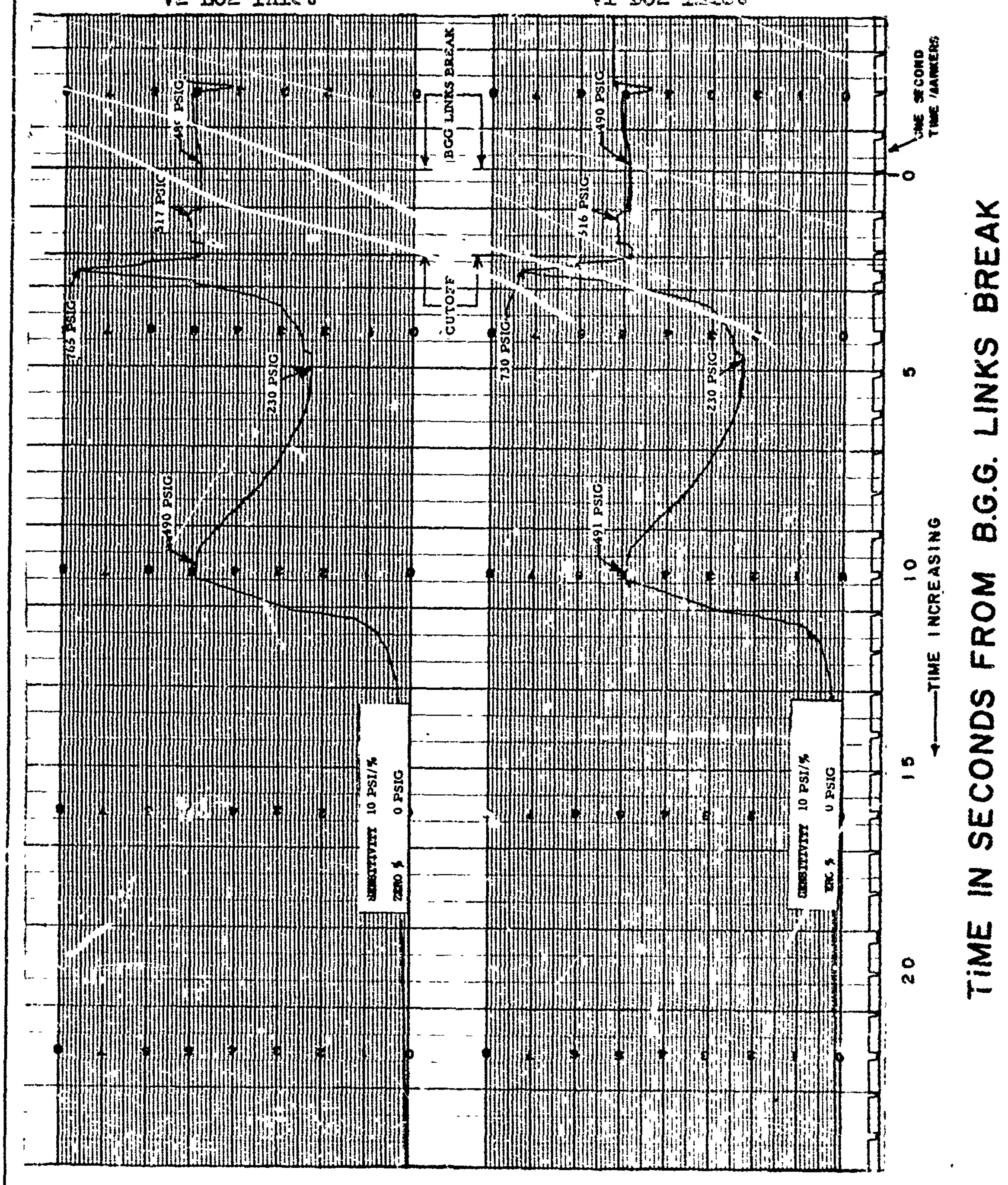
PROPULSION SYSTEM LANDLINE DATA

P 1048 P
V2 LO2 Inlet

P 1047 P
V1 LO2 Inlet



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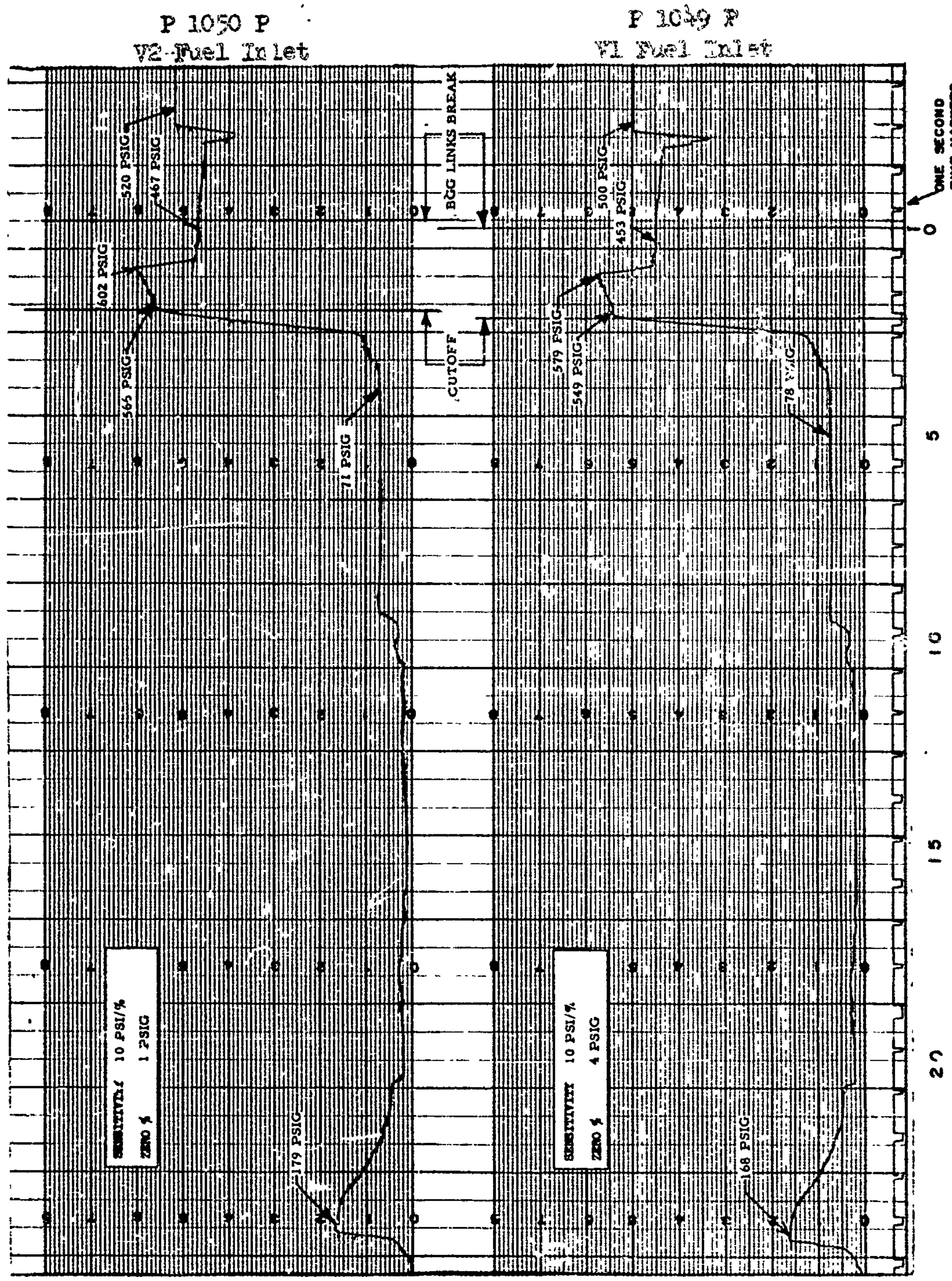
PROPULSION SYSTEM LANDLINE DATA



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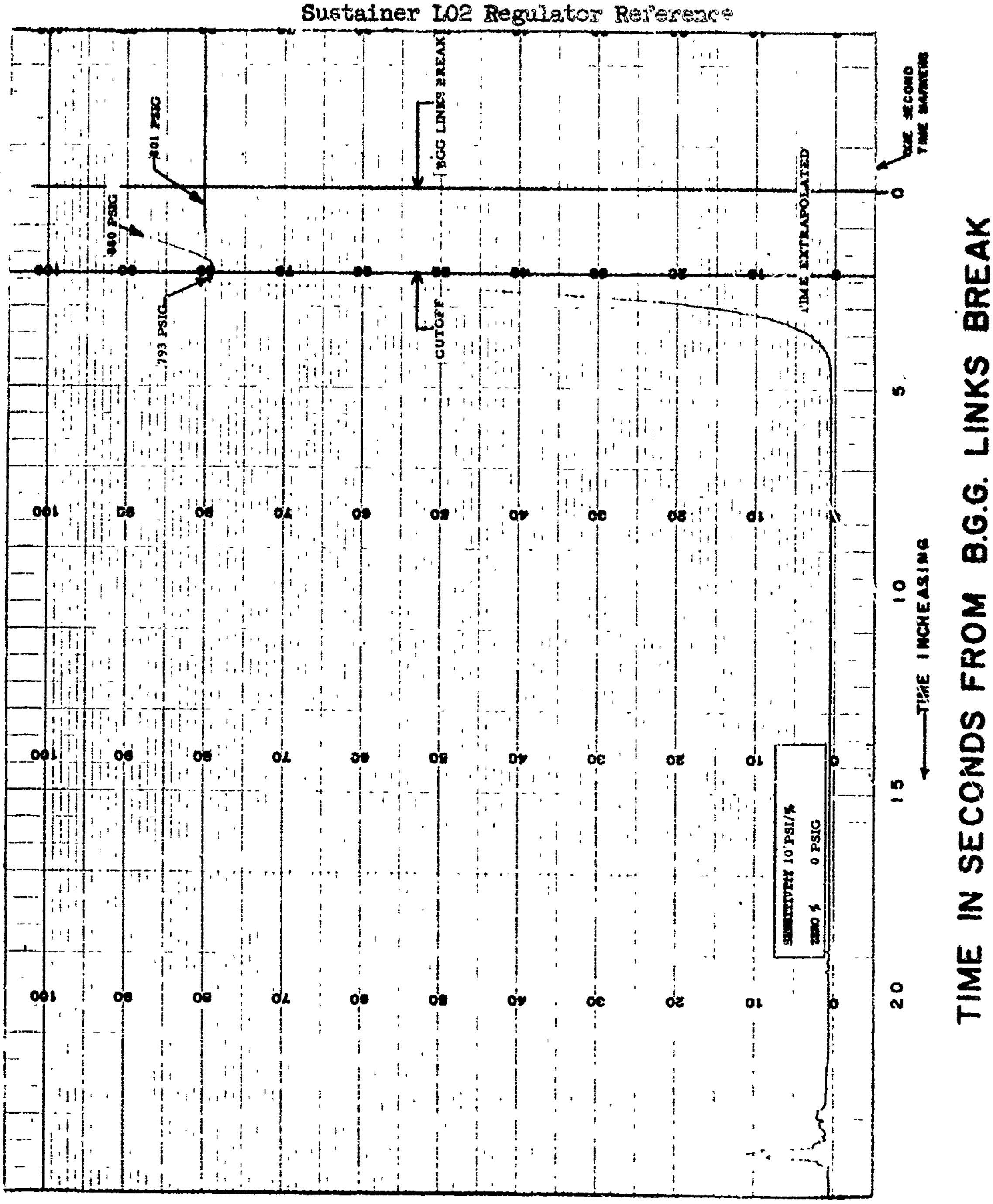
PROPULSION SYSTEM LANDLINE DATA

P 1344 P
Sustainer LO2 Regulator Reference



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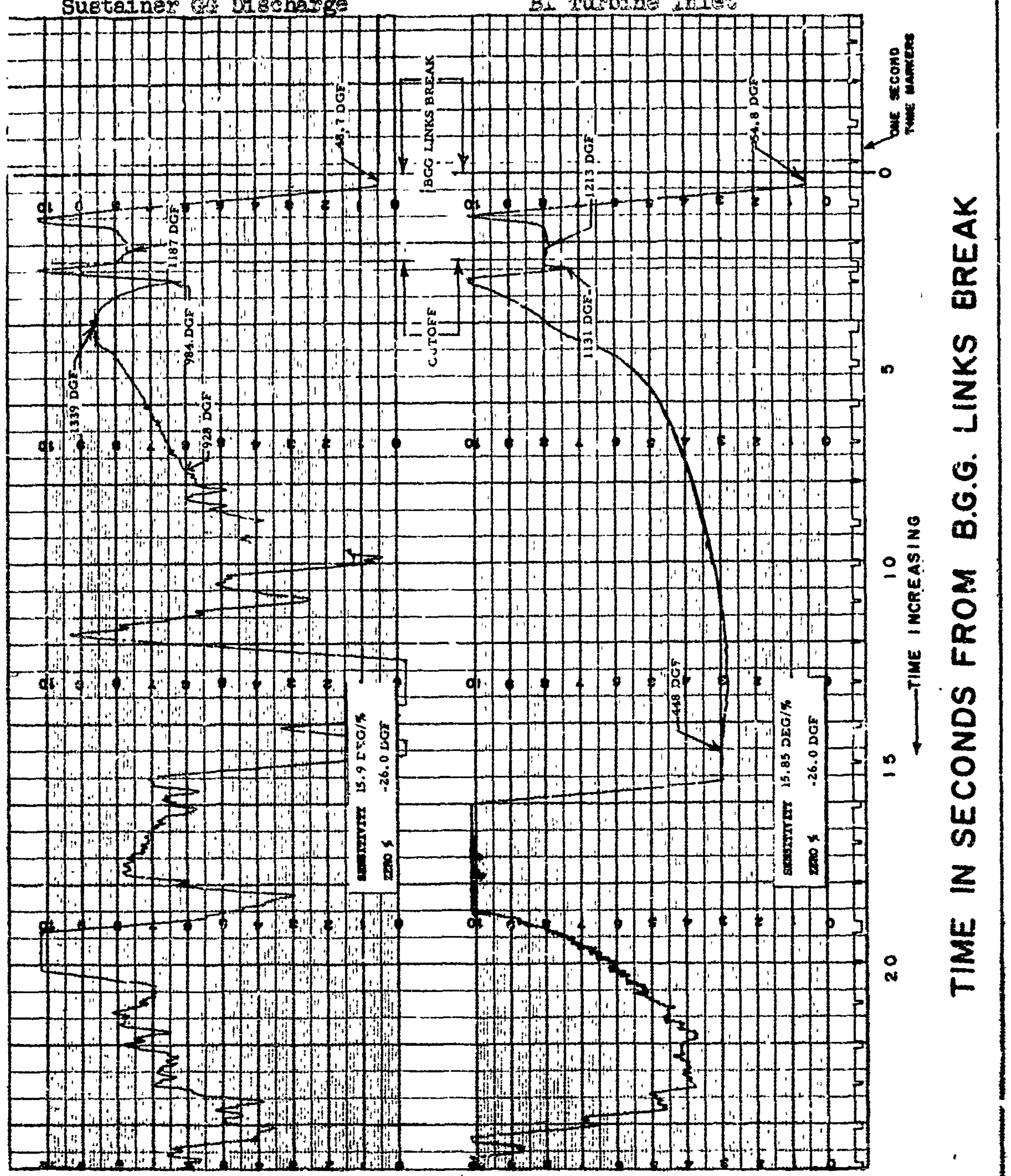
PROPULSION SYSTEM LANDLINE DATA

P 1336 T
Sustainer GG Discharge

P 1018 T
B1 Turbine Inlet



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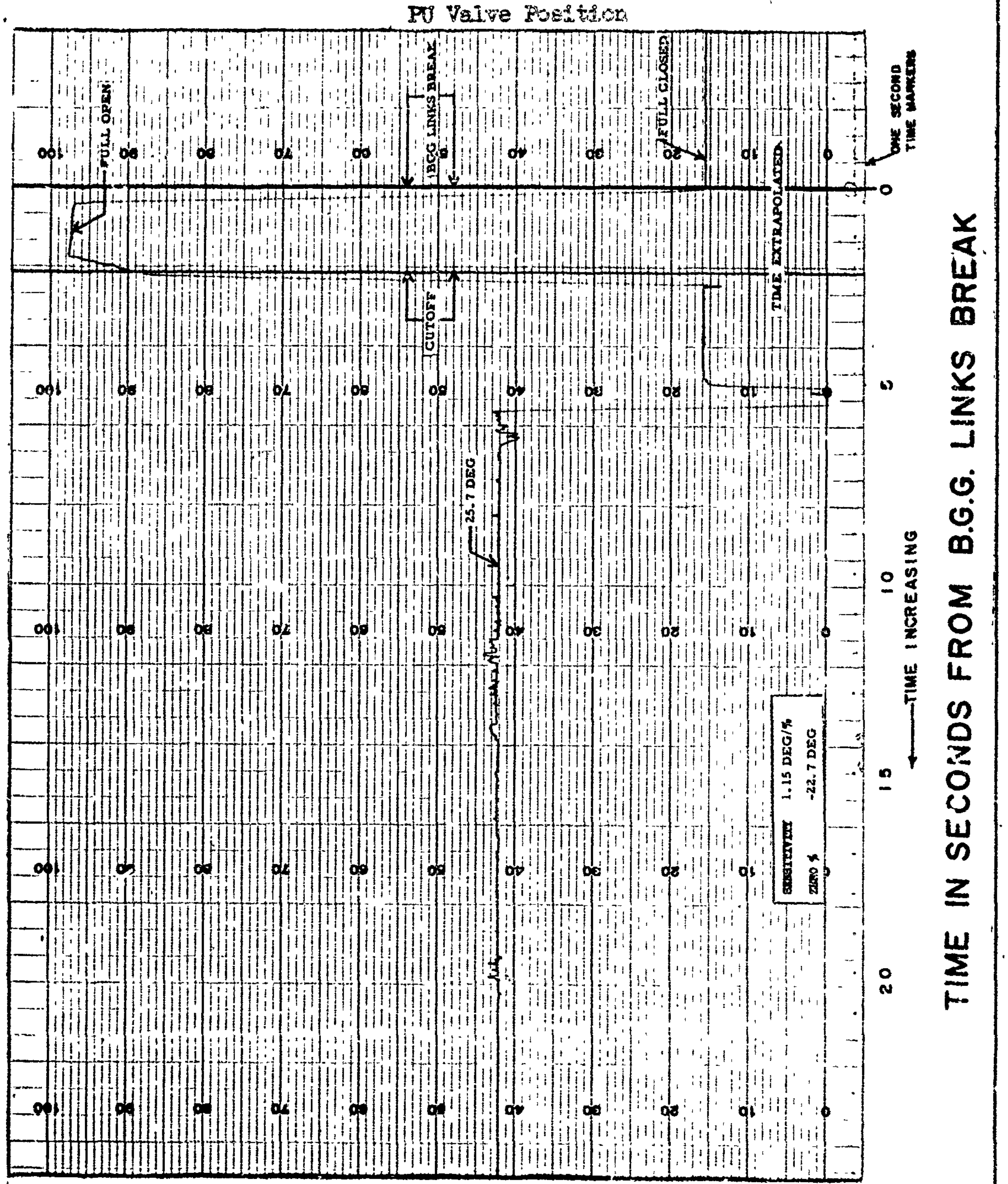
PROPULSION SYSTEM LANDLINE DATA

P 1528 D

PU Valve Position



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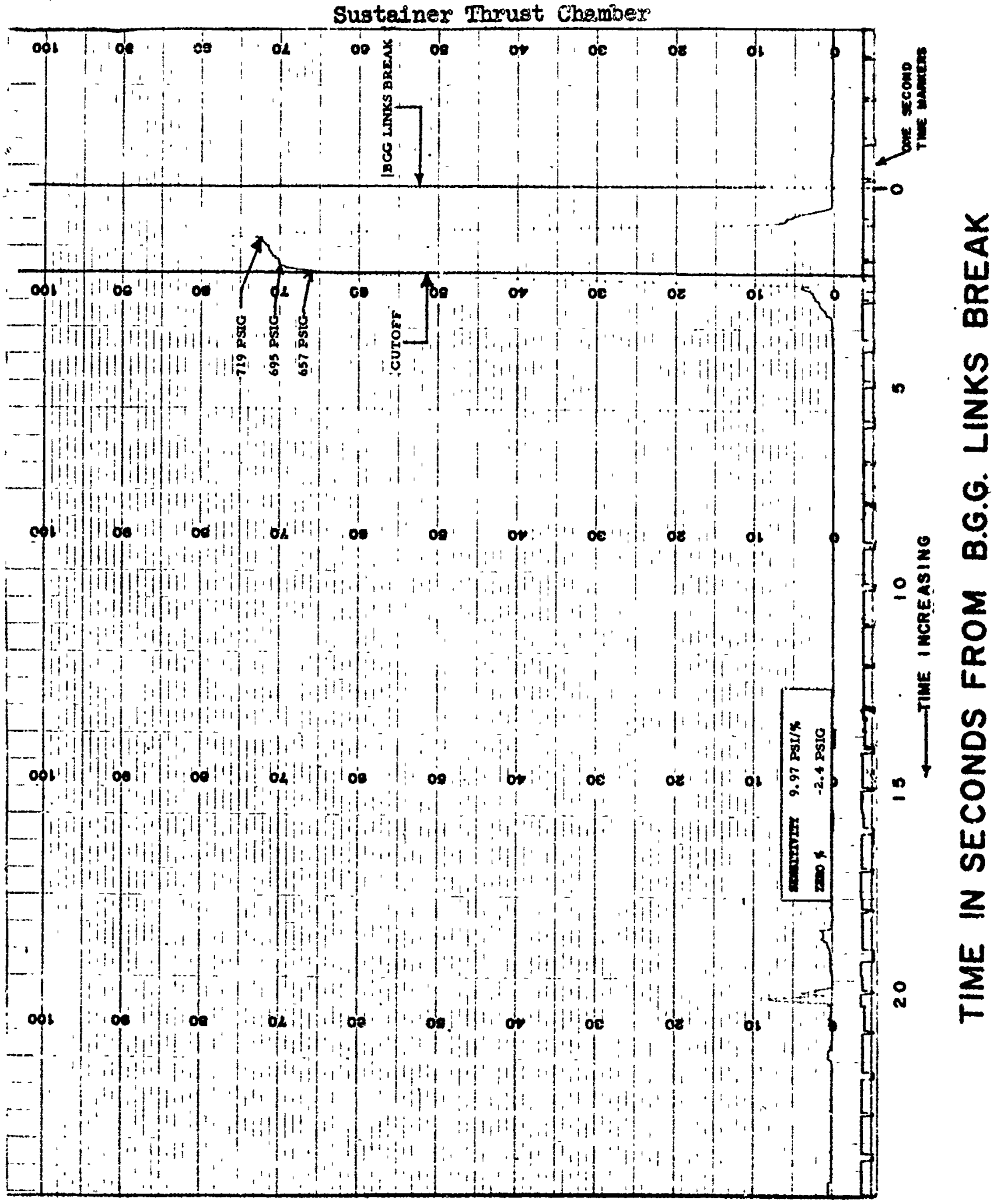
PROPULSION SYSTEM LANDLINE DATA

P 1006 P
Sustainer Thrust Chamber



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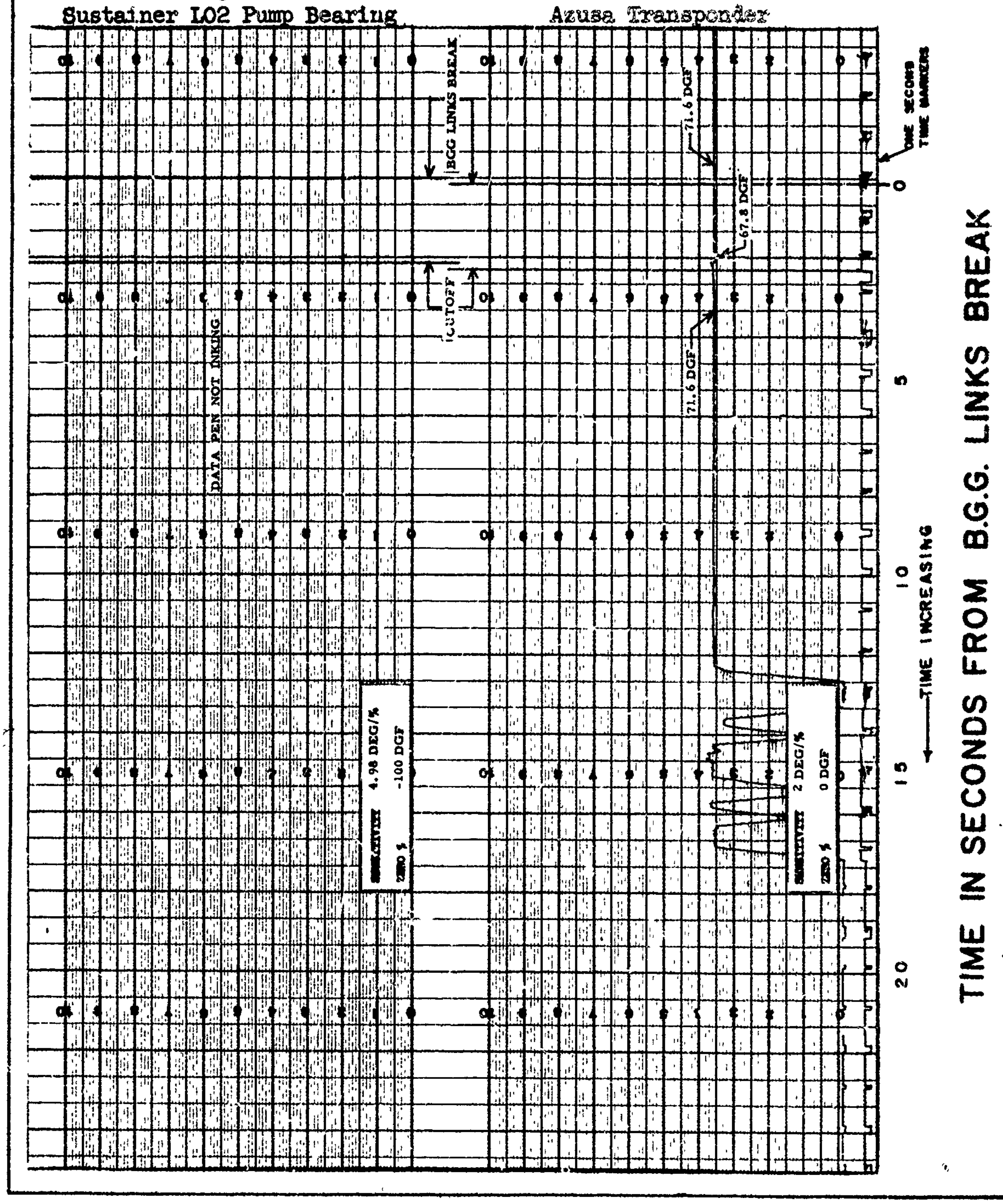
PROPULSION SYSTEM LANDLINE DATA



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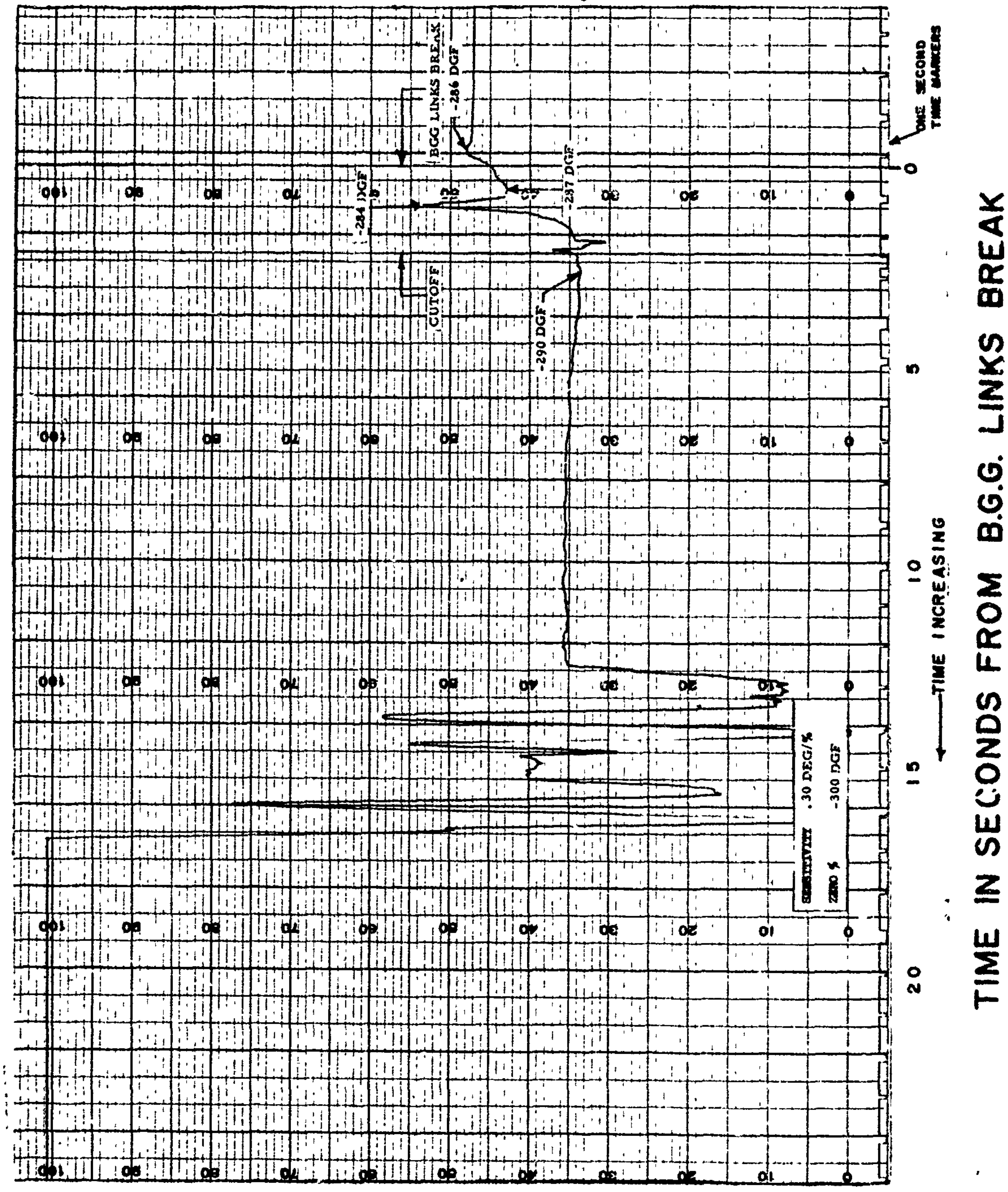
PROPULSION SYSTEM LANDLINE DATA

P 1021 T
LO2 At Breakaway Valve



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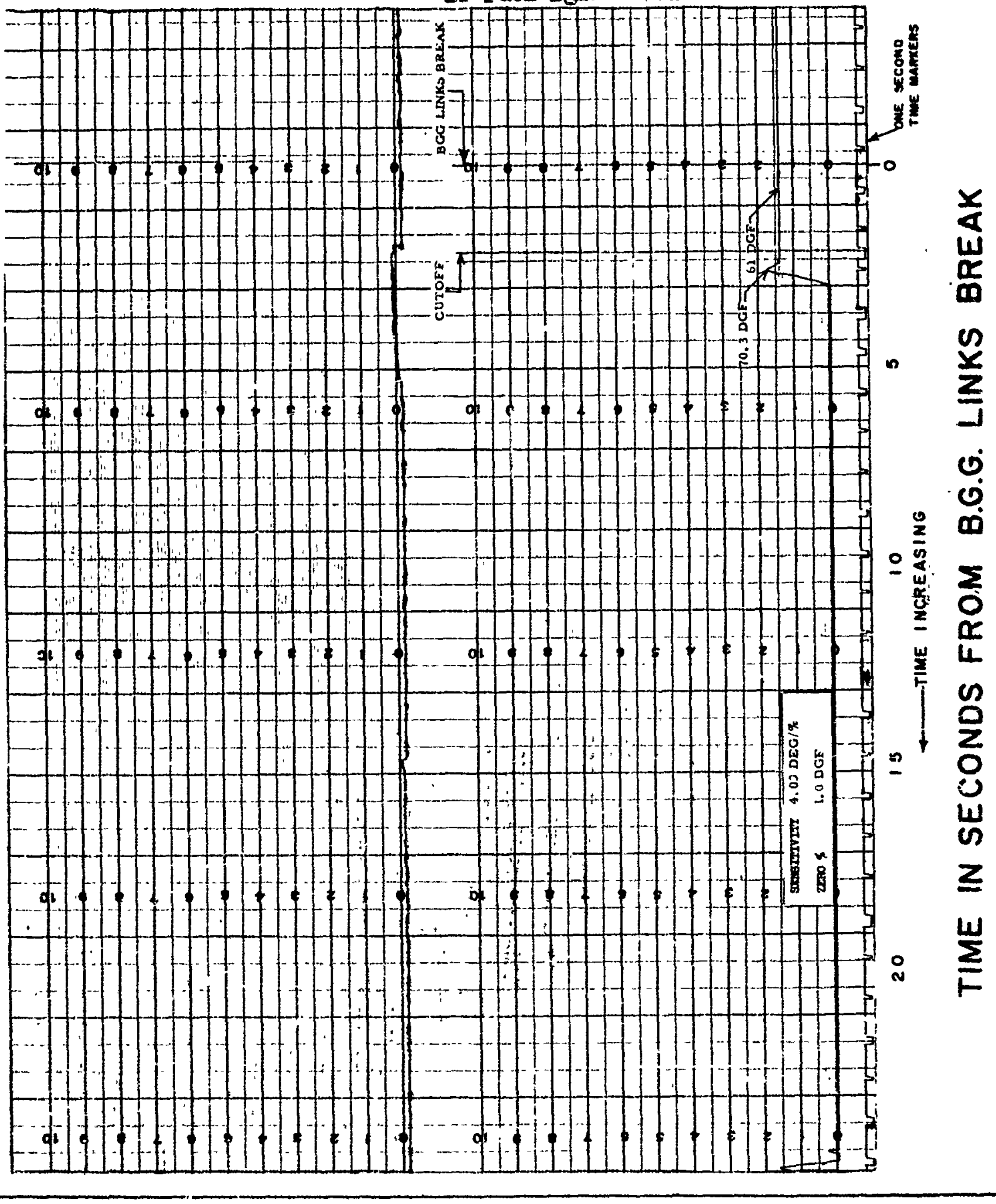
PROPULSION SYSTEM LANDLINE DATA

P 1673 T

B1 Fuel Igniter Valve Ambient



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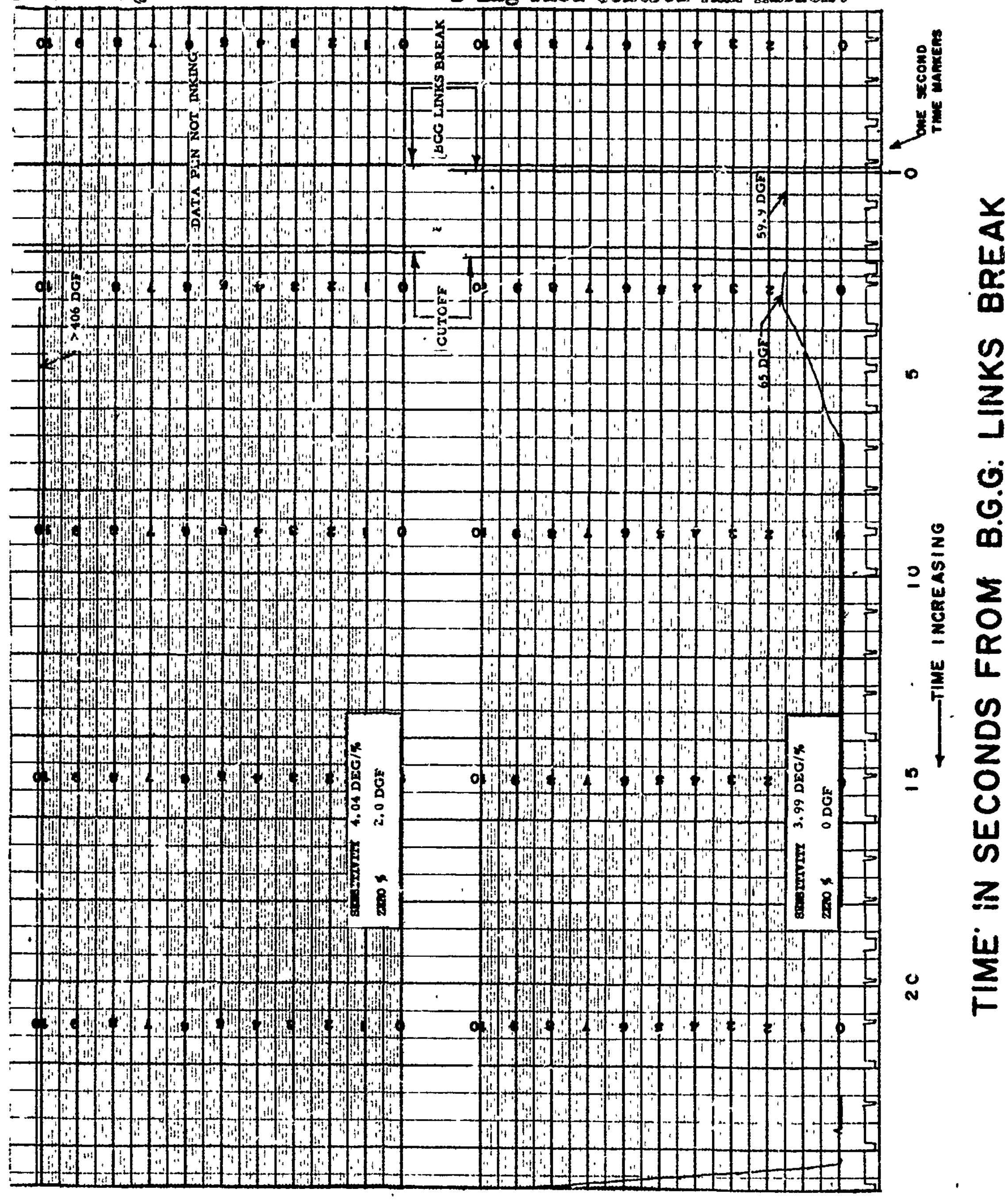
PROPULSION SYSTEM LANDLINE DATA

P 1674 T
B2 Fuel Igniter Valve Ambient

P 1675 T
B Eng Pneu Control Man Ambient



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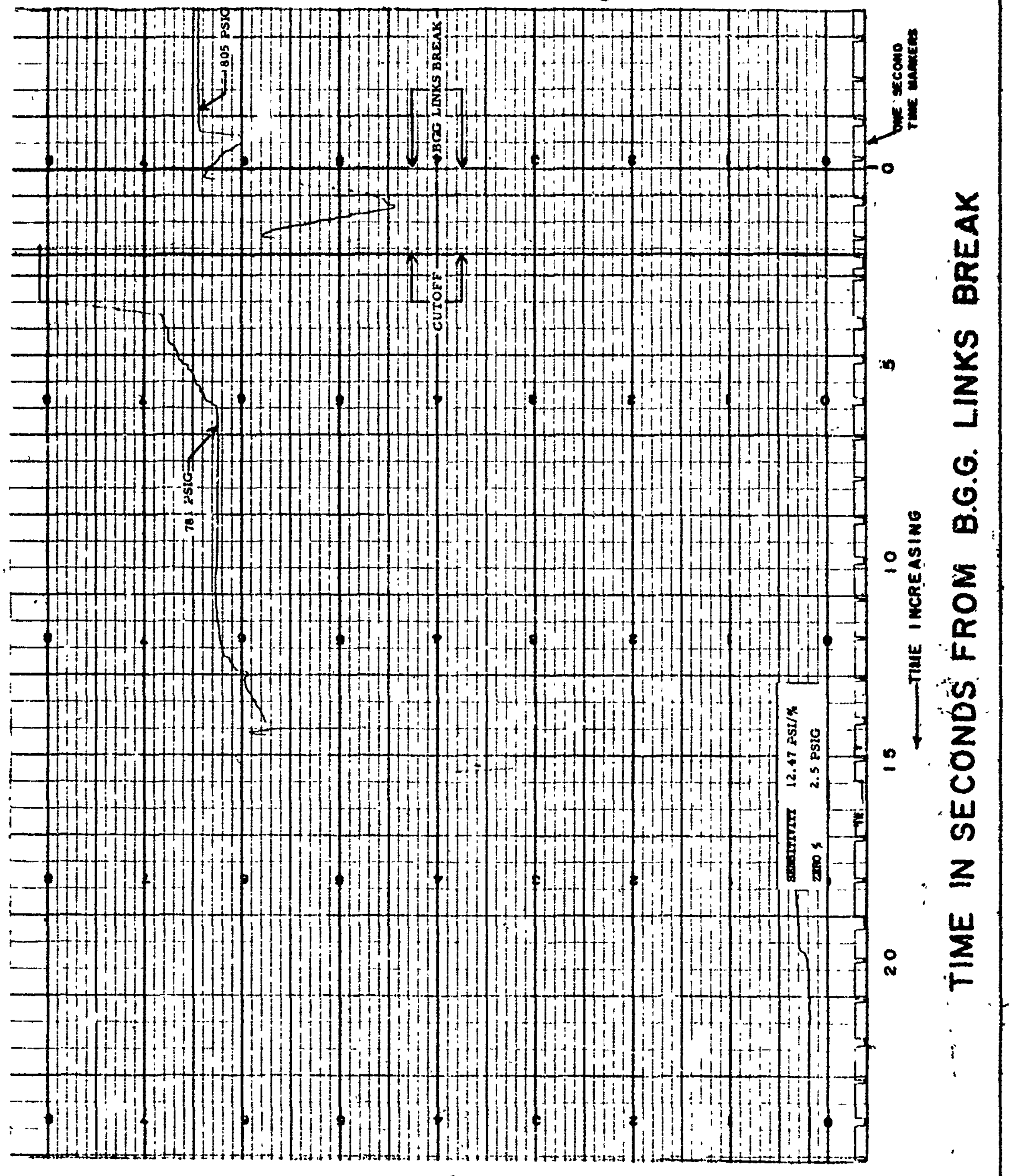
PROPULSION SYSTEM LANDLINE DATA

P 1178 P
Ground Fuel Start Tank Regulator



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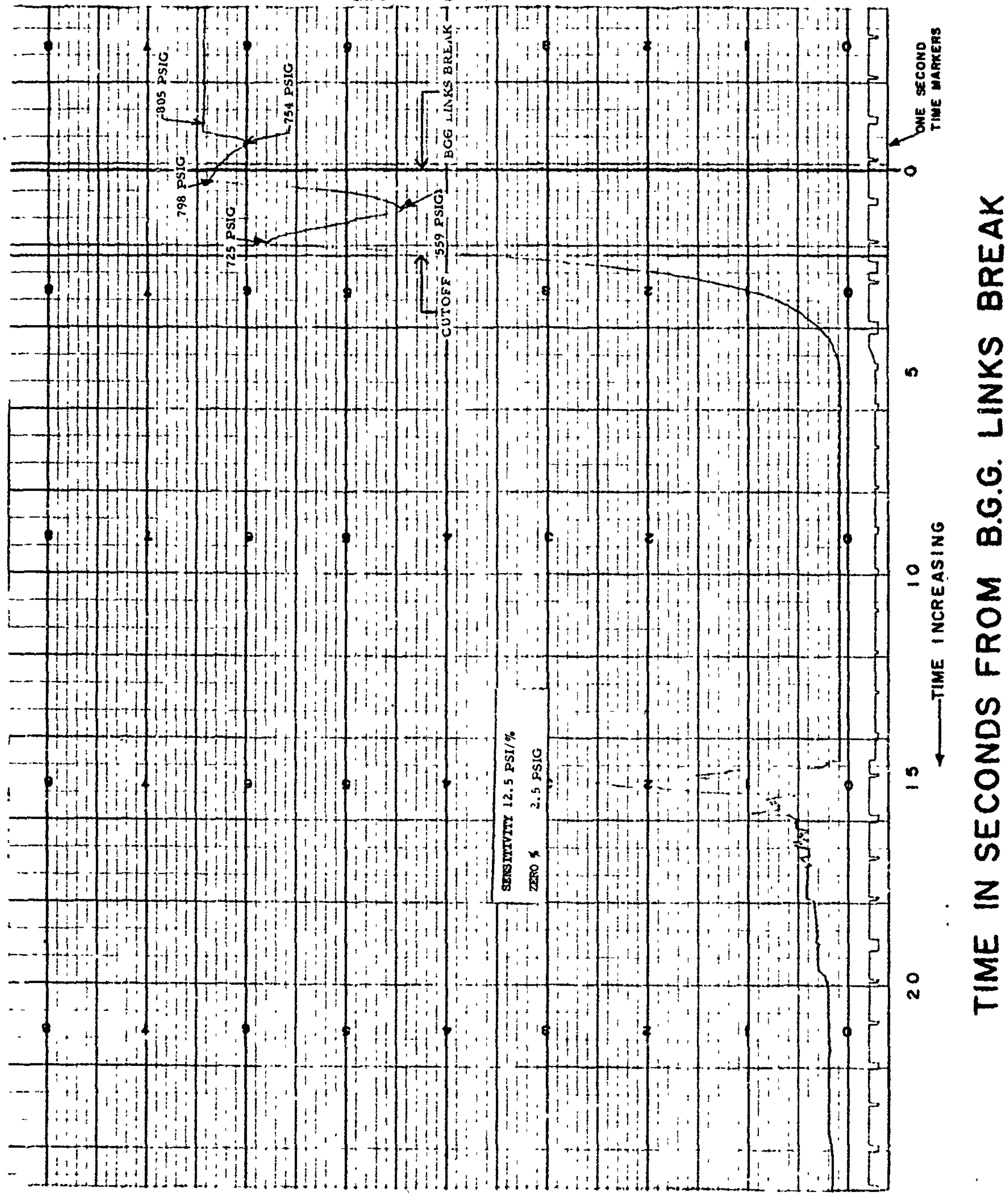
PROPULSION SYSTEM LANDLINE DATA

P 1075 P
Ground Fuel Start Tank



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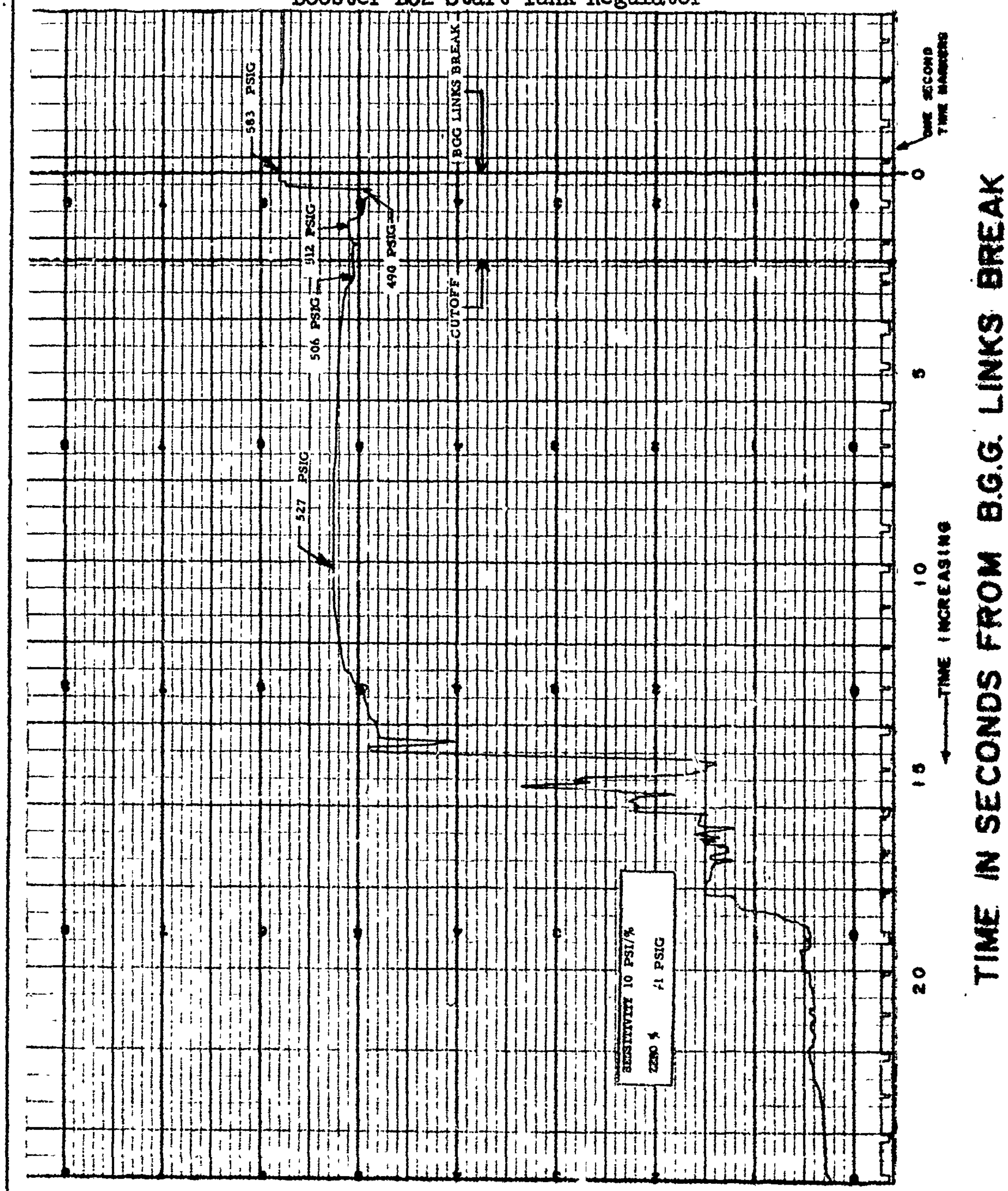
PROPULSION SYSTEM LANDLINE DATA

P 1177 P
Booster LO2 Start Tank Regulator



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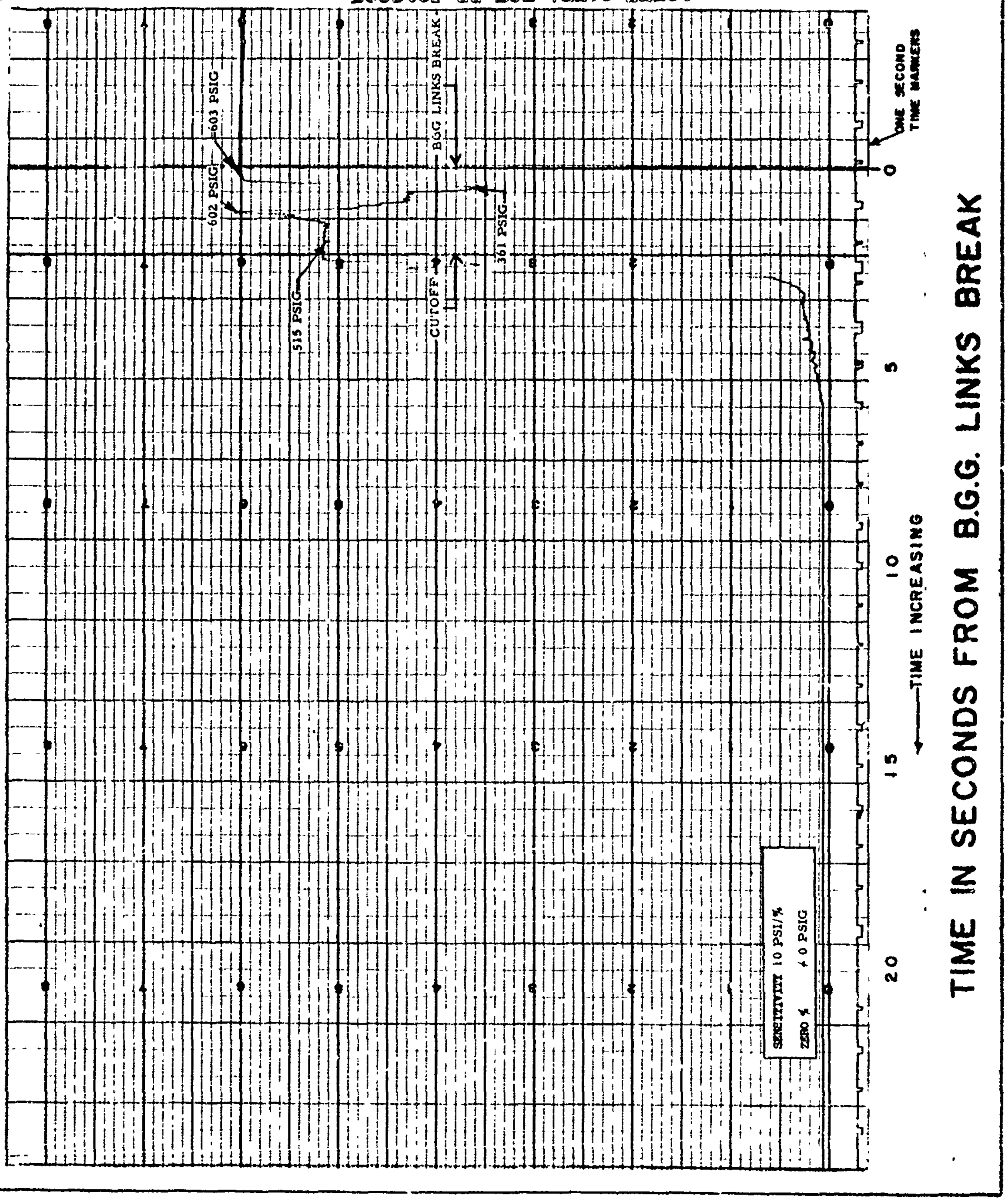
PROPULSION SYSTEM LANDLINE DATA

P 1489 P

Booster GG LO2 Valve Inlet



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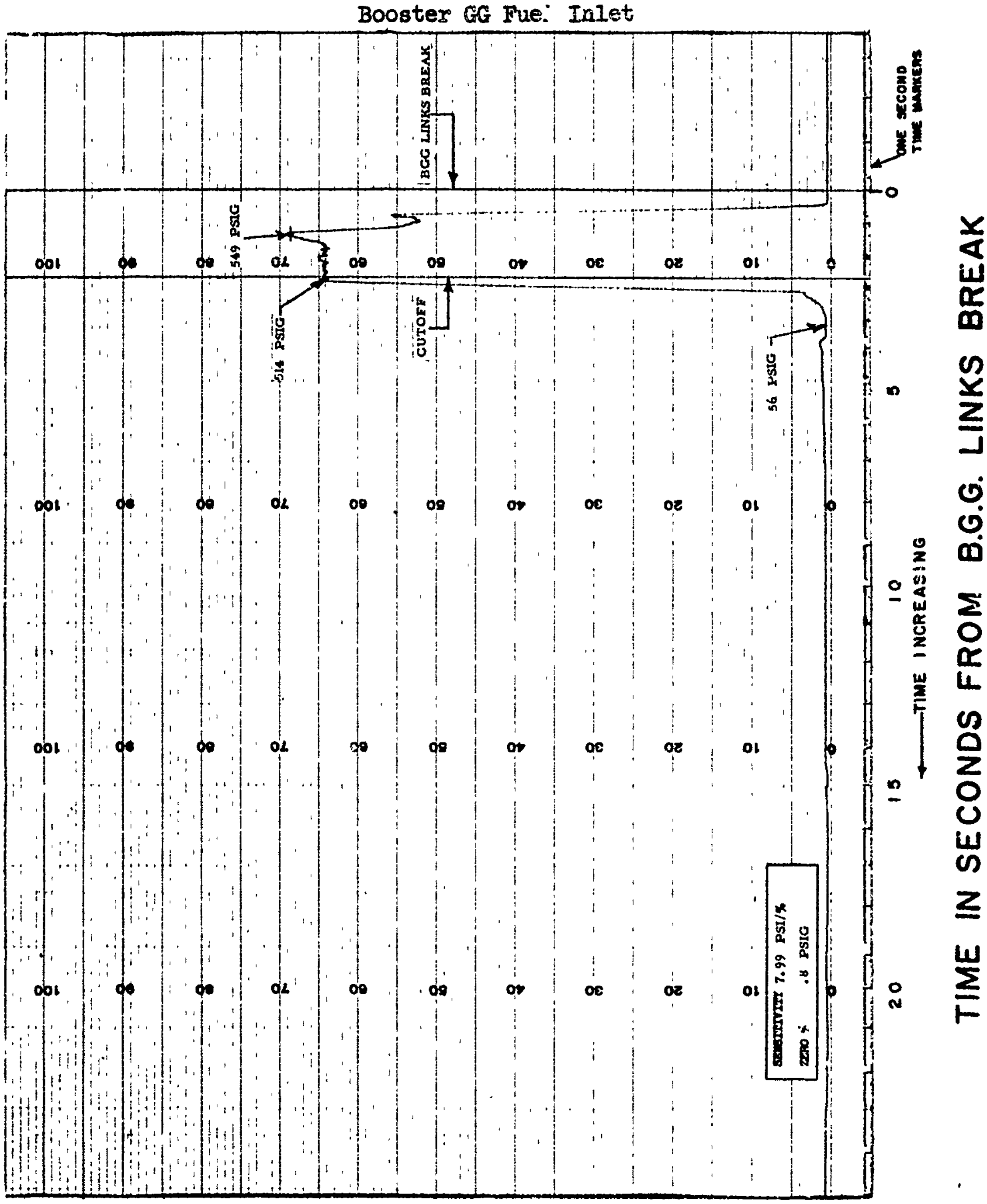
PROPULSION SYSTEM LANDLINE DATA

P 1098 P
Booster GG Fuel Inlet



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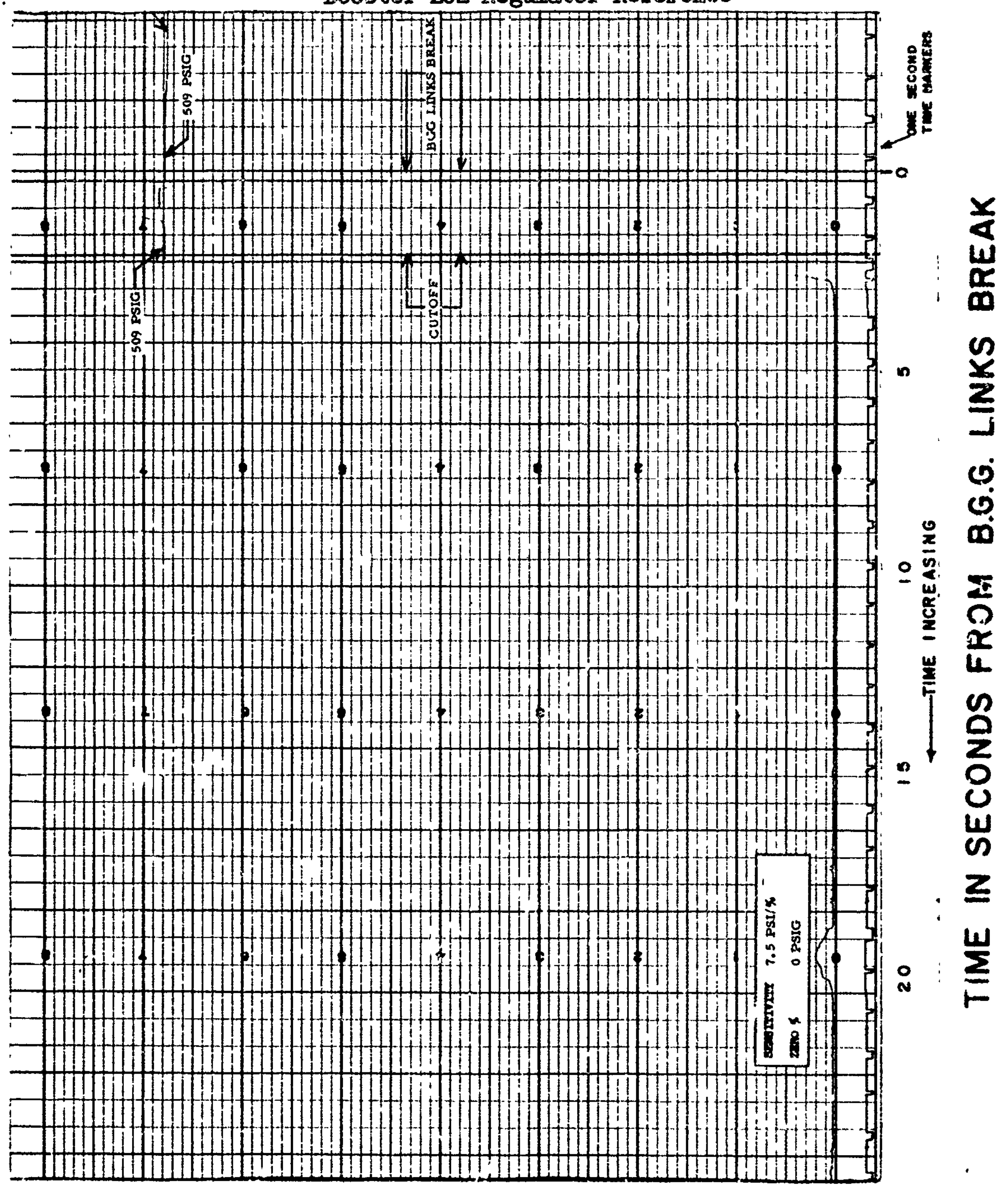
PROPULSION SYSTEM LANDLINE DATA

P 1026 P
Booster LO2 Regulator Reference



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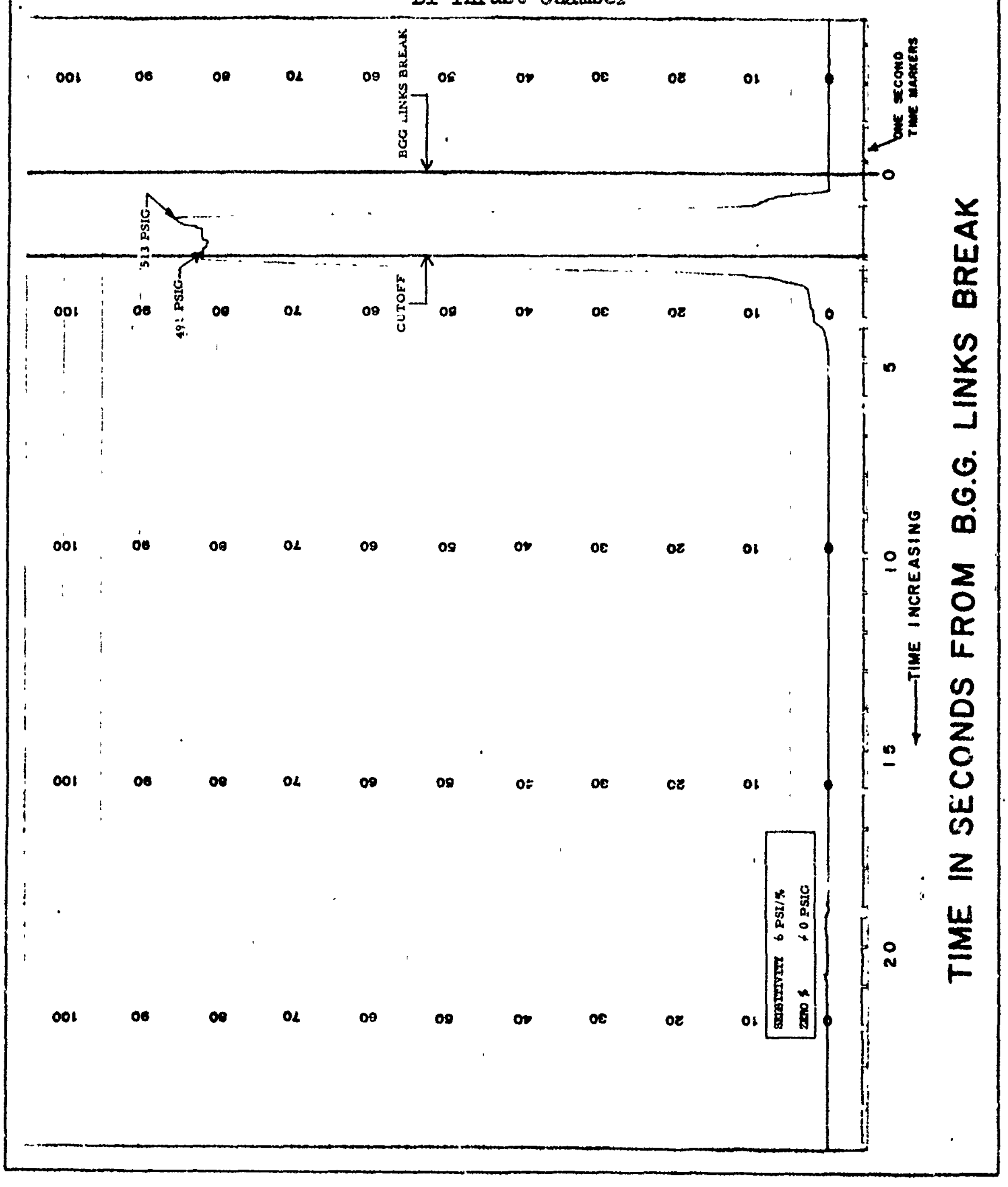
PROPULSION SYSTEM LANDLINE DATA

P 1060 P
B1 Thrust Chamber



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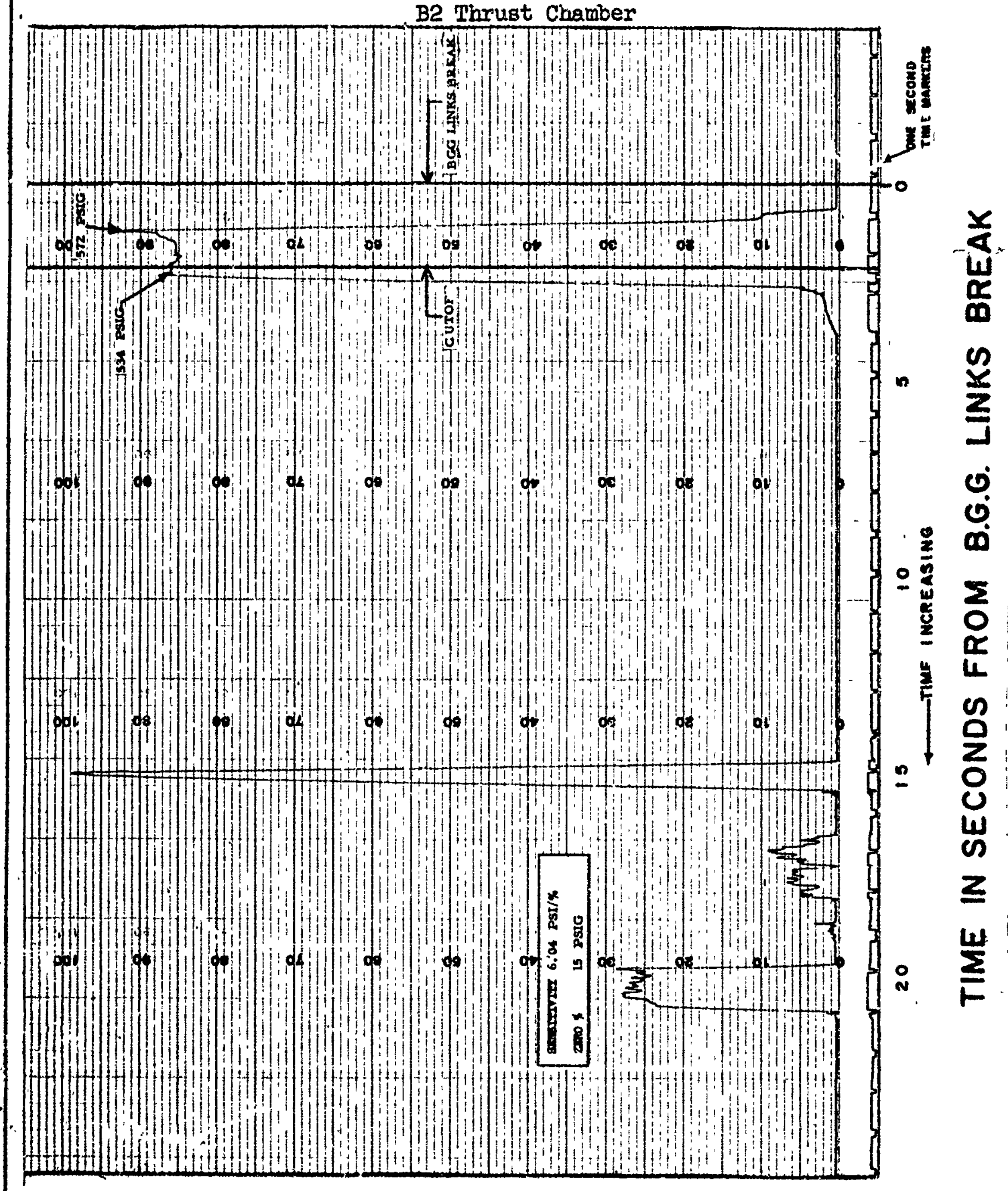
PROPULSION SYSTEM LANDLINE DATA

P 1059 P
B2 Thrust Chamber



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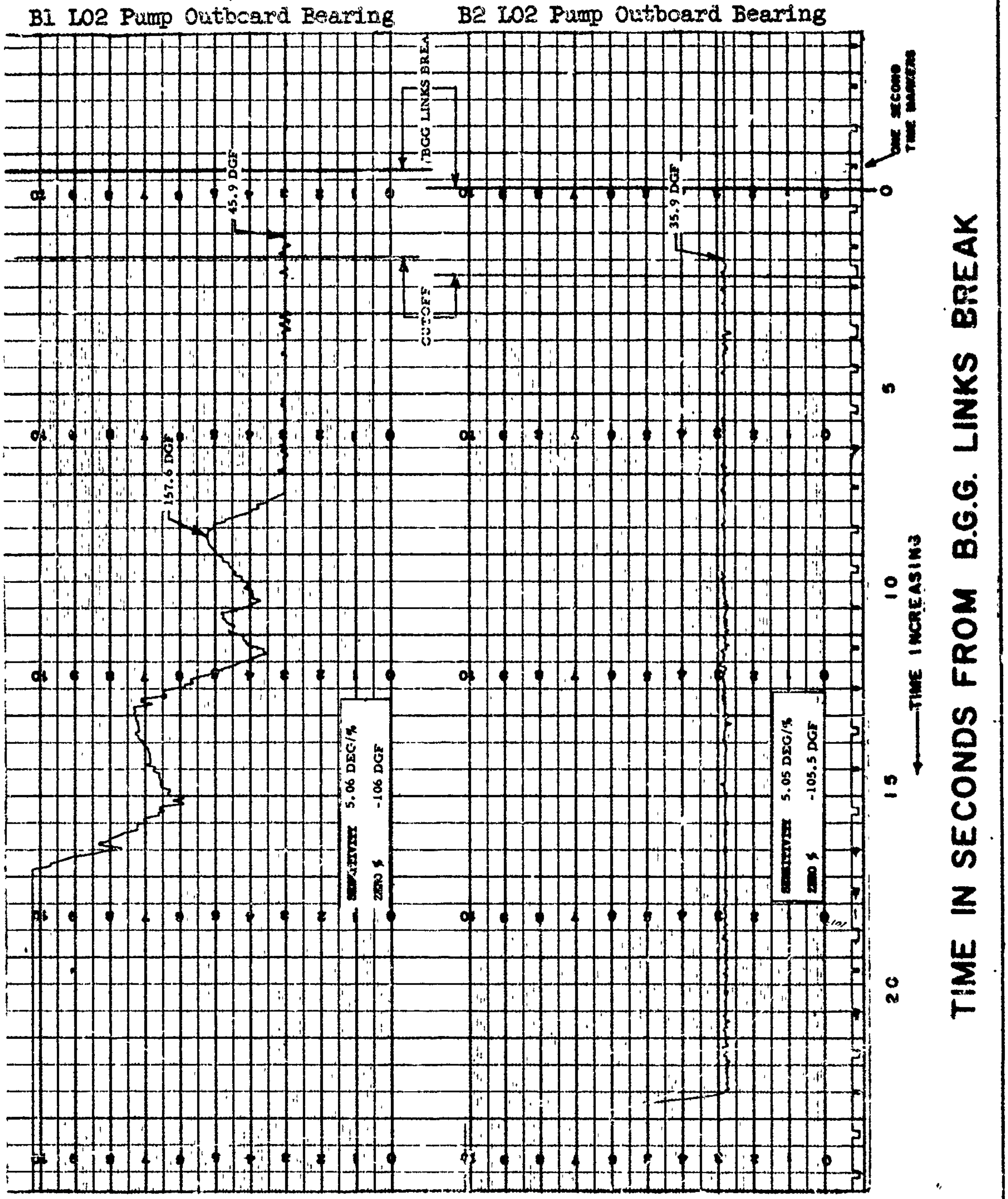
PROPULSION SYSTEM LANDLINE DATA

P 1127 T
B1 LO2 Pump Outboard Bearing

P 1126 T
B2 LO2 Pump Outboard Bearing



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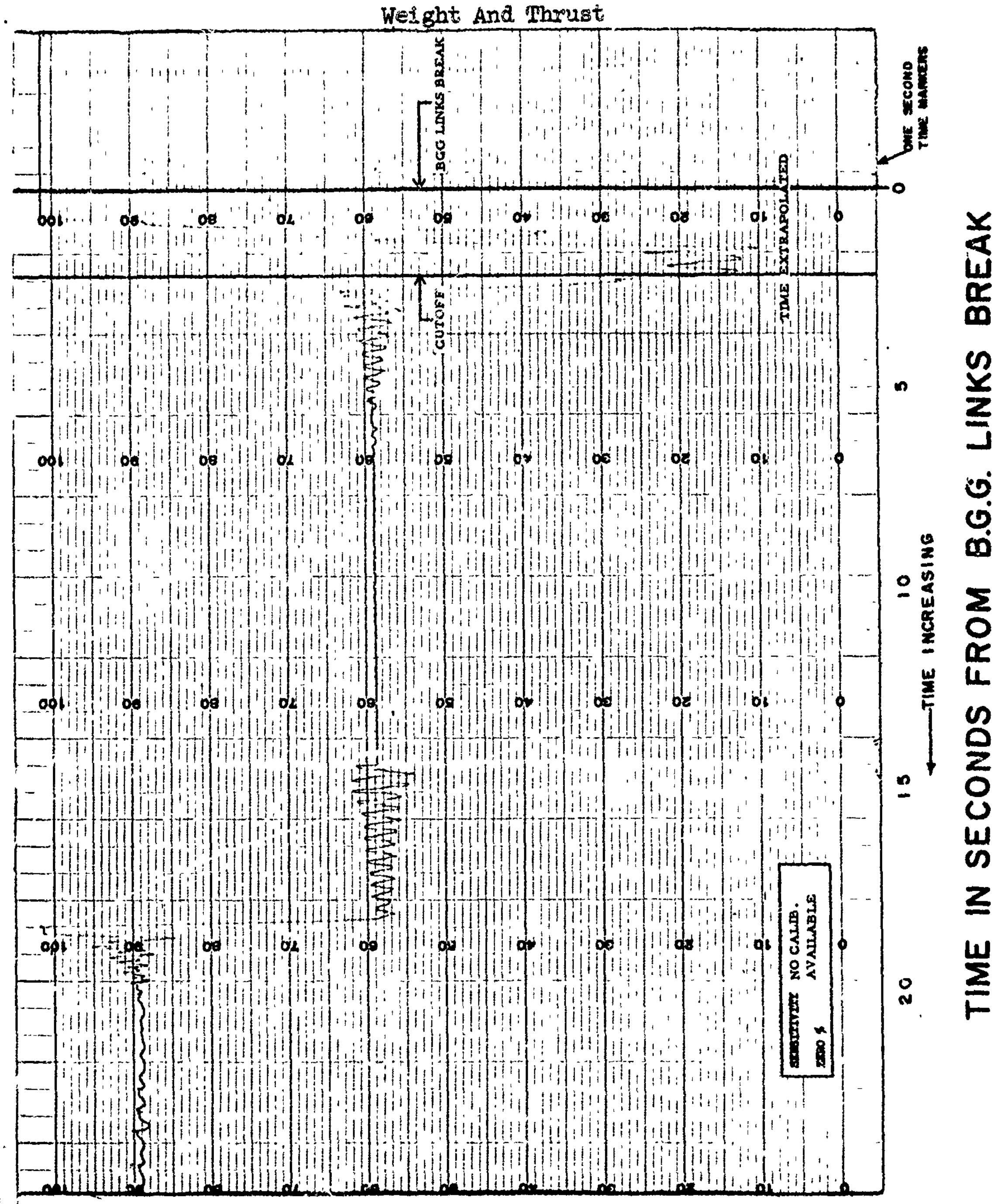
LOAD CELL DATA

N 1011 F

Weight And Thrust



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ENGINE START AND SHUTDOWN SEQUENTIAL DATA

Pen No.	Measurement No.	Description	Time Activated	Time Deactivated
29	P 1161 X	TCC Start Switch	-25.30	-----
23	P 1135 X	Prop S T Pres Relay	-25.28	----
25	P 1096 X	Vern Tks Pres Relay	-25.29	-----
148	P 1096 X	Vern Tks Pres Relay	-25.29	-----
24	P 1427 X	Vern LO2 Vent Ctl	-----	-25.29
27	P 1078 X	Vern LO2 Tk Pres Sol	-25.28	----
26	P 1079 X	Vern Fuel Tk Pres Sol	-25.28	----
20	P 1186 X	Fuel Start Tank Full	----	-25.16
30	P 1568 X	Start Tks Pres Timer	- 2.90	----
28	P 1516 X	Vern Squibs Firing	- 2.88	----
31	P 1165 X	Vern Eng Lockin Relay	- 2.43	----
32	P 1167 X	Vern PV Open Ctl	- 2.42	----
39	P 1510 X	Vernier Complete	- 1.23	----
36	P 1166 X	B&S Fuel Inj Prg Sol	- 1.22	----
45	P 1139 X	B LO2 Vlv Open Ctl	- 1.08	----
113	P 1149 X	B1 LO2 Vlv Clos Ctl	- 1.09	----
112	P 1512 X	B2 LO2 Vlv Clos Ctl	- 1.10	----
66	P 1586 X	S Ign Fuel Vlv Op Ctl	- 0.08	----
74	P 1197 X	Sustainer HSV Sol A	- 1.09	----
67	P 1196 X	Sustainer HSV Sol B	- 1.09	----
68	P 1199 X	S LO2 HSV Clsd Msw	----	- 1.04
48	P 1067 X	B2 LO2 Vlv Clsd Msw	----	- 0.98

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Pen No.	Measurement No.	Description	Time Activated	Time Deactivated
46	P 1068 X	B1 LO2 Vlv Clsd Msw	----	- 0.84
49	P 1169 X	B2 LO2 Vlv Open Msw	- 0.90	----
69	P 1198 X	S LO2 HSV Open Msw	- 0.70	----
47	P 1170 X	B1 LO2 Vlv Open Msw	- 0.63	----
44	P 1397 X	Gas Gen Squibs Timer	- 0.53	----
50	P 1142 X	Ignition Complete	- 0.54	----
44	P 1397 X	Gas Gen Squibs Timer	----	- 0.40
51	P 1143 X	Gas Gen Ign Link Bk	----	0
57	P 1145 X	BGG Vlv Open Ctl Sol	+ 0.01	----
115	P 1146 X	BGG Vlv Clos Ctl Sol	0	----
52	P 1148 X	B Fuel Vlv Open Ctl	+ 0.01	----
114	P 1150 X	B Fuel Vlv Clos Ctl	0.01	----
77	P 1587 X	SGG Vlv Open Ctl	0.01	----
116	P 1595 X	SGG Vlv Closing Sol	0.01	----
75	P 1201 X	Sustainer PUV Sol E	0.02	----
71	P 1200 X	Sustainer PUV Sol F	0.01	----
36	P 1166 X	B&S Fuel Inj Prg Sol	----	0.02
42	P 1299 X	Ign Detr Delay Timer	0.02	----
72	P 1203 X	S Fuel PUV Clsd Msw	----	0.07
78	P 1335 X	SGG Vlv Clsd Msw	----	0.07
58	P 1071 X	BGG Vlv Closed Msw	----	0.08
53	P 1070 X	B1 Fuel Vlv Clsd Msw	----	0.16
55	P 1069 X	B2 Fuel Vlv Clsd Msw	----	0.14

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Pen No.	Measurement No.	Description	Time Activated	Time Deactivated
56	P 1195 X	B2 Fuel Vlv Open Msw	0.26	----
54	P 1194 X	B1 Fuel Vlv Open Msw	0.27	----
73	P 1202 X	S Fuel PUV Open Msw	0.35	----
79	P 1499 X	SGG Vlv Open Msw	0.37	----
59	P 1147 X	BGG Vlv Open Msw	0.44	----
159	AMR	Internal Hyd Chgover	0.67	----
35	P 1302 X	B Fuel Vlv Open Timer	1.62	----
64	P 1303 X	S Fuel Vlv Open Timer	1.62	----
22	P 1503 X	GFST Vent Ctl	----	1.62
23	P 1135 X	Prop S T Pres Relay	----	1.63
25	P 1096 X	Vern Tks Pres Relay	----	1.65
26	P 1079 X	Vern Fuel Tk Pres Sol	----	1.64
148	P 1096 X	Vern Tks Pres Relay	----	1.64
27	P 1078 X	Vern LO2 Tk Pres Sol	----	1.64
67	P 1196 X	Sustainer HSV Sol B	----	1.64
71	P 1200 X	Sustainer PUV Sol F	----	1.64
69	P 1198 X	S LO2 HSV Open Msw	----	1.71
73	P 1202 X	S Fuel PUV Open Msw	----	1.80
119	P 1577 X	Release Signal	1.76	----
63	P 1441 X	B Ign Stage Timer	1.92	----
149	G 1550 X	D Contact #2 (Sus Eng Cof)	2.11	----
86	P 1588 X	S Tbn Overspeed Trip	2.155	----
38	P 1077 X	Vern Cutoff Relay Lockin	2.16	----

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Pen No.	Measurement No.	Description	Time Activated	Time Deactivated
155	P 1598 X	Vern Eng Cutoff	2.16	----
60	P 1072 X	B Cof Relay Lockin	2.16	----
107	P 1598 X	Vernier Eng Cutoff	2.16	----
102	P 1582 X	S LO2 Reg Vent Vlv Ctl	2.16	----
103	P 1561 X	B LO2 Reg Vent Vlv Ctl	2.16	----
150	P 1347 X	S Cof Signal	2.16	----
112	P 1512 X	B2 LO2 Vlv Cls Ctl	----	2.16
113	P 1149 X	B1 LO2 Vlv Cls Ctl	----	2.16
146	P 1072 X	Booster Cof Relay	2.16	----
80	P 1347 X	S Cof Relay Lockin	2.16	----
52	P 1148 X	B Fuel Vlv Open Ctl	----	2.17
50	P 1142 X	Ign Comp	----	2.17
64	P 1303 X	S Fuel Vlv Open Timer	----	2.17
66	P 1586 X	S Ign Fuel Vlv Open Ctl	----	2.17
74	P 1197 X	S HSV Sol A	----	2.17
75	P 1201 X	S PUV Sol E	----	2.17
77	P 1587 X	SGG Vlv Open Ctl	----	2.17
114	P 1150 X	B Fuel Vlv Cls Ctl	----	2.17
115	P 1146 X	BGG Vlv Cls Ctl Sol	----	2.17
116	P 1595 X	SGG Vlv Cls Ctl Sol	----	2.17
106	P 1593 X	S Engine Cutoff	2.17	----
32	P 1167 X	V PV Open Ctl	----	2.17
35	P 1302 X	B Fuel Valve Open Timer	----	2.18

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Pen No.	Measurement No.	Description	Time Activated	Time Deactivated
45	P 1139 X	B LO2 Vlv Open Ctl	----	2.18
42	P 1299 X	Ign Detr Delay Tmr	----	2.18
57	P 1145 X	BGG Vlv Open Ctl Sol	----	2.18
63	P 1441 X	B Ign Stg Timer	----	2.18
105	P 1592 X	Booster Engine Cutoff	2.18	----
60	P 1072 X	B Cutoff Relay Lockin	2.18	----
28	P 1516 X	Vern Squibs Firing	----	2.18
29	P 1161 X	TCC Start Switch	----	2.18
31	P 1165 X	VE Lockin Relay	----	2.18
39	P 1510 X	Vernier Complete	----	2.18
12	P 1575 X	Pre Start Ready	----	2.18
11	P 1137 X	Etp Prep Complete Lt	----	2.19
119	P 1577 X	Release Signal	----	2.20
159	AMR	Internal Hydraulic Changeover	----	2.20
68	P 1199 X	S LO2 HSV Clsd Msw	2.21	----
78	P 1335 X	SGG Vlv Clsd Msw	2.22	----
79	P 1499 X	SGG Vlv Open Msw	----	2.22
30	P 1568 X	ST Tk Press Timer	----	2.23
59	P 1147 X	BGG Vlv Open Msw	----	2.24
58	P 1071 X	BGG Vlv Clsd Msw	2.25	----
49	P 1169 X	B2 LO2 Vlv Open Msw	----	2.26
56	P 1195 X	B2 Fuel Vlv Open Msw	----	2.26
54	P 1194 X	B1 Fuel Vlv Open Msw	----	2.27
47	P 1170 X	B1 LO2 Vlv Open Msw	----	2.30

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FORM NO. A-703-2

CONFIDENTIAL

CONVAIR ASTRONAUTICS

Pen No.	Measurement No.	Description	Time Activated	Time Deactivated
72	P 1203 X	S Fuel Vlv Clsd Msw	2.40	----
55	P 1069 X	B2 Fuel Vlv Clsd Msw	2.44	----
53	P 1070 X	B1 Fuel Vlv Clsd Msw	2.45	----
48	P 1067 X	B2 LO2 Vlv Clsd Msw	2.54	----
46	P 1068 X	B1 LO2 Vlv Clsd Msw	2.71	----
125	P 3668 X	S LO2 Purge	3.12	----
128	P 3295 X	V LO2 Purge	3.15	----
122	P 3665 X	B1 LO2 Purge	3.18	----
123	P 3666 X	B2 LO2 Purge	3.19	----
130	P 3112 X	BGG LO2 Purge	3.19	----
129	P 3113 X	BGG Fuel Purge	3.42	----
127	P 3296 X	V Fuel Purge	5.22	----
4	P 1580 X	S Fuel Pre Vlv Clsd	8.14	----
80	P 1347 X	SCO Rel Lockin	----	9.23
106	P 1593 X	S Engine Cutoff	----	9.23
150	P 1347 X	S Cof Signal	----	9.24
155	P 1589 X	Vern Eng Cutoff	----	9.24
30	P 1568 X	Start Tks Press Timer	----	9.24
107	P 1598 X	Vernier Eng Cutoff	----	9.26
102	P 1582 X	S LO2 Reg Vent Vlv Ctl	----	9.26
102	P 1582 X	S LO2 Reg Vent Vlv Ctl	9.30	----
102	P 1582 X	S LO2 Reg Vent Vlv Ctl	----	9.33
102	P 1582 X	S LO2 Reg Vent Vlv Ctl	9.36	----
102	P 1582 X	S LO2 Reg Vent Vlv Ctl	----	9.40

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Pen No.	Measurement No.	Description	Time Activated	Time Deactivated
102	P 1582 X	S LO2 Reg Vent Vlv Ctl	9.405	----
102	P 1582 X	S LO2 Reg Vent Vlv Ctl	----	9.46
102	P 1582 X	S LO2 Reg Vent Vlv Ctl	9.46	----
102	P 1582 X	S LO2 Reg Vent Vlv Ctl	----	9.49
104	P 1591 X	S Hyd Press Switch	----	9.72
69	P 1198 X	S LO2 HSV Open Msw	11.22	----
149	G 1550 X	D Contact #2 (Sus Eng Cof)	----	11.78
72	P 1203 X	S Fuel PUV Clsd Msw	----	12.58
149	G 1550 X	D Contact #2 (Sus Eng Cof)	12.82	----
5	P 1581 X	S Fuel Pre Valve Clsd	----	12.84
2	P 1446 X	B Fuel Pre Valve Clsd	13.30	----
69	P 1198 X	S LO2 HSV Open Msw	----	13.48
2	P 1446 X	B Fuel Pre Valve Clsd	----	14.65
68	P 1199 X	S LO2 HSV Clsd Msw	----	14.74
2	P 1446 X	B Fuel Pre Valve Clsd	14.99	----
149	G 1550 X	D Contact #2 (Sus Eng Cof)	----	15.01
68	P 1199 X	S LO2 HSV Clsd Msw	15.64	15.66
85	P 1438 X	S Rough Comb Cof	----	----
49	P 1169 X	B2 LO2 Vlv Open Msw	16.16	----
3	P 1445 X	B Fuel Pre Valve Open	16.46	----
3	P 1445 X	B Fuel Pre Valve Open	----	16.66
20	P 1186 X	Fuel Start Tank Full	16.70	----
47	P 1170 X	B1 LO2 Vlv Open Msw	16.73	----
115	P 1146 X	BGG Vlv Clos Ctl Sol	17.02	----

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Pen No.	Measurement No.	Description	Time Activated	Time Deactivated
59	P 1147 X	BGG Vlv Open Msw	17.25	----
168	P 3150 X	Fuel F & D Vlv Clsd-A/B Half	----	17.43
112	P 1512 X	B2 LO2 Vlv Clos Ctl	17.84	----
57	P 1145 X	BGG Vlv Open Ctl Sol	17.87	----
113	P 1149 X	B1 LO2 Vlv Clos Ctl	17.98	----
114	P 1150 X	B Fuel Vlv Clos Ctl	17.99	----
45	P 1139 X	B LO2 Vlv Open Ctl	17.99	----
52	P 1148 X	B Fuel Vlv Open Ctl	17.99	----
68	P 1199 X	S LO2 HSV Clsd Msw	----	18.04
87	P 1156 X	B1 Tbn Overspeed Trip	18.18	----
56	P 1195 X	B2 Fuel Vlv Open Msw	18.22	----
54	P 1194 X	B1 Fuel Vlv Open Msw	18.34	----
3	P 1445 X	B Fuel Pre Valve Open	18.38	----
148	P 1096 X	Vern Tks Press Relay	19.27	----
25	P 1096 X	Vern Tks Press Relay	19.28	----
26	P 1079 X	Vern Fuel Tk Pres Sol	19.28	----
27	P 1078 X	Vern LO2 Tk Pres Sol	19.28	----
72	P 1203 X	S Fuel PUV Clsd Msw	19.96	----
148	P 1096 X	Vern Tks Press Relay	----	20.09
25	P 1096 X	Vern Tks Press Relay	----	20.10
27	P 1078 X	Vern LO2 Tk Pres Sol	----	20.11
26	P 1079 X	Vern Fuel Tk Pres Sol	----	20.13
72	P 1203 X	S Fuel PUV Clsd Msw	----	20.39
72	P 1203 X	S Fuel PUV Clsd Msw	20.40	----

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Pen No.	Measure-ment No.	Description	Time Activated	Time Deactivated
72	P 1203 X	S Fuel PUV Clsd Msw	----	20.44
87	P 1203 X	S Fuel PUV Clsd Msw	----	20.44
173	P 1988 X	LO2 95 Percent	----	20.65
173	P 1988 X	LO2 95 Percent	21.08	----
3	P 1445 X	B Fuel Pre Vlv Open	----	21.35
148	P 1096 X	Vern Tks Press Relay	21.57	----
25	P 1096 X	Vern Tks Press Relay	21.58	----
26	P 1079 X	Vern Fuel Tk Press Sol	21.59	----
27	P 1078 X	Vern LO2 Tk Press Sol	21.59	----
60	P 1072 X	B Cof Relay Lockin	----	21.62
73	P 1202 X	S Fuel PUV Open Msw	21.74	----
59	P 1147 X	BGG Vlv Open Msw	21.89	----
69	P 1198 X	S LO2 HSV Open Msw	23.74	----
69	P 1198 X	S LO2 HSV Open Msw	----	24.09
36	P 1166 X	B & S Fuel Inj Prg Sol	24.37	----
104	P 1591 X	S Hyd Press Switch	24.88	----
36	P 1166 X	B & S Fuel Inj Prg Sol	----	24.93
87	P 1156 X	B1 Tbn Overspeed Trip	24.96	----
58	P 1071 X	BGG Vlv Closed Msw	----	25.13
2	P 1446 X	B Fuel Pre Vlv Clsd	----	25.44
172	P 3153 X	LO2 F & D Vlv Clsd-A/B Half	----	26.83
58	P 1071 X	BGG Vlv Closed Msw	27.26	----
148	P 1096 X	Vern Tks Press Relay	----	27.60
25	P 1096 X	Vern Tks Press Relay	----	27.68

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Pen No.	Measure-ment No.	Description	Time Activated	Time Deactivated
27	P 1078 X	Vern LO2 Tk Press Sol	----	27.68
103	P 1561 X	B LO2 Reg Ref Vent	----	28.58
60	P 1072 X	B Cof Relay Lockin	----	28.88
148	P 1096 X	Vern Tks Press Relay	29.03	----
155	P 1598 X	Vern Eng Cutoff	29.03	----
25	P 1096 X	Vern Tks Press Relay	29.03	----
107	P 1598 X	Vernier Eng Cutoff	29.04	----
27	P 1078 X	Vern LO2 Tk Press Sol	29.04	----
150	P 1347 X	S Cof Signal	29.04	----
38	P 1077 X	Vern Cof Rel Lockin	29.05	----
71	P 1200 X	Sustainer PUV Sol F	29.06	----
75	P 1201 X	Sustainer PUV Sol E	29.07	----
73	P 1202 X	S Fuel PUV Open Msw	----	29.35
71	P 1200 X	Sustainer PUV Sol F	----	29.42
71	P 1200 X	Sustainer PUV Sol F	29.52	----
27	P 1078 X	Vern LO2 Tk Press Sol	----	29.63
25	P 1096 X	Vern Tks Press Relay	----	29.64
71	P 1200 X	Sustainer PUV Sol F	----	30.40
47	P 1170 X	Bl LO2 Vlv Open Msw	----	30.41
75	P 1201 X	Sustainer PUV Sol E	----	30.42
144	S 1235 X	Programmer Run Time	----	30.44
155	P 1598 X	Vern Eng Cutoff	----	30.69
117	M 1050 X	Msl 42 Inch Motion	----	30.74
117	M 1050 X	Msl 42 Inch Motion	30.78	----

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Pen No.	Measurement No.	Description	Time Activated	Time Deactivated
117	M 1050 X	Msl 42 Inch Motion	----	31.03
38	P 1077 X	Vern Cof Rel Lockin	----	31.24
150	P 1347 X	S Cof Signal	----	31.24
107	P 1598 X	Vernier Eng Cutoff	----	31.30
7	P 1443 X	LO2 Pre Valve Open	31.83	----
78	P 1335 X	SGG Vlv Clsd Msw	----	31.84
56	P 1195 X	B2 Fuel Vlv Open Msw	----	31.94
117	M 1050 X	Msl 42 Inch Motion	31.98	----
117	M 1050 X	Msl 42 Inch Motion	----	32.06
117	M 1050 X	Msl 42 Inch Motion	32.49	----
104	P 1591 X	S Hyd Press Switch	----	32.58
58	P 1071 X	BGG Vlv Clsd Msw	----	32.60
60	P 1072 X	B Cof Relay Lockin	----	32.60
105	P 1592 X	Booster Eng Cutoff	----	32.60
112	P 1512 X	B2 LO2 Vlv Clos Ctl	----	32.60
113	P 1149 X	B1 LO2 Vlv Clos Ctl	----	32.60
70	AMR	2 Inch Motion Signal	34.61	----
163	P 1997 X	Fuel 95 Percent	----	35.22
57	P 1145 X	BGG Vlv Open Ctl Sol	35.42	----
87	P 1156 X	B1 Tbn Overspeed Trip	35.42	----
113	P 1149 X	B1 LO2 Vlv Clos Ctl	35.52	----
87	P 1156 X	B1 Tbn Overspeed Trip	----	35.56
57	P 1145 X	BGG Vlv Open Ctl Sol	----	35.57
49	P 1169 X	B2 LO2 Vlv Open Msw	35.69	----

Pen No.	Measurement No.	Description	Time Activated	Time Deactivated
49	P 1169 X	B2 LO2 Vlv Open Msw	----	35.98
170	P 3151 X	LO2 F & D Vlv Open-Gnd Half	----	36.30
171	P 3152 X	LO2 F & D Vlv Clsd-Gnd Half	----	36.31
162	P 1311 X	Fuel 90 Percent	36.63	----
163	P 1997 X	Fuel 95 Percent	----	36.84
169	P 1996 X	LO2 Overfill	36.88	----
165	P 3147 X	Fuel Overfill	36.89	----
164	P 1999 X	Fuel 100 Percent	36.89	----
163	P 1997 X	Fuel 95 Percent	36.90	----
70	AMR	2 Inch Motion Signal	----	37.45
51	P 1143 X	Gas Gen Ign Link Bk	----	37.46
45	P 1139 X	B LO2 Vlv Open Ctl	----	32.61
46	P 1058 X	B LO2 Vlv Clsd Msw	----	32.61
51	P 1143 X	Gas Gen Ign Link Bk	32.61	----
52	P 1148 X	B Fuel Vlv Open Ctl	----	32.61
114	P 1150 X	B Fuel Vlv Clos Ctl	----	32.61
85	P 1438 X	S Rough Comb Cof	----	32.61
117	M 1050 X	Msl 42 Inch Motion	----	32.69
26	P 1079 X	Vern Fuel Tk Press Sol	----	32.90
166	P 3148 X	Fuel F & D Vlv Open-Gnd Half	32.98	----
117	M 1050 X	Msl 42 Inch Motion	33.16	----
170	P 3151 X	LO2 F & D Vlv Open-Gnd Half	33.16	----
115	P 1146 X	BGG Vlv Clos Ctl Sol	----	33.47
49	P 1169 X	B2 LO2 Vlv Open Msw	----	33.48

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Pen No.	Measurement No.	Description	Time Activated	Time Deactivated
55	P 1069 X	B2 Fuel Vlv Clsd Msw	----	33.49
117	M 1050 X	Msl 42 Inch Motion	----	33.84
54	P 1194 X	B1 Fuel Vlv Open Msw	----	33.94
87	P 1156 X	B1 Tbn Overspeed Trip	----	34.27
87	P 1156 X	B1 Tbn Overspeed Trip	34.32	----
166	P 3148 X	Fuel F & D Vlv Open-Gnd Half	----	34.33
167	P 3149 X	Fuel F & D Vlv Clsd-Gnd Half	----	34.41
87	P 1156 X	B1 Tbn Overspeed Trip	----	34.52
69	P 1198 X	S LO2 HSV Open Msw	34.53	----
69	P 1198 X	S LO2 HSV Open Msw	----	34.54

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PNEUMATIC SYSTEM

Pneumatic system performance was satisfactory prior to and during engine firing. Abnormalities noted subsequent to cutoff are attributed to fire and explosion damage sustained during this interval. Propellant tank pressure data indicate that the integrity of the tanks was maintained until at least 31 seconds when the initiation of abnormal decay in pressure was recorded. Intermediate bulkhead integrity was maintained until 34 seconds.

The first recorded indication of damage to the pneumatic system occurred at 2.28 seconds. A review of film coverage indicated an explosion at 2.22 seconds. Beginning at 2.28 seconds sustainer control bottle discharge pressure dropped from 3010 to 900 psig in 0.2 seconds, then decayed to 60 psig by 5 seconds. When the discharge pressure decay reached about 750 psig, satisfactory operation of the sustainer controls pneumatic regulator could not be maintained. By 3.05 seconds regulator discharge pressure had decayed to 60 psig and stabilized. These data indicate the loss of a high pressure helium line downstream of the controls bottle through fire damage in this general area.

The LO_2 and fuel tank pressures during engine firing were adequate at 25.3 and 61.0 psig. With the closure of the propellant valves at sustainer cutoff, the small ullage present in the LO_2 tank was rapidly overpressurized to 30.1 psig before the regulator could respond to the sensed pressure and lock up. This level was maintained until 14.5 seconds when the PCU appeared momentarily to go into emergency, then return to Sequence III with a corresponding drop and surge in LO_2 tank pressure. At 16.1 seconds the PCU went into emergency, initiating decay of LO_2 tank pressure to yield a greater safety margin. (A review of film coverage indicated the boil-off valve to open momentarily at 7.4 seconds then open permanently at 11.5 seconds).

The final emergency condition of the PCU probably occurred automatically when fuel tank pressure decayed to less than 53 psig subsequent to 14.5 sec. By 19.7 seconds LO_2 tank pressure had decayed to a stable level of 8.6 psig which was maintained until 31 seconds. Fuel tank pressure over the interval from 15 to 31 seconds exhibited a step decrease to 32.1 psig.
From 31 seconds on, an accelerated rate of decay in fuel tank pressure resulted in all stations of the intermediate bulkhead exhibiting a negative differential pressure by 35 seconds. Structural integrity of this component was questionable subsequent to this time. Actual cause of missile explosion at 37.5 seconds may not be determined conclusively. However, rupture of the bulkhead just prior to this time is likely.

Satisfactory supply pressures were achieved in all bottles prior to engine ignition. Computations indicate that approximately 105 pounds of helium at a pressure of 3060 psig and a temperature of -316°F were aboard the missile to furnish booster tank pressurization requirements. The special fiberglass separation fitting supply bottle was intentionally not charged for the FRF. Post test inspection of hardware established that all helium bottles were intact after the explosion.

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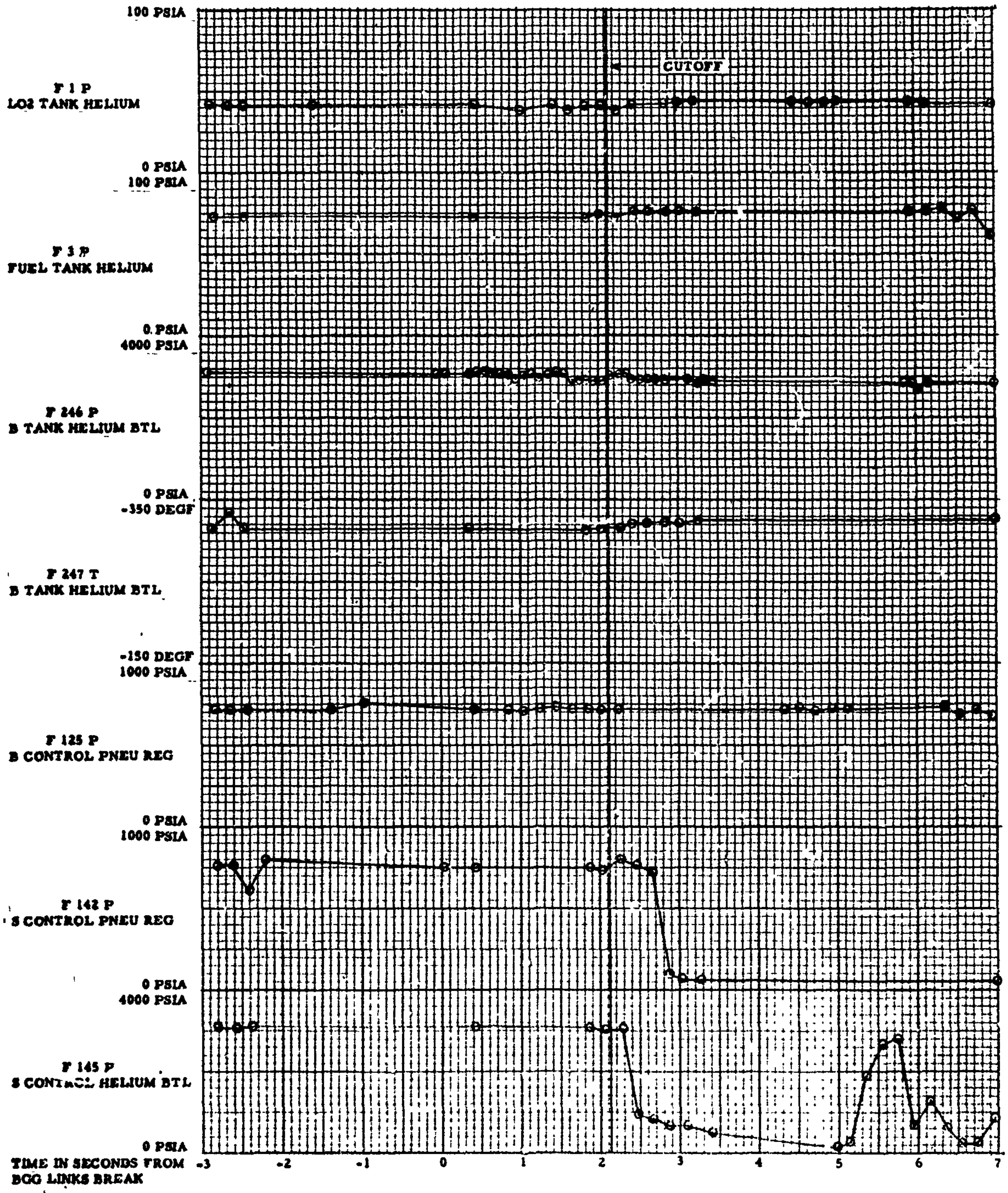
PNEUMATIC SYSTEM
COMMUTATED TELEMETRY DATA



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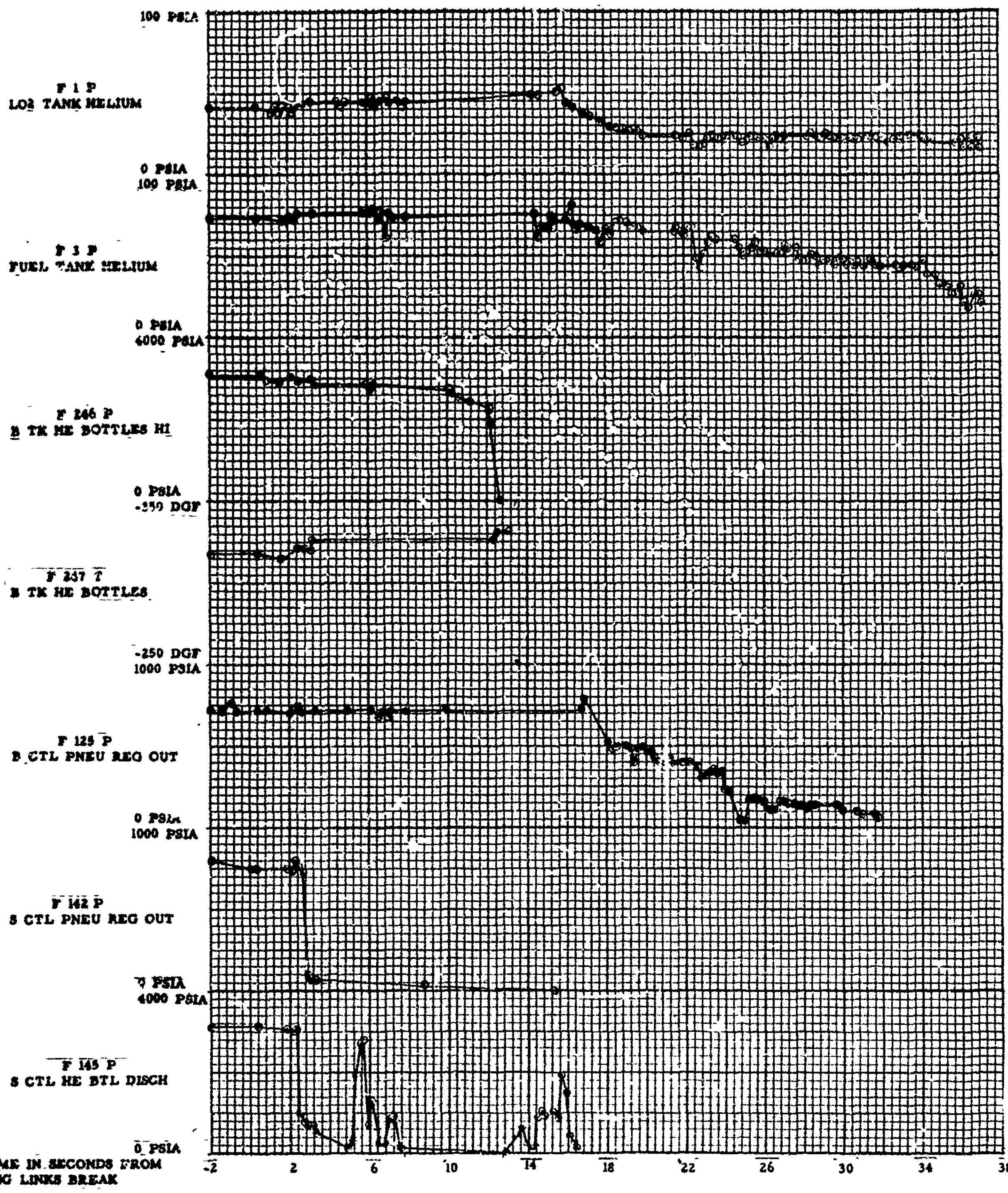
PNEUMATIC SYSTEM
COMMUTATED TELEMETRY DATA



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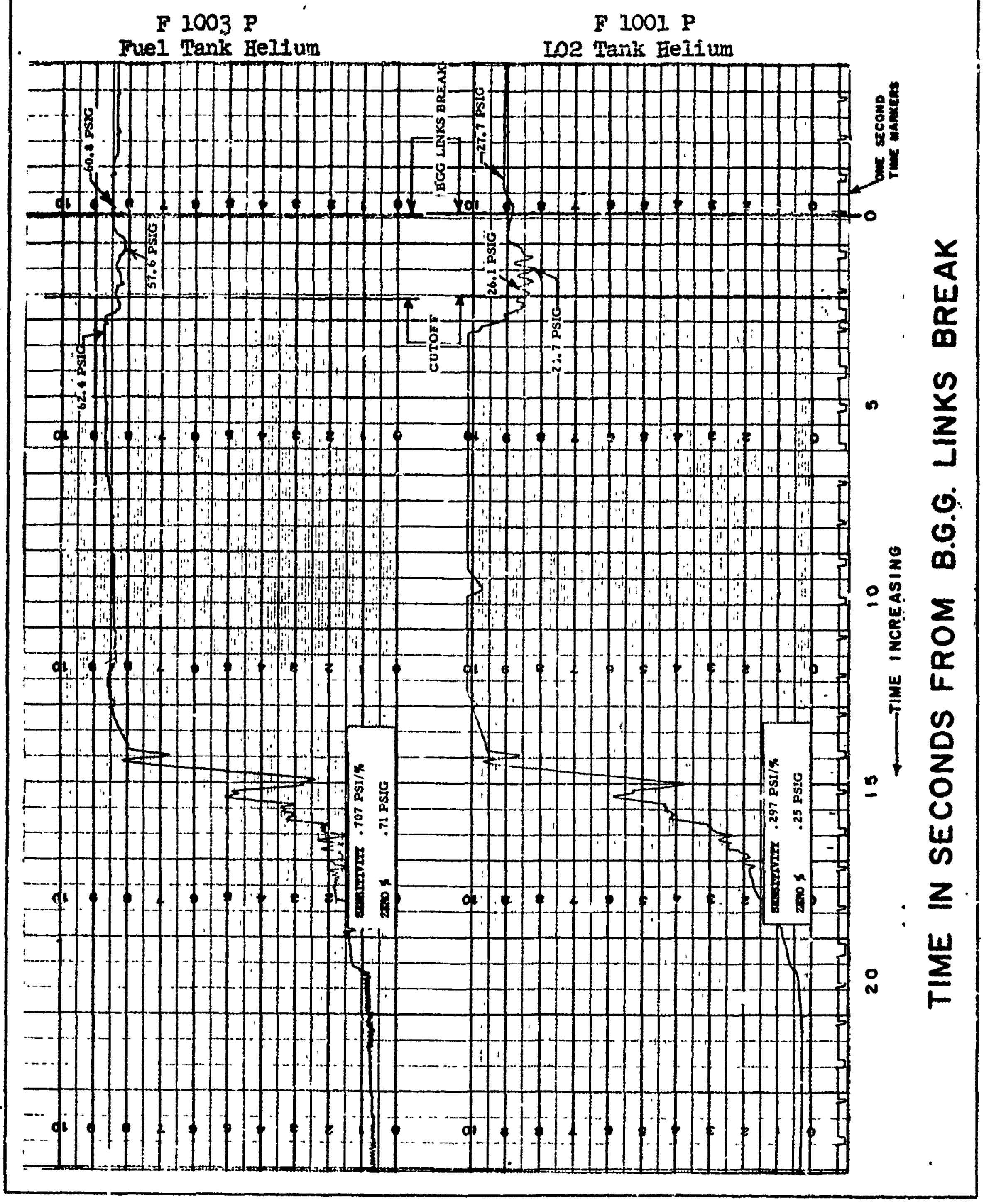
PNEUMATIC SYSTEM LANDLINE DATA



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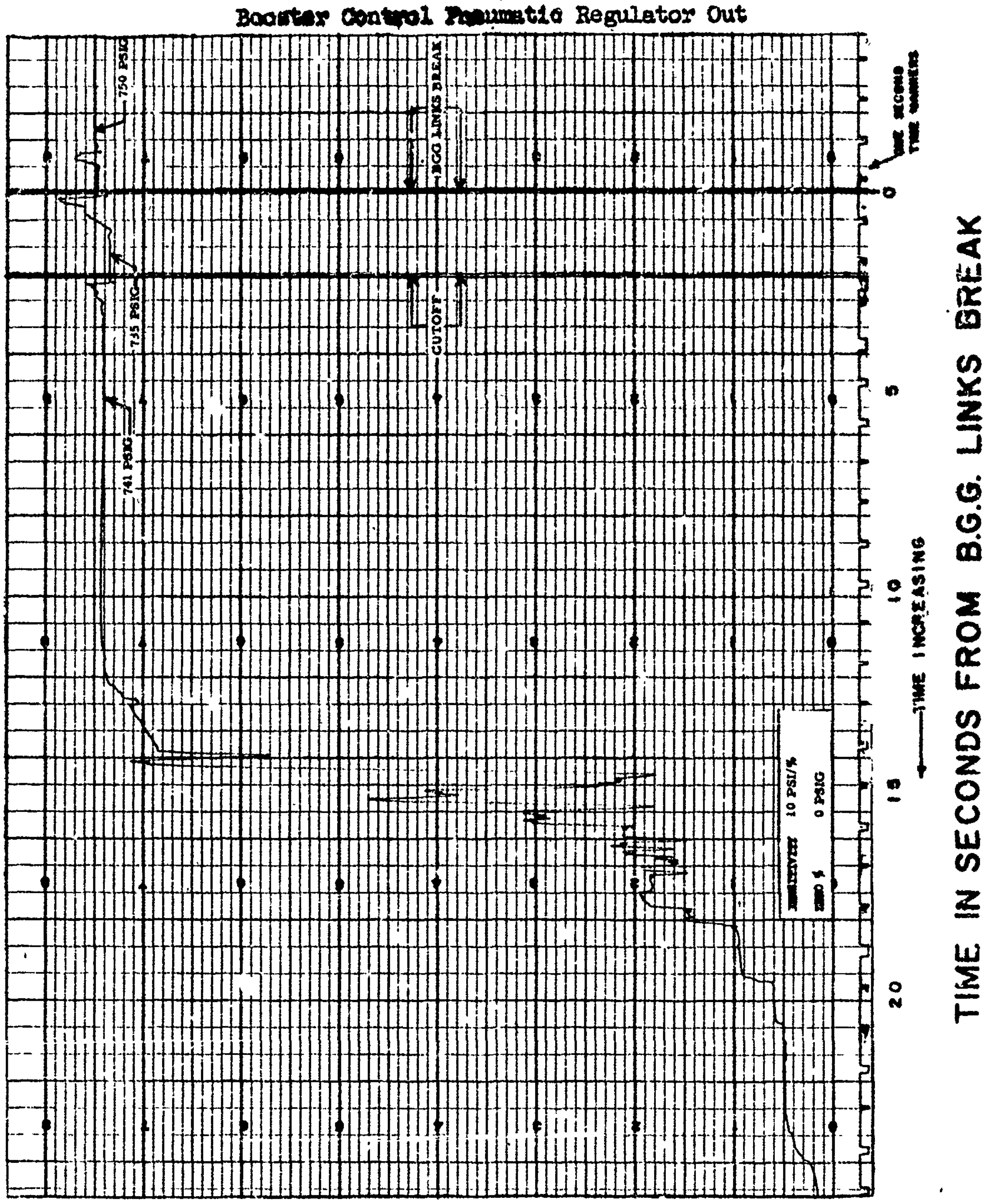
PNEUMATIC SYSTEM LANDLINE DATA

F 1125 P
Booster Control Pneumatic Regulator Out



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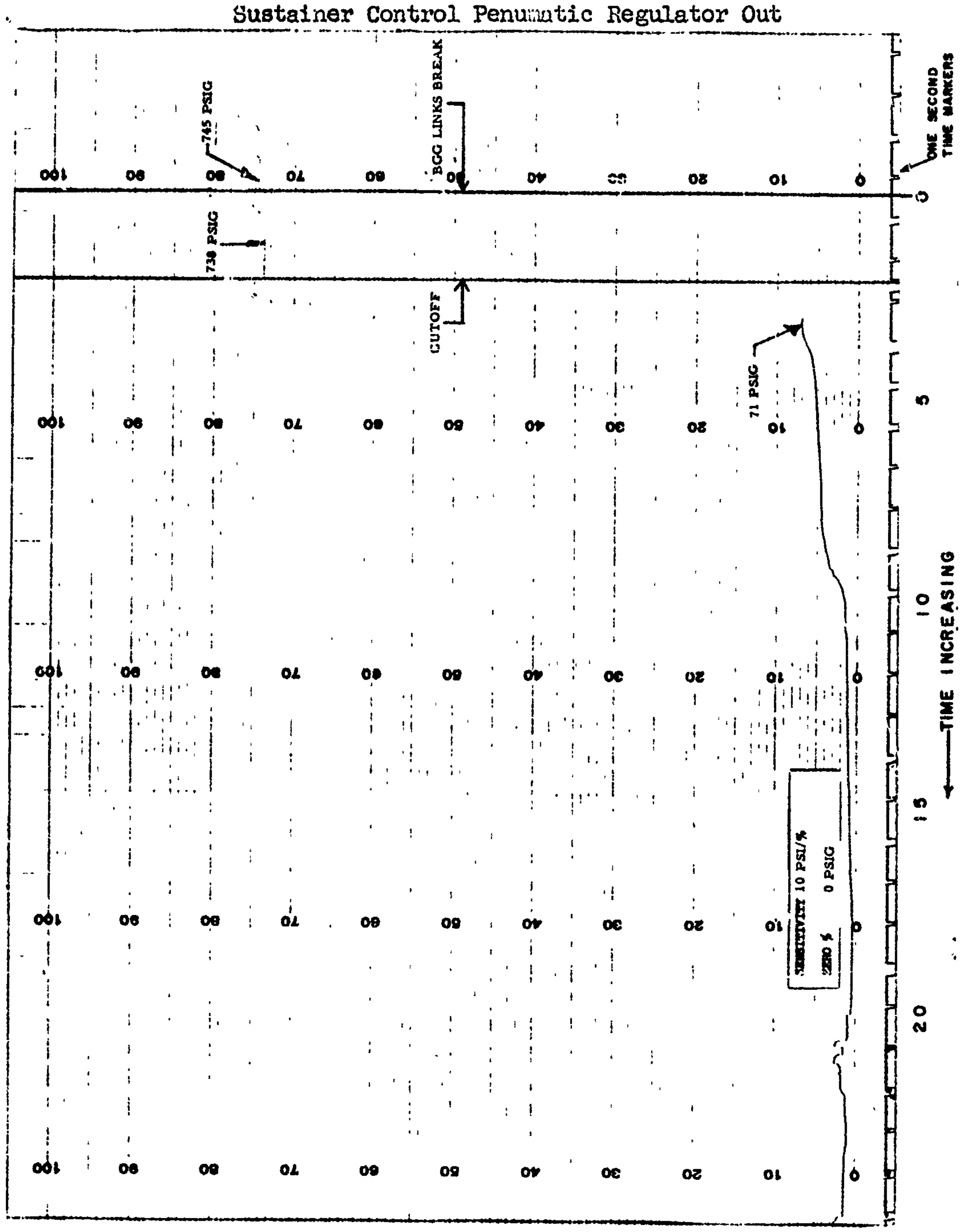
FNEUMATIC SYSTEM LANDLINE DATA

F 1142 P
Sustainer Control Penumatic Regulator Out



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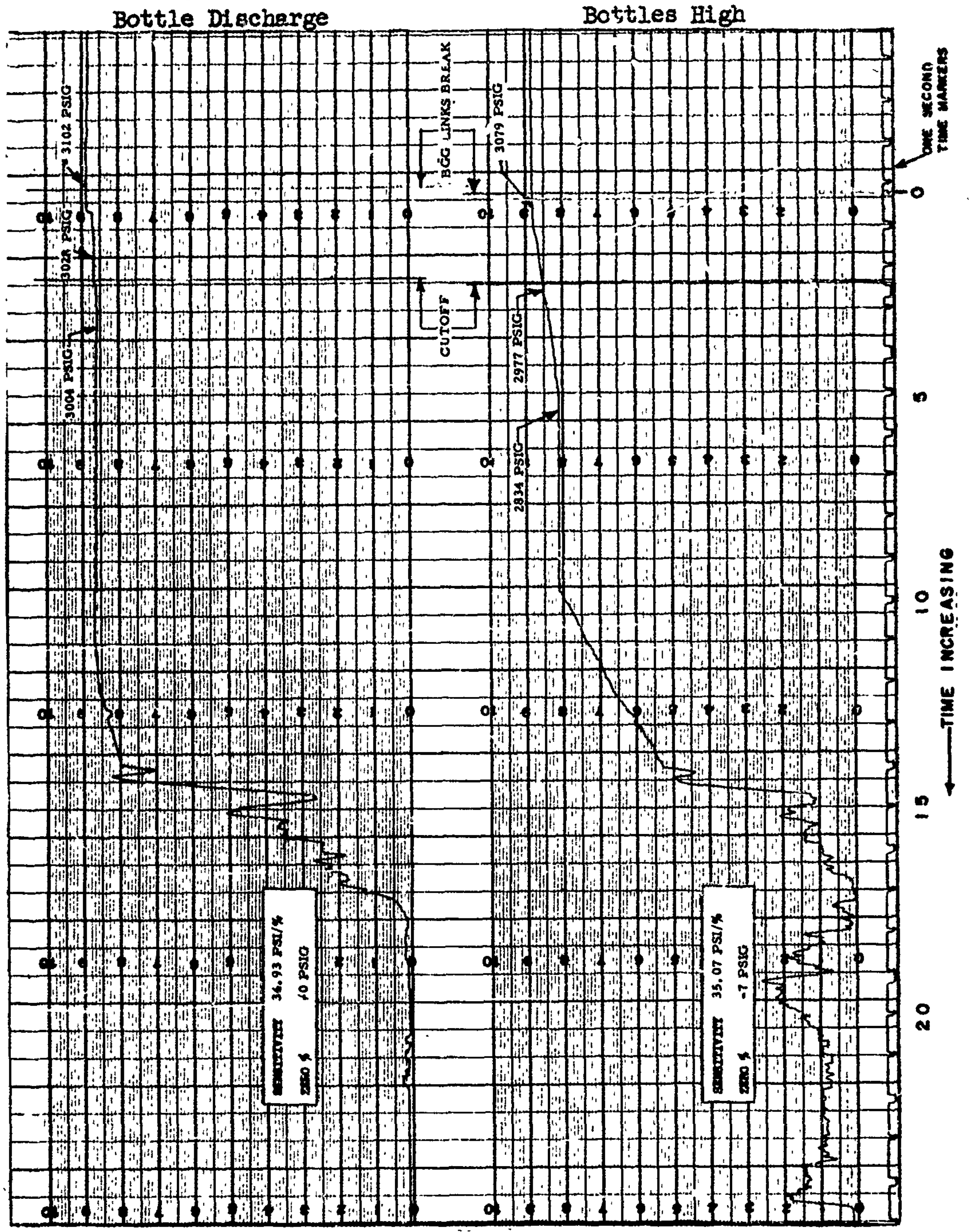
PNEUMATIC SYSTEM LANDLINE DATA

F 1121 P
Booster Control Helium
Bottle Discharge

F 1246 P
Booster Tanks Helium
Bottles High



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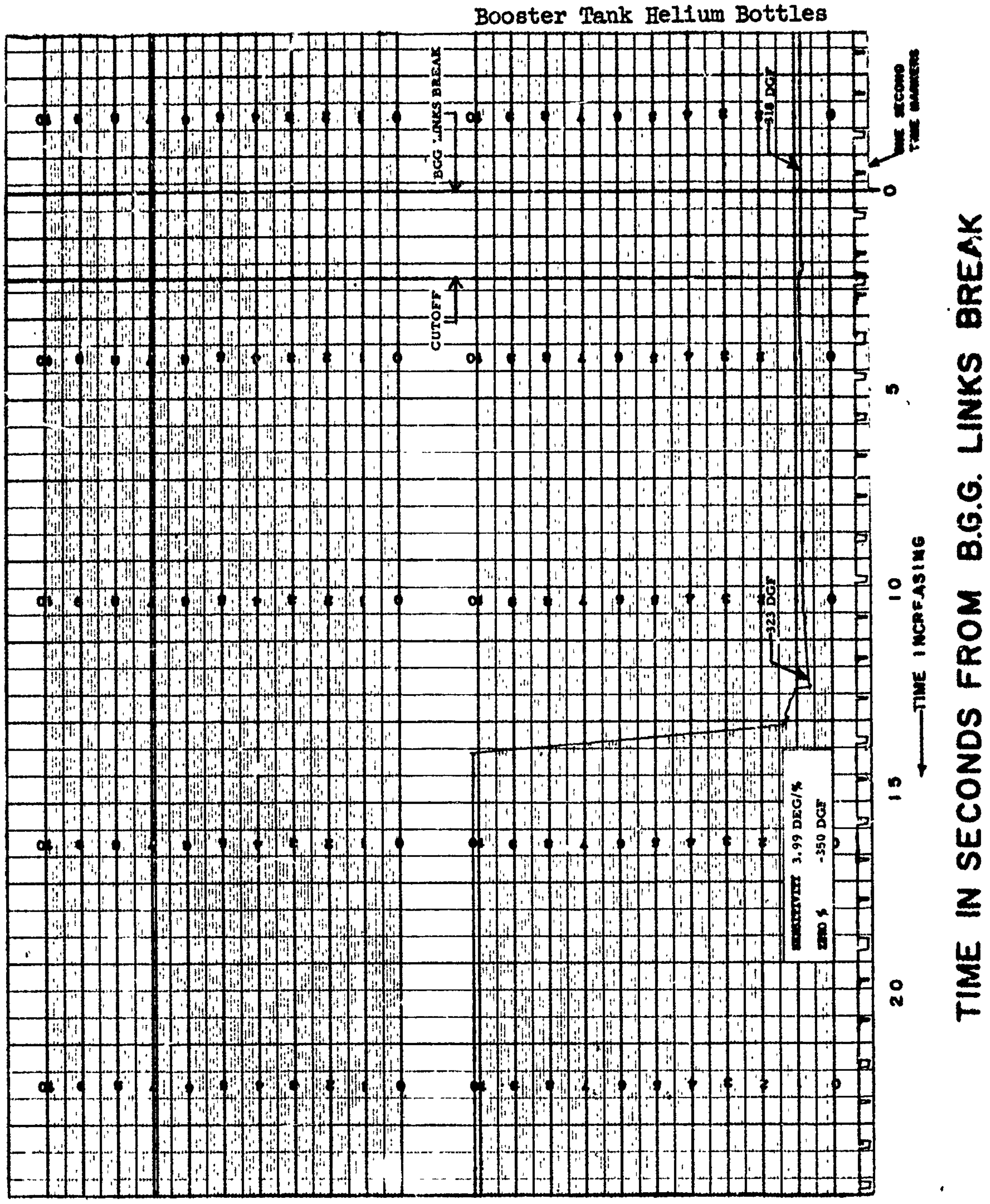
PNEUMATIC SYSTEM LANDLINE DATA

F 1247 T
Booster Tank Helium Bottles



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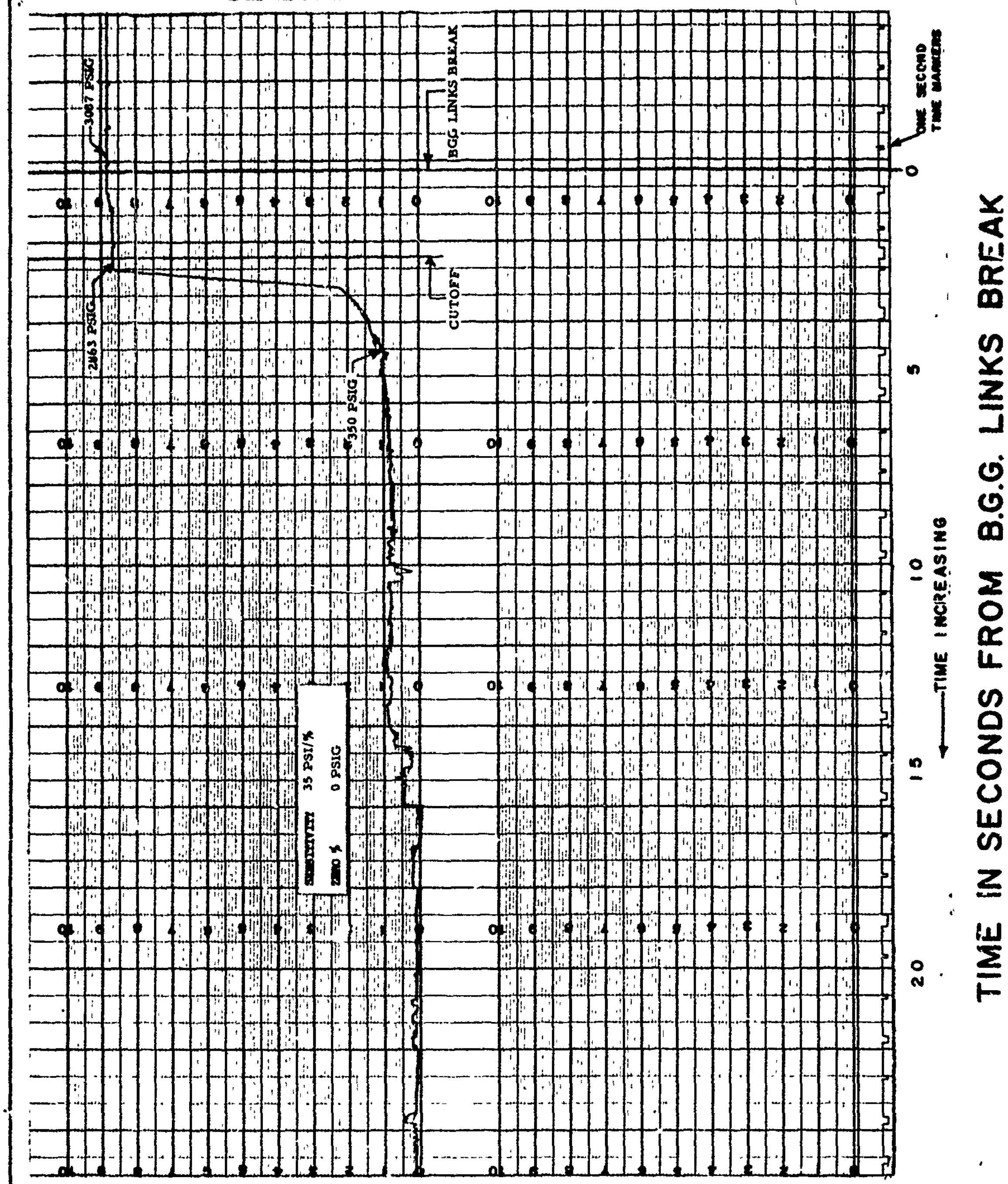
PNEUMATIC SYSTEM LANDLINE DATA

F 1145 P

Sustainer Control Helium Bottle Discharge



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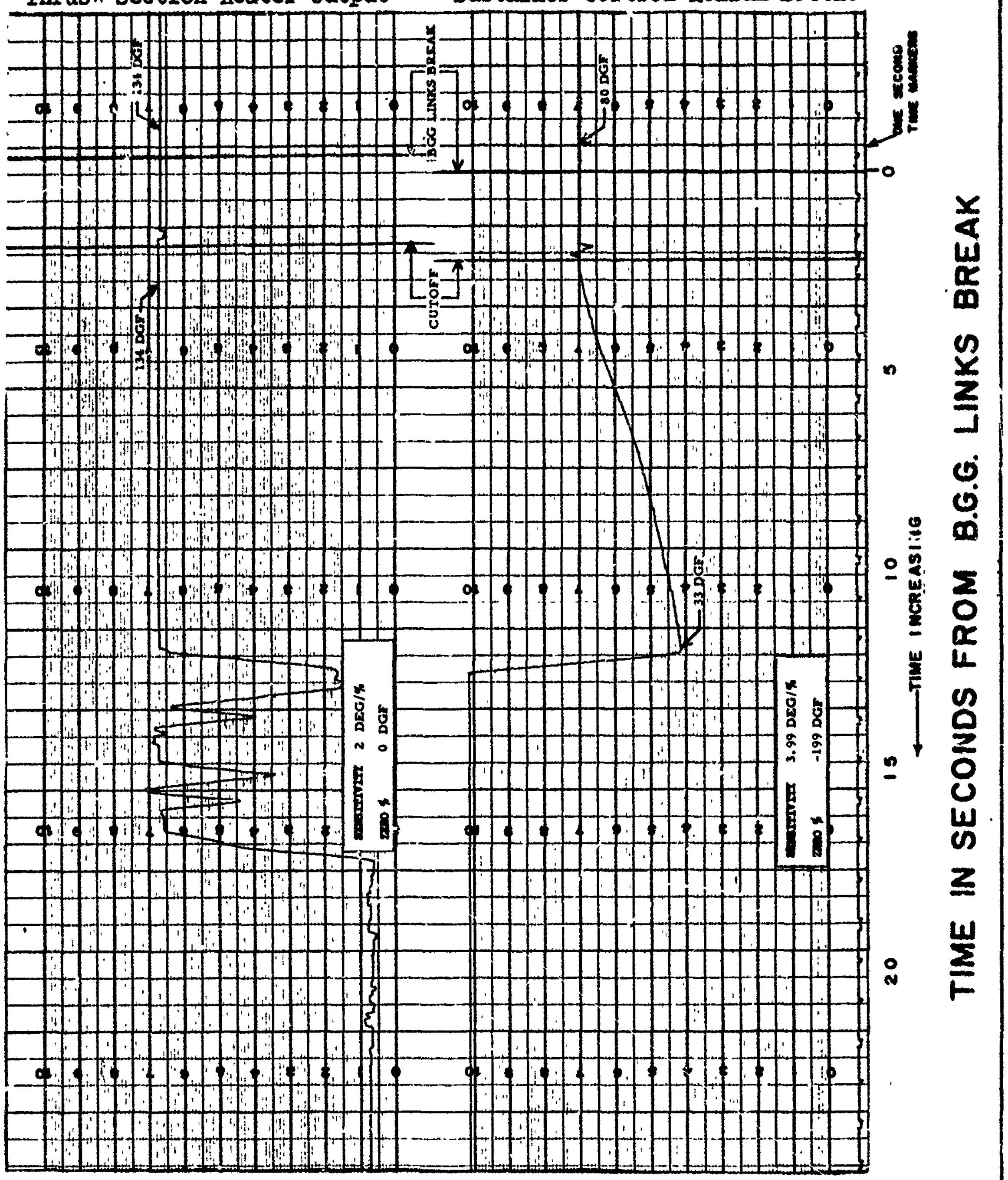
PNEUMATIC SYSTEM LANDLINE DATA

N1353T
Thrust Section Heater Output

F 1290 T
Sustainer Control Helium Bottle



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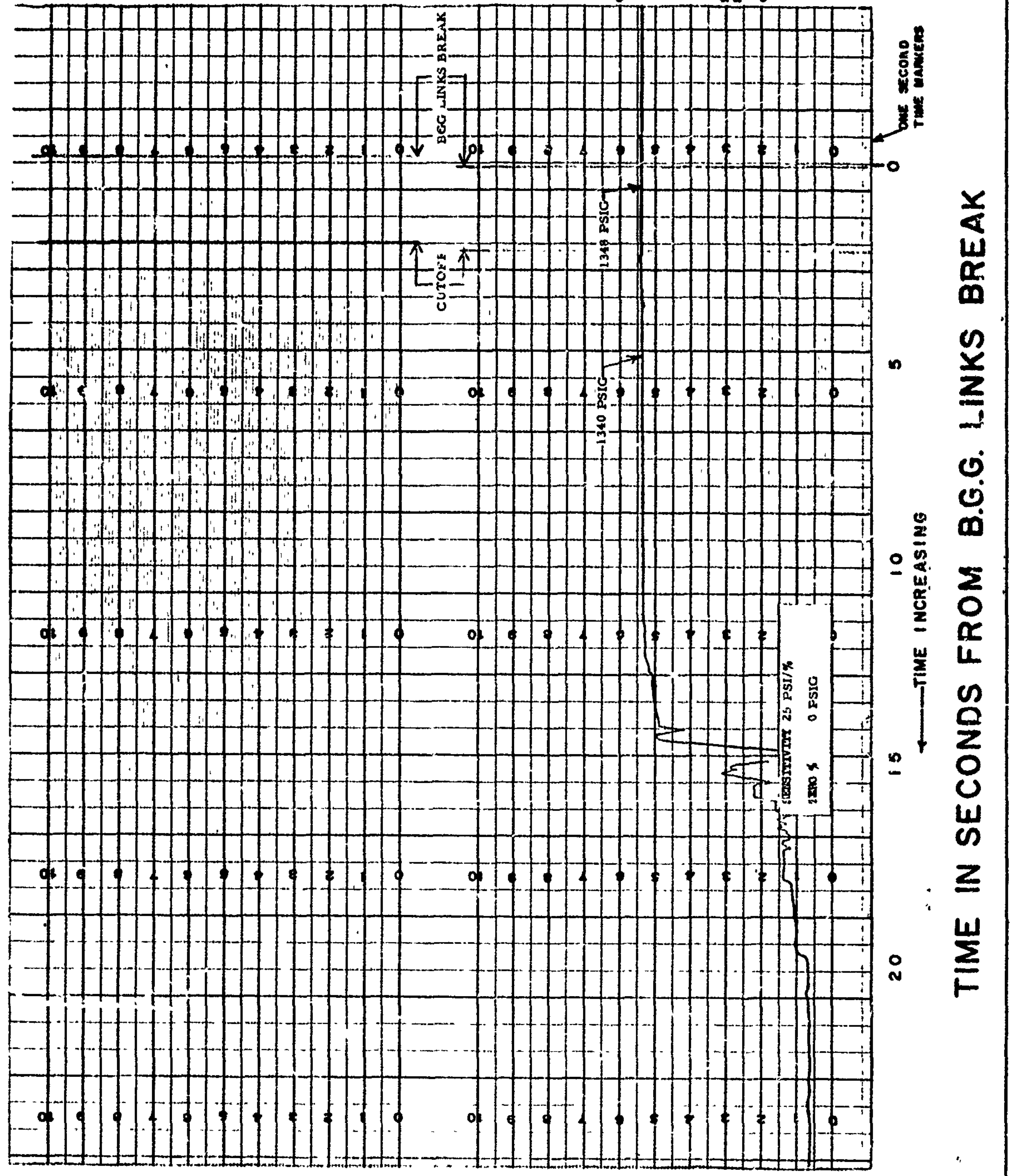
PNEUMATIC SYSTEM LANDLINE DATA

F 1194 P
Facility GN2 Supply



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HYDRAULIC SYSTEM

Booster and sustainer/vernier hydraulic system operation was normal prior to and during engine firing. Following sustainer cutoff, sustainer hydraulic system performance exhibited abnormal pressure decay characteristics which appeared to begin at 2.3 seconds.

Sustainer hydraulic ground pressure was maintained at a stable 1925 psig until -0.9 seconds when a normal negative 90 psi transient drop in hydraulic pressure was recorded. This pressure transient is the result of hydraulic demands from the head suppression valve. At 0.2 seconds hydraulic pressure began to rise, reaching an airborne system peak of 3320 psig at 1.7 seconds. From 1.7 to 2.0 seconds the pressure decayed normally to 2985 psig where it should have stabilized. From 2.0 to 2.3 seconds, a lesser rate of decay was recorded. Pressure at 2.3 seconds was 2800 psig. By 2.4 seconds it had dropped to 2215 psig. From 2.4 to 9.8 seconds the pressure decayed in steps to 1035 psig, then dropped rapidly to return system pressure of approximately 110 psig when the pre-charge pressure of the vernier solo system accumulators was reached.

The abnormal rapid rate of decay recorded after 2.3 seconds and the inability of the system to maintain pressure at 2000 psig (ground system pressure) indicate the loss of hydraulic oil commencing at approximately 2.3 seconds.

Booster system pressure appeared to be quite satisfactory, rising from a ground system level of 1925 psig to an airborne system peak of 3430 psig. A steady state pressure of 3080 psig was maintained until 6.4 seconds when the pressure abruptly became quite erratic, exhibiting oscillations with a peak to peak magnitude of approximately 1350 psi. This behavior appears indicative of a loss of hydraulic oil in the high pressure side of the system.

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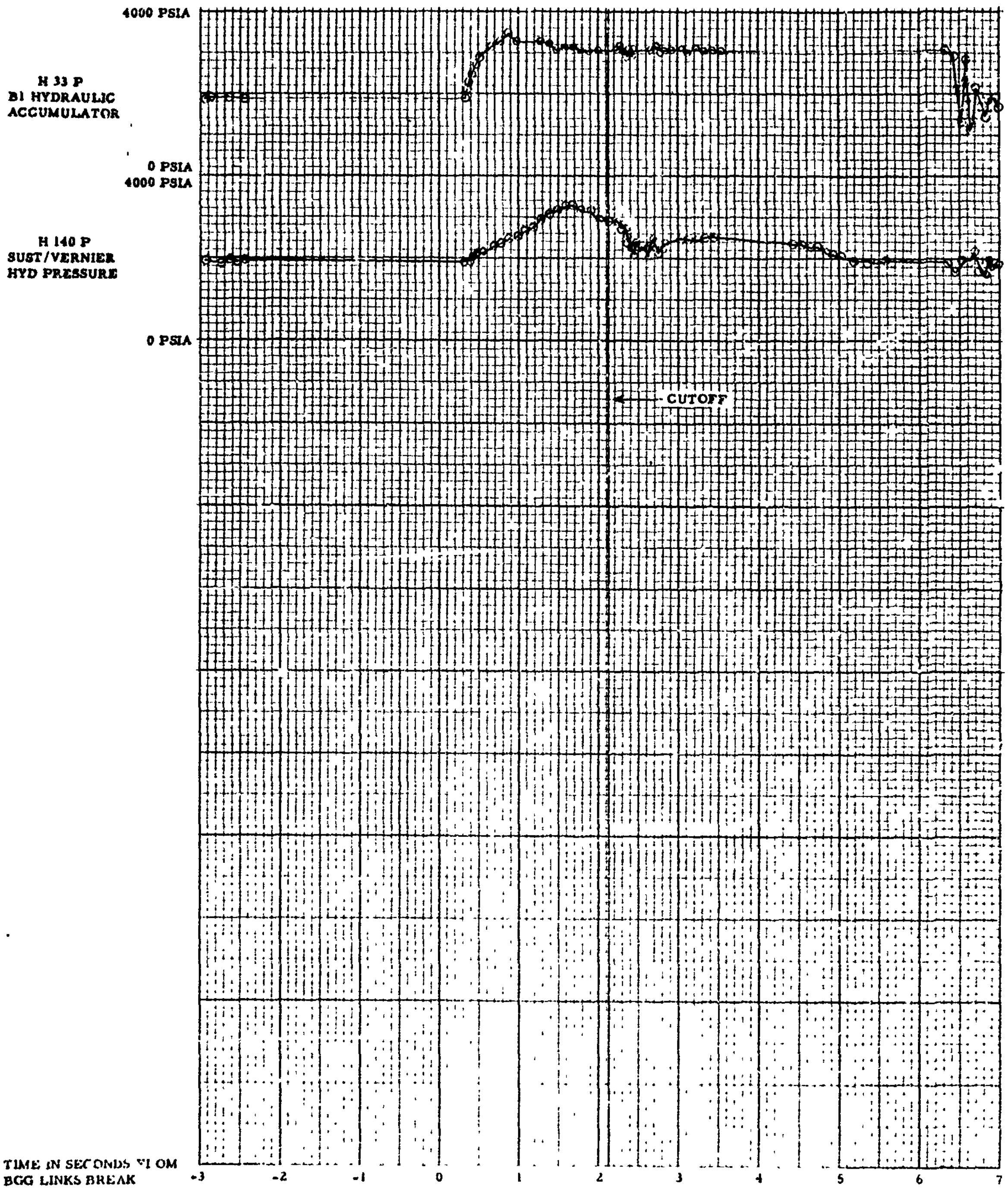
HYDRAULIC SYSTEM
COMMUTATED TELEMETRY DATA



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FLIGHT CONTROL SYSTEM

Flight Control System performance was satisfactory during engine run and for a period after engine shutdown.

A gimbal program for the booster engines in pitch and then yaw was planned. Even though engine position data were deteriorated after 6.4 seconds, it was evident that the engines were following the pitch program properly. Displacements of all engine positions at ignition were also normal.

Indications of erratic engine movement began at 8.4 seconds on both telemetry and land lines instrumentation. At this time, telemetered data indicated that Booster No. 1 engine moved positive 2.90 degrees in pitch and 2.50 degrees in yaw. The Vernier No. 2 pitch roll trace indicated a positive movement of 38 degrees.

The sustainer yaw telemetry trace had a discrepancy in that the trace was out of band in the negative direction until 8.9 seconds, at which time the trace moved out of band in the positive direction and remained there. Landline data refutes this, and show the engine properly at null.

All pre-count checks and countdown tests were satisfactory. Countdown tests consisted of a guidance/autopilot loop test, a gyro torquing test, an integrator gimbaling test, a rate gyro response test, and a gyro stiction test.

System telemetry data appear on the following pages.

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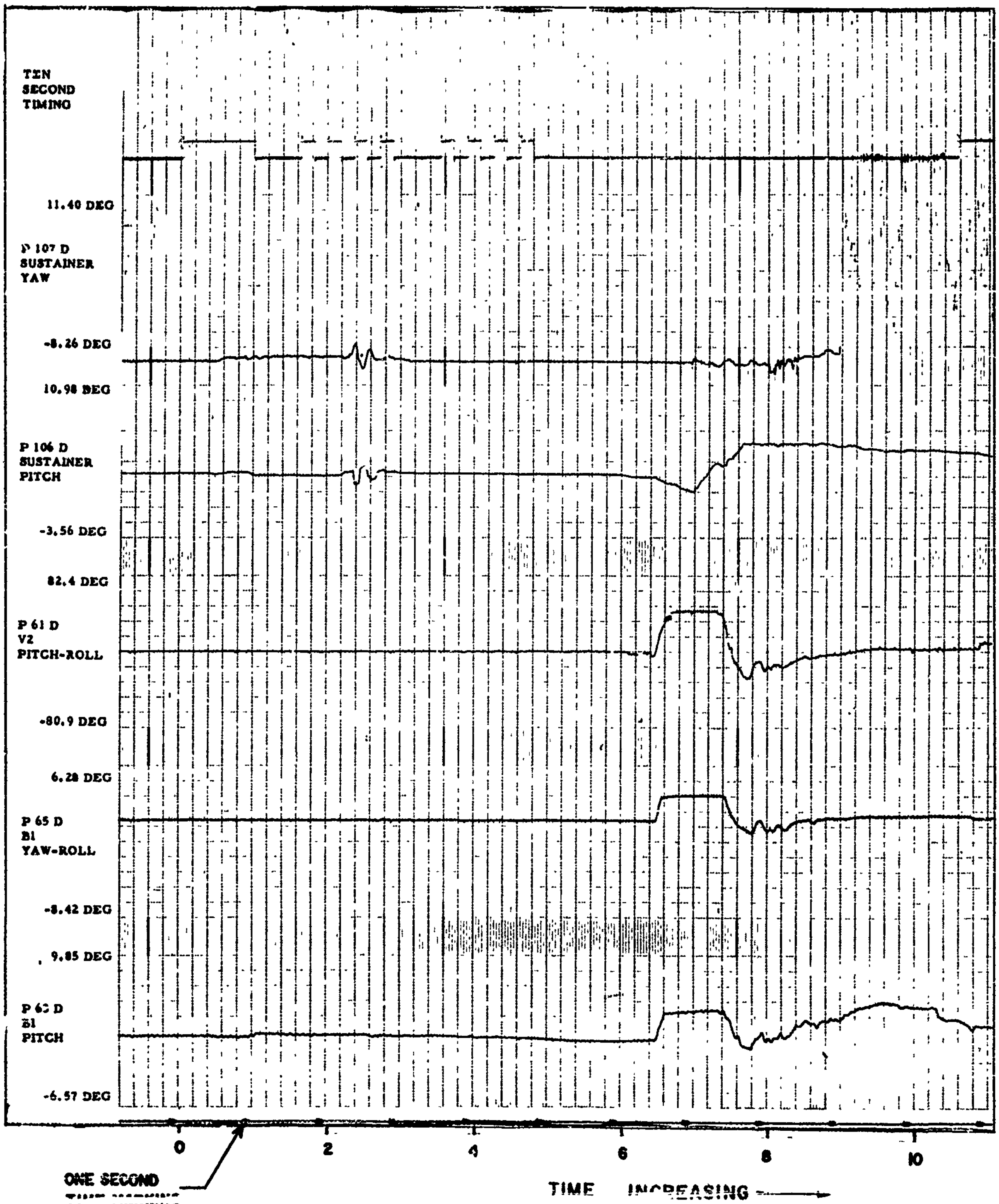
FLIGHT CONTROL SYSTEM
CONTINUOUS TELEMETRY DATA



TIME IN SECONDS FROM B.G.G. LINKS BREAK

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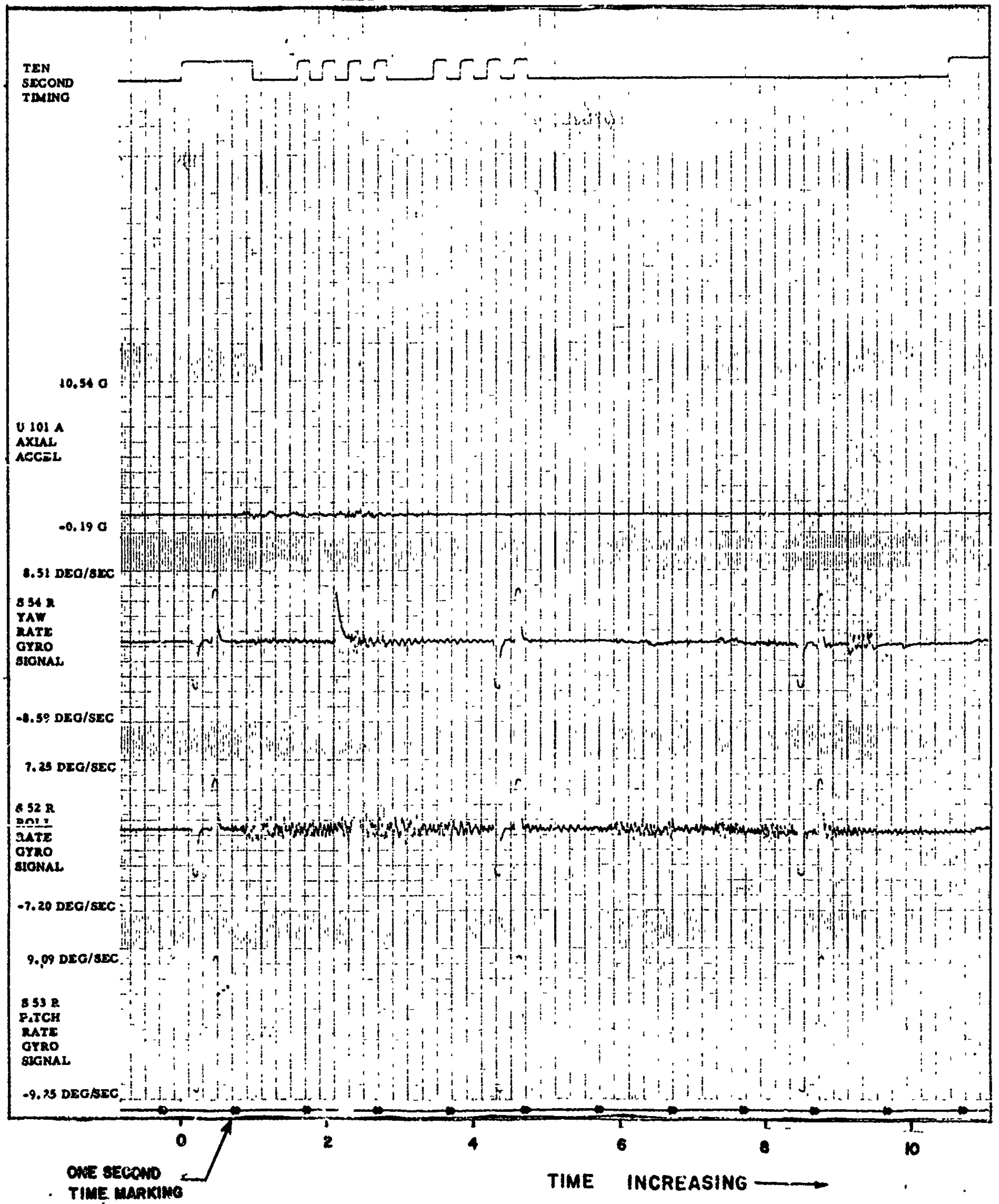
FLIGHT CONTROL SYSTEM
CONTINUOUS TELEMETRY DATA



TIME IN SECONDS FROM B.G.G. LINKS BREAK

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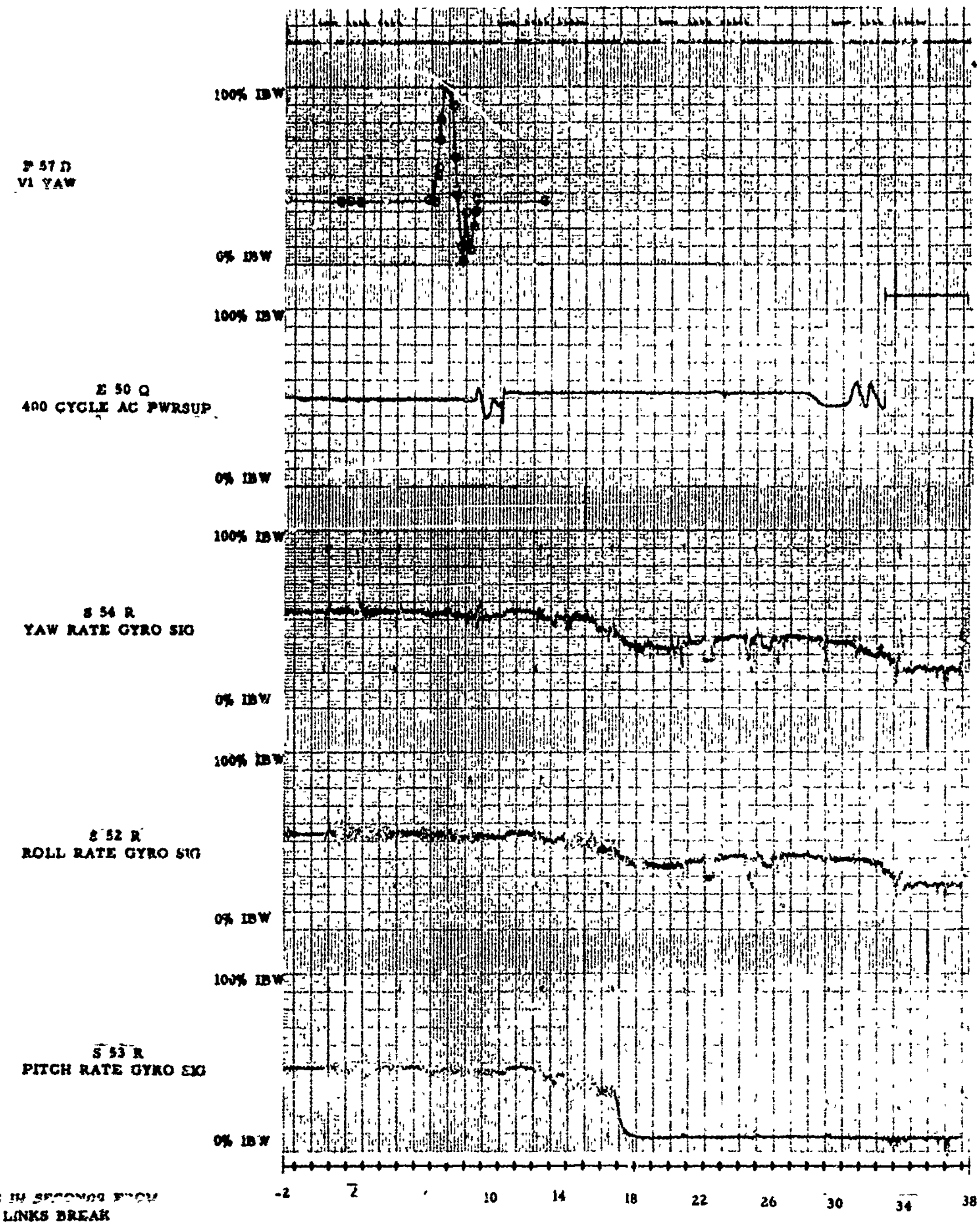
FLIGHT CONTROL SYSTEM
CONTINUOUS TELEMETRY DATA



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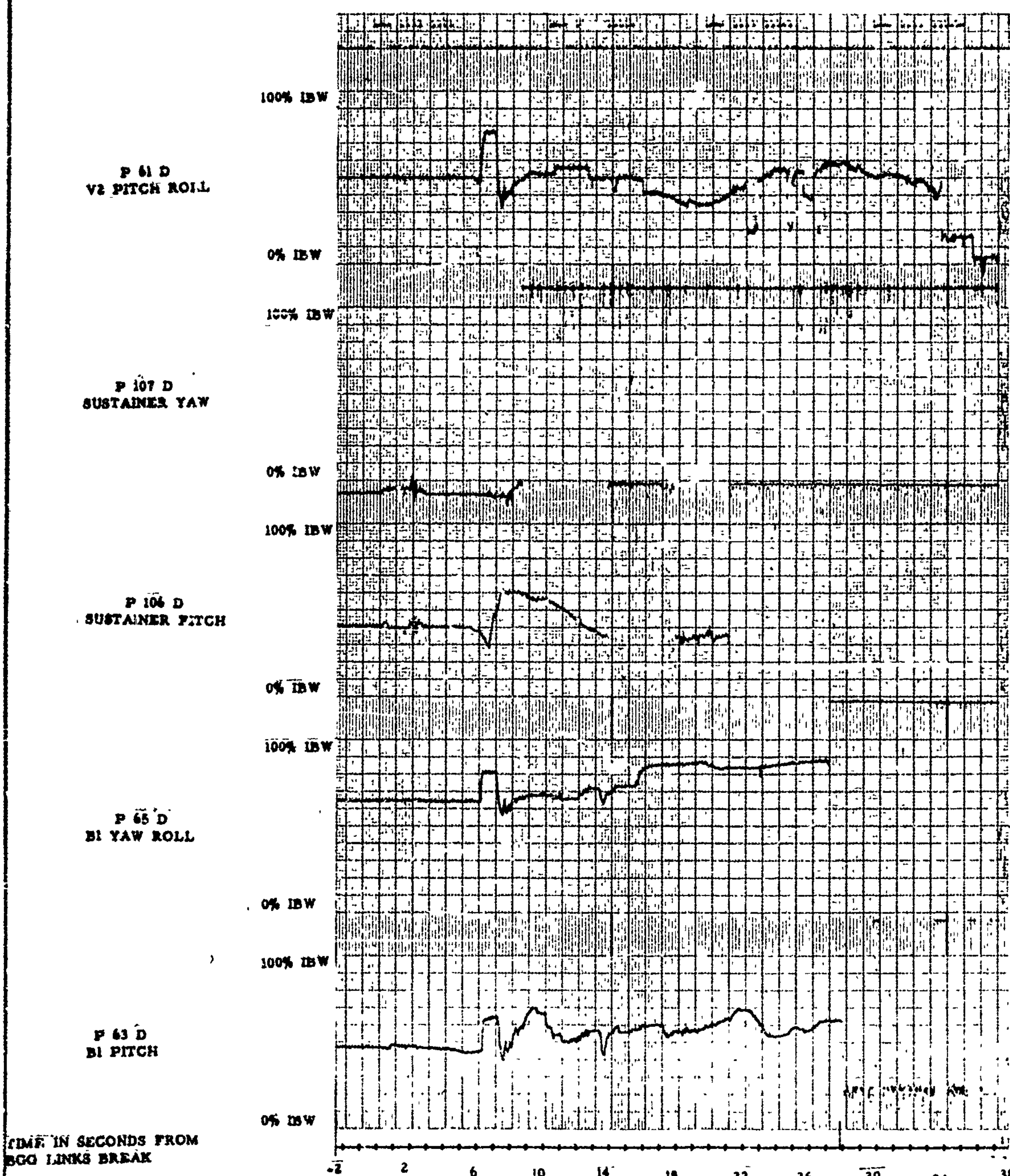
FLIGHT CONTROL SYSTEM
CONTINUOUS TELEMETRY DATA



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GUIDANCE SYSTEM

Performance of the Guidance System was satisfactory. All planned count-down operations and tests were completed without difficulty or incidents. There were no discrepancies reported by the guidance monitor set operator.

Telemetered data indicated normal system operating levels until loss of AC electrical power at + 30.5 seconds.

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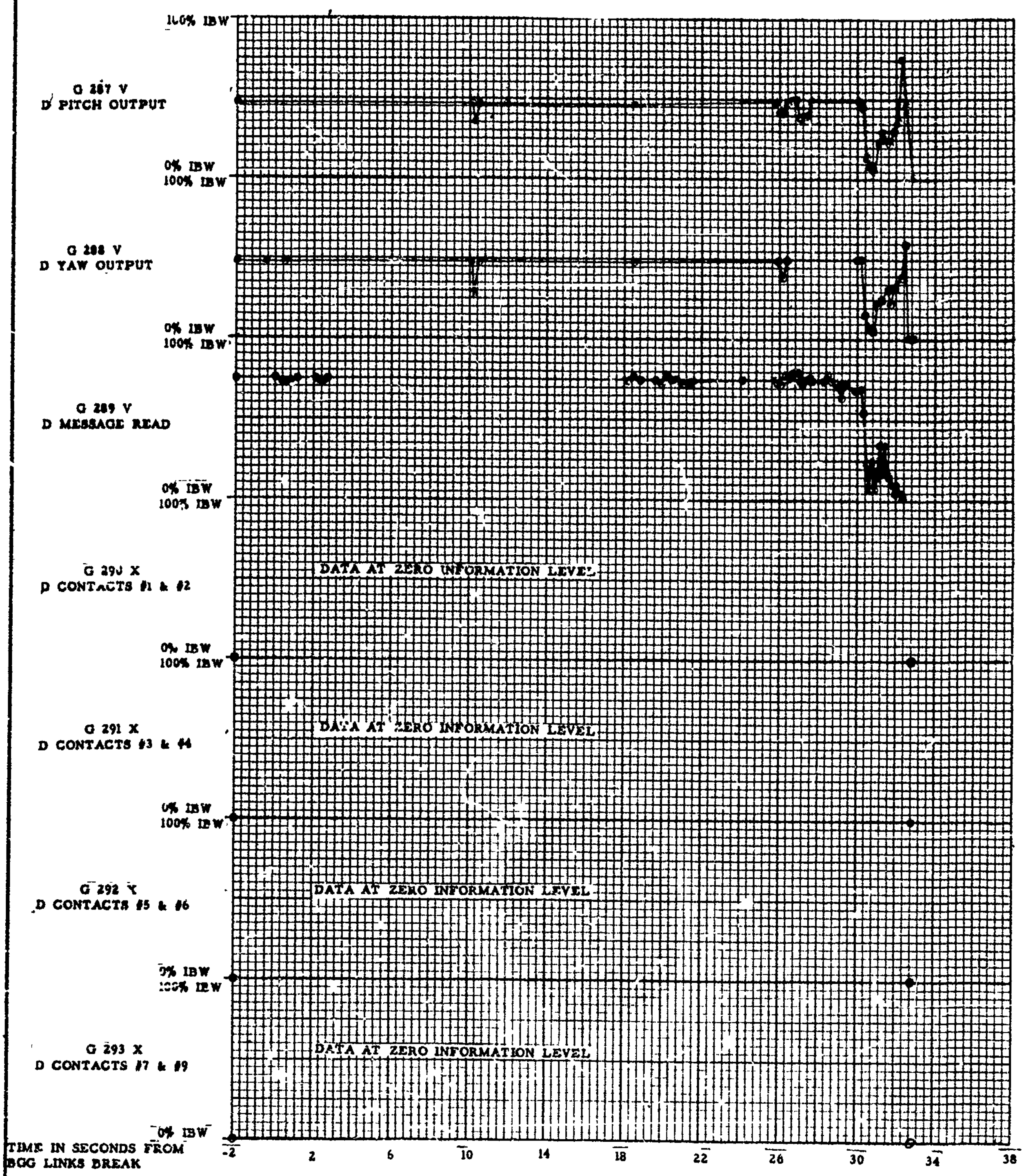
GUIDANCE SYSTEM
COMMUTATED TELEMETRY DATA



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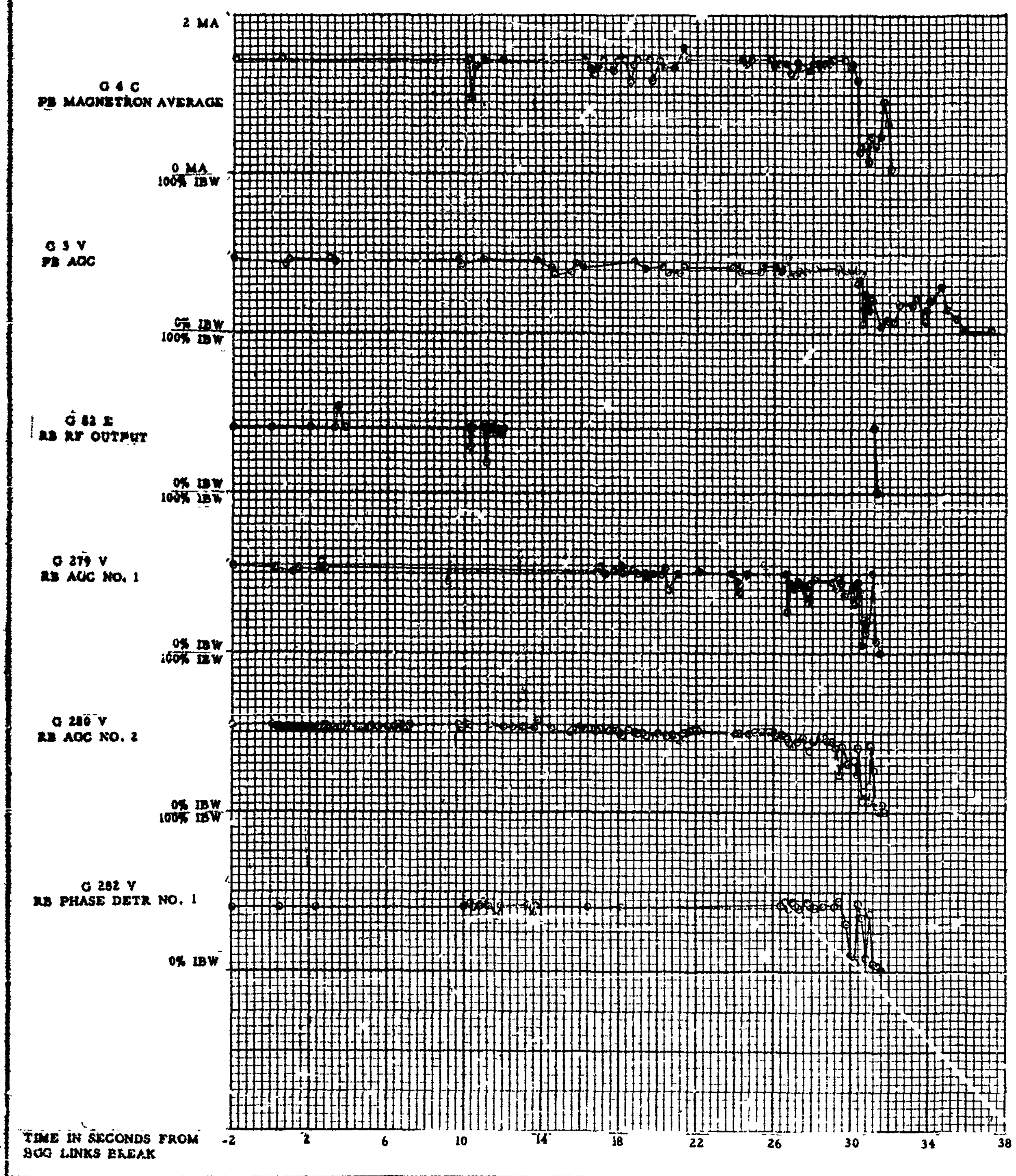
GUIDANCE SYSTEM
COMMUTATED TELEMETRY DATA



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ELECTRICAL SYSTEM

System performance was satisfactory prior to and during engine firing. Abnormal behavior indicated by system parameters after engine cutoff is attributed to fire and explosion damage incurred during the interval.

Inverter frequency, 398.8 cps prior to ignition, exhibited the normal transient at vernier engine firing, rising momentarily to 400 cps. From 0 to 8.9 seconds when a change to external AC and DC power was effected, frequency remained between 398.8 and 400.0 cps. Transients during the changeover reached a maximum of 406 and a minimum of 390 cps. By 10.6 seconds, frequency had attained a stable level of 397 cps. This level was maintained until 28.2 seconds when instabilities in frequency were indicated. Loss of power occurred at 32.9 seconds.

Minor oscillations which were noted in the frequency throughout the test are attributed to instrumentation since the oscillations were present during external and internal power operation.

The DC voltage remained at a satisfactory 27.3 volts until changeover to external power at 8.9 seconds. During changeover a transient drop to 15.4 volts was indicated. After 10.6 seconds various transient voltage drops were indicated. The majority of these transients are not reflected in the performance of user systems. The DC voltage, however, did not decay after 10.6 seconds, reaching 23 volts at 31.5 seconds. At this time the voltage dropped abruptly to 9.6 volts, and was lost entirely at 32.9 seconds.

Inverter phase A voltage remained at 114.4 volts until changeover to external power when a change of level to 113 volts occurred. By 30.4 seconds the AC voltage had increased to 114 volts. At this time the loss of phase A voltage was recorded. This loss of voltage is reflected in Azusa, guidance, propellant utilization, and autopilot data at 30.4 seconds.

Panel operators reports indicate DC and AC voltages, and AC frequency, prior to ignition to be 28.5 and 115.0 volts, and 398 cps respectively.

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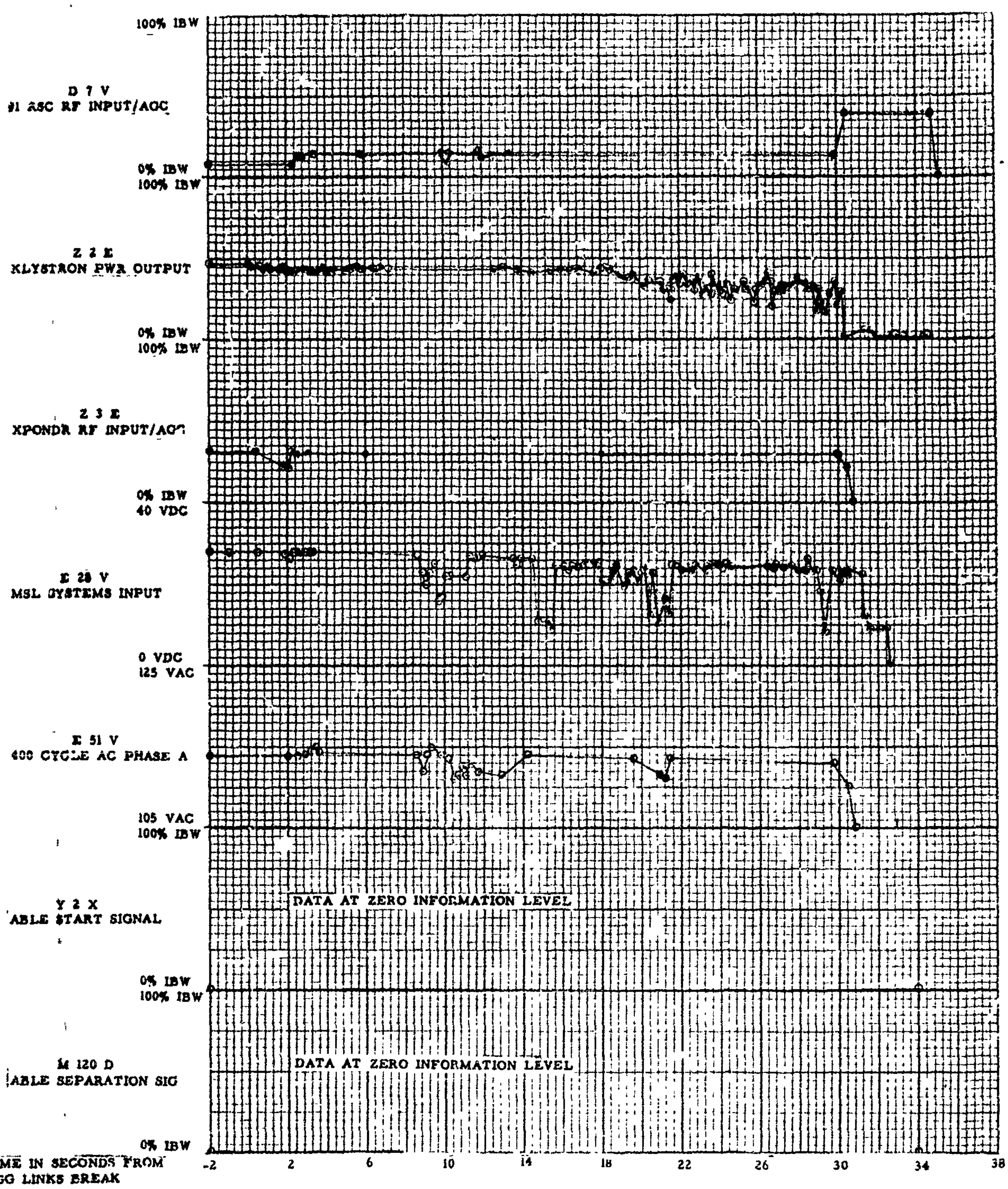
ELECTRICAL SYSTEM
COMMUTATED TELEMETRY DATA



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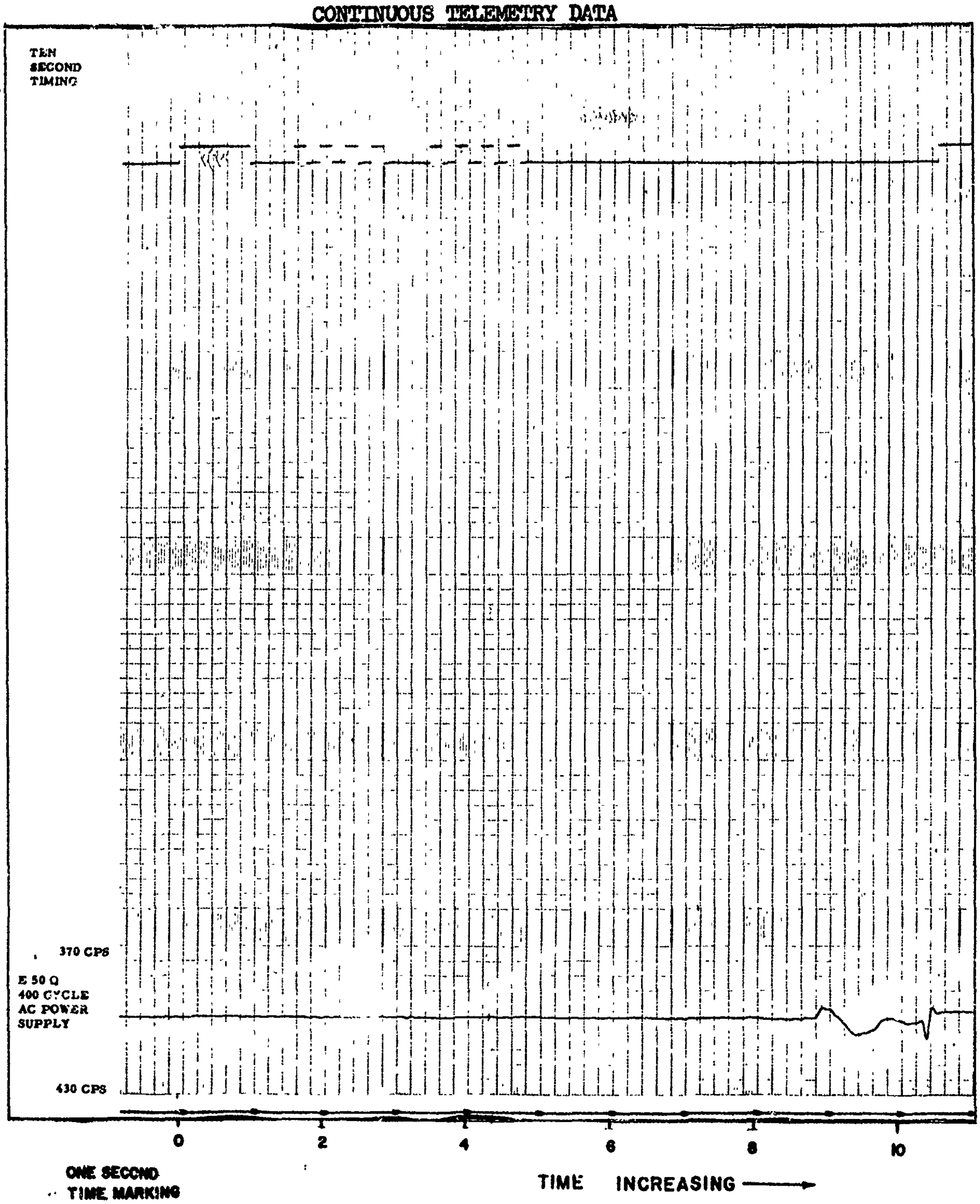
MISSILE ELECTRICAL SYSTEM
CONTINUOUS TELEMETRY DATA



TIME IN SECONDS FROM B.G.G. LINKS BREAK

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RANGE SAFETY COMMAND SYSTEM

Performance of the Range Safety Command System was satisfactory. Countdown tests and operations were completed without incident.

Telemetered data indicated an essentially constant and satisfactory r-f input/agc level until +30.2 seconds, when rapid decrease in level was indicated. There were no inadvertent command system outputs prior to loss of data.

NOTE: During an FRF operation, inert dummy destructor packages are installed in lieu of the destructors carried in flight.

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AZUSA SYSTEM

Performance of the Azusa System was satisfactory. AMR reported a "GO" transponder with no change prior to engine cutoff. Received signal strength at the AMR ground station was -123 DBW. Recovery, modulation, and coherency were satisfactory.

Telemetered power output data indicated that klystron power output was essentially constant and satisfactory until +30.4 seconds. R-f input/agc data was essentially constant and satisfactory until + 18.7 seconds when a gradual decrease was indicated. This decreasing trend continued until loss of data at 30.4 seconds.

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AIRFRAME

All data and engineering sequential film indicate that the missile airframe remained structually intact until after failures occurred in the thrust section.

Sections of this report which deal with the propulsion system, pneumatic system, and PU system performance, and the film review, should be referenced for supporting data.

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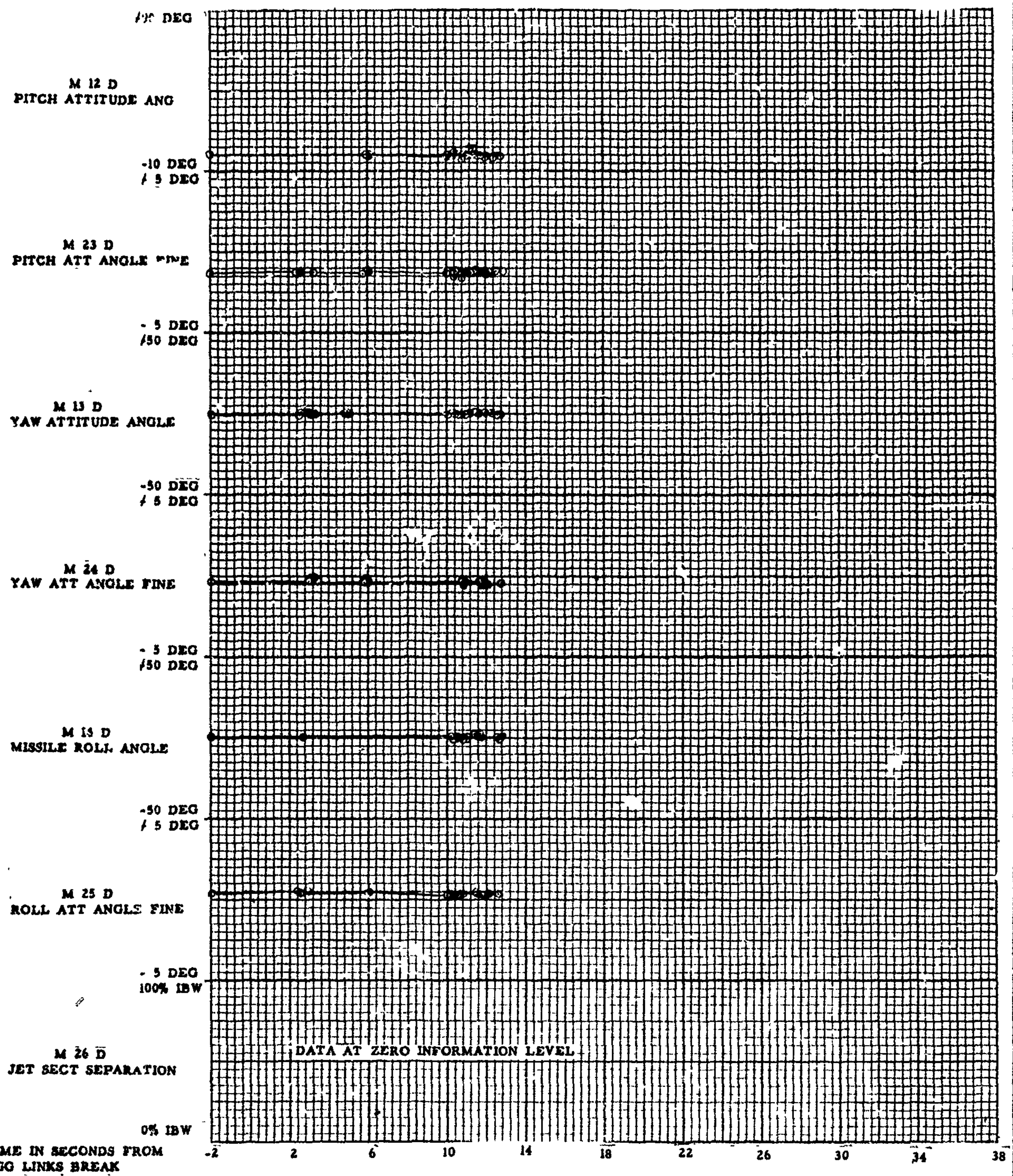
AIRFRAME SYSTEM
COMMUTATED TELEMETRY DATA



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FACILITIES AND SITE

Operation of all facility equipment was satisfactory prior to and during engine firing. Operation of the water systems was satisfactory although the magnitude of the fire following cutoff was such that the firex system was incapable of controlling it.

Launcher operation was satisfactory and as simulated release was properly achieved with all holddown cylinder pressure decay specifications being met according to FTP-L-006.

Test values obtained on holddown cylinder characteristics were as follows:

	Specifications	Test Values
Time Slope at 2550 psig	(min) 0.130 sec.	B_1 = 0.149 sec. B_2 = 0.185 sec.
Pressure 0.5 sec. after 2550 psig	(max) 350 psig	B_1 = 274 psig B_2 = 241 psig
Time differential at start of pressure decay	Less than 0.01 sec.	0.004 sec.
Maximum cylinder differential pressure after 2550 psig	Less than 400 psig	33 psig
Release signal to 2550 psig	Less than 0.5 sec.	0.401 sec.

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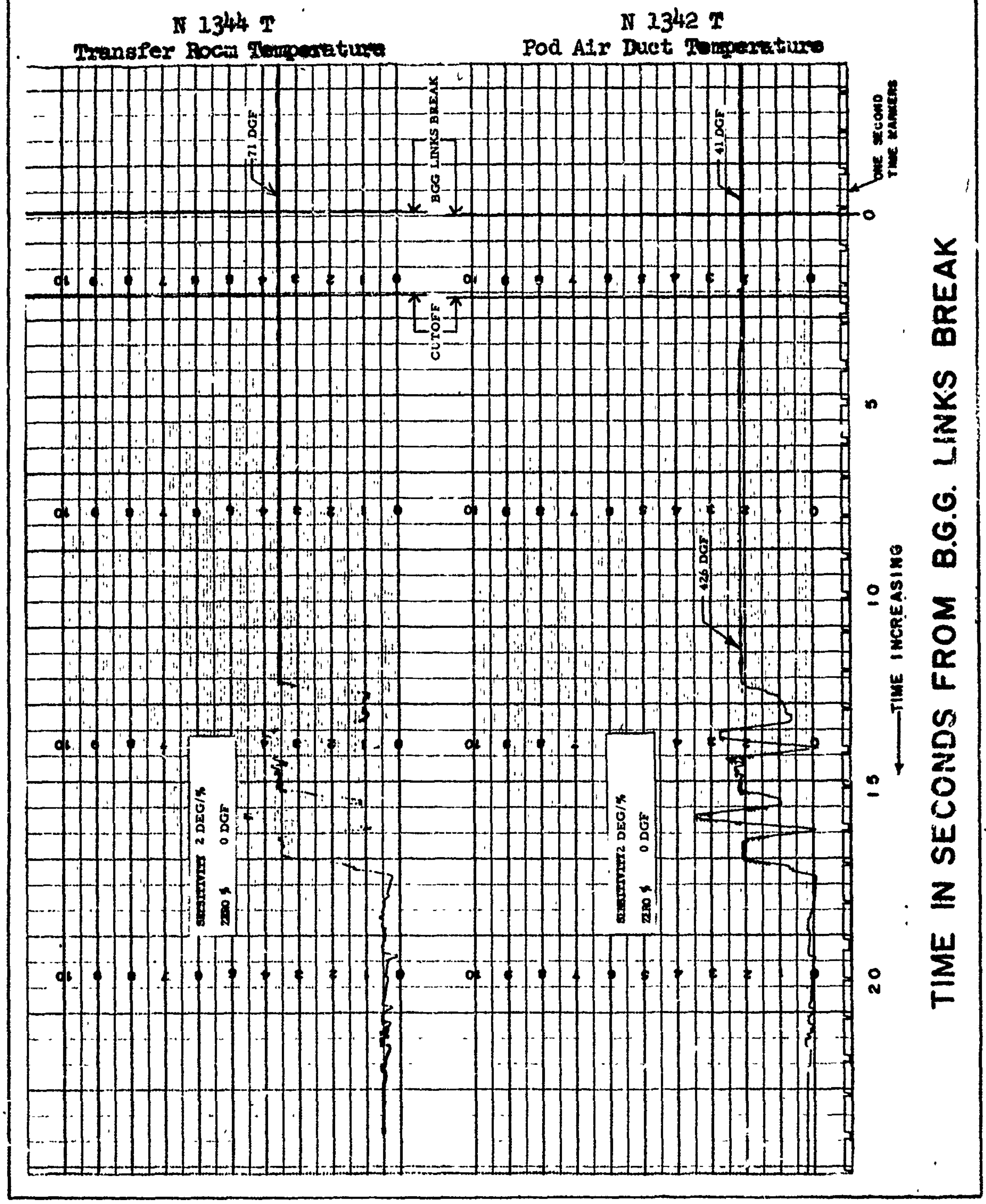
FACILITY LANDLINE DATA



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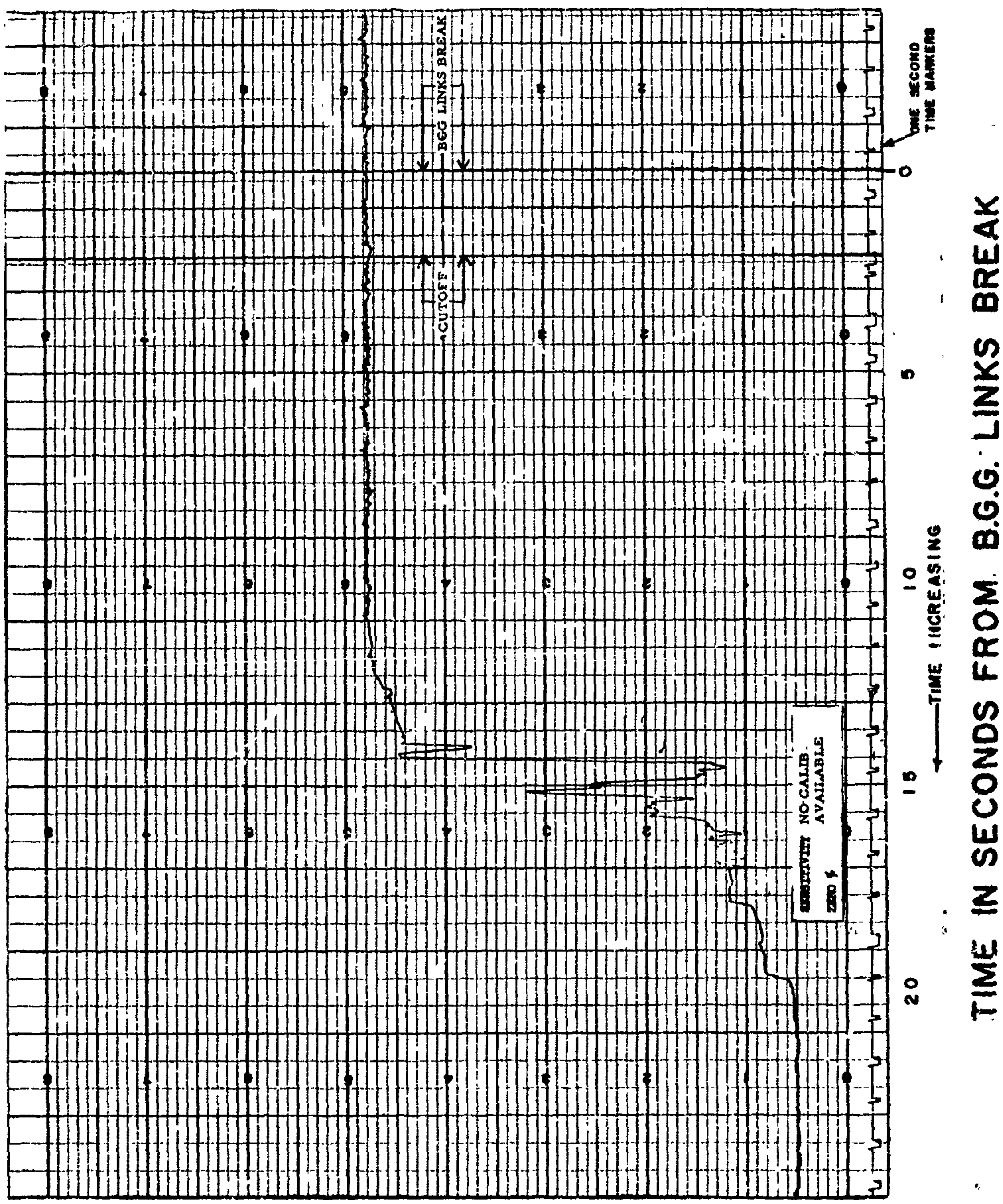
INSTRUMENTATION 6 VOLT POWER SUPPLY



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PROPELLANT UTILIZATION SYSTEM

Performance of the Propellant Utilization System was satisfactory. Landline and telemetered data indicated normal system performance until the time when failures were evident in other areas.

Landline and telemetered data indicate the error demodulator output voltage was -0.13 VDC (0.14% fuel rich) prior to ignition. A LO2 rich transient was observed during the engine firing interval. Transients of this nature have been observed on other "C" Series missile firings.

Although the mass ratio error data were varying after cutoff the general trend was in a fuel rich direction and indicated a 4.8% fuel rich condition at 10.5 seconds. At this time an abrupt shift in the LO2 rich direction occurred reaching 4.2% LO2 rich by 11.0 seconds. The EDO data then remained essentially steady until 13.0 seconds when it went abruptly to 13.6% fuel rich and reached the telemetry channel lower bandwidth at 16.3 seconds (20.9% fuel rich). Data remained at this level until 26.9 seconds. Variations between this level and 3.5% fuel rich occurred until 35 seconds and then remained at the 20.9% fuel rich level for the remainder of the test.

PU valve position data is discussed in the propulsion section of this report.

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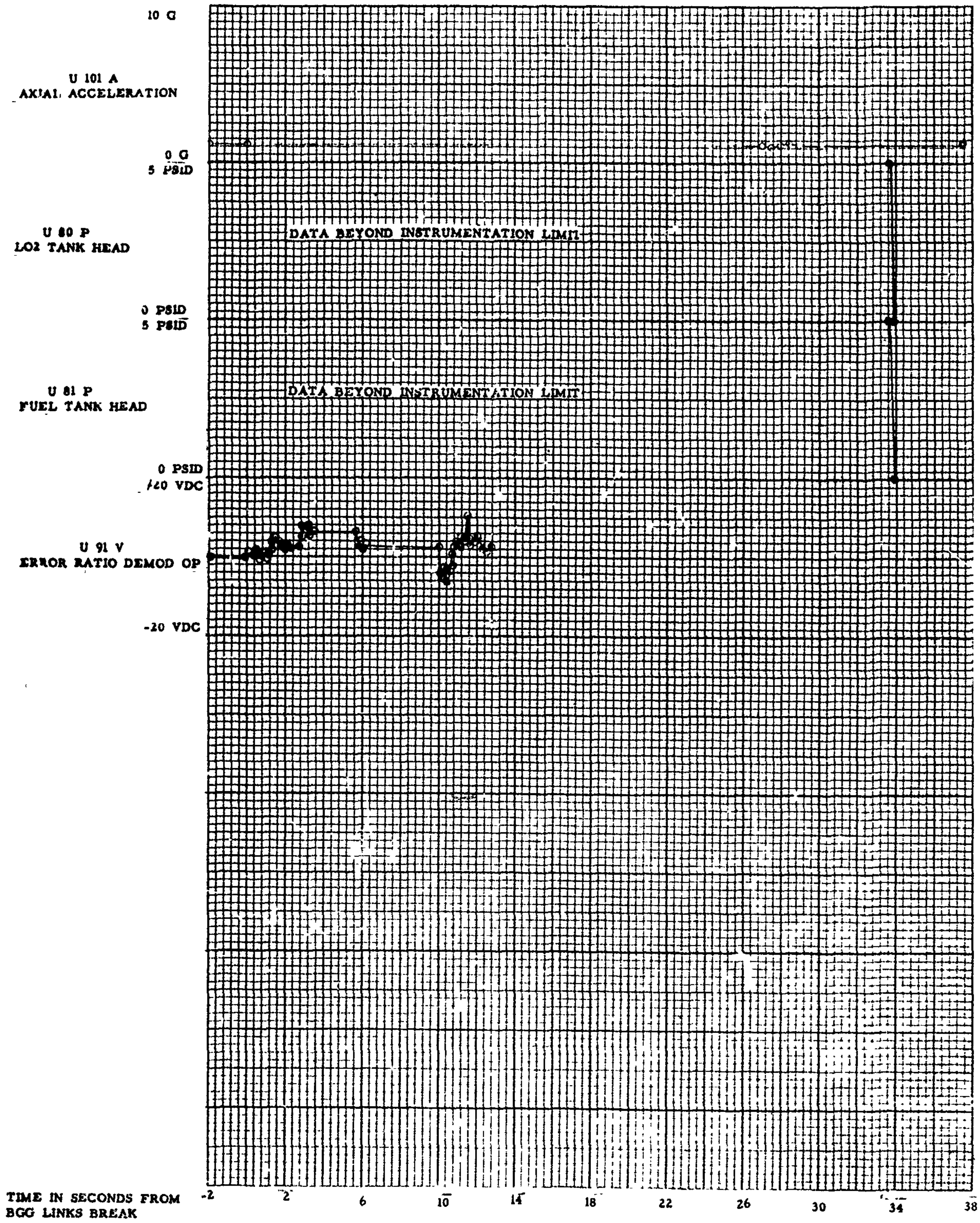
PROPELLANT UTILIZATION SYSTEM - COMMUTATED TELEMETRY DATA



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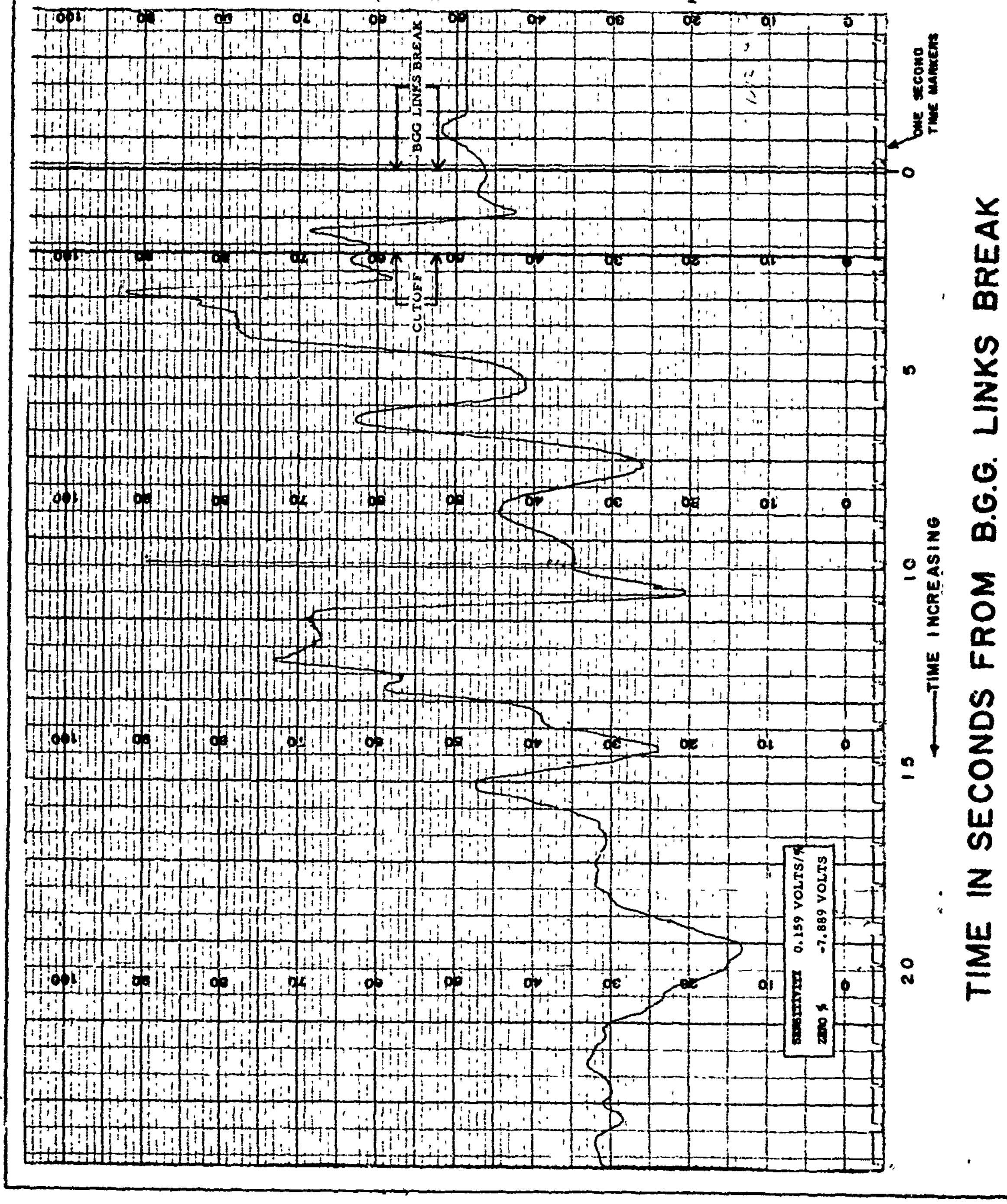
PROPELLANT UTILIZATION SYSTEM LANDLINE DATA

U 1091 V
Error Ratio Demodulator Output



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PROPELLANT TANKING SYSTEM

Missile 9C was tanked by procedure PLUG 114B which was designed to assure the propellant weights would fall within the established tolerances of ± 1000 pounds. Both LO_2 and fuel were tanked within the allowable tolerances as designated by this procedure.

Fuel was tanked to the overfill probe and drained back until the probe light blinked out. This procedure was designed to yield a volume of 1528 cubic feet of fuel.

LO_2 was tanked to a delta weight of 8450 pounds above the LO_2 95 percent probe level in Sequence III pressurization.

After securing tanking, a loss of 200 pounds of LO_2 through the start tank is expected thus giving a final ignition LO_2 weight of 8250 pounds above the 95 percent probe light in Stage III pressure. Due to LN_2 dump a weight of 7450 pounds over the 95 percent probe in Stage III was the desired final load cell read out, redlined at ± 300 pounds. The Error Demodulated Output was redlined at 0.03 volts ± 0.9 volts.

Recorded load cell weights have been corrected for gravity, gas displacement and ice and frost weight. Correlation between the PLCU and load cells and totalizer for fuel is qualitative only since the engine plumbing contained fuel prior to tanking. Thus a correction was made to the load cell and totalizer readings.

	Nominal Desired	Calculated	Load Cells	PU	Totalizer
LO_2 Weight at Stage III 95% Probe Light	166,174*	165,749**	165,441	---	---
LO_2 Weight at Ignition	174,424*	174,049**	173,741	173,455	---
Fuel Weight at Ignition	1527.9 ft^3	76,091***	75,855	---	76,063

* Based on 70.4 lbs/ft^3 LO_2 density and assumed volume.
** Based on 70.22 lbs/ft^3 LO_2 density, assumed volume and load cell weight.
*** PLCU fuel weight.

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TELEMETRY SYSTEM

Operation of the telemetry system was satisfactory. Signals were received until +37.5 seconds. The 0.8 volt transducer power supply indicated evidence of heavy loading starting at +12.9 seconds. All measurements receiving excitation voltage from this source were valid for qualitative information only after this time. There was one hold for telemetry during the count at -18 minutes which lasted for two and one-half hours. This hold was due to loss of telemetry power supply. During the hold the RF package was changed and checked. The telemetry power supply package was changed and the signals were satisfactorily received.

There was one unsatisfactory measurement - P 197 D, sustainer yaw. The oscillator needed adjustment in the telemetry package.

The following pages list the measurements carried on this test.

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FUNCTIONAL DESCRIPTION OF TELEMETRY INSTRUMENTATION

MEAS. NO.	DESCRIPTION	TRANSDUCER PART NO.	TRANSDUCER LOCATION	MEASUREMENT RANGE	COMMENT
D 1V D 3X	RSC CUTOFF OUTPUT RSC DESTRUCT OUTPUT	NA NA	NA NA	031 vdc 0-1 vdc	The output voltages of the command packages are measured via telemetry to assist in determining if, and the time at which, manual or automatic cutoff or destruction of the missile is commanded.
D 7V	#1 RSC RF INPUT/AGC	NA	NA	15 100k µ v	General operation of the command system is indicated by the measurement of the voltage proportional to the ground signal as it is received by the command package #1.
E 50Q E 28V E 51V	400 CYCLE AC PWRSUP MSL SYSTEMS INPUT 400 CYCLE AC PHASE A	NA NA NA	NA NA NA	370 430 cps 0 38 vdc 105 125 vac	Indication of the main missile battery and inverter operation is obtained by measuring the inverter a-c voltage and frequency output and the missile systems d-c input on the load side of the power changeover switch.
F 1P F 3P	LO2 TANK HELIUM FUEL TANK HELIUM	89-00502-032 89-00502-033	QUAD 3, STA 480 QUAD 4, STA 969	0 50 psia 0 100 psia	To determine if proper pressurization of the main propellant tank is maintained, potentiometer-type transducers are plumbed into the tanks, near the top, to measure the helium pressure.
F246P F247T	B TK HE BOTTLES HI B TK HE BOTTLES	89-00502-007 7-01633-1	QUAD 3, STA 1225 QUAD 2, STA 1194	0 3500 psia - 380 -80 deg F	The amount of residual helium in the booster tank helium supply bottles is determined by measuring the pressure and temperature in the helium bottles. In the latter portion of the booster phase of flight, the 0 to 400 psi bottle pressure measurement, more accurately defines the amount of residual helium. The pressure measurements utilize potentiometer-type transducers while the temperature utilizes a resistant-type transducer.
F125P F142P F145P	B CTL PNEU REG OUT S CTL PNEU REG OUT S CTL HE BOTTLE DISCH	89-00502-004 89-00502-005 7-01731-9	UPPER INST BOX SUST INST BOX QUAD 2, STA 1194	0 800 psia 0 1000 psia 0 3500 psia	Operation of the control pressurization system is indicated by measuring the output pressures of the control pneumatic regulators and the discharge pressure and temperature of the sustainer control helium supply bottle. The pressure measurements are picked up by potentiometer-type transducers plumbed into the appropriate helium lines while the temperature measurement is picked up by a resistance-type transducer plumbed into the sustainer control helium bottle.

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FUNCTIONAL DESCRIPTION OF TELEMETRY INSTRUMENTATION (Continued)

MEAS. NO.	DESCRIPTION	TRANSDUCER PART NO.	TRANSDUCER LOCATION	MEASUREMENT RANGE	COMMENT
G 4C	PB MAGNETRON AVERAGE	NA	NA	0 1.6 ma	Performance of the guidance pulse beacon is indicated by measuring the current through the crystal in the mixer, the AGC voltage which is proportional to the received signal strength, and the magnetron and the modulator currents which are proportional to the duration, rate, and amplitude of the pulses transmitted by the pulse beacon.
G 3V	PB AGC	NA	NA	0 -80 dbm	
G 82E	RB RF OUTPUT	NA	NA	0 2 W	Guidance rate beacon performance is indicated by measuring the power output of the beacon, the AGC voltages which are proportional to the signal strength at the receivers, and the drift in the transmitter frequency.
G279V	RB AGC NO. 1	NA	NA	0 -100 dbm	
G280V	RB AGC NO. 2	NA	NA	0 -100 dbm	
G282V	RB PHASE DETR NO. 1	NA	NA	-25 25 mv	
G287V	D PITCH OUTPUT	NA	NA	-20 20 vac	Guidance decoder performance is indicated by measuring the steering commands generated by the guidance system, the voltage which is proportional to the rate of acceptance of received messages, and the discrete commands sent to the autopilot from the guidance system.
G288V	D YAW OUTPUT	NA	NA	-20 20 vac	
G289V	D MESSAGE READ	NA	NA	0 -2.4 vdc	
G290X	D CONTRACTS #1 and #2	NA	NA	0 -2.4 vdc	
G291X	D CONTRACTS #3 and #4	NA	NA	0 -2.4 vdc	
G292X	D CONTRACTS #5 and #6	NA	NA	0 -2.4 vdc	
G293X	D CONTRACTS #7 and #9	NA	NA	0 -2.4 vdc	
H 33P	B1 HYD ACCUMULATOR	89-00502-039	QUAD 1, STA 1211	0 3500 psia	Pressure of the hydraulic fluid, measured by a potentiometer-type transducer plumbed into the discharge line of the B1 hydraulic accumulator, in conjunction with the autopilot measurements, provides information on the operation of the booster hydraulic system.
H140P	S/VERN HYD PRESS	89-00502-007	QUAD 1, STA 1198	0 3500 psia	Pressure of the sustainer/vernier hydraulic fluid, measured by a potentiometer-type transducer plumbed into the high pressure line between the high pressure manifold and the vernier servo valves, in conjunction with the autopilot measurements, provide information on the operation of the sustainer/vernier hydraulic system.
M 12D	PITCH ATTITUDE ANGLE	7-01638-1	Y AXIS, STA 1027	- 75 15 deg	Three attitude gyros provide information on missile attitude with respect to the launching pad. Two outputs, coarse and fine, are telemetered from each gyro. The coarse measurements are the direct outputs of the gyros while the fine or more accurate measurements are obtained through a 10 to 1 gear ratio from the gyros.
M 13D	YAW ATTITUDE ANGLE	7-01638-1	Y AXIS, STA 1027	- 45 45 deg	
M 14D	MISSILE ROLL ANGLE	7-01638-1	Y AXIS, STA 1027	- 45 45 deg	
M 23D	PITCH ATT ANGLE FINE	7-01638-1	Y AXIS, STA 1027	- 5 5 deg	
M 24D	YAW ATT ANGLE FINE	7-01638-1	Y AXIS, STA 1027	- 5 5 deg	
M 25D	ROLL ATT ANGLE FINE	7-01638-1	Y AXIS, STA 1027	- 5 5 deg	
M120D	ABLE SEPARATION SIG	NA	NOSE CONE ADAPTER	0-3 inches	A linear motion extentiometer is used to indicate the rate of separation of the upper stage.

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FUNCTIONAL DESCRIPTION OF TELEMETRY INSTRUMENTATION (Continued)

MEAS. NO.	DESCRIPTION	TRANSDUCER PART NO.	TRANSDUCER LOCATION	MEASUREMENT RANGE	COMMENT
N 25D	JET SECT SEPARATION	7-01676-1	QUAD 2, STA 1133	0 15 ft	Rotary potentiometer; spaced around the periphery of the fuel tank provide data on the translation of the booster jettison section and comparative velocity for the first fifteen feet of booster separation at staging.
P 83B	B2 PUMP SPEED	7-01237-3	QUAD 4, STA 1225	5680 6400 rpm	Tachometers mounted on the turbopumps indicate if the pumps maintain constant speed, thus providing information on both pumps operation and gas generator operation.
P349B	S PUMP SPEED	7-01437-13	QUAD 3, STA 1234	9400 10900 rpm	
P 6P	S THRUST CHAMBER	89-00502-005	SUST INST BOX	0 1000 psia	Indication of the overall performance of the propulsion system, and information for computing thrust is provided by potentiometer-type transducers plumbed into the booster, sustainer, and vernier thrust chambers measuring the pressure of the combustion gases.
P 59P	B2 THRUST CHAMBER	89-00502-003	QUAD 3, STA 1220	0 600 psia	
P 60P	B1 THRUST CHAMBER	89-00502-003	Y AXIS, STA 1220	0 600 psia	
P 28P	V1 THRUST CHAMBER	7-01737-1	X AXIS, STA 1127	0 400 psia	
P 29P	V2 THRUST CHAMBER	7-01737-1	X AXIS, STA 1127	0 400 psia	
P 26P	B LO2 REG REFERENCE	89-00502-003	UPPER INST BOX	0 600 psia	Performance of the gas generators liquid oxygen regulators is indicated by potentiometer-type pressure transducers plumbed into the helium lines supplying the reference pressure to the regulators.
P344P	S LO2 REG REFERENCE	89-00502-005	SUS INST BOX	0 1000 psia	
P 10P	B1 LUBE OIL INJ MAN	89-00502-005	LOWER INST BOX	0 1000 psia	To verify proper lubrication of the turbopumps, the oil pressures are measured by potentiometer-type transducers plumbed into the lube oil manifolds.
P341P	S LUBE OIL MANIFOLD	89-00502-005	SUST INST BOX	0 1000 psia	
P 38P	B2 FUEL PUMP DISCH	89-00502-005	LOWER INST BOX	0 1000 psia	These measurements of pressure and temperature in the propellant flow lines between the turbopumps and the combustion chambers verify proper operation of the turbopumps and supplement the thrust chamber pressures for general engine performance analysis. The pressure measurements utilize potentiometer-type transducers while the temperature measurement utilizes a resistance-type transducer.
P 56P	S LO2 PUMP INLET	89-00502-019	SUST INST BOX	0 150 psia	
P332P	S LO2 PUMP DISCH	89-00502-005	SUST INST BOX	0 1000 psia	
P350P	S FUEL INJ MANIFOLD	89-00502-005	SUST INST BOX	0 1000 psia	
P530T	S LO2 PUMP INLET	7-01649-7	QUAD 3, STA 1208	-300 -270 deg F	
P 14T	ENGINE COMP AMBIENT	7-01684-3	QUAD 2, STA 1210	0 500 deg F	To measure the ambient conditions in the engine compartment, a potentiometer-type pressure transducer is mounted on the lower instrumentation box, which is attached to the booster lube oil tank. A resistance-type temperature transducer is mounted on the A-frame which supports the jettison rails.
P 17T	B2 TURBINE INLET	7-01741-9	QUAD 3, STA 1218	500 1500 deg F	Data on the operation of the booster gas generator is provided by a resistance-type transducer measuring the temperature of the gas being delivered to the B2 turbine.

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FUNCTIONAL DESCRIPTION OF TELEMETRY INSTRUMENTATION (Continued)

MEAS. NO.	DESCRIPTION	TRANSDUCER PART NO.	TRANSDUCER LOCATION	MEASUREMENT RANGE	COMMENT
P 72X	BOOSTER CUTOFF RELAY	NA	NA	- 0 28 vdc	The booster, sustainer, and vernier cutoff relays are instrumented in the engine electrical circuit and telemetered to provide indication of engine cutoff times.
P 77X	VERNIER CUTOFF RELAY	NA	NA	0 28 vdc	
P347X	S COF RELAY LOCKIN	NA	NA	0 28 vdc	
S 52R	ROLL RATE GYRO SIG	NA	NA	-8 8 deg/sec	Performance of the autopilot displacement and rate gyros is determined by measuring the d-c voltage at the dual demodulators which represents the a-c output signal of the autopilot emitter followers. In effect, these measurements are a time history of missile stability during flight.
S 53R	PITCH RATE GYRO SIG	NA	NA	-8 8 deg/sec	
S 54R	YAW RATE GYRO SIG	NA	NA	-8 8 deg/sec	
P 63D	B1 PITCH		QUAD 4, STA 1212	-5 5 deg F	Potentiometer-type transducers, measuring engine positions, are shaft coupled to the gimbal block of the thrust chambers to provide a measurement of engine responses and movements.
P 65D	B1 YAW ROLL		Y AXIS, STA 1212	-5 5 deg F	
P106D	SUSTAINER PITCH		X AXIS, STA 1210	-3 3 deg F	
P107D	SUSTAINER YAW		Y AXIS, STA 1210	-3 3 deg F	
P 57D	V1 YAW	7-01414-1	QUAD 2, STA 1128	0 50 deg F	Linear potentiometers are mechanically linked to the actuators to provide position information on the verniers. Again, this information includes engine responses and movements.
P 61D	V2 PITCH ROLL	7-01422-1	X AXIS, STA 1128	-70 70 deg F	
P528D	S MAIN FUEL VALVE			-45 95 deg F	To verify simultaneous emptying of propellant tanks and to verify that the proper ratio between fuel and liquid oxygen residuals were maintained throughout the flight, measurements are made of propellant flows, PU valve position, and error ratio demodulator output. Operation of the PU system is further monitored by means of the Vibrotron tank level measurements.
U 91V	ERROR RATIO DEMOD OP	NA	NA	M20-20 vdc	This voltage obtained from the PU bridge error (after passing through a demodulator) is the ratio of residual propellants in the missile tanks.
U 80P	LO2 TANK HEAD	7-01225-3		0 5 psid	The propellant head pressures are measured by potentiometer-type differential pressure transducers.
U 81P	FUEL TANK HEAD	7-01225-3		0 5 psid	
U101A	AXIAL ACCELERATION	7-01413-7	Y AXIS, STA 928		A Vibrotron (vibrating wire) accelerometer measures missile acceleration which is used in conjunction with other measurements to compute various other missile parameters.
Z 2E	KLYSTRON POWER OUTPUT	NA		0 12 w	Performance of the airborne Azusa system is determined by measuring the power output of the klystron and the interrogation signal level.
Z 3E	TRANSPONDER RF INPUT/AGC	NA		-120 0 dbm	
Y 2X	ABLE START SIGNAL	NA	NA	vdc	Signal from sustainer cutoff relay to initiate the Able start sequence.

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LANDLINE INSTRUMENTATION SYSTEM

Operation of the landline instrumentation was satisfactory throughout the operation. Measurements were lost during the later part of the operation as the instrumentation pickups and/or associated wiring was damaged.

The following measurements did not yield completely satisfactory data for reasons stated:

Measurement No.	Description	Comment
P 1324 T	S Pump Bearing LO2	Data pen did not ink during firing.
P 1344 P	S LO2 Reg Ref	Timing pen did not operate properly during firing.
P 1528 D	S Main Fuel Valve	Latest calibration was run 9-3-59.
P 1178 P	GFST Reg	Latest calibration was run 9-22-59.
P 1674 T	B2 Fuel Ign Vlv Amb	Data pen did not ink during firing.
N 1011 F	Wt Thrust Sys - Thrust	No calibration.
N 1342 T	Pod Air Duct	Latest calibration was run 9-4-59.
N 1344 T	Transfer Room Temp	Latest calibration was run 9-4-59.

On the following pages are presented a functional description of the landline instrumentation. Sequence measurements are not listed although this data for propulsion system appear in the propulsion system section of this report.

FUNCTIONAL DESCRIPTION OF LANDLINE INSTRUMENTATION

MEAS. NO.	DESCRIPTION	TRANSDUCER PART NO.	TRANSDUCER LOCATION	MEASUREMENT RANGE	COMMENT
F1001P	LO2 TK-HELIUM	7-01377-3	QUAD 2, STA 481	0-45 psia	The propellant tanks helium pressures are displayed on strip chart recorders, and monitored by an observer to insure that proper tank pressures are maintained during an FRF or prior to launch. During an FRF the data from these measurements also indicate the overall performance of the pressurization system. Potentiometer-type transducers are plumbed into the tanks above the liquid level to sense the helium pressure.
F1003P	FUEL TK HELIUM	7-01377-5	QUAD 4, STA 963	0-100 psia	
F1121P	B CTL HE BTL DISCH	7-01403-1	QUAD 1, STA 1233	0-3500 psia	To insure that a sufficient supply of helium is contained in the tank and control helium bottles prior to launch, the pressure and temperature conditions of the helium in the bottles are displayed on strip chart recorders. During an FRF, these measurements provide data on the consumption rate of helium and on the general performance of the pressurization system. The potentiometer-type pressure transducers and the resistance-type temperature for the tank supply bottle measurements are plumbed into the bottles while the potentiometer-type pressure transducers for the control supply bottle measurements are plumbed into the discharge lines.
F1145P	S CTL HE BTL DISCH	7-01403-5	QUAD 3, STA 1196	0-3500 psia	
F1246P	B TK HE BOTTLES HI	7-01403-5	QUAD 3, STA 1221	0-3500 psia	
F1247T	B TK HE BOTTLES	7-01633-1	QUAD 2, STA 1194	M380-M80° F	
F1290T	S CTL HE BOTTLE	7-01633-1	QUAD 3, STA 1196	M380-M80° F	
F1125P	B CTL PNEU REG OUT	89-00502-004	UPPER INST BOX	0-800 psia	To verify performance of the booster and sustainer control pneumatic regulators and to verify that sufficient pressure is being delivered to the control manifolds during an FRF or prior to flight, potentiometer-type pressure transducers are plumbed into the lines between the regulators and manifolds.
F1142P	S CTL PNEU REG OUT	89-00502-005	SUST INST BOX	0-1000 psia	
F1194P	FACILITY GN_2 SUPPLY	7-01226-801	GROUND	0-3500 psia	A potentiometer-type transducer is plumbed into the gaseous nitrogen supply line at the outlet of the Pressurization Control Unit to verify that the gaseous nitrogen pressure is adequate to purge the engines prior to ignition.
G1026V	PITCH ANALOG	NA	NA	M30-30 vdc	In order to monitor operation of the guidance system during pre-launch checkout the guidance steering and discrete commands are measured. These measurements, along with various autopilot measurements, provide information on the response of the autopilot to guidance commands during the loop test.
G1027V	YAW ANALOG	NA	NA	M30-30 vdc	
G1549X	D CONTACT #1	NA	NA	OFF-ON	
G1550X	D CONTACT #2	NA	NA	OFF-ON	
G1551X	D CONTACT #3	NA	NA	OFF-ON	
G1552X	D CONTACT #5	NA	NA	OFF-ON	
G1553X	D CONTACT #6	NA	NA	OFF-ON	
G1554X	D CONTACT #7	NA	NA	OFF-ON	

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FUNCTIONAL DESCRIPTION OF LANDLINE INSTRUMENTATION (Continued)

MEAS. NO.	DESCRIPTION	TRANSDUCER PART NO.	TRANSDUCER LOCATION	MEASUREMENT RANGE	COMMENT
L1368D	PIN MOTION B1 SIDE			0-5 in.	An indication of the time at which the launcher hold-down pins retract and data on the velocity and acceleration of pin retraction is provided by linear potentiometers mounted on the pins.
L1369D	PIN MOTION B2 SIDE				
L1127P	HOLDDOWN CYL B1 SIDE	7-01498-1		0-6500 psia	Strain gage pressure transducers plumbed into the launcher holddown and release cylinders indicate the time at which the cylinders are vented and allow a comparison of the pressure decay rates in the two cylinders.
L1128P	HOLDDOWN CYL B2 SIDE	7-01498-1		0-6500 psia	
L1382S	B1 KICK STRUT LOAD			0-60 K lbs	The load exerted on the nacelle structure by the kick struts, through the nacelle shock absorbers, is measured by strain gages mounted on the upper part of the shock absorber rods.
L1383S	B2 KICK STRUT LOAD			0-60 K lbs	
M1050X	MSL 42 INCH MOTION	NA	GROUND	OFF-ON	Missile 42-inch motion, the time at which the auto-pilot gyros uncage, was selected as test zero time especially for use in computing trajectory data. The time of this occurrence is obtained through the use of a circuit in the autopilot umbilical. When the umbilical pulls loose the curcuit is broken and this is recorded as zero time.
N1342T	POD AIR DUCT		GROUND	0-200° F	These failure-type measurements determine any mal-function of the pod cooling and transfer room air conditioning systems. The temperature measurements utilize thermocouples, while the valve position indication is obtained through use of a microswitch. They are displayed on strip chart recorders to enable visual monitoring during pre-launch operations.
N1344T	TRANSFER ROOM		GROUND	0-100° F	
N1343X	POD AIR DUCT VALVE		GROUND	OFF° F	
P1083B	B2 PUMP SPEED	7-01237-3	QUAD 4, STA 1125	0-6790 rpm	To aid in determining the performance of the pro-pellant turbopumps during an FRF or prior to launch, the speeds of the pumps are measured by tachometers and displayed on oscillographic recorders.
P1084B	B1 PUMP SPEED	7-01237-1	QUAD 4, STA 1196	0-6790 rpm	
P134,B	S PUMP SPEED	7-01437-13	QUAD 3, STA 1234	0-12000 rpm	
P14390	S NAA RCC ACCEL			0-2 K cps	Accelerometers mounted on the thrust chamber domes measure the vibrations caused by combustion in the chambers. Limits of frequency and amplitude are set so that if exceeded for a specified time duration, the engines will be cut off. Binary counters record the time for which the limits are exceeded.
P14520	B1 NAA RCC ACCEL			0-200 g	
P14530	B2 NAA RCC ACCEL			0-2 K cps	
P1437W	S RCC BINARY COUNTER			0-100 ms	
P1454W	B1 RCC BINARY COUNTER			0-100 ms	
P1455W	B2 RCC BINARY COUNTER			0-100 ms	
P1528D	S MAIN FUEL VALVE			0-90 deg	Information on the performance of the PU system during an FRF and prior to launch is obtained by measuring the position of the PU valve (through recording the output of the PU demodulator). This function is also monitored on a strip chart recorder to assure that the valve is operating correctly prior to launch.

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FUNCTIONAL DESCRIPTION OF LANDLINE INSTRUMENTATION (Continued)

MEAS. NO.	DESCRIPTION	TRANSDUCER PART NO.	TRANSDUCER LOCATION	MEASUREMENT RANGE	COMMENT
P1003P	B2 LO2 PUMP INLET	7-01647-807	QUAD 4, STA 1228	0-150 psia	To aid in determining operation of the propellant feed system from the propellant tanks to the turbo-pumps, strain gage transducers, measuring pressure, are plumbed into the LO2 and fuel lines at the inlets to the B2 turbopump.
P1004P	B2 FUEL PUMP INLET	7-01692-1	QUAD 3, STA 1200	0-100 psia	
P1006P	S THRUST CHAMBER	7-01637-7	SUST INST BOX	0-1000 psia	Indication of the overall performance of the propulsion system, and information for computing thrust is provided by strain gage-type transducers plumbed into the booster and sustainer thrust chambers measuring the pressure of the combustion gases.
P1059P	B2 THRUST CHAMBER	7-01687-5	QUAD 3, STA 1220	0-600 psia	
P1060P	B1 THRUST CHAMBER	7-01687-5	QUAD 4, STA 1220	0-600 psia	
P1026P	B LO2 REG REFERENCE	87-93900-003	QUAD 2, STA 1204	0-600 psia	Performance of the gas generators liquid oxygen regulators is indicated by potentiometer-type pressure transducers plumbed into the helium lines supplying the reference pressure to the regulators. They are displayed on strip chart recorders and monitored to assure that the regulators are operating correctly during an FRF or prior to flight.
P1344P	S LO2 REG REFERENCE	87-93900-002	SUST INST BOX	0-1000 psia	
P1027P	VERNIER FUEL TANK	89-00502-037	QUAD 2, STA 1204	0-1000 psia	Potentiometer-type transducers plumbed into the helium lines used to pressurize the vernier tanks indicate that the tanks are properly pressurized prior to ignition. The data obtained also aid in determining vernier performance during tank-fed operation.
P1030P	VERNIER LO2 TANK	89-00502-037	QUAD 4, STA 1220	0-1000 psia	
P1047P	V1 LO2 INLET	7-01620-7	QUAD 4, STA 1116	0-800 psia	To aid in determining vernier performance, pressure measurements are made by stain gage-type transducers plumbed into the propellant lines at the inlets to the verniers and flow rate measurements are made in the propellant lines with vane-type flowmeters, the pressure measurements are also visually monitored to assume proper operation of the system prior to launch.
P1048P	V2 LO2 INLET	7-01620-7	QUAD 2, STA 1116	0-800 psia	
P1049P	V1 FUEL INLET	7-01687-15	QUAD 3, STA 1114	0-800 psia	
P1050P	V2 FUEL INLET	7-01687-15	QUAD 1, STA 1114	0-800 psia	
P1042R	VERNIERS LO2 FLOW	7-01479-1	QUAD 4, STA 1184	37-43 gpm	
P1043R	VERNIERS FUEL FLOW	7-01478-1	QUAD 4, STA 1184	28-33 gpm	
P1075P	GFST PRESS	7-16517-13	GROUND	0-1000 psia	A strain gage-type transducer plumbed into the ground fuel start tank measures the pressure of the helium gas to determine that the tank is properly pressurized prior to ignition.
P1177P	B LO2 START TANK REG	89-00502-005	LOWER INST BOX	0-1000 psia	To assure that the regulators, which control the pressurization of the ground fuel start tank and the booster LO2 start tank, are operating correctly potentiometer-type pressure transducers are plumbed into the helium lines at the outlets of the regulators.
P1178P	GFST REGULATOR	89-00502-005	GROUND	0-1000 psia	

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MEAS. NO.	DESCRIPTION	TRANSDUCER PART NO.	TRANSDUCER LOCATION	MEASUREMENT RANGE	COMMENT
P1235P	VERN LO2 TANK REG	89-00502-037	QUAD 4, STA 1220	0-1000 psia	To assure that the regulators controlling the pressurization of the vernier propellant tanks are operating properly, the output pressure of the regulators is measured by potentiometer-type transducers plumbed into the helium lines.
P1236P	VERN FUEL TANK REG	89-00502-037	QUAD 2, STA 1208	0-1000 psia	
P1100P	BGG COMBUSTION CHM	89-00502-004	UPPER INST BOX	0-800 psia	Performance of the booster and sustainer gas generators is indicated by measuring the pressure in the BGG, the propellant flow rates to both gas generators, and the temperatures of the gases produced by both gas generators. The pressure measurements utilize potentiometer-type transducers, the flow measurements utilize vane-type flowmeters, and the temperatures utilize thermocouples.
P1489P	B GAS GEN LO2 VLV IN	89-00502-004	UPPER INST BOX	0-800 psia	
P1037R	B GAS GEN LO2 FLOW			0-8 lb/sec	
P1051R	B GAS GEN FUEL FLOW			0-25 lb/sec	
P1333R	S GAS GEN LO2 FLOW			0-3 lb/sec	
P1334R	S GAS GEN FUEL FLOW			0-7 lb/sec	
P1336T	S GAS GEN DISCH	27-01247-1	QUAD 4, STA 1234	0-1500° F	
P1018T	B1 TURBINE INLET	27-01247-1	QUAD 3, STA 1202	0-1500° F	
P1126T	B1 LO2 PUMP OTBD BRG			M100-400° F	To verify that the LO2 pump bearing heaters have maintained the bearings temperature adequately prior to engine ignition, thermocouples are inserted to measure the temperature of the bearing races.
P1127T	B2 LO2 PUMP OTBD BRG			M100-400° F	
P1324T	S PUMP BEARINGS - LO2			M60-200° F	
P1673T	B1 FUEL IGN VLV AMB	7-01265-803	QUAD 1, STA 1221	0-200° F	Thermocouples mounted on the B1 and B2 igniter fuel valves, and the engine control pneumatic manifold serve as an engine compartment fire detection system during an FRF or during the period immediately following a launch abort.
P1674T	B2 FUEL IGN VLV AMB	7-01265-803	QUAD 2, STA 1221	0-200° F	
P1675T	ENG CTL PNEU MAN AMB	7-01265-803	QUAD 4, STA 1240	0-200° F	
S1048V	PROGRAMMER PITCH SIG			0-2.7 vac	These autopilot measurements, together with the guidance system steering and discrete commands, are displayed on strip chart recorders. During the autopilot-guidance loop test, the gyro torque test, and the integrator servo gimbaling test, they are monitored to verify the operating condition of the autopilot system.
S1049V	PROGRAMMER ROLL SIG			0-60 vac	
S1069V	ROLL INT OUTPUT SIG			M4-4 vac	
S1072V	PITCH INT OUTPUT SIG			M7-7 vac	
S1073V	YAW INT OUTPUT SIG			M7-7 vac	
S1107V	B1 PCH ACTR FEEDBACK			M12-12 vac	
S1108V	B2 PCH ACTR FEEDBACK			M12-12 vac	
S1113V	V1 YAW ACTR FEEDBACK			M5-7 vac	
S1114V	V2 YAW ACTR FEEDBACK			M5-7 vac	
S1118V	V2 PCH ACTR FEEDBACK			M11-11 vac	
S1119V	V1 PCH ACTR FEEDBACK			M11-11 vac	
S1121V	GYRO TEST SIG			M5-5 vac	
S1123V	INTEGRATOR TEST SIG			M11-11 vac	
S1126V	B1 YAW ACTR FEEDBACK			M12-12 vac	
S1129V	B2 YAW ACTR FEEDBACK			M12-12 vac	
S1147V	PITCH GYRO AMP OTP			M10-10 vac	
S1148V	YAW GYRO AMP OUTPUT			M10-10 vac	
S1149V	ROLL GYRO AMP OUTPUT			M10-10 vac	
S1216V	S PCH ACTR FEEDBACK			M10-10 vac	
S1217V	S YAW ACTR FEEDBACK			M10-10 vac	
S1235V	PROGRAMMER RUN TIME			OFF/ON	
S1244X	PRE-ARM SIGNAL			OFF/ON	

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SECTION II

DAMAGE SURVEY

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DAMAGE SUMMARY

Blast effects were extensive at ground zero, but fell off rapidly as a function of the distance from the blast center -- approximately 40 feet south of the flame bucket center line. It is estimated the blast equaled that which would be produced by 60,000 pounds of TNT.

Ground Zero Plus 200 Feet

The missile was completely destroyed, many of its pieces impacting more than 800 feet from ground zero.

The test stand was extensively damaged and portions must be rebuilt. About 58 feet of the launch stand structure was collapsed by the explosion and requires dismantling and complete rebuilding. Parts of the approach ramp and the support beams around the flame bucket were distorted. All the enclosed rooms beneath the ramp suffered interior damage; the instrumentation and transfer room equipment was a complete loss. Only the electrical conduits and wires in the south end of the ramp area appear to be useable. The light standards around the pad require realigning. Fire protection systems, high pressure gas, propellant and various systems piping require complete rework. Both umbilical towers were destroyed. The launcher appears to be damaged beyond repair. The cable tray to the blockhouse was damaged considerably at the stand end -- many cables burned.

Farther out, damage in the fuel area was negligible except that the transfer unit was destroyed.

200 To 400 Feet From Ground Zero

Damage in the liquid oxygen area was light consisting of only sheet metal damage to the transfer unit and the liquid nitrogen subcooler. Maximum atmospheric overpressure recorded by mechanical blast gauge was 5.0 psi at 300 feet with underpressure at 0.6 psi.

400 To 600 Feet From Ground Zero

The service tower in the maintenance area was relatively undamaged. Some elevator doors on the tower were partially blown off. Corrugated fiberglass panels were damaged and the glass windown in the driver's cab broken.

600 To 800 Feet From Ground Zero

This area vacant except for front section of blockhouse, which was undamaged.

800 To 1000 Feet From Ground Zero

Blockhouse undamaged, although, guard leaning against the inner doors was jarred by concussion. Blockhouse personnel reported a sharp jolt. Minor damage occurred to the equipment shelter building behind the blockhouse, such

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as cracks in the plaster. Windows on the east side of the ready room, near the blockhouse, were blown out. The windows in the guard shack at the main gate were broken and there were shrapnel holes in the walls.

1000 To 2000 Feet From Ground Zero

There was only superficial damage to Complex 13. Complex 11 suffered little significant damage, although the tower curtains were torn loose, some windows shattered, light fixture panels broken and similar damage. Several civilian cars in the ready room parking lot received minor damage from falling missile fragments.

Blast Effects Beyond 2000 Feet From Ground Zero

At approximately 2600 feet, the doors on the San Diego resident engineers portable office, located west of Complex 12, were forced in breaking the locks.

At approximately 3500 feet, a security guard stationed at the road block at the south entrance of the ICBM road was blown into the ditch. He suffered a sprained ankle.

At approximately 7000 feet, windows were shattered in the Northrop hangar.

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RECOVERED MISSILE HARDWARE

After the explosion, the parts of Missile 9C were gathered by Complex 12 personnel, identified, and placed in a roped off area on the concrete apron west of the ramp. Here the various pieces were laid out in the relative positions which they occupied as a complete missile on the handling trailer backed up to the launcher in preparation for erection, as shown in the accompanying photograph. This simplified the arranging of the pieces and the determination of which components were unaccounted for.

In general, the parts which were located in Quadrants II and III showed extensive fire damage while those from I and IV did not. The sustainer chamber, including the power package, was recovered intact with the exception of the lube tank and sections of tubing. Only the top flange of the lube tank, with the pressurizing valve attached, was found. The exhausterator in the Quad II - III area was burned away. The sustainer boot was found intact in the skimming pond.

The booster turbopumps and chambers sustained considerable damage not only from the fire and explosion, but also from being blown a considerable distance into the concrete spillway. B2 thrust chamber, which was still mounted on a section of thrust structure, showed indications of extreme heat. The side normally facing the sustainer engine was badly charred and the silver solder had melted between the chamber tubes. The high pressure fuel and LO_2 ducts were burned in two approximately four feet upstream from the main propellant valves. Nearly all the tubes in the combustion area were collapsed.

B1 thrust chamber was found attached to a large section of thrust structure including most of B1 nacelle. Attached to the same structure were the B2 turbopump and booster lube tank. The turbine and a piece of the gear box were broken off.

The fuel pump side of the power package showed indications of fire. The lube tank was crushed and was torn open in several places. A short section of the low pressure LO_2 duct, including the LO_2 fill and drain valve, was still attached to the turbopump as was a section of the low pressure fuel duct. The Quad IV riseoff disconnect panel was still in place although the disconnects were damaged. A large area of the B1 nacelle from Quad IV showed considerable fire damage. Many of the tubes in the B1 chamber combustion area had been collapsed.

The number 1 turbopump was found a short distance from number 2 pump. It also showed indication of burning on the fuel pump side. Short sections of the low pressure LO_2 and fuel ducts, the booster gas generator, the booster hydraulic pump, and the gas generator LO_2 start tank high and low pressure relief valves were still attached to the pump assembly.

The booster turbine exhaust duct was torn into several pieces and badly burned. The outer shell of the heat exchanger was completely burned away leaving

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only the coils intact.

All parts of the booster and sustainer main fuel systems were recovered. The booster fuel pre-valve actuator and butterfly, although recovered separately, were in the full open position. The sustainer fuel pre-valve actuator was broken off and was in the fully extended or open position. The butterfly, still mounted on the apex, was in the closed position. The female half of the fuel disconnect valve was in fairly good condition but the poppet was cocked to one side and partially open. This half of the fuel disconnect was still bolted to the pre-valve; however, the pre-valve body had broken, leaving the upper flange still attached to the tank section. The airborne fuel fill and drain valve was intact but torn from the low pressure fuel duct. The male half of the main fuel disconnect, badly dented, was still attached to a section of the fuel Y-duct. The fuel start system from the Quad II rise-off disconnect panel to the B1 turbopump and booster gas generator have been located intact although quite badly burned. Other than the fill and check valve and staging disconnect, the sustainer fuel start system is largely unaccounted for.

The No. 2 vernier package was recovered fairly intact although a large part of the tubing had been burned away. The propellant valve was broken into several pieces and all components showed considerable damage from fire. The No. 1 vernier, with the exception of the propellant valve and engine mounting structure, has not been found.

The vernier LO_2 and fuel systems, including the start package, were broken into many pieces. The vernier fuel tank, a piece of the fill and check valve, and part of the pressurizing manifold were recovered and showed extreme fire damage. The vernier LO_2 start tank and all related start package components were located. Indications are that the tank exploded but all other components were in fairly good condition.

The booster and sustainer main LO_2 system was not damaged by fire, but was broken into many pieces by the explosion. The LO_2 disconnect valve was recovered with the poppet partly open and cocked to one side. The structure supporting the poppet was broken loose from the valve body. The LO_2 tank outlet elbow was still attached to the tank skin. The pre-valve and connecting ducting to the disconnect valve were not found.

The gas generator start tank was torn away from the LO_2 start system. The tank was in good condition, as were the other components with the exception of the fill and check valve, which was broken into two pieces.

The major components of the airborne hydraulic system have been recovered. The only parts unaccounted for are assorted check valves, tubing, flow limiters, filters, and the V1 pitch and yaw actuators. Most of the recovered parts showed little damage although the booster reservoir was dented and the sustainer reservoir badly burned.

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With the exception of the manual fuel shutoff valve and minor pieces of plumbing the airborne pressurization system was complete. Components which were located in Quads II and III showed considerable damage from fire.

Large and small pieces of tank skin and thrust structure were scattered over the complex area. Several large sections of the missile tank were found but the major portion of the tank section disintegrated into small fragments. It is estimated that 75 percent of the tank skin, 30 percent of the firewall, and 90 percent of the booster structure have been recovered. Both jettison tracks with their staging disconnect panels were recovered.

Sections of pod doors and equipment which was mounted in the pods was spread over a wide area. The Azusa canister and the No. 1 Range Safety Command power supply were recovered but only fragments of the remaining canisters were found. None of this equipment showed evidence of fire damage.

Several components have been removed from the restricted area for disassembly and inspection. The entire sustainer engine assembly was transported to Hangar J for removal of the turbopump, LO_2 dome, and injector. The turbopump was further disassembled in the Rocketdyne Modification Lab by Rocketdyne personnel to permit members of the investigation committee to inspect the components for evidence of a malfunction. The head suppression valve servo controller has been removed from the sustainer and shipped to Canoga Park for disassembly by Rocketdyne. The vernier LO_2 start tank pressurizing package, vent valve, low pressure relief valve, and fill and check valve, the fittings and broken tubing still attached, were taken to the Rocketdyne Lab for inspection. The sustainer fuel pre-valve actuator and a section of the sustainer low pressure fuel duct were also taken to Hangar J for inspection. The sustainer low pressure fuel duct and high pressure fuel duct were opened for the committee prior to removing the sustainer from the roped off area.

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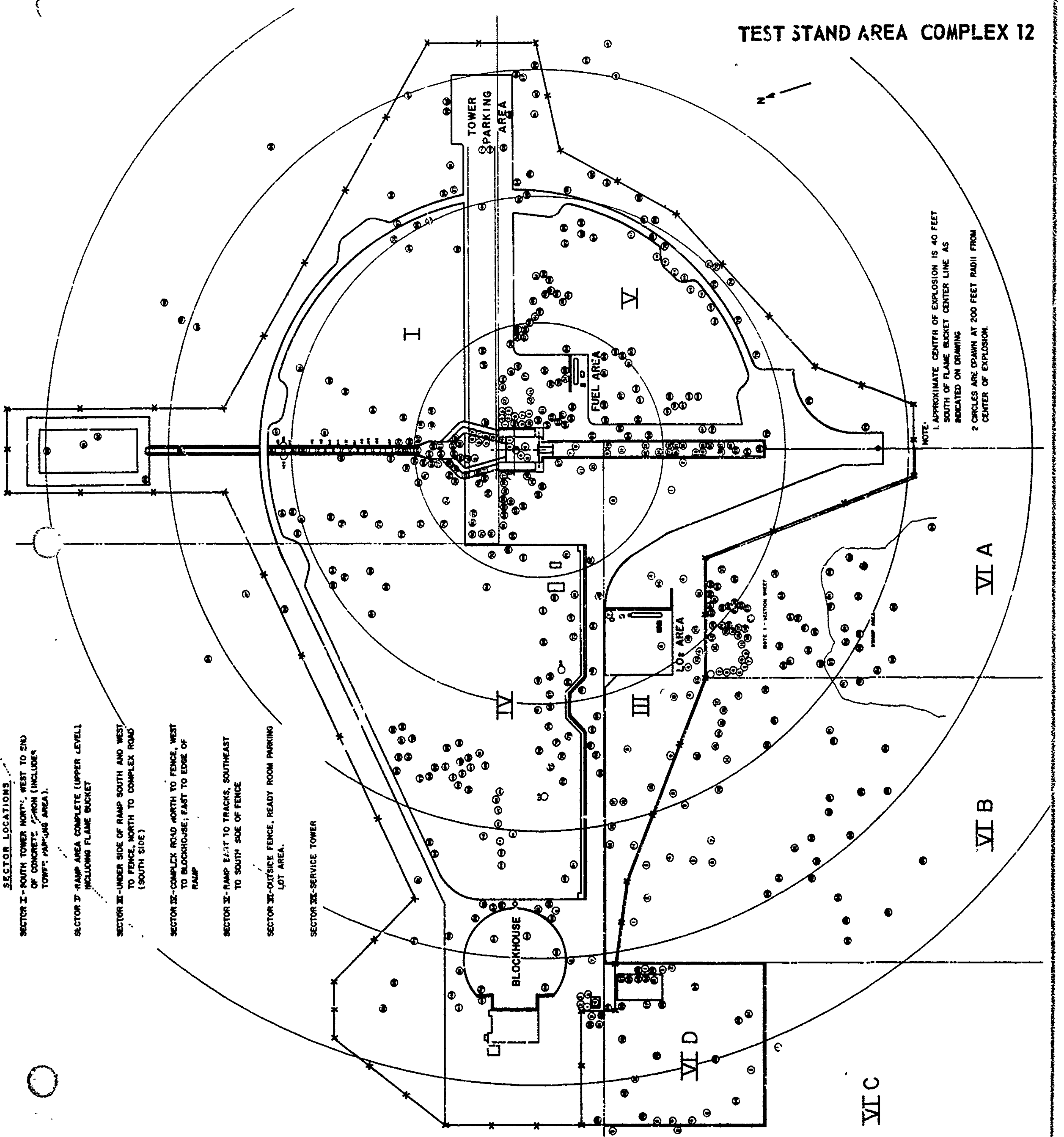
CONVAIR ASTRONAUTICS

PAGE NO.

REPORT FTA-6182

TEST STAND AREA COMPLEX 12



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FORM NO. A-703-2

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RECOVERED MISSILE HARDWARE

Following is a list of recovered missile parts, showing sector location and weight (where available) of each part. Item numbers refer to scatter map (p. 2-7)

Sector I

Item No.	Description	Weight (Lbs.)
1	B-2 chamber	1200.0
2	Quad II disconnect	2.44
3	Ground fuel start line	42.0
4	Quad IV staging disconnect (upper) and rail	28.0
5	B-1 hyd. accumulator	9.1
6	Booster heat exchanger coil	67.0
7	Quad II staging disconnect upper and lower	10.5
8	Tank skin .030 (4 ft^2)	
9	Nacelle 7-77101-805	
10	Booster nacelle 7-77228-13; tank skin .023 (2 ft^2)	
11	Quad I lower corrugated section; Quad II fuel pressurizing orifice and piece of flange 7-17139-7	2.5
12	B-1 nacelle frame and boot	
13	Vernier prop valve (no Ser #)	1.5
14	RMI bellows and portion of fuel Y duct	
15	Grd fuel start tank shield	
16	B-1 chamber; B-2 power package; Quad IV staging disc. (lower) and rail; Apex and pre-valve (closed); booster LO_2 reg; booster turbine exhaust; Quad IV disconnect and missile structure; B-1 nacelle shows	

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Item No.	Description	Weight (Lbs.)
	sign of melting on one side; booster lube tank (ruptured); booster tank bottle	2209.7
17	B-1 power package; booster GG (blade valve open)	624.0
18	Hyd. mainfold 7-27208 structure	
19	Changeover valve	
20	Sust. actuator	
21	V-2 fairing	2.5
22	Hand loader; plenum chamber (sust.); vernier solo accumulator; vernier position transducer	2.14
23	Igniter fuel line	1.88
24	Vernier fuel tank	7.0
25	Electrical arming switches; check valve Kohler K-1248-10; relief valve	
26	Vernier LO_2 start press. unit; vernier fuel start press. unit; piece of vernier fuel fill & ck.; booster GG LLR; check valve	6.46
27	Low press LO_2 duct; A frame support member, piece of vernier LO_2 tank; tank skin 8 ft^2	
28	All of the following found in Item: 7-08231-15 Ser. 338 7-08231-15 Ser. 337 7-08231-15 Ser. 339 Burned bottle	943.0

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Item No.	Description	Weight (Lbs.)
	Bottle	
	Bottle	
	Booster ctls. bottle	
	LN_2 shroud 87001-511-A-06	
	Piece thrust barrel 4' x 1' x 1'	
	Piece of thrust barrel 6' x 4'	
	Hyd. reservoir	
	Piece of LN_2 shroud	
	Sust. elec. ctl. box	
	Eng. compart. water heat shield	
	7-84123-353	
	Thrust barrel	
29	Tank skin 4 ft^2 .022	10.0
30	Separation flask	
31	Sust. boot	
32	Mcog valve	
33	Launcher box	
34	Doghouse	
35	Monitor nozzle	
36	Umbilical A frame	
37	Tank skin .024 2 ft^2	
38	Igniter fuel & vernier LO_2 bracket with connection	11.0
39	Thrust structure Quad IV 1' x 4"	

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Item No.	Description	Weight (Lbs.)
40	Missile skin 2 ft^2 .026 7-73001-87	
41	Missile skin $1\frac{1}{2}$ ft^2 .040	20.0
43	Duct pressure relief valve 4 ft LO_2	
44	Vernier LO_2 line 5 ft.	
45	Major portion of vernier LO_2 tank	6.5
46	Tank skin near RMI fuel .029	
47	Vernier LO_2 tank vent valve	1.84
48	Booster pre-valve and RMI fuel	21.0
49	Barrel section with separation fitting 1 ft^2	
50	Fuel fill and drain valve	19.0
51	Fuel pre-valve actuator 7-02287-17 (open position)	
52	Fuel tank flange (mod)	15.0
53	BGG fuel orifice block	3.0
54	Booster fuel Y duct 2 ft.	
55	Fuel pre-valve control lines (booster) J4332 P-433 (3 ft)	
56	Piece of skirt 2' x 3'	
57	Connection box	
	NA 5-22765B flow meter	
	Pressure switch	
58	Piece of structure 4' x 3"	
59	Part of B-2 engine instrumentation box	
60	Piece of fuel tank and 1.5' x 1'	

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Item No.	Description	Weight (Lbs.)
61	(Acid area) LO_2 reg & relief valve & sustainer half disconnect panel	
62	Booster half of 28 panel	
63	J298, pressure transducer S/N 3621 (He bottle transducer)	
64	Servo valve 7-84501-501 accumulator	
65	Wire harnesses 7-11365-1-03, and parts of others, badly burned electrical connectors, pieces of electrical J-box, all attached and tangled to B-1 engine and plumbing	
66	Vernier oxidizer supply line 6' long 7-22217-139	
67	LN_2 overboard line 7-87574-13	
68	MFCO, AFCO arming switches, attached to section of fuel tank, washed down spillway	
69	2 pressure transducers (H33P and another mounted at same bracket). Harnesses 7-17741-13-01-701, 7-16270-1-03	
70	Pod I disconnect plug P2011 and 1' attached wires	
71	Umbilical solenoid	
72	Motion limit lanyard switch, attached to booster section	
73	Duct and bellows 7-22233-501 E/04	
74	Umbilical A Frame	

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Item No.	Description	Weight (Lbs.)
75	Piece of demate ring 6' x 1.5'	4.5
76	Ducting and bellows assy. 7-01239-1	
77	P181	
78	Piece of Apex 2' x 2' with lines and wiring attached	
79	2' piece of VE conduit and wiring	
80	Rocketdyne #9504-45050D	
81	Rocketdyne pt. #9669-44168A fill and check valve 1 ft. dia. bottle with line #7-23368-41 attached (oxidizer start tank)	
82	Airborne Thiokol LO_2 valve	
83	GG LO_2 start tank bottle	
84	LO_2 fill and check valve - No. 9669-44168	
85	Piece of LN_2 overboard duct 3" x 7"	
87	One range safety antenna	
88	Doghouse door	
89	Pod I umbilical doghouse, umbilical receptacles J3002, J4060. Plugs and receptacles 4066, 4067, 4068 and mounting bracket with short length of wire	
90	J3235, J3237 and 2 other receptacles with mounting bracket	
91	93P2 (plug) with 1' of wire	
92	Launcher conduit and wiring (approx 15 ft)	
93	J3017, J3006, J3024 and mounting bracket	

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Item No.	Description	Weight (Lbs.)
94	1 # piece of canister, P17 attached	
97	Disconnect plugs P3042, P3044. Plugs P295, J295, P11 B-2 wiring and clamps, relay box	
98	007776 pressure transducer, B-2 RCC coax (2' piece)	
99	7-67594-1 (load harness, conduit. Piece of junction box)	
100	J3235 tlm plug, scattered bits of wiring	
101	Main body of Azusa can (hit tower apparently)	
102	1 # piece of end of Azusa can	
106	Vernier start tank & separate piece of line	
107	LN_2 spray manifold (2 pc ea 8') parts of yoke; various check valves and pressure switches #7-01626-7 F1048P	
	Booster separation fitting & piece of barrel 6" x 1'	4.5
109	7-84271-11	
110	Rocketdyne 9512-59052 (2 pc)	
111	Quad I section of fire shield 3' x 2.5'	
112	7-84123-357	
113	Piece of fuel tank cone 6' x 2'; piece of barrel section 1' x 1.5'	
114	Scatter debris: LN_2 lines; Pod cooling "Y"; LN_2 fill and drain line 7-87932-9	

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Item No.	Description	Weight (Lbs.)
	Piece of bulkhead with eng. ctl. helium	
	Supply line #7-87105-37	
	Pt. #7-84123-65 7-84123-11	
	Missile stabilization pin support (struct. sect.)	
	7-84123-363	
115	1 ' x 1.5' piece of fuel tank	
116	7-77913-18	
117	LN_2 shroud probe	
[illegible]	Piece of vernier engine fairing	
120	1" hydraulic hard line 7-84123-367	
121	Tangled thrust section wiring, washed down spillway	

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Sector II

Ramp area complete (upper level), including flame bucket.

Item No.	Description	Weight (Lbs)
1	Booster skirt section	20.
2	A/B reg and relief valve	13.
3	Sustainer engine and pump package	
4	Gnd fuel start tank	
5	Vernier engine	42.5
6	Vernier engine mount	18.
7	Warning light control boxes	
8	Piece of pressurization duct	1.30
9	95% LO2 tank level probe	.96
10	Piece of low pressure duct	.42
11	Camera case	12.
12	Camera case	
13	Tie down cover plate	
14	Camera case	
15	Parts of missile tank skin	1.16
16	Blast band on Able adapter	
17	Gage and valve used to pressurize tank on second stage	
18	LO2 tank sensing line	5.3
19	7-76759-7 piece of cable way fairing	6.5
20	LO2 pressurization duct and manual shut off valve	

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Item No.	Description	Weight (Lbs)
21	Atlas to Able adapter and top of LO2 tank	
22	Piece of tower over the 4th stage	
23	LO2 pressurizing duct	11.5
24	Piece of booster skirt section	
25	Piece of LO2 tank baffle	

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Sector III

Under side of ramp south and west to fence; north to complex road (south side).

Item No.	Description	Weight (Lbs)
1	Able 1st stage	
2	Upper section LO2 tank	169.
3	Tank section, from under pod marked "Power Changeover"	
4	LO2 tank antislosh baffles	
6	Piece 6" low pressure duct	1.25
7	7-73608-1	
8	7-73412-11/01	
9	7-73254	
10	Pod door parts	1.26
11	Inverter stator winding	4.94
12	7-41773 Ser. #11	1.50
13	7-81132 LO2 sensing line, 7-81132-13 LO2 sensing line	1.82
14	Boil off valve cover	3.03
15	Unidentified cylinder, 3" dia., 10" long, alum. dome one end, other end flat teflon with connector similar to coax. Whole assy. fiberglass covered,	1.38
16	Piece AP can 10' south 2nd light	.18
17	Canister, 20' south road, 75' east 2nd light	
18	Armature 25' south road, 75' east 2nd light	4.78

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Item No.	Description	Weight (Lbs)
19	Tank section - 15' west of SW corner LO2 pad	30.

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FORM NO. A-785-2

CONFIDENTIAL

Sector IV

Complex.road north to fence; west to blockhouse; east to ramp and spillway.

Item No.	Description	Weight
1	Portion of servo can	.80
2	Oil pump	2.34
3	J-203 servo can plug	1.94
4	A/P displacement gyro (located in guard shack)	4.22
5	Bottom part of servo can (located in guard shack)	1.86
6	Part of missile LO2 duct	8.0
7	Propulsion tubing	5.6
8	Part of amplifier out of servo can	.50
9	LO2 staging disconnect flange	3.12
10	2' x 5' piece of tank	.25
11	LO2 tank skin	.6
12	LO2 tank skin 15 ft. by 4 ft.	25.
13	Transducer - part no. unknown	.32
14	Small pieces of tank skin, facility plumbing, grating	5.0
15	Rib - part #7-77234-13	.73
16	Sustainer hydraulic accumulator	2.4
17	Umbilical solenoid	1.5
18	7-73102 LO2 tank bulkhead	3.82
19	7-77703-101 fairing for separation charge	1.7
20	7-06344-5 disconnect	2.0
21	60 sq. inches of fuel tank skin	.45

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Item No.	Description	Weight
22	Portion of propulsion harness - 14" long	.41
23	Shradex valve - believed on separation bottle	.12
24	6" x 16" piece of skirt cowling	1.94
25	Vernier engine fairing - 6 sq. ins.	.04
26	Vernier engine fairing - approx. 140 sq. ins.	.38
27	Thrust section plumbing - 2 ft. long	6.2
28	Insulation shield top of LO2 tank 1 ft^2	.18
29	Thrust section bracing	4.1
30	Transducer mounting	.04
31	Small piece metal	.01
32	Piece of metal	.02
33	Sign blown down	10.0
34	Stabilization support and piece of skirt 6" x 2'	13.0
35	Turbine drive	3.3
36	Differential transformer SN 106	.92
37	12" sq. inches of pod door	1.10
38	Generator	17.68
39	A/P servo can - amplifier assembly 7-417639 SN 150	3.4
40	Pod cooling duct	3.6
41	Wire #P215C0 and P27A0 (Missile Pwr Wiring)	.04
42	Skirt fairing (10' x 3" section)	1.24
43	Piece of tank section and ¼ tubing (tubing #7-73608-1)	.16

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Item No.	Description	Weight
44	Section of skirt (6" x 2")	.36
45	Piece of station 1130 cableway cover	.01
46	Piece of baffle section (LO2 tank)	.23
47	Section of skirt cover (4' x 2')	.11
48	Piece of wire (#Q116A22)	.08
49	Canister clamp	.03
50	Section of tank marked (power changeover)	.02
51	Top of inverter can	.24
52	Cover for transducer with a S/N 35, Mfd P/N 89-00502-032	.44
53	AC pwr/changeover switch	13.5
54	DC pwr/changeover switch	1.04
55	Hysterisis motor P/N 55A59, 115V 40 cps Mfd Globe	.72
56	Bottom of PU can	.2
57	Ring section for LO2 duct from Sta 1133	12.94
58	Top of R/S can S/N 35	6.46
59	Plug from pwr changeover can	1.58
60	Transformer - prim - 155V 400 cycle - sec 124 ∠ 2 volts 20 watts, 211-1008	1.21
61	Quick disconnect from PU system	1.44
62	Lid from top of PU manometer	.22
63	Thrust section demate separation fitting (8" x 12")	8.06

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Item No.	Description	Weight
64	Thrust section demate separation fitting (6" x 30")	2.84
66	Ground half LO2 valve	54.5
69	Pod section - 7-73701	.06
70	Keco duct - 1 ft. long	.08
71	Keco duct - 8 ft. long	6.6
72	Bracket - No. 7-73608-1-01	.40
73	Bracket - No. 158-579-1	.32
74	Harness and plugs P371, P372, P373	8.
75	Pod door 12" x 6"	.90
76	Center post of pod door - 3 ft. long	1.02
77	Transducer 7-12092-13-02	.50
78	LO2 pre-valve bracket	2.7
79	Canister part - dwg 211-101, S/N 108	.11
80	Part of A/P servo can	.38
81	Separation fitting	2.04
82	Umbilical receptacle	6.0
83	Lower section of pod assembly	.81
84	Thrust section railing - 4 ft.	25.
85	Umbilical receptacle	.12
86	Bottom of PU canister	.22
87	RSC saddle and piece of skin	.47
88	Marman clamp - A/P canister	.08

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Item No.	Description	Weight
89	6" x 4" piece of canister	.23
90	Small bracket - B-361	.02
91	Cannon plug - 6 ozs.	.38
92	Canister saddle with attached straps	.31
93	Piece of range safety canister - 6" x 10" x 2"	1.6
94	Electronic part - No. 7-36072	.03
95	Part of power changeover switch	.14
96	Cannon plug	.08
97	Canister saddle	.22
98	Tubing - 3 ft., 3/8" dia.	.70
99	Bottom of canister 7-36077 and 7-36042	.61
100	10" x 12" piece of skin; plug 7-73860-7; bracket 7-73440-15	1.2
101	Motor - generator - type R800-1A	1.3
102	Part of canister 6" x 12"	.39
103	Part of power changeover plug	.06
104	Large section of A/P servo canister	2.6
105	Range Safety electronic parts	.52
106	Ring from fuel duct	2.1
107	Pressure transducer	.1
108	Transformer	.3
109	Relay assembly - part No. 36047	3.7
110	Base of range safety command canister	4.82

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Item No.	Description	Weight
111	Base of power changeover canister	11.32
112	Large piece of range safety command can	11.0
113	Bracket - 7-36051	1.96
114	Umbilical harness (J1007) - 6 ft. long	.94
115	Piece of range safety command canister	1.82
116	Part No. 211400A	9.7
117	Clamp and strap assembly	1.18
118	RSC components S/N 110	.74
119	Base of RSC can	1.4
120	LO2 ring	1.8
121	Saddle support	
122	Bracket	1.7
123	Top of inverter can	3.5
124	Part of canister	.1
125	Tubing - 3 ft. long, $\frac{1}{4}$" dia.	.38
126	Tag - 7-73705-17	1.56
127	Stabilizer section - 4" x 10", 10 lbs.	10.
128	Quad II - part of sust. staging disconnect panel	3.5
129	Potted 7 pin plug, marked "FF12"	.13
130	Umbilical face plate	.09
131	Part of mercury manometer	1.66
132	LO2 tank baffle skin - 2 sq. ft.	.60

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Item No.	Description	Weight
133	2 ft. long piece of pod door hinge	.31
134	7-41879-17 part # - part unknown	.27
210	Part canister - 7-41767 S/N 149	12.14
211	7-84244-9 valve	.29
212	Gear	.02

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Sector V

Ramp east to tracks; southeast to south side of fence

Item No.	Description	Weight
	N.S. Cor. section	
1	Pc. launcher ladder sect	20.
2	Missile section, pod door area	.74
3	1007-4050 skirt thrust section - umbilical	14.42
4	Missile tank, panel section	3.0
5	Water hose - pod cooling	1.52
6	Unidentified	4.3
7	Unidentified (possibly B2 nacelle)	11.2
8	Canister clamp	.52
9	Part of canister	.61
10	Pod deluge nozzle	3.41
11	Ramp railing	10.3
12	Miscellaneous missile tubing	.70
13	7-77201-59	.43
14	Power receptacle, C tower	1.2
	N.E. Corner concrete pad	
15	Launcher tubing - unidentified	.92
16	Complex water line flange	.32
17	Miscellaneous tubing - portion of launcher	6.7
	East-from ramp	
18	Hold down release from top of JA2	
19	PA speakers	11.3

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Item No.	Description	Weight
	Northwest Corner concrete pad	
20	Canister clamp	.31
21	RCA camera cover	.54
22	Special "C" flood light	
	South of end of east track	
23	Hydraulic pump motor	
24	Pad deluge water line	10.2
25	MOPS jack boxes (2)	15.1
26	Keco cover	6.3
27	Case for motor, hydraulic pump	
28	Communications box with railing	
29	Top section special service tower	
	Northeast corner of concrete pad	
30	Keco trailer panel	6.7
31	AN tubing	.87
32	6" gate valve	
33	Missile section - channel (LO2 tank baffle)	1.4
34	Booster skirt section	105.
35	RCA camera tower	
36	GE nosecone service tower (bottom section)	
37	Launcher structure - tubing	
38	Camera mount (RCA)	
39	Hydraulic valve - complex	

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Item No.	Description	Weight
40	Booster skirt section	35.4
41	Solenoid valve (special service tower)	
42	Water pipe	
43	CIA valve	
44	Gate valve and 6' water line (C tower)	
45	4" - 8" water control switches (C tower)	
46	Air cooling line (GE tower)	
47	RCA camera mount	
48	Pod cooling 10" duct	5.0
49	Part of green destruct box (Range Safety)	.34
50	Canister clamp	.21
51	Hydraulic tubing and tee	.55
52	Skin and canister clamp, canister part	.61
53	Convair part #7-03245-17	.37
54	J-15, J-16 (bottom of canister)	.58
55	J3042 and harness; J3040 and harness, J3025	6.73
56	Pod door section	3.1
57	Power box - relay (special service tower)	
58	Miscellaneous telemetry part	.24
59	Circuit breaker (special C tower)	.68
60	Waveguide (X-band - missile)	.41
61	Section bottom of pod	1.8

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Item No.	Description	Weight
62	C tower, transformer	
63	GE tower cooling tubing	
64	Pod door part	.89
65	C tower electrical box	
66	C tower hoist	
67	Dase of C tower	
68	Waveguide flange, pod #2 GE Guidance antenna	.87
69	GE 7728580; J1, J2, J3, J4, S/N C12 (GE Guid)	2.16
70	Explosion proof control box	
	Centerline of camera plate; Sta. 3 ≁ 34 (center of road	
71	Conduit	1.4
72	Support tubing	.6
73	Thrust section tubing	.4
74	Ramp railing	
75	Control switches (C tower)	
76	76123-15 missile structure (LO2 tank baffle)	.76
	From end of ramp	
77	Fiberglass fairing (top of pod)	.13
78	TVA 94393-501 pod fairing	3.4
79	Large section of tank	15.2

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Item No.	Description	Weight
	South of fuel trench and east of ramp	
80	7-73001-147, communications box cover, missile skin (doubler)	8.2
81	Communications cable	3.4
82	Angle iron from launcher	
83	Unidentified, connector	.25
84	Missile skin section	2.2
85	Unidentified metal sheet	1.7
86	Large unidentified sheet	6.7
87	Fire hose cover and missile tank pieces	16.2
88	Skirt section and tank pieces	5.1
	Many pieces of missile tank in sandy area south of fuel storage and east of ramp	
89	Al. channel - several pieces; also large section of LO2 (LO2 tank baffle)	10.3
90	7-76123-21-F doubler from noted channel	.66
91	Water pipe and tank section	1.3
92	7-73406-11 hinge and part of missile tank	.43
93	115V outlet launcher and harness section and channel section	3.4
	West of perimeter, South and North of line fuel storage bunker	
94	Part of canister shell, pipe and wire	2.6
95	Parts of pod door area	1.3
96	Flat pod cooling duct, canister clamp, missile tank section, cond. it	

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Item No.	Description	Weight
97	Water main and valve - Azusa boom F/C cover	6.3
98	Canister piece	.33
99	Able antenna	.41
100	Large section missile tank	11.7
101	Possible cover, assembly 0-051530 S/N 2	1.2
102	Possible cover plate	.37
103	Missile tank skin - burned	.49
104	Missile skin - possible canister piece	.69
105	Electro-mechanism valve - S/N 3-1027	.31
106	Part of launcher inside Dempster Dumpster	6.1
107	Plate - instruction	.34
108	12' cable with connector	1.7
	Drain lake outlet	
109	Part of TVA 94393-12 sheet	.23
110	Possible parts of canister (2)	.12
111	Fiberglass	.08
112	Part of canister (possible)	.36
113	Part of canister and 7-73433 bracket; 7-73308-35 tubing and 7-73610-805 tubing	
114	Parts of canister	2.6
115	Parts of guidance antenna	.80
116	Possible part of canister	.41

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Item No.	Description	Weight
117	Parts of decoder canister (3)	.29
118	Circuit breaker housing	3.8
119	Section of thrust section	14.3
120	Unidentified part	2.1

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Sector VI - A

Outside fence, ready room parking lot area

Item No.	Description	Weight
1	Missile skin 2' sq. - seam and bracket holes 6' from fence	4.26
2	Tank skin 6' from fence	17.0
3	Tank skin 10' from fence	.11
4	Cloth 2" sq. 15' from fence	.1
5	Welded tank section 20' from fence	5.0
6	Missile skin 18' from fence	3.0
7	#7-43563-7 30 ft. from fence	.04
8	Missile seam 27 ft. from fence	1.0
9	Pod door part white and red 28' from fence	.32
10	18" tube (1")	.20
11	Unidentified strip found in circle 10' from fence	1.
12	2" x 8" pod door part 6' from fence	.14
13	2' x 3' missile skin 5' from fence	2.64
14	3" x 12" corrugated skin 5' from fence	.10
15	4" x 6" pod door 20' from fence	.48
16	Part of pod door and long strip with 2 holes for tubes (#10) 25' from fence (LO2 baffles)	.03
17	Tube goes with above 12" x 3/4" 20' from fence	.18
18	Strip #6P7-73605-39; HT7X1220, 17' from fence	.20
19	Fiberglass top of pod, 15' from fence	.21

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Item No.	Description	Weight
20	RMI LO2 covering fiberglass 18' from fence	.22
21	Pod door part 2" x 6"	.05
22	LO2 baffle 3' x 3" 30' from fence	2.0
23	3 pieces of LO2 baffle part 2' long with 2 holes (3/4"); 2 pieces of missile skin	1.82 .9
24	Silk-like layers of honey combed fiberglass, 2 pieces 10' from fence	.20
25	2' of 4 wire shielded cable 15' from fence	.2
26	Nut and bolt asembly on large missile skin, #VA94391-7 2 of above A and B assembly part #7-73440-502, B/02; bracket 7-73440-15 20' from fence	5.0
27	LO2 baffle 5" x 18" 30 ft. from fence	.46
28	LO2 baffle #7-76123-21 (all pieces marked LO2 baffle, looks like this part) 5" x 24" 25' from fence	.50
29	Honeycombed white nylon, 1 thickness 20' from fence	.04
30	Pod door parts and fiberglass 4 thick., 15' from fence	.58
31	Fiberglass over nylon and missile skin 10' from fence	.18
32	Missile skin 3' from fence	.96
33	Fiberglass 3' from fence	.14
34	Silk, white honeycomb prints 6' from fence	.03
35	Missile skin 30' from fence	.32
36	Area covered with insulation from LO2 fill facility line	

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Item No.	Description	Weight
37	Pod cooling duct, where attached to bird, 15'	2.0
38	Small parts of missile skin, pod door and baffle throughout VI-A area	
39	Missile skin and LO2 baffles	2.14
40	Missile skin in swamp 60 ft. from fence	.94
41	8" O ring	.12
42	3/4" tubing	.26
43	DB 3010 thick (thrust section)	1.21
44	Fiberglass from pod door 80' from fence	.16
45	GE 7641009G1, Decoder Com on piece of skin	.16
46	18" x 6" metal fragment with seam, green on one side	.82
47	Baffle, 2½' and missile skin	.35
48	Pod door part (hinge) and flood lamp assembly	3.0
49	Inside of pod door and piece of aluminum with white paint on one side	.52
50	Large piece of missile skin 5' x 3'	10.90
51	Aluminum ducting	1.52
52	Missile skin and corrugated 3 thickness of stainless steel	2.36
53	Missile skin	.42
54	Missile skin, large	11.0
55	Missile skin, large	9.0
56	Missile skin, large	4.5

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Item No.	Description	Weight
57	Missile skin, tank section	1.22
58	Missile skin, large	10.
59	Missile skin, large unable to reach	
60	Large approximately 2' x 3' fragments of missile skin	
61	Large approximately 2' x 3' fragments of missile skin	
62	Large approximately 2' x 3' fragments of missile skin	
63	Large approximately 2' x 3' fragments of missile skin	
64	Large approximately 2' x 3' fragments of missile skin	

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Sector VI - B

Item No.	Description	Weight
1	Cannon plug	.08
2	Piece battery	.18
3	Piece metal - tank section	7.0
4	Piece thrust section metal, 2 pieces	1.28
5	Metal piece	2.18
6	Metal tank section	1.14
7	Transducer	.3
8	2 pieces metal 4" sq.	.47
9	Piece battery and metal tank	6.0
10	Canister strap south six ft. piece battery	.64
11	Piece terminal board	10.8
12	Piece battery	.7
13	Piece pod door	1.5
14	Piece pod door hinge	0.26
15	Piece metal 15' x 12" tank section	1.0
16	Pieces tank section and wire harness and waveguide section with 16' area; also piece tubing and pod door	4.84
17	Piece tubing brace; also piece metal IR 406572 with 6 ft. area, also 7-73106-13 metal brace; several small pieces tank also	.66
18	2 pieces pod doors	1.01
19	Piece metal rail	9.50
20	Piece tank section 4 ft. sq.	5.0

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Item No.	Description	Weight
21	1 piece metal tank section 2 x 6 ft.	.9
22	Piece antenna above doghouse. Also few small pieces in 10' area	1.25
23	Metal rail piece TVA 94393-39	.5
24	Piece of metal axis 7-73001-111; also small pieces metal 10 ft. area	1.4
25	Piece metal storage secon. mods.	.72
26	Piece tubing oxidizer tank anti-slosh, also brackets on tubing	.84
27	Large piece fairing and metal in area	13.5
28	Several pieces tubing PU	.9
29	Piece battery or engine	.8
30	2 pieces pod doors, top section; also battery pieces in area	6.6
31	Piece coax cable from Azusa canister P-132	.5
32	Piece canister 7-41713	3.
33	Piece pod door top section	3.25
34	Pod door frame work	3.06
35	Mercury trap	.5
36	Piece 12" circle metal	.8
37	Large piece tank section with LO2 connect	27.0
38	IR 489238 piece metal; also piece tubing	5.5
39	Canister top, autopilot 7-41383 (IR 58-N)	2.93
40	Pod Access door (piece)	.5
41	Large piece missile skin unable to reach	1.4
42	Large piece missile skin unable to reach	1.5

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Sector VI - C

Item No.	Description	Weight
1	7-3308-19; 7-716892; 7-36063-1, small ¼" tubing	
2	Large half moon piece of metal	2.5
3	Small piece of skin (tank section)	

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Sector VI - D

Outside fence, ready room parking lot area

Item No.	Description	Weight
1	5 ft. piece of pipe rail	2.
2	PU mercury trap	2.1
3	Possibly small motor (servo)	1.
4	K. Lawrence auto LF window broken (door)	
5	Piece of metal	.3
6	Burned substance (probably not metal	.11
8	Piece of metal (green on one side and oily)	.10
9	Small piece of metal	
10	Rubber "O" ring	
13	Piece of rubber #531	
14	Adel clamp	
15	Bolt AN 1½" w/washer and nut	.1
16	Rubber (½ circle)	
17	6" sq. piece of missile skin alongside of coffee urn #2626600001-2	.29
18	B.B. Beebe's car trunk hit by object unknown (piece of metal lying on trunk)	5.
19	Bob Carpenter's station wagon top left side, front and back, 2 dents on top	
20	Small piece metal (missile)	.01
21	Small piece metal	.02
24	Metal cap	.03
26	Piece of metal inside fence	
27 - 35	Windows broken in ready room	

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CONVAIR ASTRONAUTICS

RECOVERED MISSILE HARDWARE
IN ASSEMBLY AREA

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RECOVERED MISSILE HARDWARE IN ASSEMBLY AREA
(MT-59-79511.1)
(Photograph to be Supplied Later)

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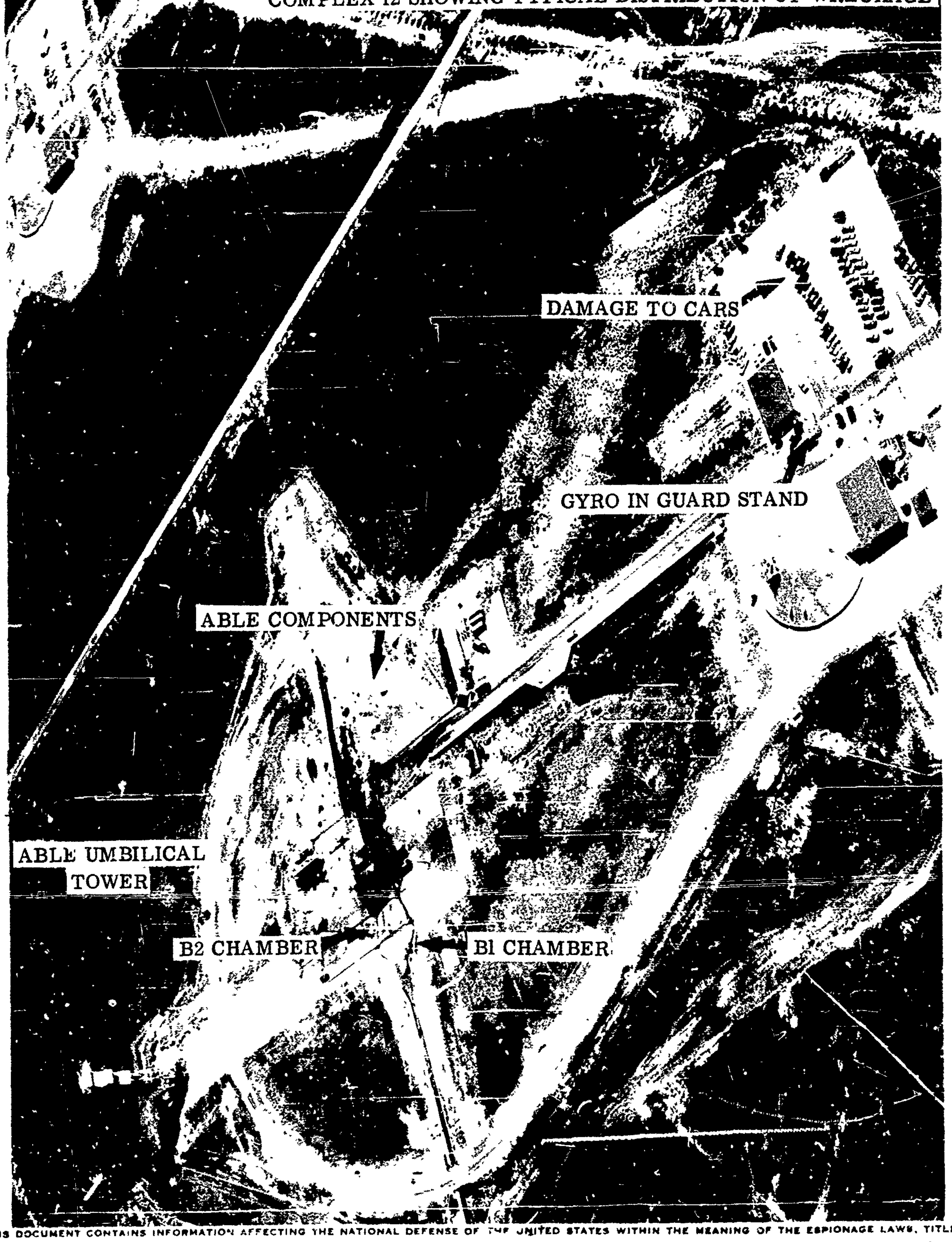
COMPLEX 12 SHOWING TYPICAL DISTRIBUTION OF WRECKAGE



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LOCATION OF THE BOOSTER THRUST CHAMBERS AND THE BOOSTER POWER PACKAGE
B1 THRUST CHAMBER AND BOOSTER POWER PACKAGE
B2 THRUST CHAMBER

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BI CHAMBER AND BOOSTER POWER PACKAGE
NOTE HELIUM BOTTLE.

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SUSTAINER ENGINE AS IMPACTED ON THE LAUNCHER

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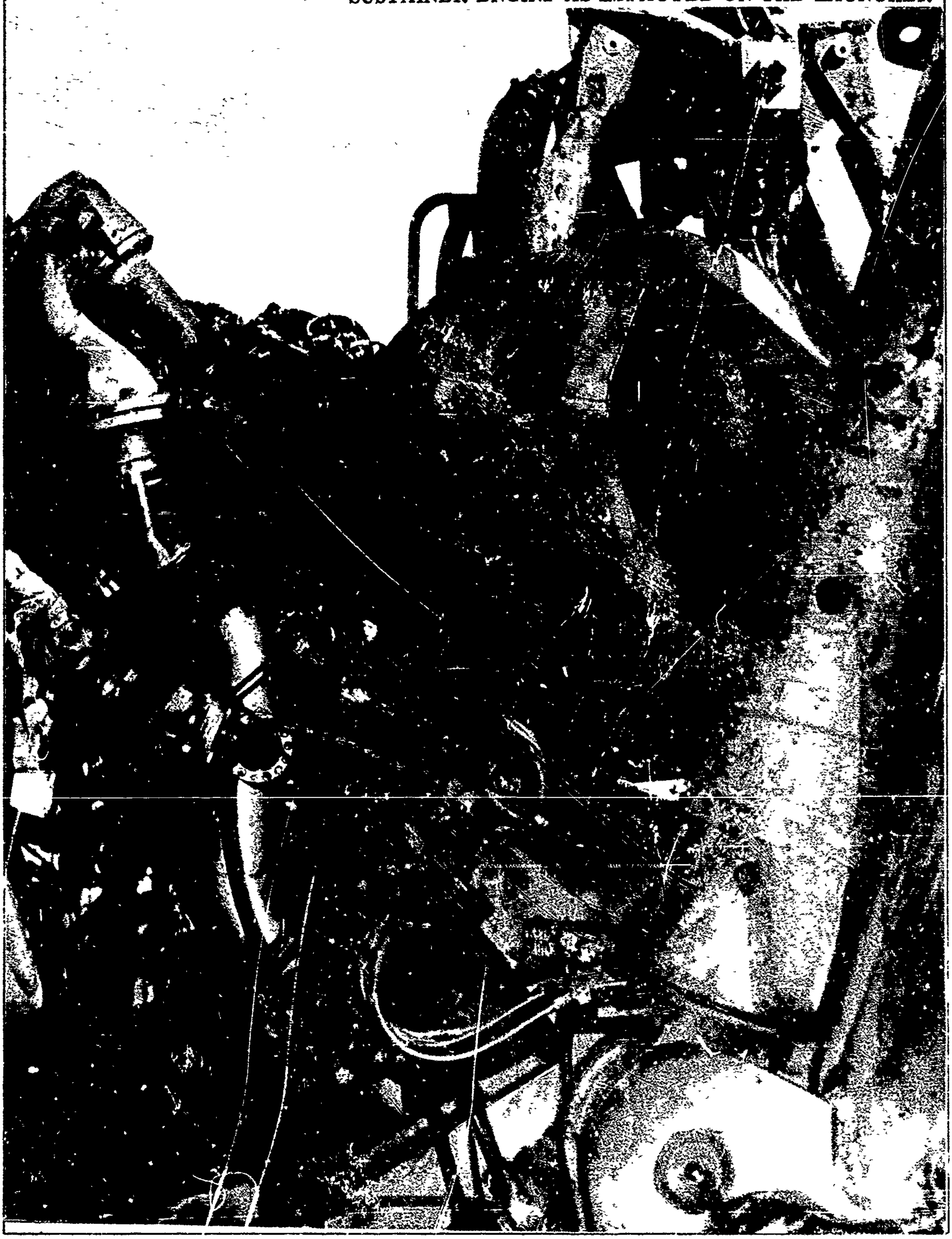
SUSTAINER ENGINE AS IMPACTED ON THE LAUNCHER



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SUSTAINER ENGINE BEING LIFTED FROM THE LAUNCHER
NOTE THE FUEL PUMP INLET DUCTING

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FORM NO. A-703-2

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SUSTAINER ENGINE AFTER REMOVAL FROM THE LAUNCHER
NOTE THE HIGH PRESSURE FUEL DUCTING

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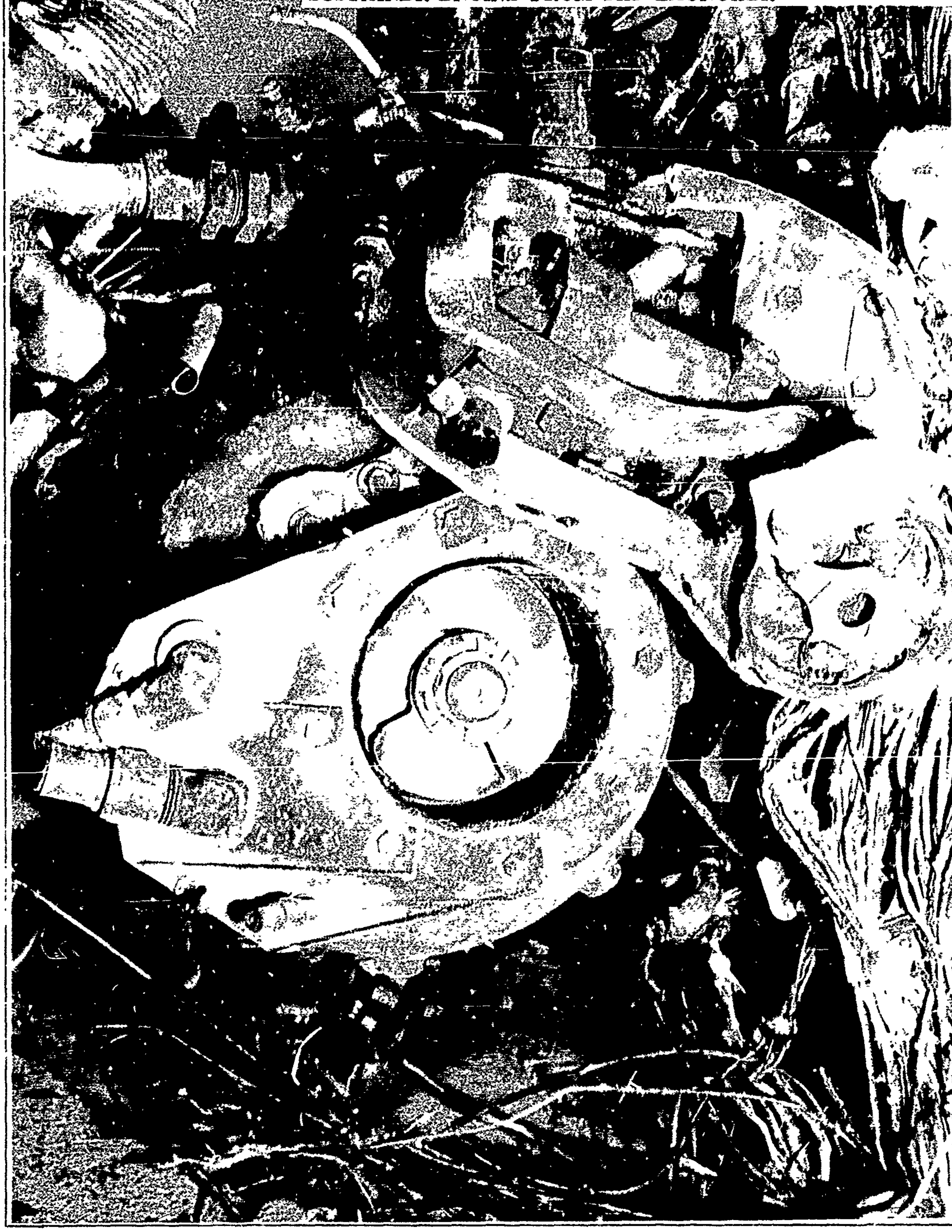
SUSTAINER LO2 PUMP INDUCER AFTER REMOVAL OF THE SUSTAINER ENGINE FROM THE LAUNCHER



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LN2 SHROUD AND HELIUM TANK BOTTLES LODGED AT BRIDGE OVER FLUME

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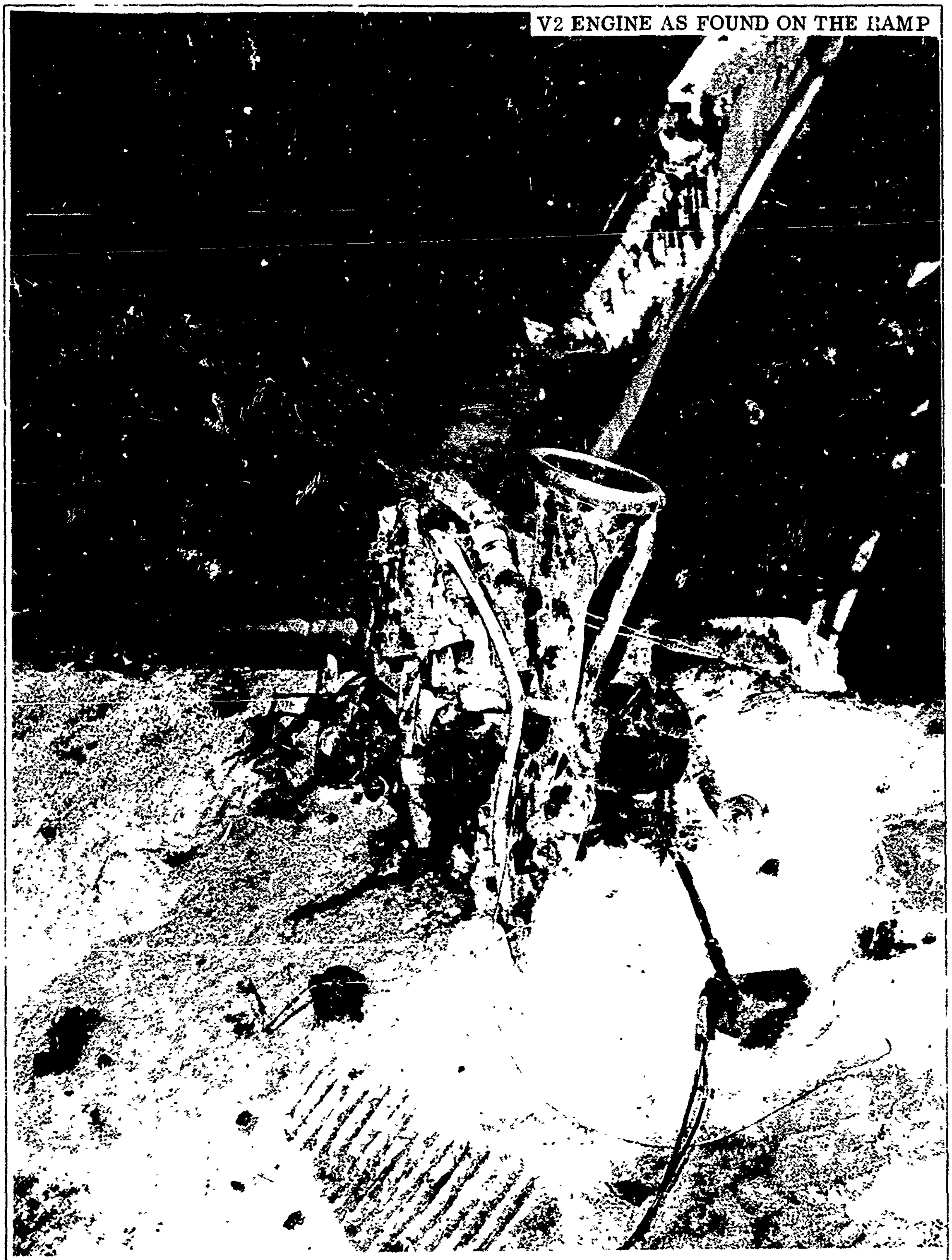

V2 ENGINE AS FOUND ON THE RAMP

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BOOSTER SECTION OF THE LO2 RMI VALVE FOUND NEXT TO THE NORTHWEST FENCE BEYOND PERIMETER ROAD

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BOOSTER SEPARATION FITTING FOUND ON PERIMETER ROAD EAST OF THE RAMP

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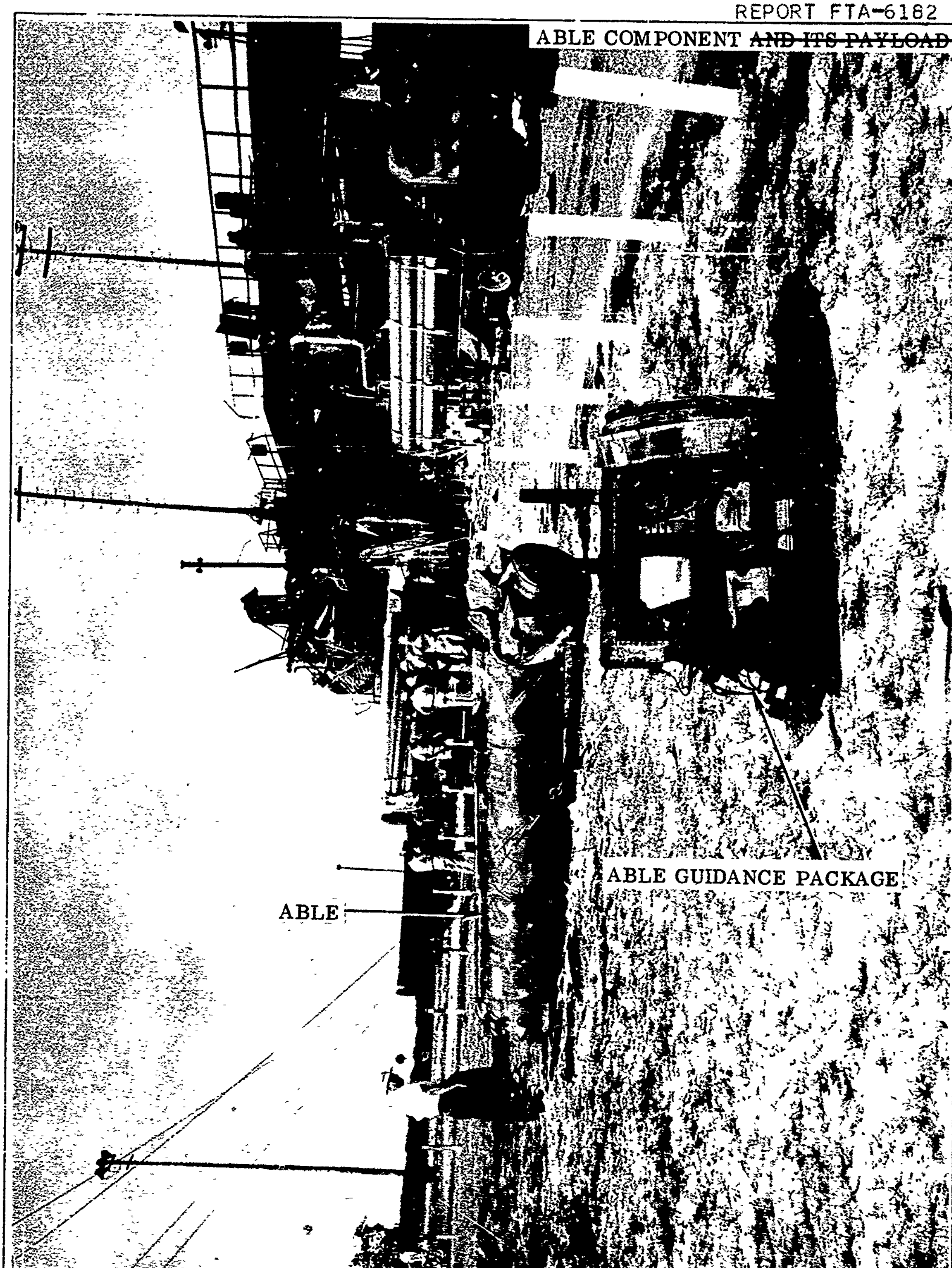

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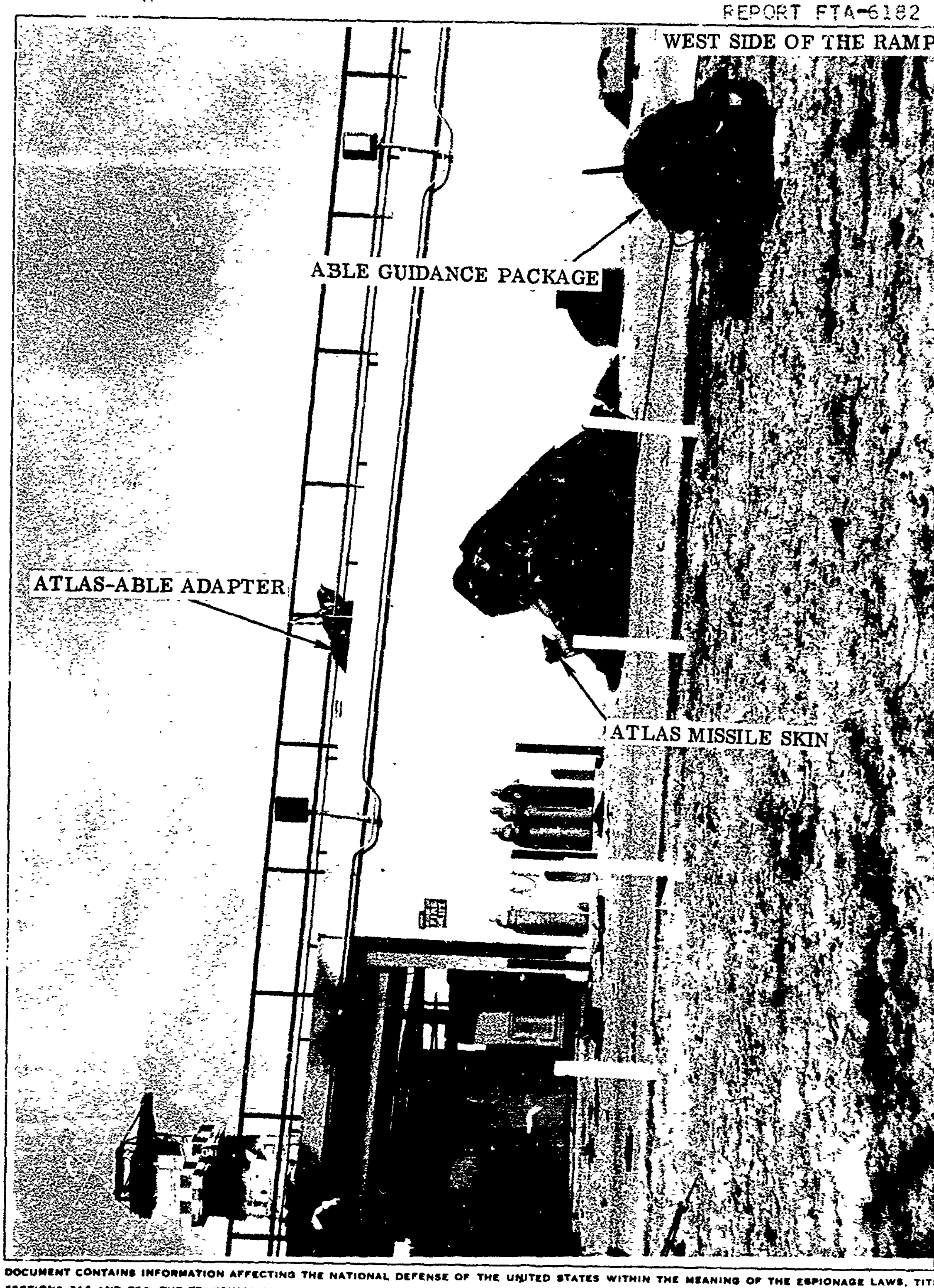

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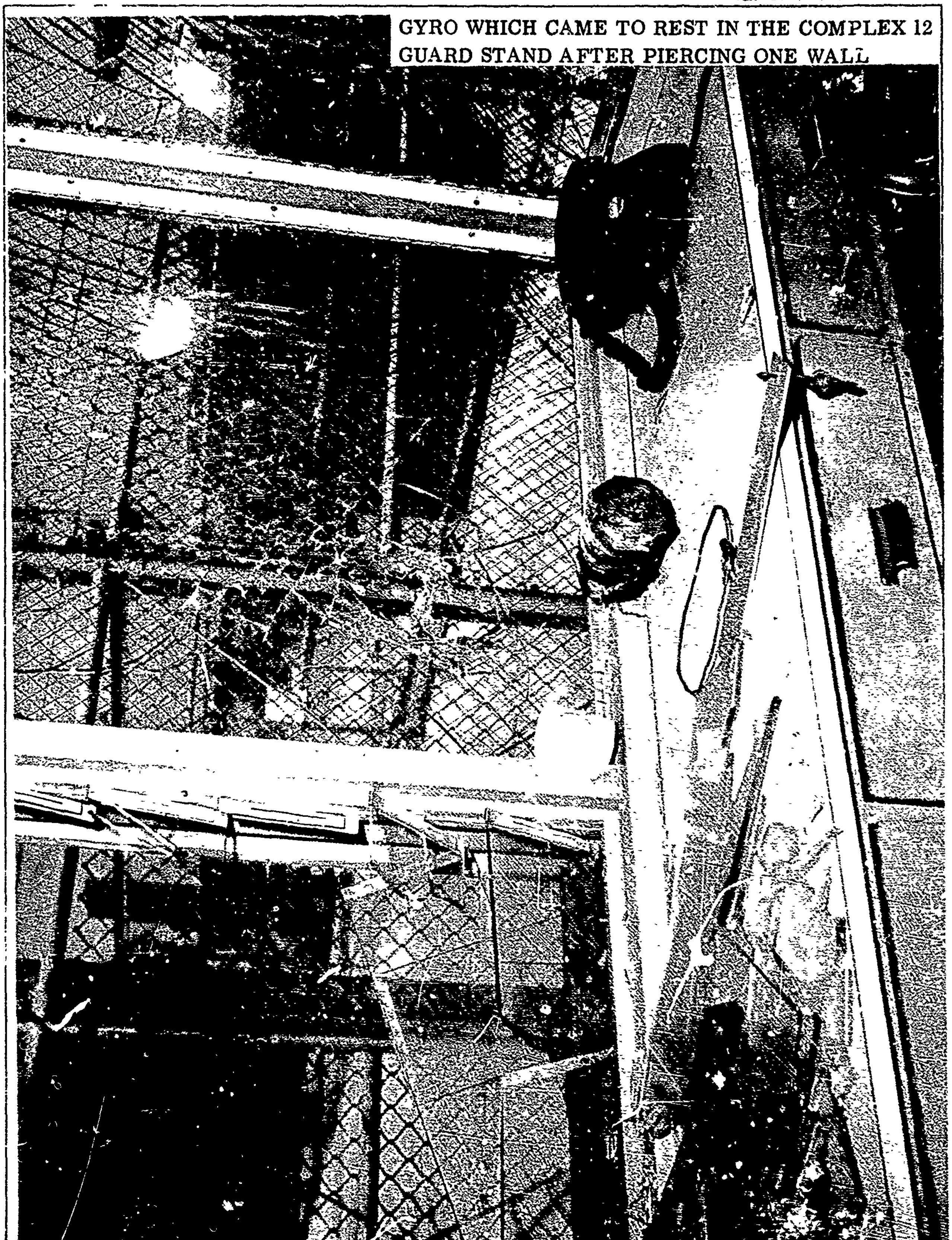

GYRO WHICH CAME TO REST IN THE COMPLEX 12 GUARD STAND AFTER PIERCING ONE WALL

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COMPLEX FACILITY DAMAGE

The test stand was extensively damaged so that a portion of the stand will have to be rebuilt from the ground up. Added damage occurred in the equipment shelter building in back of the blockhouse, to the ready room, the guard house, the fuel area, and the LO2 area. The service tower was in the maintenance area and was relatively undamaged. Approximately ten pieces of mobile equipment partially owned by AMR and Convair were destroyed.

Damage To Launch Stand

The launch stand structure from the north end of the instrumentation and transfer room to the south side of the drive-thru (a distance of about 58 feet) was collapsed by the explosion and will require dismantling and complete rebuilding from the ground up. Extensive damage was done to the other parts of the approach ramp and the support beams around the flame bucket are distorted; however, the support columns of the launcher and basic structure in other areas appear to be sound. All the enclosed rooms beneath the ramp suffered interior damage since all siding was blown off. An extensive amount of electrical work will be necessary in rebuilding the stand. Only the electrical conduits and wires in the south end of the ramp area appear to be useable, and this is a small part of the electric wiring on the stand. Extensive mechanical work such as fire protection, piping, high pressure gas and propellant piping will require complete rework or replacement. The flame bucket is undamaged, service tower tracks are undamaged, and the flume leading out to the skimming basin is undamaged. Both umbilical towers were completely destroyed. The launcher appears to be intact but is probably damaged beyond repair.

Other Area Damage

Damage in the fuel area was negligible except the transfer unit, which was completely destroyed. Damage in the liquid oxygen area was essentially negligible, only sheet metal damage to the transfer unit and to the liquid nitrogen subcooler. The cable tray to the blockhouse was damaged considerably at the stand end where many of the cables were burned. The water valve pit suffered minor damage when the concrete block curb around the top of the pit was blown in and damaged many of the water gauges in the pit. The light standards in the vicinity of the pad will require relighting. In the service tower, which was at the far end of the track, corrugated fibre glass panels were damaged and the glass window in the driver's cab was broken due to the shock. Elevator repairs are required.

Windows on the east side of the ready room were blown out. The guard shack at the main gate has all windows broken and shrapnel holes thru the walls. The equipment shelter in back of the blockhouse suffered superficial damage such as the plaster cracking in the latrine and loosening of the corrugated asbestos siding panels.

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For expeditious purposes, the Range Contractor, Pan American Airways, has been elected to perform certain services in assistance to Convair in the appraisal of damage. This work is presently under way and has been completed including the transfer area portion. The task as such for rehabilitation of the stand through special effort will probably be confined to the local test stand area and the fuel systems area. It is anticipated that this appraisal will be concluded 4 October.

All Test Ground Support Equipment, with the exception of inaccessible portions located in the transfer room, has been reviewed and placed in a preselected area for purposes of inspection and evaluation. Four categories have been established relating to the extent of damage:

1. Relatively no damage; use as is.
2. Minor type damages; repair with the assistance of Convair Shops and/or Range Support Contractor.
3. Recommended for re-use; requiring vendor or subcontractor refurbishment and testing.
4. Recommended for scrap salvaging, possible components for spares. Disposition to Scrap Salvage Yard, AMR or Astronautics, San Diego.

It is anticipated that additional items will be added to this list after further inspection of the damaged area.

Definite reviews have been made of this equipment and necessary quality control action has been taken. According to the appropriate category, disposition will be made by 7 October; this includes subcontractor repair and/or rebuild.

Severable facilities have been removed. Items are presently under evaluation for possible future use. Disposition to be in accordance with recommendations from local AMR personnel.

Separate evaluation of damage has been undertaken by Convair, AMR personnel and Installation - Corps of Engineers group. The Corps of Engineers has been given all authority to proceed with rehabilitation of the Test Stand and Fuel Area, without consideration for the TGSE and "D" series modification. Bid information regarding costs and schedules is available through Plant Engineering, Department 250.

It is presently planned that work by the Corps of Engineers will commence on Sunday 4 October 1959. This work is generally in agreement with Convair's recommendation regarding stand rehabilitation. Corps of Engineers personnel and associated groups have been furnished work space area in the Convair, AMR Complex #12 ready room.

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A Sales Order has been released, dated 1 October 1959, regarding Order #2-1-62, Work Order #514-5502. This particular Sales Order relates to letter contracts, Supplemental Areeement #13, pertinent to AF Contract 04 (645)-4 regarding TGSE installation and related modifications. This Sales Order has been released under Mr. C. W. Blakey, Manager of Contracts, concurred in by Mr. F. D. Robbins, Deputy Air Force Plant Representative, Convair-Astronautics. The document is addressed to AMC Ballistic Missile Center, Los Angeles, California.

The TGSE installation will proceed as originally designated and with the approval of the Corps of Engineers on scheduled joint occupancy dates. The TGSE installation will commence for "D" series modifications in approximately 8 to 10 weeks. This is premised upon availability of Transfer Room, structural steel, mechanical areas and conduit ducting.

Other subcontractors performing work formerly conceived on work orders submitted through the AMC Ballistic Missile Center have been invited to review damages and evaluate the status of work under contract. They will advise the coordinator on recommended action and revised schedules.

Work on areas outside the test stand and fuel system areas, including the service tower, blockhouse, guard shack, ready room, and LO2 areas, will be refurbished on normal work order through the range support contractor.

Not considering the transfer room area, which has been designated a hazardous area by Convair and range support safety groups, clean-up of the other rooms and outside slab locations has been attended to very adequately.

It is presently estimated that a total of four and one-half months will be required to place the complex in an operational "D" Series configuration.

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RAMP SHOWING COLLAPSE OVER THE TRANSFER ROOM

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PART OF THE ABLE UMBILICAL TOWER NEXT TO THE FUEL STORAGE BLAST WALL

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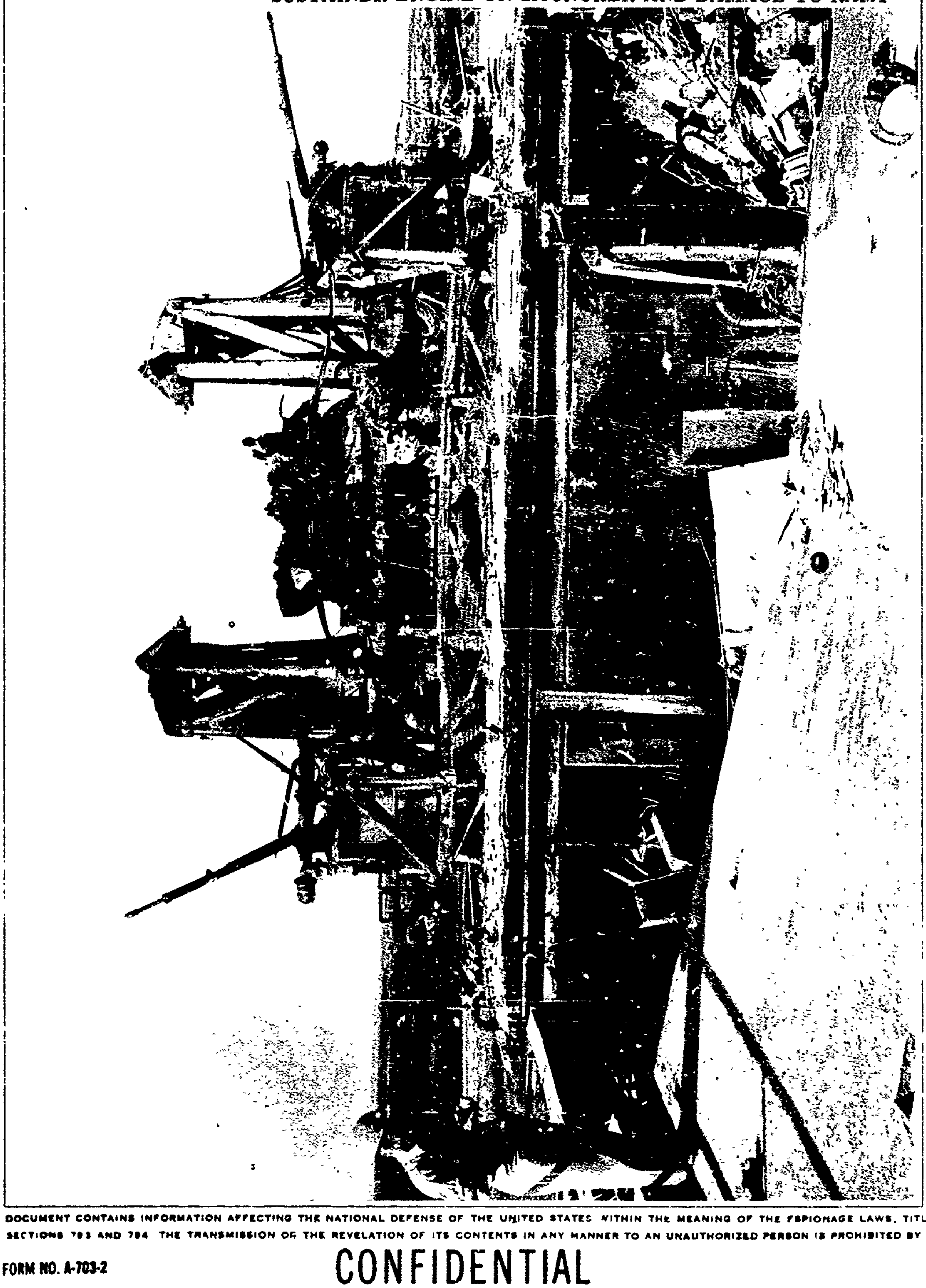
SUSTAINER ENGINE ON LAUNCHER AND DAMAGE TO RAMP



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RAMP IMMEDIATELY IN FRONT OF TH- LAUNCHER
OVER THE TRANSFER ROOM

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DAMAGE TO THE WEST SIDE OF THE RAMP
OVER THE TRANSFER ROOM

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DAMAGE TO THE EAST SIDE OF THE RAMP OVER THE TRANSFER ROOM

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TRANSFER ROOM AREA FROM WEST SIDE ABOVE

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SHEARED LOAD CELL---QUAD IV

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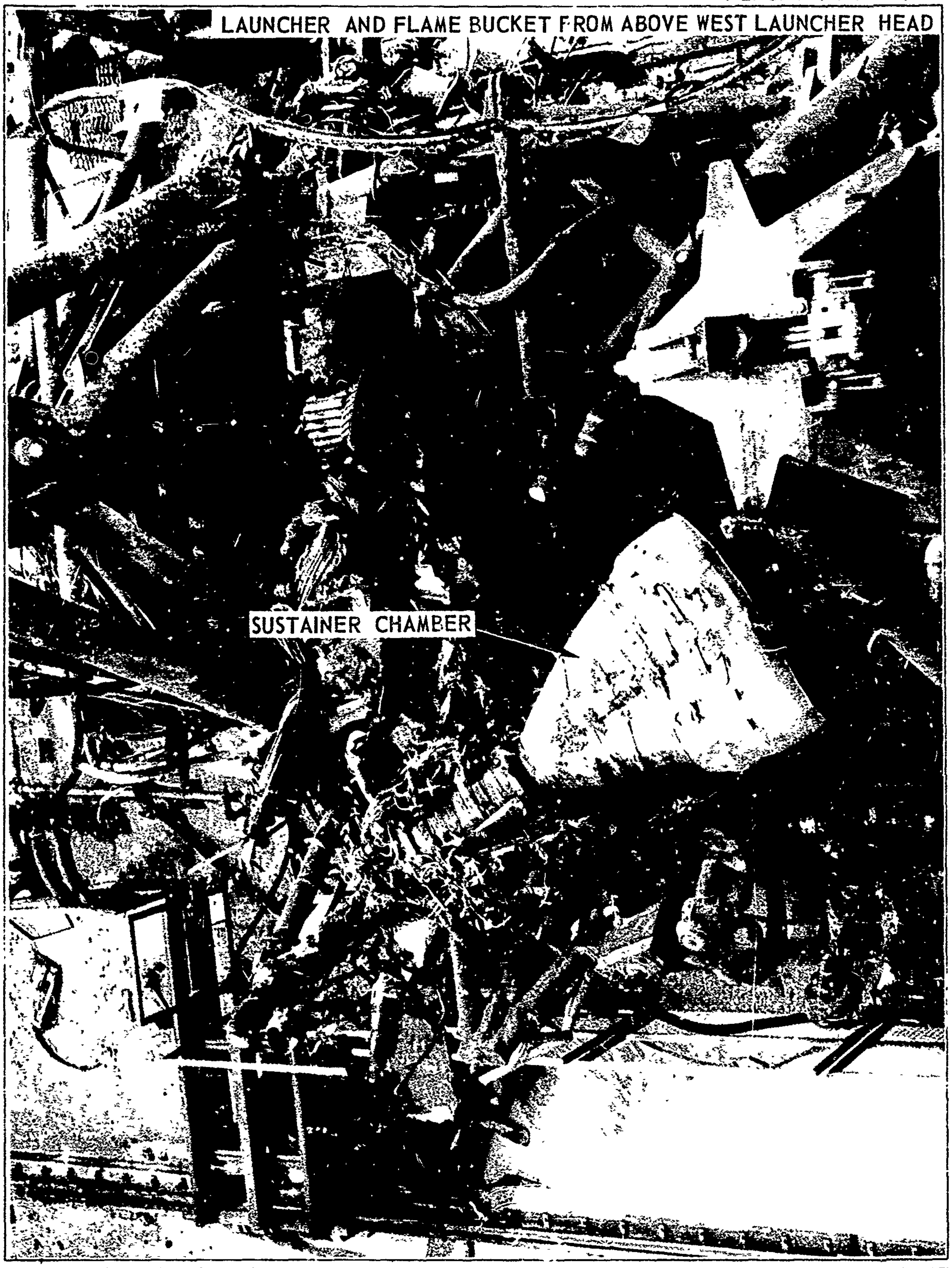

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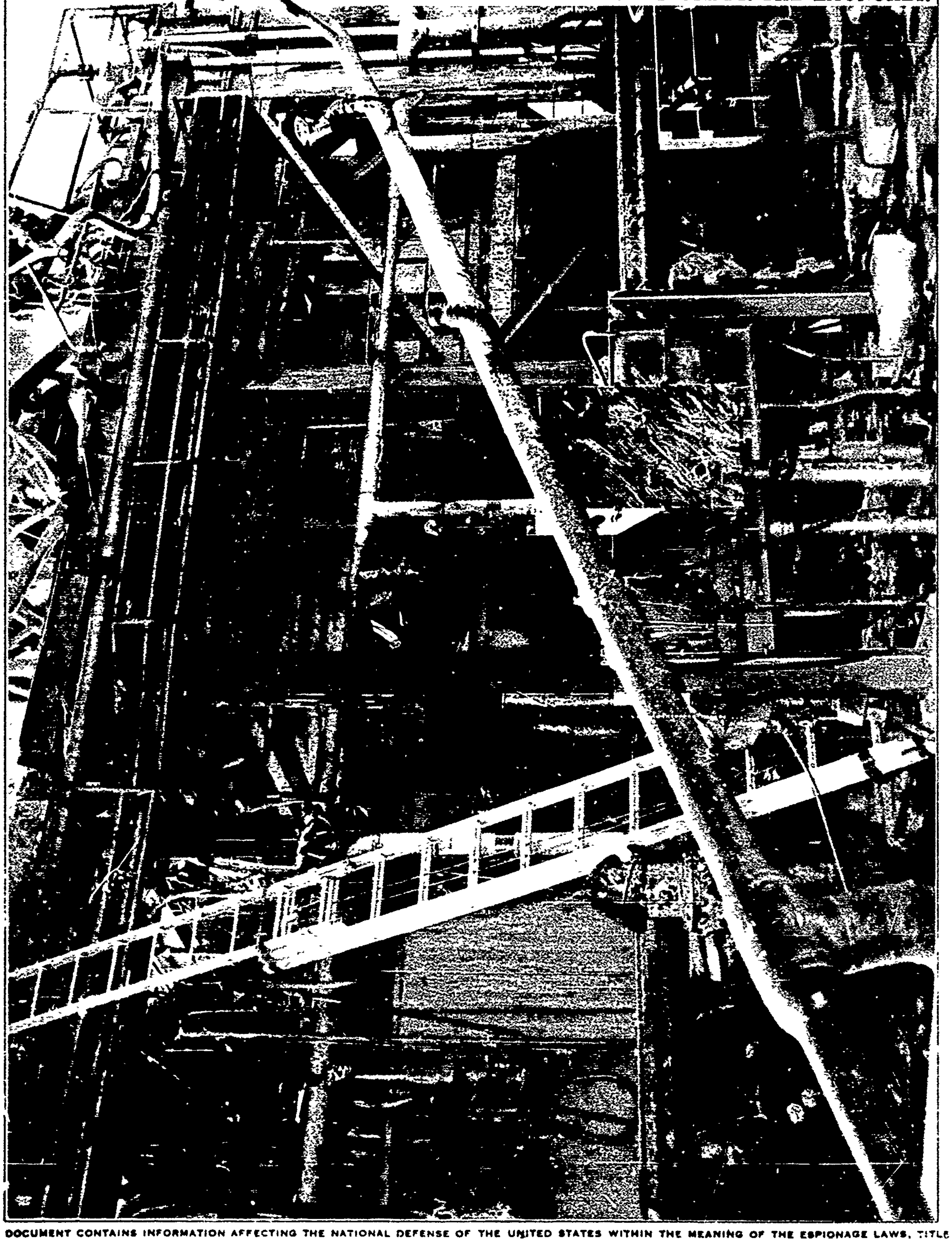
EAST SIDE OF THE RAMP UNDER THE LAUNCHER



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PART OF THE ABLE UMBILICAL TOWER ON PERIMETER ROAD EAST OF THE RAMP

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CONVAIR ASTRONAUTICS

PAGE NO.

REPORT FTA-6182

INTERIOR OF THE COMPLEX 12 READY ROOM

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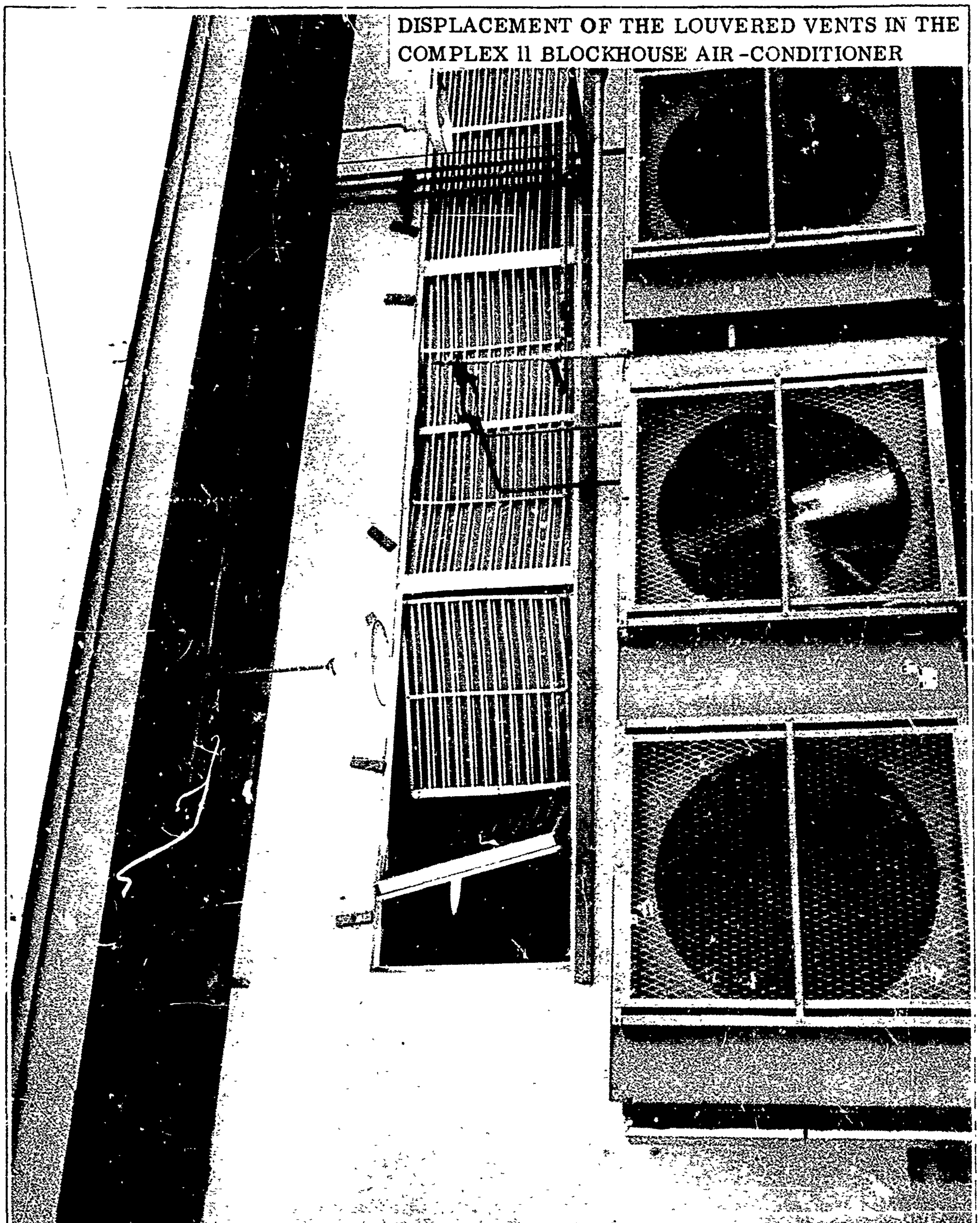
DISPLACEMENT OF THE LOUVERED VENTS IN THE COMPLEX 11 BLOCKHOUSE AIR-CONDITIONER



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CONDITION OF SERVICE TOWER

Second Deck

All panels in west side blown out, no structural damage to principal frames.

Elevator control switch on west side blown loose.

Approximately 25 percent of north side curtain straps ripped loose.

Tower door on west elevator blown loose, east tower door in place and retracted.

East tower door from deck 9 jammed in open door at second level.

Overhead light in east elevator blown out.

P/N 7-36085-5 power changeover switch on S.W. wing from missile.

Third Deck

All panels on west side blown out.

STL telephone wire from eleventh deck broken.

Light shade near elevator on west side blast damage.

Firex system on west side bent by blast. Remove and replace, new hangars required.

Electrical conduit and conduit box bent and ripped loose. N.W. corner.

Pressurized waveguide on N.W. corner damaged.

Fourth Deck

All West paneling blown out.

West elevator corridor paneling blown loose.

Fifth Deck

East tower elevator door blown loose.

Torn curtains on N.E. side.

All west panels blown loose.

Light shade in west elevator corridor bent.

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Fifth Deck (cont'd)

Small electrical part of missile on deck in west elevator corridor.

Sheet metal panel support in west elevator corridor damaged.

Sixth Deck

All west panels blown loose.

Approximately 10 percent curtain straps torn loose on north curtain, zipper torn out.

East elevator door blown loose.

Hole in curtain on N.W. corner.

Seventh Deck

All west panels torn loose.

Curtain torn on N.W. corner.

Electrical plug from missile on west deck (CBWT VG 88 C/V)

Eighth Deck

Approximately 95 percent west panels blown loose.

Ninth Deck

West tower elevator door blown loose.

East tower elevator door blown clear, on second deck.

North tower curtain ripped in N.W. corner.

Small curtain in S.W. corner destroyed.

North curtain torn in lower N.E. corner.

Tenth Deck

West tower elevator door blown loose.

North curtain torn two places in lower N.W. corner.

Eleventh Deck

Both tower elevator doors blown loose.

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Twelfth Deck

All okay.

Thirteenth Deck

All west side fiberglass paneling gone.

Fourteenth Deck

All okay.

Penthouse

Door blown loose.

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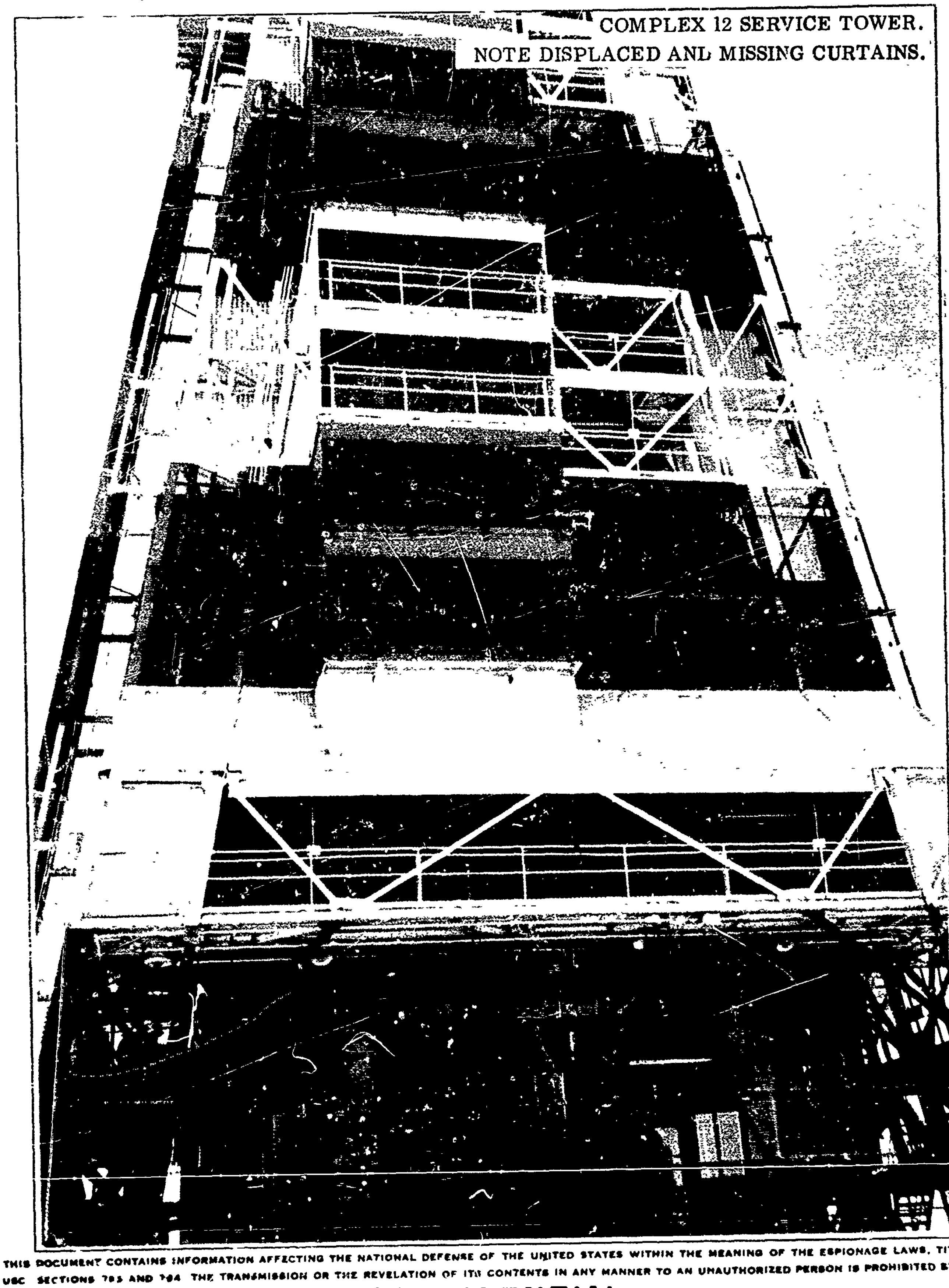

COMPLEX 12 SERVICE TOWER.
NOTE DISPLACED ANL MISSING CURTAINS.

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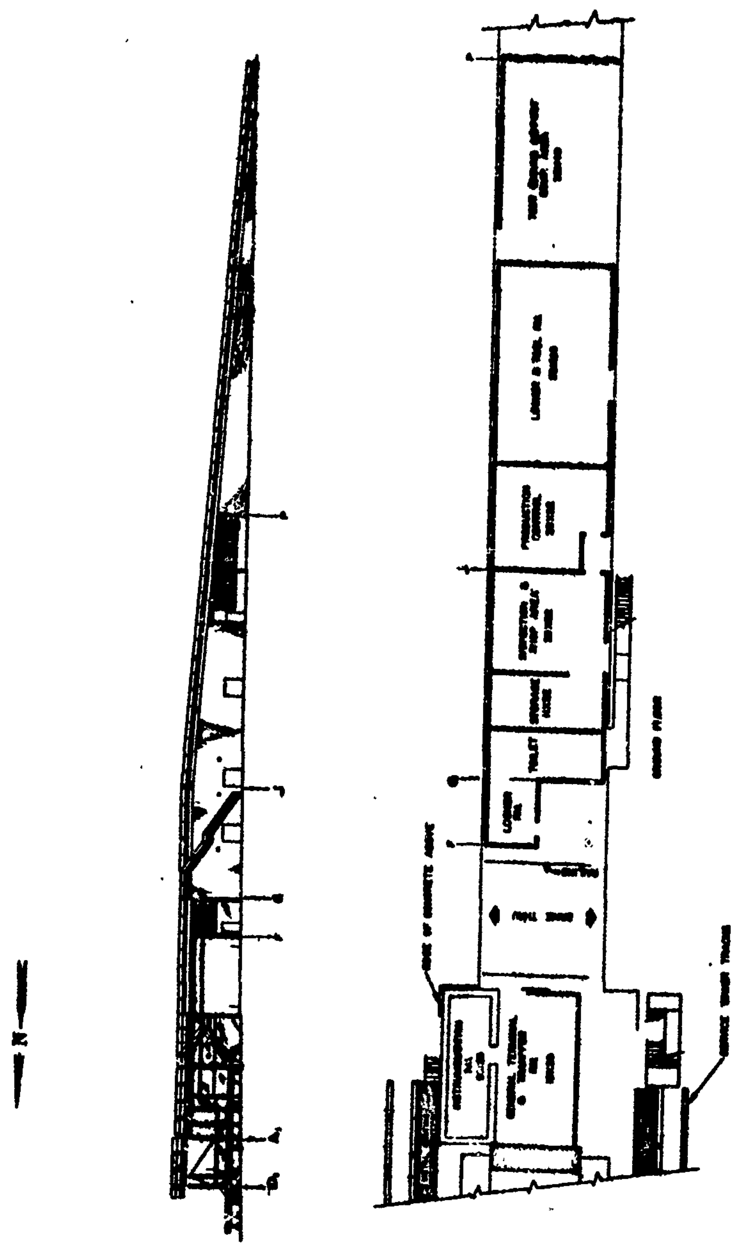
APPROACH RAMP
COMPLEX 12



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DETAILED DAMAGE ASSESSMENT

Mechanical Systems

LO2 System

LO2 fill line, LO2 topping line and LO2 dump line - all north of trench will have to be disassembled, checked, cleaned and re-insulated. Some replacement will be necessary.

GN2 System

Most piping, valves, gages, etc., north of trench must be replaced.

HE System

Complete piping system must be replaced.

LN2 System

Complete system must be replaced.

Fuel System

All piping on test stand - replace.

Fuel Area

a. Fuel transfer unit - complete replacement.
b. All piping - pressure check and clean.
c. All valves - disassemble, check and clean.
d. Fuel tank - inspect and clean.
e. Filter - clean and pressure check.
f. Totalizer - disassemble, check, calibrate and reassemble.

LO2 Area

a. Reinsulate LO2 topping heat exchanger.
b. Straighten and replace sheet metal on transfer unit.

Water System

Remove and replace all piping above ground level with the following exceptions:

a. Flame bucket cooling - remove valves, clean and check for proper operation. Pressure check pipes.

b. Tower Firex - pressure check stub-up.

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Water Systems (Cont'd)

c. Some piping on west side of stand may be usable if it withstands pressure checking.

Valve Pits

Clean up and replace gauges.

Pressurization System

Replace all ducting north of stub-up in electrical room.

Pod Cooling System

Replace all piping and ducts north of column line "G".

Instrument Room Air Conditioning

Replace completely.

Hydraulic Pneumatic Piping

Replace completely.

Launcher Area

Replace Launcher and all associated mechanical parts.

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ELECTRICAL SYSTEMS

Instrumentation and Transfer Room

All equipment in this area complete loss.

Communication - Transfer Room Termination

a. Complete loss.
b. Possibility of cable splice.
c. All terminal equipment must be replaced.

Cable Tray and Pit (Landline) - severely damaged

a. All landline cables severed entering Transfer Room - will require replacement. Convair and STL states cannot be spliced.
b. Tray covering damage - slight except at east end, which is severely damaged.

Mops System

Complete loss in Transfer Room Terminal Box

a. Replace cables with possibility of splices.
b. All racks to be replaced.
c. Validation.

Facility Power - Complete loss in test stand - transfer room

Ramp Area - North of Column "J"

a. Possibility of splices in Manhole 5.
b. Check manhole and conduit from No. 5 to 6.
c. Conduit stub-ups probably damaged into transfer room.
d. Validate system.

LO2 Area

Electrical okay.

Fuel Areas

a. Electrical Facility Receptacles - good condition.

   (1) Recheck wiring.
   (2) Megg wiring out.
   (3) Repaint receptacles.

b. Warning Light

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Warning Light (continued)

(1) Appears to be okay - check foundation.
(2) Repaint.
(3) Megg connections.

c. Light Pole

(1) Check for alignment.
(2) Remove wiring.
(3) Replace all fixtures.
(4) Repaint.

P. A. System - Ramp Area

a. All new equipment in loss area.
b. New cable from blockhouse - splice if possible.
c. Validate wiring.

West Side of Test Stand

a. Receptacle Stand

(1) Remove wiring.
(2) Clean and check circuit breakers.
(3) Replace damaged fixtures.
(4) Paint stand and receptacle.

b. Street Lighting

(1) One Light pole bent.
(2) One light pole bent - to be replaced.
(3) check wiring.
(4) Replace fixtures and/or wiring.
(5) Paint.

c. Flood Light (hard hat area)

(1) Seems alright.
(2) Check wiring.
(3) Repaint.

East Side of Test Stand

a. Street Light:

(1) Check wiring.
(2) Repaint.

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Ramp Lighting

a. Flood Light - East Side:

(1) Remove fixtures.
(2) Check wiring to "J" Box.
(3) Megg Out.
(4) Repaint.

b. Flood Light - West Side - complete loss:

Remove and replace.

c. South of Column "J":

(1) Replace all broken fixtures.
(2) Check all wiring to "J" Box.
(3) Replace all broken fixtures.

d. North of Column "J"

Complete loss.

Camera Pads along Perimeter Road

a. Appeared tc be little or no damage.
b. Recheck and megg wiring.
c. Repaint as necessary.

Service Tower and Area

Substantially intact.

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TEST GROUND SUPPORT EQUIPMENT AND SEVERABLE FACILITY DAMAGE REPORT COMPLEX 12

Condition Code
1. Relatively no damage; use as is.
2. Minor type damages; repair with the assistance of Convair shops and/or range support contractor.
3. Recommended for re-use; requiring vendor or subcontractor refurbishment and testing.
4. Recommended for scrap salvaging, possible components for spares. Disposition to scrap salvage yard, AMR or Astronautics, San Diego.

LIST NO. I MAJOR ITEMS TGSE

END ITEM NO.	TGSE INV. NO.	P/N	ITEM	COST	COND. CODE	LOCATION IF REMOVED FROM COMPLEX 12	DATE AND TIME REMOVED FROM COMPLEX 12	REMARKS
61		7-89507-1	Trailer, Liquid Nitrogen	$35,337	1	Complex 11	24 Sept. PM	Req'd for scheduled operation
61		7-89507-1	Trailer, Liquid Nitrogen	$35,337	1	Complex 11	24 Sept. PM	Req'd for scheduled operation
61	1058	7-89507-1	Trailer, Liquid Nitrogen	$35,337	2	Hangar "K"	28 Sept. AM	Req'd for scheduled operation
61		7-89507-1	Trailer, Liquid Nitrogen	$35,337	3	----------	----------	
61		7-89507-1	Trailer, Liquid Nitrogen	$35,337	3	----------	----------	
NAA 6.5	0156	9636-55587-31	Pneumatic Test Console	Unknown	2	----------	----------	
NAA 18.8	0614	902701	Cart Trichlor Flushing	Unknown	2	----------	----------	
NAA 18.5	0170	9636-55501-41	Lube Oil Service Unit	Unknown	2	----------	----------	
63	0583	7-09241	Trailer, Hyd. Pneu. Supply Unit	$65,135	4	----------	----------	Check for future requirement
63	0598	7-09241	Trailer, Hyd. Pneu. Supply Unit	$65,135	4	----------	----------	Check for future requirement

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END ITEM NO.	TGSE INV. NO.	P/N	ITEM	COST	COND. CPDE	LOCATION IF REMOVED FROM COMPLEX 12	DATE AND TIME REMOVED FROM COMPLEX 12	REMARKS
63	0763	7-09241	Trailer, Hyd. Pneu. Supply Unit	$65,135	4	----------	----------	Check for future requirement
58.2	0571	7-89505-1	Compressor, Helium	$[illegible],412	2	----------	----------	Check for future requirement
58.2		7-89505-1	Compressor, Helium	$49,412	2	----------	----------	Check for future requirement
55	0241	7-02221	Tanking Unit, Missile Fuel	$88,724	4	----------	----------	
67	0389	7-06205	Motor Generator, 400 Cycle	$16,992	3	----------	----------	
62	0759	7-89510-1	Control Unit, Pressurization, Missile (PCU - Control Unit, H-2 Heat Exchanger)	$106,282	3	----------	----------	Return to San Diego for possible repair and disposition
64	0348	94-22000-001	Generator, Diesel, Emergency AC Power	$30,597	1	----------	----------	Located equip. shelter behind blockhouse
64.1	1067	27-06127-1	Load Bank, Diesel Engine Generator	$ 1,390	1	----------	----------	Located equip. shelter behind blockhouse
77.0	0613	7-54373	Checkout Equip. Mobile Telemetering	$528,519	1	Hangar "K"	25 Sept. PM	
359		27-52565-1	Equip. Inst. Missile System Check	$198,000	1	Hangar "K"	25 Sept. PM	
76	0360	7-89506-1	Air Cond. Unit A Series Keco	$27,004	1	Hangar "K"	26 Sept. AM	
L-5	313	7-66000-3	Trailer, Power Distb. A to C	$31,000	1	Hangar "K"	28 Sept. PM	
54	0244	7-02222	Transfer Unit, LO2	$69,909	2	----------	----------	
			Heat Exchanger Vaporizer		2	H--------	----------	Component End Item #54

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END ITEM NO.	TGSE INV. NO.	P/N	ITEM	COST	COND. CODE	LOCATION IF REMOVED FROM COMPLEX 12	DATE AND TIME REMOVED FROM COMPLEX 12	REMARKS
18.2.1		7-4945-2-829	Service Lines and Equip.	$80,000	4	Hangar "K"	30 Sept. AM	
		7-49452-815	Installation, Launcher					
3.1.1		7-96015-3	Flame Deflector	$ 8,646	1	----------	----------	
9.0.2		7-96109-827	Service Tower, Missile	$167,500	2	----------	----------	
76.3.4		7-08620-5	Air Cooling System Missile	$65,070		----------	----------	
76.3.4			Pod Cooling Evaporator		1	----------	----------	
76.3.4			Air Handling Unit		4	----------	----------	
76.3.4			Pod Cooling Duct		4	----------	----------	
10		7-09237	Transfer Table	$173,185	1	----------	----------	
9.3.1		7-49340-1	Tower Installation, Nosecone Umbilical Support	$21,901	4	Salvage	29 Sept. PM	
9.4		7-04392-1	Tower Second Stage Service AMR 12	$160,900	4	----------	----------	
76		7-89506-1	Air Cond. Unit Keco	$27,004	3	----------	----------	
61.1		7-89511-1	R V U	$28,996	3	----------	----------	To be evaluated by Engr. and shop prior to final disp.
4.1		7-09383-1	Cover, Flame Pit Assy.	$ 4,216	2	----------	----------	
5.3		7-09377	Ladder Maintenance Flame Deflector	$ 1,894	1	----------	----------	
7.1		7-09281-1	Safety Net, Flame Deflector	$ 558	2	Hangar "K"	1 Oct. AM	Requires Safety Check

NOTE: Numerous TGSE Items cannot be shown on this report until access and cleanup can be accomplished in the Transfer Room Area. It can be assumed that the majority of items will be condition code 4.

LIST NO. 2: MAJOR SEVERABLE FACILITY ITEMS (NOT INCLUDING TEST EQUIPMENT)

INV. NO.	ITEM	COST	COND. CODE	LOCATION IF REMOVED FROM COMPLEX 12	DATE AND TIME REMOVED FROM COMPLEX 12	REMARKS
US-3795	Trailer, Tube Bank, Helium	$11,563	1	Hangar "K"	26 Sept. AM	Gauges calibrated 28 Sept. and returned to service
10270	Pumping Unit	$ 284	1	----------	----------	
US-1228	Truck, Fork Lift	$ 6,498	2	Hangar "J"	30 Oct. AM	
US-1167	Trailer, Tube Bank, Helium	$11,563	3	----------	----------	Repair to be handled by Base Support. Est. repair cost $3,000
US-1775	Trailer, Tube Bank, Helium	$11,563	1	Hangar "K"	26 Sept. AM	Gauges calibrated 28 Sept. and returned to service

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LIST NO. 3 SEVERABLE FACILITY ITEMS DAMAGED BEYOND ECONOMICAL REPAIR

INVENTORY NUMBER	ITEM	COST
US-4174	Voltmeter, 666-SC S/N 24	$ 40.00
US-4181	Voltmeter, 666-SC	$ 40.00
US-4104	Voltmeter, 666-SC	$ 40.00
US-4111	Voltmeter, 666-SC	$ 40.00
US-4319	Voltmeter, 630-A S/N 29530	$ 60.00
10374	Head Light	
10372	Head Light	
10375	Head Light	
10373	Head Light	
US-1475	Drill, Elec. 1/2" S/N AD 7633	$ 26.00
US-4586	Drill, Elec. 3/4" S/N 531600	$119.00
US-3294	Drill, Elec. 1/2" S/N [illegible]737523	$ 27.00
US-4585	Drill, Elec. 3/4" S/N 531603	$119.00
US-4616	Drill, Elec. 1/4" S/N 350306	$ 45.00
US-4604	Drill, Elec. 1/4" S/N 350340	$ 45.00
US-4625	Drill, Elec. 1/4" S/N 350314	$ 45.00
US-4610	Drill, Elec. 1/4" S/N 350320	$ 45.00

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LIST NO. 3 SEVERABLE FACILITY ITEMS DAMAGED BEYOND ECONOMICAL REPAIR

INVENTORY NUMBER	ITEM	COST
US-4590	Drill, Elec. 1/4" S/N 350338	$ 45.00
US-4594	Drill, Elec. 1/4" S/N 350311	$ 45.00
US-4609	Drill, Elec. 1/4" S/N 350345	$ 45.00
US-0675	Desk, Exec.	$ 90.00
US-2356	Desk, Exec.	$ 90.00
US-0772	Desk, Exec.	$ 90.00
US-3167	Cabinet, File 5 Dwr	$185.00
US-2038	Cabinet, File 5 Dwr	$ 63.00
US-4242	Locker	$ 30.00
US-4301	Locker	$ 30.00
US-4289	Locker	$ 30.00
US-4239	Locker	$ 30.00
US-4249	Locker	$ 30.00
US-1854	Bin Storage	$ 23.00
US-4300	Locker	$ 30.00
US-4290	Locker	$ 30.00
US-1830	Bin Storage	$ 23.00

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INVENTORY NUMBER	ITEM	COST
US-2020	Bin Storage	$ 23.00
US-3198	Cabinet, 2 Dwr.	$ 20.00
US-0934	Bin Storage w/door	$ 45.00
US-0697	Desk, Exec.	$ 90.00
US-4291	Locker	$ 30.00
US-4288	Locker	$ 30.00
US-4302	Locker	$ 30.00
US-4244	Locker	$ 30.00
US-4299	Locker	$ 30.00
US-0936	Bin Storage	$ 23.00
US-4246	Locker	$ 30.00
US-3569	Locker	$ 30.00
US-4247	Locker	$ 30.00
US-3662	Cabinet	$ 92.00
US-3658	Cabinet	$ 92.00
US-0920	Bin Storage	$ 23.00
US-0938	Bin Storage	$ 23.00
US-2017	Bin Storage	$ 23.00

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INVENTORY NUMBER	ITEM	COST
US-2606	Bin Storage	$ 23.00
US-0935	Bin Storage	$ 23.00
US-1164	Bin Storage	$ 23.00
US-0933	Bin Storage	$ 23.00
US-0937	Bin Storage	$ 23.00
US-0187	Ladder Step 6' Foot	$ 20.00
US-1389	Ladder Step 10' Foot	$ 27.00
US-3213	Bench, Work Laminated	$ 89.00
US-4278	Water Cooler	$150.00
US-2626	Bench, Work	$ 60.00
US-3661	Cabinet	$ 92.00
US-3370	Bin, Roto	$ 40.00
US-3385	Bin, Roto	$ 40.00
US-2628	Bench, Work	$ 60.00
US-2629	Bench, Work	$ 60.00
US-3216	Bench, Work	$ 89.00
US-2376	Vise, Wilton	$ 17.00
US-2377	Vise, Wilson	$ 17.00

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INVENTORY NUMBER	ITEM	COST
US-2389	Vise, Pipe	$ 17.00
US-2634	Bench, Work	$ 60.00
US-2631	Bench, Work	$ 60.00
US-1234	Arbor, Press	$ 56.00
US-2195	Grinder (Dual Wheel)	$ 65.00
US-2373	Vise	$ 17.00
US-2530	Bench, Work	$ 89.00
US-3521	Cabinet, File 5 Dwr	$ 72.00
US-2509	Cabinet, File 5 Dwr. Legal	$ 72.00
US-2513	Cabinet, File 4 Dwr, Legal	$ 72.00
US-1260	Cabinet (5 x 8) 2 Dwr	$ 7.00
LIST NO. 4 SEVERABLE FACILITY ITEMS DAMAGED BUT REPARABLE		
US-4957	Kit Tube Flaring	$ 32.00
US-4959	Kit Tube Flaring	$ 32.00
10430	Grinder, Bench 6" S/N 3440478	$ 58.00
US-4893	Screwdriver Pneu. S/N T383132	
US-4593	Drill, Pneu. 1/2" Clipest S/N 72134	$ 68.00
US-4856	Drill, Pneu. 1/4"	$ 68.00

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LIST NO. 4 SEVERABLE FACILITY ITEMS DAMAGED BUT REPARABLE

INVENTORY NUMBER	ITEM	COST
US-4546	Riveter, Pneu. S/N H759852	$275.00
US-4539	Riveter, Pneu. S/N 63666	$275.00
US-4772	Wrench, Impact, Pneu. S/N 164127	$ 64.00
US-4839	Wrench, Impact, Pneu. S/N 152457	$ 64.00
US-4837	Wrench, Impact, Pneu. S/N 152452	$ 64.00
US-1289	Drill, Pneu. S/N 4110	$ 68.00
US-0007	Riveter, Pneu. S/N 715059	$275.00
US-4879	Drill, Pneu. S/N T385545	$ 68.00
US-2639	Wrench, Pneu.	$ 64.00
US-4838	Wrench, Pneu.	$ 64.00
US-4848	Wrench, Pneu.	$ 64.00
US-4369	Voltmeter S/N 67287	$ 40.00
US-3325	Chair, Drafting	$ 17.00
US-2719	Chair, Drafting	$ 19.00
US-3979	Chair, w/o arms	$ 16.00
US-4950	Fan, Elec. 16" Osc.	$ 24.00
US-2387	Vise	$ 17.00

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INVENTORY NUMBER	ITEM	COST
US-3379	Bin, Roto	$ 40.00
10427	Ladder, Step	$ 20.00
US-4822	Chair, Exec.	$ 30.00
US-1369	Clothes Rack	$ 22.00
US-1418	Chair, Drafting	$ 17.00
US-4974	Fan, Elec. Pedestal	$ 52.00
10200	Scale, Platform	$ 48.00
	Ladder Extension	
	Fan, Elec. Pedestal	$ 52.00
	Water Cooler	$150.00
US-0538	Chair, Exec.	$ 32.00
US-0580	Chair, Exec.	$ 32.00
US-2369	Machine, Stencil	$ 19.00
US-4777	Chair, Exec.	$ 30.00
US-0294	Chair, w/o arms	$ 15.00
US-0349	Chair, w/o arms	$ 15.00
US-3644	Table, Typist	$ 39.00
US-3636	Table, Typist	$ 39.00

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INVENTORY NUMBER	ITEM	COST
US-4730	Scale, Platform (1000 lbs)	$ 88.00
US-0772	Desk, Exec.	$ 90.00
US-4744	Desk, Exec.	$ 90.00
US-3167	Cabinet, File 5 Dwr.	$ 63.00
US-2038	Cabinet, File 5 Dwr	$ 63.00
US-0675	Desk, Exec.	$ 90.00
US-1267	Cabinet, File (5 x 8) 2 Dwr.	$ 7.00
US-1820	Chair, Exec.	$ 32.00
LIST NO. 5 MINOR TGSE ITEMS DAMAGED BEYOND ECONOMICAL REPAIR		
GSE-31093	Igniter Tester S/N P021	
GSE-30015	Igniter Tester	
	Jack, 5 Ton Hydraulic	
LIST NO. 6 MINOR TGSE ITEMS DAMAGED BUT REPARABLE		
GSE-914	Wrench, Torque S/N 3	$ 25.00
GSE-212	Wrench, Spanner S/N 11	$ 70.00
GSE-276	Wrench, Spanner S/N 7	$ 70.00
GSE-943	Wrench, Spanner S/N 15	$ 70.00
GSE-944	Wrench, Spanner S/N 16	$ 70.00

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INVENTORY NUMBER	ITEM	COST
GSE-941	Wrench, Spanner S/N 13	$ 70.00
GSE-491	Wrench, Spanner S/N 6	$ 70.00
	Wrench, Open End 5"	$141.00
	Wrench, Open End 5"	$141.00
GSE-328	Wrench, Open End 6"	$141.00
GSE-820	Wrench, Open End 5"	$141.00

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LIST NO. 7 TV CAMERA AND RELATED EQUIPMENT

PART NUMBER	ITEM	COST	CONDITION CODE	REMARKS
RCA-MI-36098E	Explosion Proof Pan and Tilt Unit	$3,000	4	Equipment not required for replacement
RCA-MI-36074B	Explosion Proof Camera Housing	$ 500	4	
Crouse Hines #7997	Glass for Explosion Proof Camera Housing	$ 20	4	
RCA-MI-36124-2	Auto-Zoom Lens (30-150mm) DC Model	$1,400	4	
RCA-MI-36067	Camera TV Model ITV-6A	$ 800	4	
RCA-MI-36068A	Camera Control Monitor Model ITV-6 w/rack and auxiliary control unit	$3,600	4	
RCA-MI-36056	Vidicon Tube Type 7038	$ 235	4	
RCA-MI-13309	24 Conductor Cable 450 ft.	$ 450	4	
RCA-MI-83	Coaxial Cable Type RG-11/u	$1,300	4	
RCA-MI 82	Control Cable 12 Conductor	$ 950	4	

NOTE: (1) All cost are estimated.

(2) These items not indicated on location drawing. All items were on test stand, in transfer room, or conduit.

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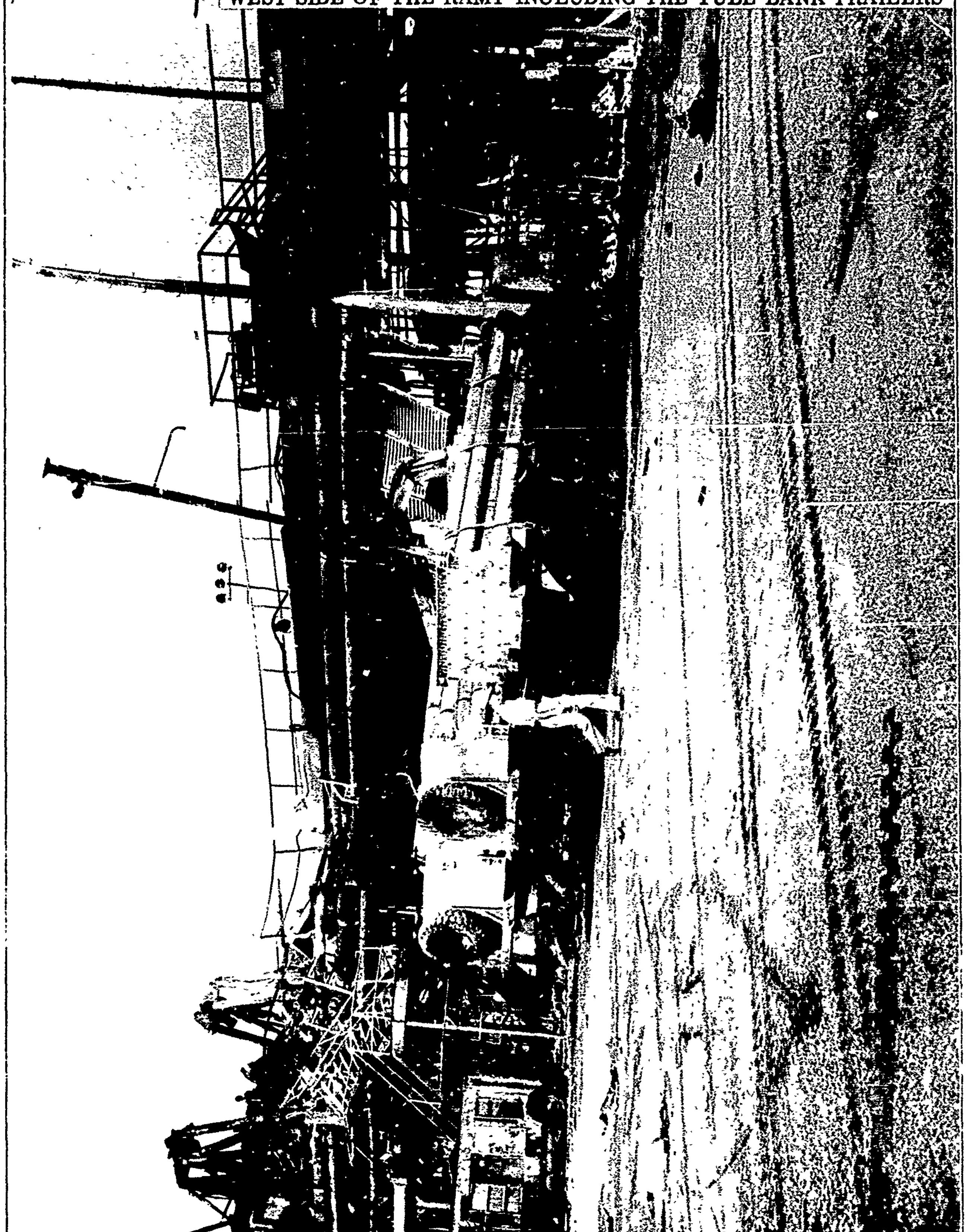
WEST SIDE OF THE RAMP INCLUDING THE TUBE BANK TRAILERS



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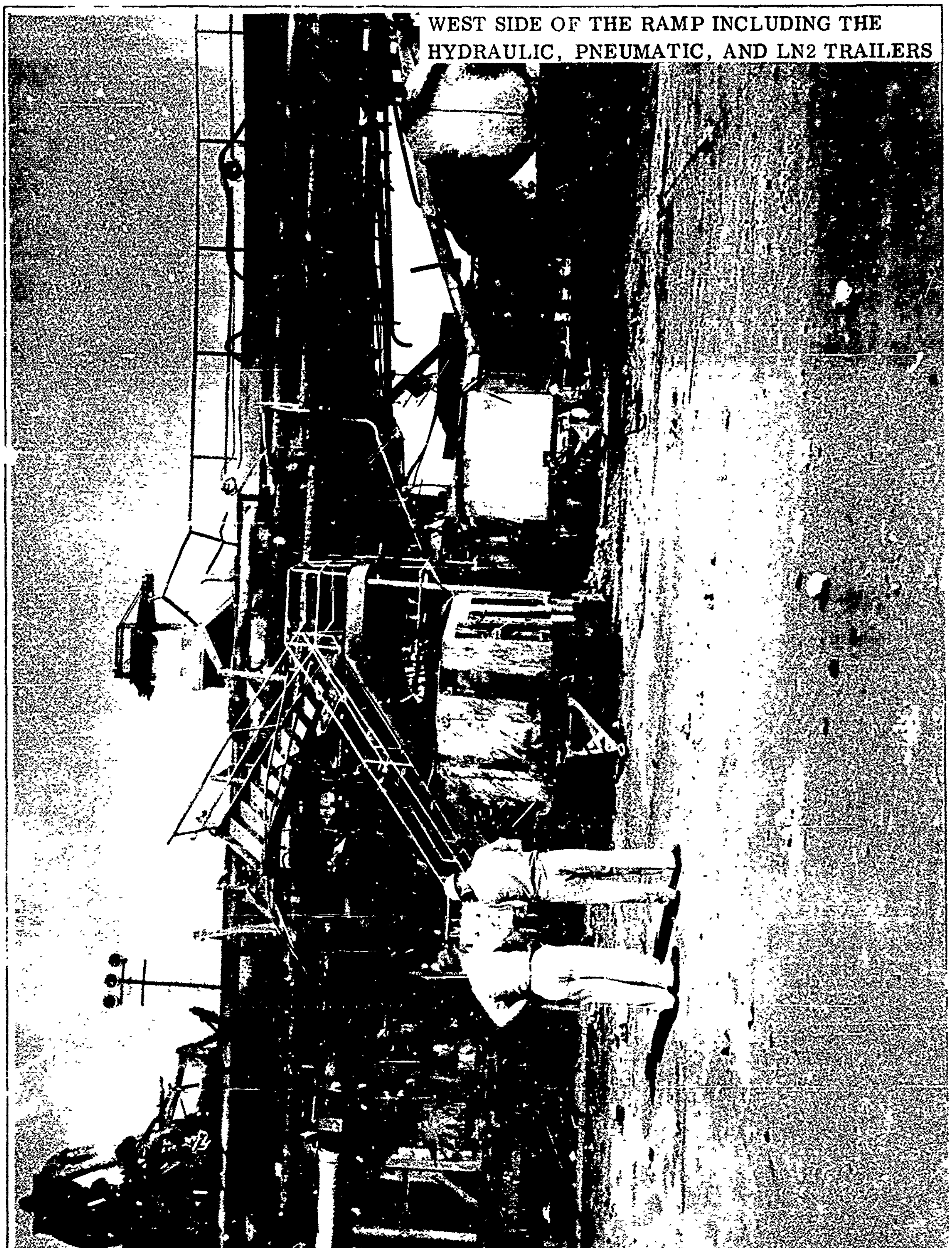

WEST SIDE OF THE RAMP INCLUDING THE HYDRAULIC, PNEUMATIC, AND LN2 TRAILERS

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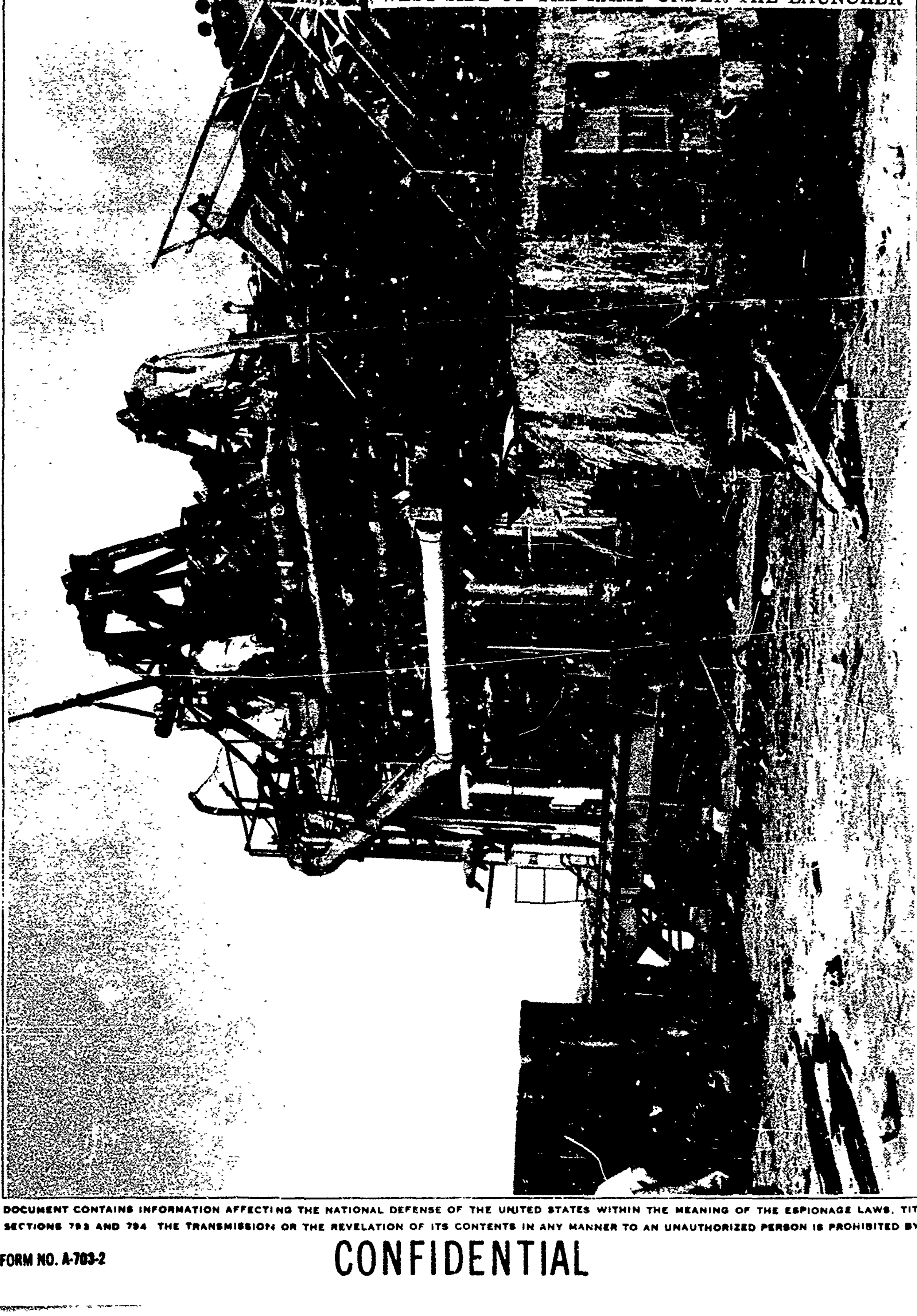
WEST SIDE OF THE RAMP UNDER THE LAUNCHER



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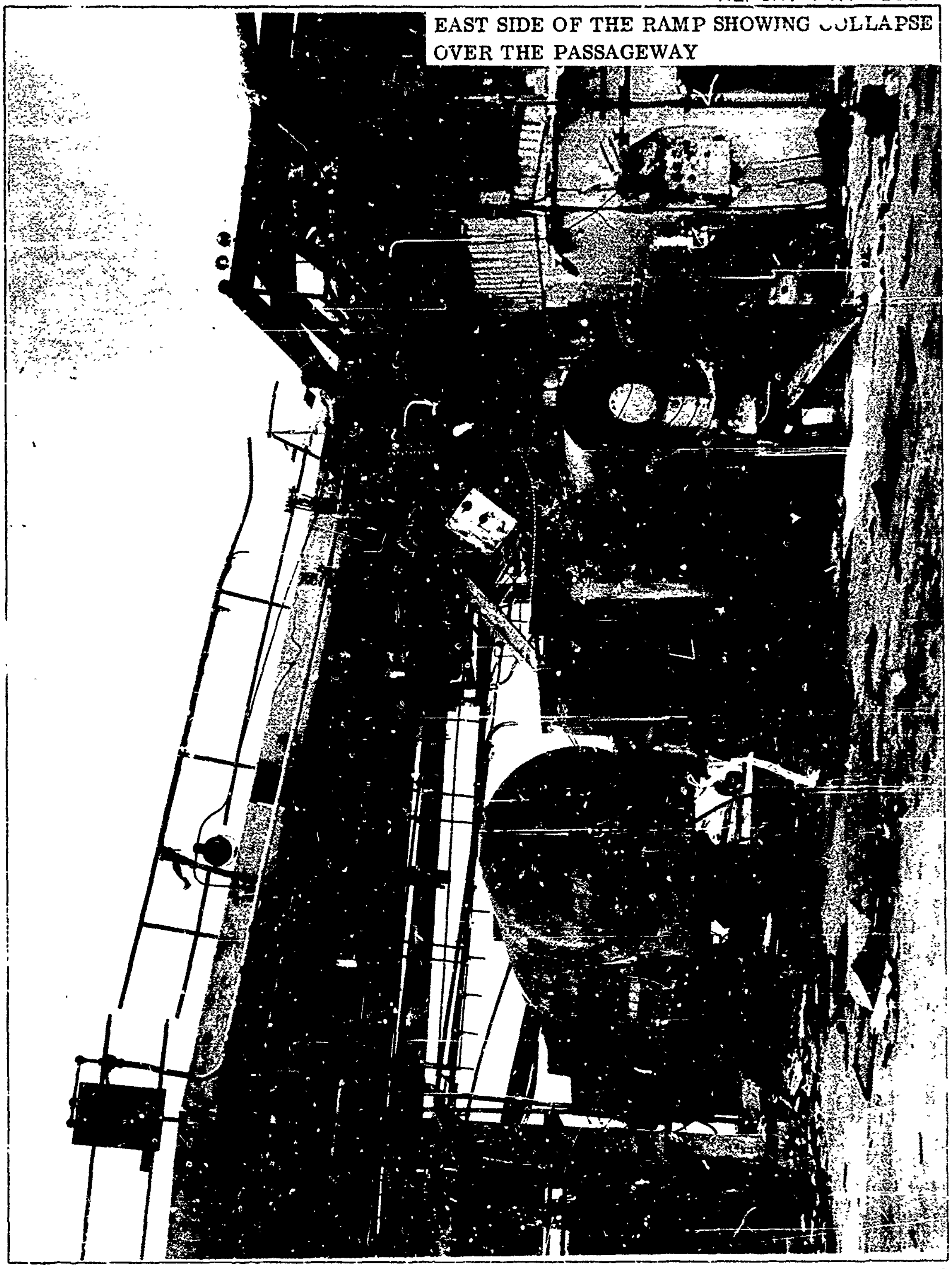
EAST SIDE OF THE RAMP SHOWING COLLAPSE OVER THE PASSAGEWAY



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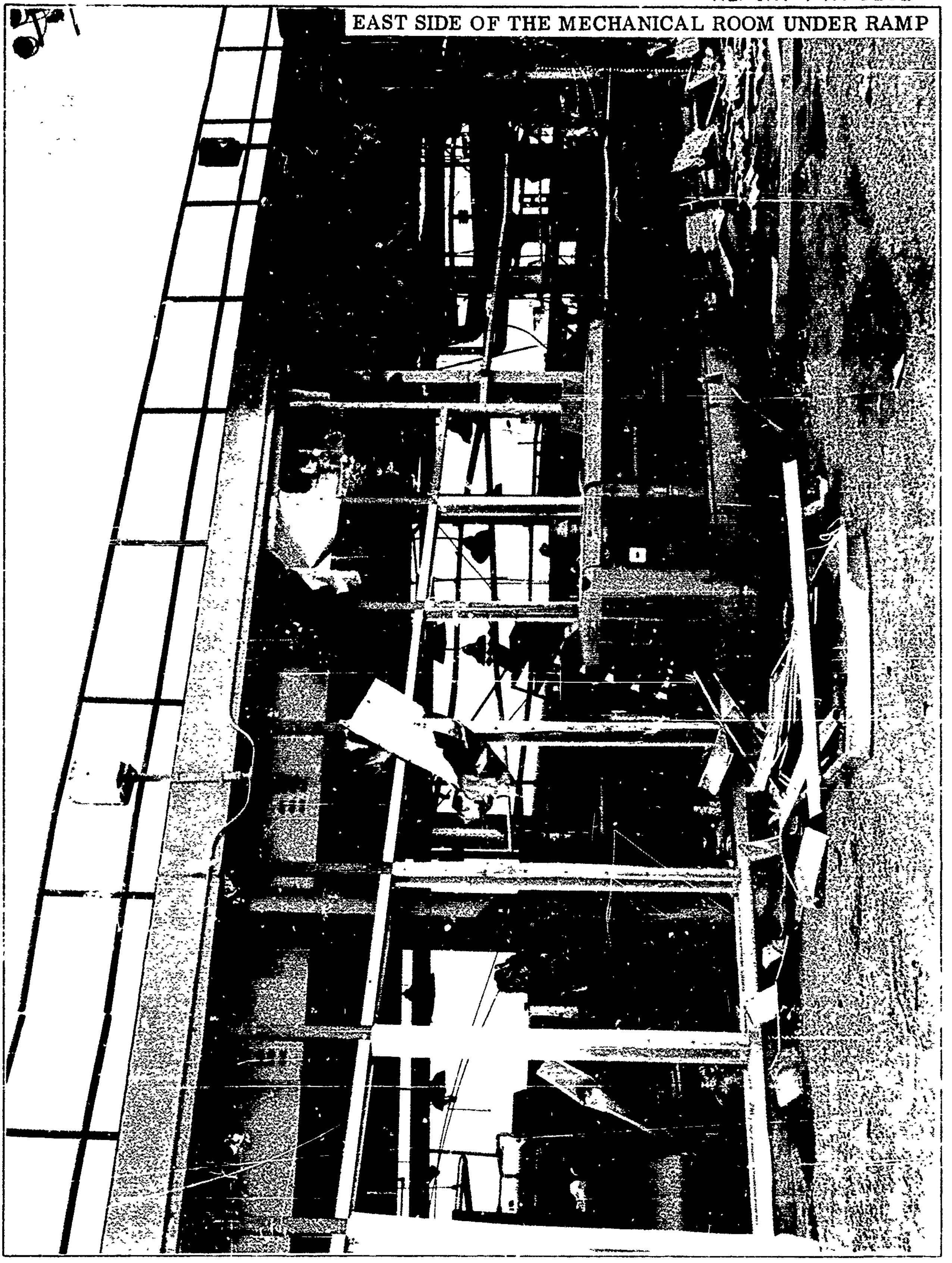
EAST SIDE OF THE MECHANICAL ROOM UNDER RAMP



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DAMAGE TO PERSONAL AUTOMOBILES

Damage to personal automobiles caused by the explosion of Missile 9C was as follows:

1. Volkswagon Sedan (1959). Damage consisted of windshield shattered, hood dented in two places, right door dented in two places, left door dented in one place, roof panel dented in several places, right-rear quarter panel dented.

2. Peugeot Four Door Sedan (1959). Damage consisted of sun roof, rear roof and trunk deck, dented.

3. Renault Dauphine Four Door Sedan (1957). Damage consisted of right hand front door caved in, caved area over left rear door (roof), right front fender scratched, right front door panel damaged.

4. Chrysler Windsor Four Door Sedan (1957). Damage consisted of hood knocked out of alignment, cracked windshield, right front door caved in, right rear fender panel caved in, right rear fender caved in, right rear window chrome molding torn loose (1 piece), roof panel caved in, in numerous places.

5. Plymouth Four Door Sedan (1952). Damage was to the hood only.

6. Chevrolet Bel-Air Hard Top Two Door (1954). Damage consisted of trunk deck ripped open, rear panel above trunk deck dented.

Estimated damage was $1,250.00.

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DAMAGE INFLICTED BY LO2 PREVALVE BUTTERFLY TO CAR IN THE COMPLEX 12 PARKING LOT

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PART OF THE LO2 PREVALVE BUTTERFLY FOUND WEST OF THE PARKING LOT THIS PART INFLICTED THE DAMAGE TO THE TRUNK LID OF THE AUTOMOBILE PICTURED IN THIS REPORT.

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BLAST EFFECTS OUTSIDE COMPLEX 12 AREA

A survey was made of Complex 11 and Complex 13 immediately after the test to ascertain the extent of damage. In addition, reports were gathered from outlying areas.

At Complex 13, only superficial damage was incurred.

The only significant damage at Complex 11 was as follows:

Tower Area

On the 6th, 7th and 8th deck, curtains partly torn loose on North side. No damage to missile. No other damage in tower area.

Ready Room

1. Ceiling tile off - 6 ft. sq. area, South side.
2. Screens blown loose - North side.
3. Light fixture side panels broken in several areas in ready room.

Guardhouse

1. Windows shattered - two on North side.
2. Door frame sprung - North side.

Blockhouse

Ventilators at power transformer room blown in - North side.

Blockhouse Rest Room

1. Rest Room window blown out.
2. Ceiling 8' x 14" blown off.
3. Loud speaker blown off wall.

Pad Services Office

1. Two panels of vents knocked off.
2. Demineralized water station door, lock and screen damaged.

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The security guard stationed at the road block at the south entrance of the ICBM road was blown into the ditch at the time of the blast. This road block was located approximately 3500 feet from ground zero. The guard turned his ankle.

An employee at the Snark Hangar was standing near a window when the blast occurred. The window shattered, the employee cut on the arm. The Snark Hangar is located approximately 7000 feet from ground zero.

Superficial damage sustained from the secondary blast effects includes the Snark Hangar (broken windows), Complex 11, and the resident engineers office buildings. The safety glass (reinforced with chicken wire) windows on the North side of the gate guardhouse of Complex 11 were broken. The window frames on the North side of the ready room were warped on Complex 11. The doors on the San Diego resident engineer's portable office buildings were forced inward breaking the locks. The buildings are located west of Complex 12 approximately 2600 feet from ground zero.

Due to the angle of the missile at the time of the explosion the blast was directed in a south southwest direction as indicated by photos and the blast gauges.

The elevator doors on the Complex 12 service tower were partially blown off. The extent of this damage included the door on the 11th deck. The tower is located approximately 600 feet from ground zero, to the east.

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BLAST GAGE DATA

Blast data were recorded during the Missile 9C accident at six locations within the Complex 12 area. The data were recorded by means of mechanical peak pressure gages (range 0 to 5 psi). Briefly the blast gages are constructed as follows:

The gage assembly is cylindrical in shape.

The cylinder face plate is orificed and is directed toward the area of interest.

A diaphragm is located behind the orifice.

Attached to the diaphragm is the recording mechanism.

Data are recorded by means of a sapphire needle attached to the diaphram. Displacement of the diaphragm in turn displaces the needle and the information is etched on a small mirror (approximately ½ inch wide by 1 inch long). Following use of the gage, a laboratory calibration is performed by applying pressure in one psi increments. The calibration information is recorded on the mirror that was used during the test so that the test data and calibration appear together.

The following table summarizes information obtained from the blast gauges:

SITE	OVERPRESSURE (lbs)	EQUIVALENT TNT* (K lbs)	UNDERPRESSURE (lbs)	APPROXIMATE DISTANCE FROM COMPLEX 12
20	3.4	38	0.3	425'
21	2.3	25	0.4	520'
22	5.0	20	0.6	300'
23	3.4	55	0.4	580'
24	2.9	60	0.4	680'
25	0.7	26	0.3	1450'

* Amount of TNT required to create overpressure value recorded at each location.

Electrical blast gages installed at the complex were inoperative.

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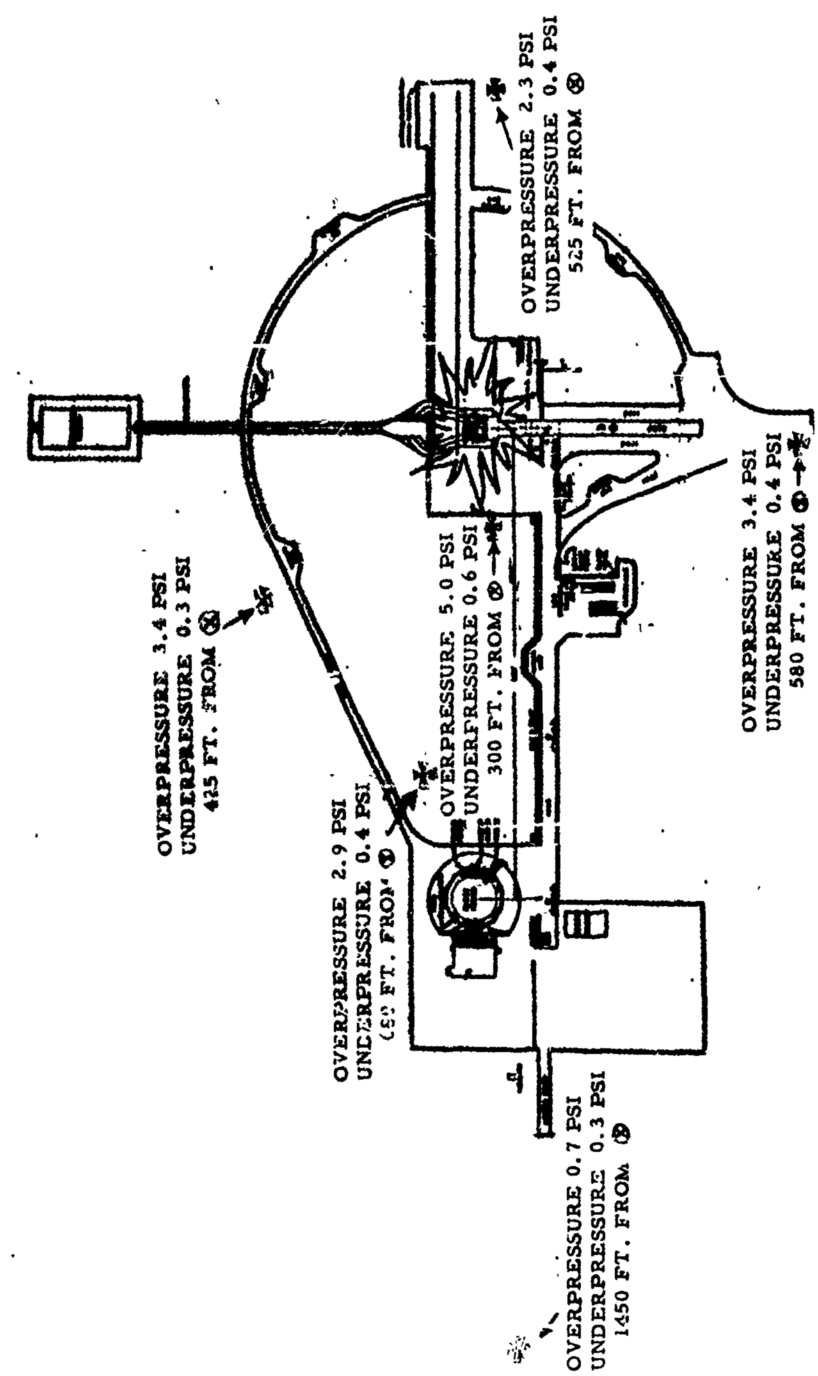
BLAST GAUGE DATA



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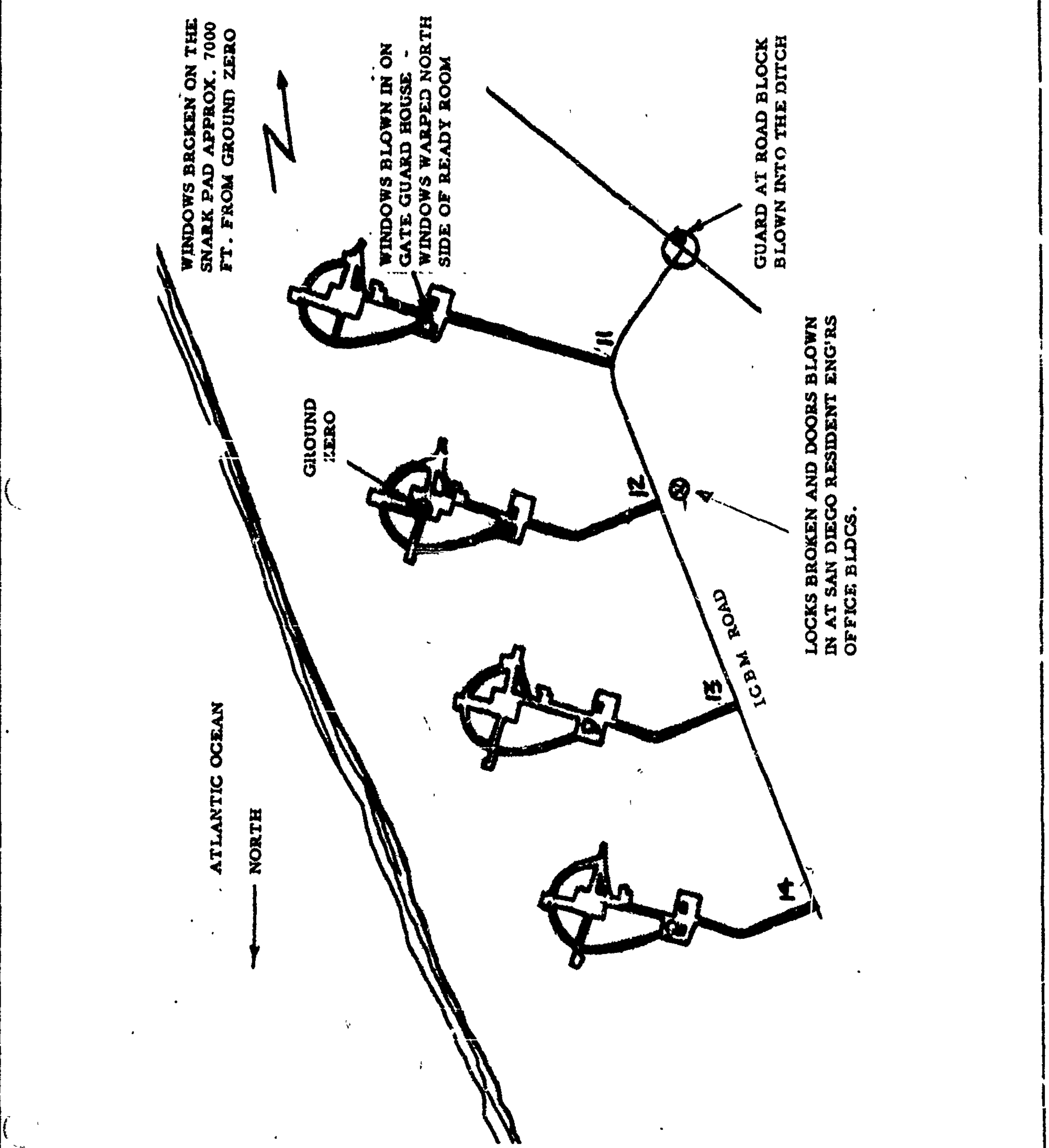
DAMAGE FROM SECONDARY BLAST EFFECTS



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SECTION III

APPENDIX

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SAFETY REPORT

Safety Measures Taken Immediately After Missile 9C Failure

A preliminary investigation was made for fuel spillage and jelled LO_2.

Area was inspected to determine which areas should be restricted for access of personnel.

Air Force Project Office (Major R Lengnick) was contacted and offered services of the Safety Section to serve in an advisory capacity.

The Chief Safety Engineer in San Diego was contacted and notified that there were no personnel injuries.

The Chief Safety Engineer at AMR appointed to the Preliminary Accident Investigation Board.

Safety Measures Taken During Missile 9C Failure Investigation

Pan American facilities were contacted and arrangements were made to have the damaged high pressure tank trailers bled off to prevent accidental discharging or rupture of tanks.

Pan American facilities were contacted and all damaged pressurized fire extinguishers were discharged.

Arrangements were made with Operations Support to have the extremely hazardous areas roped off with signs to prevent access of personnel.

Arrangements were made with Base Security to restrict the damaged area to all personnel upon the approval of Convair Safety, in case of a strong wind condition.

A comprehensive test was made of the damaged area with the Pan American Fire Inspection team and it was ascertained that all damaged fire fighting equipment was discharged.

Safety Inspectors were assigned and given instructions to restrict all personnel from dangerous areas.

The Staff Assistant was contacted to arrange for aerial photos to be taken to provide documentary pictures of the after effects of the high order explosion.

Arrangements were made with Pan American Medical Section to provide ambulance services during the investigation and clean-up.

Protective clothing was provided for personnel engaged in clean-up.

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SECURITY REPORT

Action Taken After Missile 9C Failure

Guards were posted at Complex 12 gate with orders to admit only those personnel on preliminary inspection team.

Chief of Industrial Security in San Diego was contacted by telephone to inquire if he had any special instructions.

Provost Marshal, Col. S. Bruno, was contacted to determine if he desired the Office of Special Investigations to conduct investigation.

The Chief of Industrial Security was appointed to the preliminary investigation committee.

A preliminary survey of area was made to determine possibility of compromise of classified information.

Action Taken After Preliminary Survey

Safes under ramp for classified matter were inspected. Classified information that had not been destroyed by fire was destroyed. There was no compromise of security information.

Contents were removed from clothing lockers and sealed in individual boxes to be claimed later by owners. Personal tool boxes were removed to secure area to be inspected and claimed by owners.

Close liaison was maintained with technical assessment committee to determine any indications of sabotage.

A conference was held with Provost Marshal regarding inspection. The OSI was not interested.

Salvaged parts were placed in roped off area and a guard was posted to prevent unauthorized tampering.

Security regulations were observed at all times.

There was no indication of sabotage.

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HISTORY OF XSM-65C MISSILE NO. 9

Atlas Missile 9C arrived at Hangar J, AMR, on 5 April 1959. Receiving inspection was completed on 6 April 1959 and mandatory hangar tasks and checks were begun.

Missile 9C was scheduled as the booster for the Atlas/Able IV Venus probe with launch date planned for 6 June 1959. Due to technical difficulties the test was cancelled and the missile placed in temporary storage at Hangar K.

On 15 May 1959, Missile 9C was transported to Patrick Air Force Base as a display for Armed Forces Day and returned to Hangar K for storage on 18 May.

The missile remained in a temporary storage condition until the week of 27 July 1959, when it was demated to allow modifications to the fuel staging valve area. After completion of the modifications and remating, tests and checks were started in preparation for the planned moon satellite test.

Planned testing was performed in accordance with planning documented in report ZC-7-132, Flight Test Directive, Atlas/Able IV, Series "C" Missile No. 9. Unplanned operations were accomplished on an "as required" basis. A brief summation of significant events and major tests follows:

Date	Event
4 April	Arrived at Hangar J, AMR.
5 April	Weighed.
6 April	Receiving inspection completed.
10 April	Satisfactory hangar composite.
11 April	Demated to change sustainer control bottle and remove sustainer tank pressurization bottle and all associated plumbing.
13 April	Sustainer weighed.
14 April	Remated and weighed.
15 April	Transferred to Complex 12 and erected.
28 April	Successful propellant tanking.
30 April	Successful flight acceptance composite test.

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Date	Event
5 May	Returned to Hangar K, dropped approximately 6 inches while handling.
15 May	Transported to PAFB as display for Armed Forces Day.
18 May	Returned to Hangar K and temporary storage.
27 July	Demated for modifications to the fuel stage valve.
17 August	Remated.
27 August	Weighed, transferred to Complex 12, and erected - ~~Jarred while weighing.~~
28 August	Demated to replace B2 turbine bellows.
30 August	Remated.
4 September	Successful fuel tanking.
9 September	Satisfactory propellant tanking.
10 September	Successful flight acceptance composite test.
11 September	Successful propellant tanking.
18 September	Successful Atlas/Able IV Flight Acceptance Composite Test.
21 September	FTF countdown review.
24 September	Flight Readiness Firing and loss of missile.

Testing of individual missile and complex systems and missile/complex compatibility was performed as follows:

Airborne Guidance System

System difficulties, significant events, and testing performed to prepare this system for the flight readiness firing are documented below. Three documented system tests were performed, one in Hangar J and two at Complex 12.

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The following system components were received with the missile at AMR:

Pulse Beacon, Serial No. 24

Rate Beacon, Serial No. 14

Decoder, Serial No. 12

BJ-3BG-01-09, a guidance system test, was performed on 8 April 1959 in Hangar J, AMR, in accordance with test procedure 7-94030F. Results were satisfactory.

P2-3BG-01-09, a guidance system test, was performed on 22 April 1959, at Complex 12, in accordance with test procedure 7-94030F with satisfactory results.

P2-3BG-02-09, a guidance system test, was performed on 2 September 1959, at Complex 12, in accordance with test procedure 7-94030F with satisfactory results.

1. On 6 April 1959, the decoder and rate beacon were removed for laboratory modifications. The pulse beacon was removed to facilitate waveguide calibrations.

2. On 7 April 1959, the following components were installed aboard the missile.

   Pulse Beacon, Serial No. 12

   Rate Beacon, Serial No. 11

   Decoder, Serial No. 19

3. On 8 April 1959, the checkout test set was validated utilizing procedure 7-94029.

4. On 9 April 1959, satisfactory system performance was demonstrated during a guidance/autopilot integrated test.

5. On 10 April 1959, satisfactory system performance was demonstrated during test BJ-3C0-01-09, a missile composite systems test.

6. The missile was erected on 15 April 1959, and complex testing was started.

7. On 27 April 1959, blockhouse compatibility was satisfactorily demonstrated.

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8. On 28 April 1959, during test P2-3BN-03-09, a propellant tanking test, the system was interrogated by the ground guidance station with the service tower secured in the maintenance area. Results were satisfactory.

9. On 2 September 1959, test P2-3BG-02-09, a guidance system test, was performed in accordance with test procedure 7-94030F with satisfactory results. System waveguide calibrations were also performed utilizing test procedure FTP-G-001.

10. On 8 September 1959, guidance system/blockhouse compatibility was satisfactorily demonstrated in accordance with test procedure FTP-G-007.

11. Satisfactory system performance was demonstrated during the Flight Acceptance Composite Test performed on 10 September 1959, the Atlas/Able IV FAC Test on 18 September 1959, and during the countdown review on 21 September 1959.

12. X-1 Day tests were performed utilizing procedure FTP-M-014 on 22 September 1959. Results were satisfactory.

Airframe

The following lists the checks of airframe components that were made and the difficulties encountered during preparation of the missile for the flight readiness firing.

1. Installation of the nacelle fire shields was begun on 6 April 1959 and completed on 8 April 1959.

2. On 10 April 1959 the main missile support bearings were cleaned per TPS 7924 and booster separation leak checks were performed per TPS 8054.

3. On 4 May 1959 the booster separation fittings were sprayed with WD 40.

4. On 6 May 1959, during preparations for removing the Convair nose adapter and making a fit check of the STL Able adapter, the missile was dropped one and one half to two inches. The missile was in a mated and stretch condition. The booster demate cradle was placed under the jettison portion of the thrust section. This booster cradle was placed under the thrust section as a safety precaution because of uncertainty of the center of gravity of the missile, with the nose adapter and nose handling fixture removed. This task was accomplished per prep sheet number 8467.

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It was discovered that the right hand jack indicator was not in a complete closed position. When this was discovered the lever was placed in a closed position (fully closed). After this was done, the indicator bypassed the stop, causing the valve to open, releasing the pressure. The missile dropped when this happened.

The corrugations of the thrust section of Quad I came in contact with the booster cradle, causing slight damage to the corrugation. This was repaired per IR Number 402941 dated 6 May 1959. The entire thrust section was given a complete inspection, particularly in the area of the separation fittings and flight disconnects. No visible damage was evident from this accident in any area.

5. The fuel tank was purged on 31 July 1959 per TPS 9334. This purge was initiated in an effort to remove fuel which remained in the tank after missile removal from the stand.

6. The side load strut assembly was lubricated on 3 August 1959 per FTP-A-001A and TPS 9361.

7. On 7 August 1959, a check was made of the main missile support bearings per TPS 219.

8. On 11 August 1959, the canister straps were checked per TPS 9558.

9. On 24 August 1959, a STL Able adapter fit check was performed per TPS 8469.

10. On 26 August 1959, a clearance check of the jettison rail support installation was made per TPS 633.

11. On 27 August 1959, part of the forward belly band fell from the trailer during missile erection and gouged the LO2 tank skin in six places. Patches were installed on five of these places. Satisfactory pressure checks of the tank were completed on 8 September 1959.

12. On 29 August 1959, the booster separation fittings were sprayed with WD 40.

13. On 3 September 1959, the staging disconnects were satisfactorily leak checked.

14. On 8 September 1959, the separation valves were checked per FTP-B-002 and TPS 688.

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15. On 9 September 1959, a torque and clearance check of the booster separation fittings was made.

<u>Azusa Transponder System</u>

Azusa transponder Serial No. 243 was received with Missile 9C at AMR.

There were three documented system tests, two at Complex 12 and one in Hangar J. They were:

BJ-3BZ-01-09, performed on 8 April 1959, in accordance with procedure 7-94079 and TPS 8105.

P2-3BZ-01-09, performed on 23 April 1959, in accordance with procedure 7-94078 and TPS 8253.

P2-3BZ-02-09, performed on 4 September 1959, in accordance with procedure 7-94078 with DA 286 and TPS 595.

Testing operations, significant events, and difficulties encountered in preparing this system for the flight readiness firing are presented chronologically below.

1. On 9 April 1959, during a Missile Composite System Test dry run, the transponder unlocked at the minimum input signal specification (-76 DBM) and spiking was observed on the output power. The canister was removed and checked in the Azusa Field Service Center. After the adjustments were made, the canister was reinstalled on the missile.

2. On 10 April 1959, satisfactory system performance was demonstrated during Missile Composite System Test BJ-3C0-01-09. The antenna was then removed in preparation for demating the missile.

3. On 16 April 1959, the canister was removed from the missile on instructions from San Diego. Canister Serial No. 243 had not been properly accepted by Air Force Inspection in the factory prior to missile shipment to AMR.

4. On 17 April 1959, after missile erection at Complex 12, service tower interference prevented installation of the antenna. As a result, a twelve by fifteen inch hole was cut in the 4th deck of the service tower and the antenna was installed.

5. On 22 April 1959, canister Serial No. 163 was installed on the missile.

6. On 23 April 1959, after a satisfactory system test, the antenna was removed and sent to Complex 13 for use on Missile 5D.

7. On 29 April 1959, a temporary antenna was installed. On 30 April 1959, system performance was satisfactory during Flight Acceptance Composite test P2-3BN-05-09.

8. A new boom antenna was installed on 4 September 1959, and a blockhouse compatibility test performed in accordance with TPS 542 was satisfactory. The heliax cable calibrations were also satisfactorily completed utilizing TPS 543.

9. Satisfactory system performance was demonstrated during Flight Acceptance Composite Test P2-3CO-01-09 performed on 10 September 1959, and also during the Atlas/Able IV FAC Test P2-3CO-02-09, on 18 September 1959.

10. During the countdown review on 21 September 1959, the transponder was non-coherent and was removed after the test and sent to the Field Service Center where testing verified non-coherency Canister Serial No. 204 was received from the Field Service Center and installed on the missile on 22 September 1959. After installation, a satisfactory test with the Azusa Ground Station was performed.

There were no further difficulties encountered in preparing this system for the flight readiness firing.

Flight Control System

Although systems check out of Missile 9C began on 6 April 1959 in the hangar area, flight control and guidance checks were not started because the necessary checkout equipment had not been validated. The flight control system checkout prep sheet No. 7833 had the following items cancelled:

Item	Remark
3-1b	This item was deleted because it was inadvertently included in procedure 7-94001. This item deals with servo valve adjustment and the servo valves are not adjusted after the factory adjustment has been made.
5-11A and 5-11G	These items were deleted because they were accomplished during validation of the flight control checkout trailer.

1. On 7 April 1959, Servo Canister, Serial No. 40 was removed from the missile and replaced with Servo Canister, Serial No. 50. Servo Canister, Serial No. 40 was

sent to the gyro laboratory. The laboratory reported the roll integrator out of phase but further investigation proved this to be erroneous.

2. On 8 April 1959, Servo Canister, Serial No. 50 was removed from the missile and Servo Canister, Serial No. 40 was re-installed. Servo Canister, Serial No. 40 had to be removed because the programmer would not recycle, further checks at the gyro laboratory also indicated that the programmer would not recycle. Servo Canister, Serial No. 40 was IR'd (IR 401260) for intermittent operation of sub-routines 0,1,2, and 3.

   Validation of the flight control checkout trailer equipment was completed. Vernier engine No. 1 was aligned in accordance with TPS 7832. Started a flight control confidence check which revealed the P 101-H harness to be shorted. The short was caused by the shield ground being connected to pin-H. Immediate repair was initiated.

3. On 9 April 1959, performed a satisfactory pre PEAT Test. A flight control/guidance integrated test was conducted per procedure 7-94088 and TPS 8021. This test was satisfactory with the exception of three Midwest Oscillograph channels which had their sensitivity turned down. Gyro Canister, Serial No. 35 and Servo Canister, Serial No. 50 were used for this test.

   A "dry run" composite test was conducted to get the system ready for the true composite test. One discrepancy occurred; engine cutoff signals came through at improper times. This discrepancy was traced to the propulsion panel which had not been reset after completion of the flight control/guidance integrated test. This was an operational problem.

4. On 10 April 1959, Flight Control System participation in the composite test was satisfactory.

5. On 13 April 1959, installed Part Number 7-84200-5 booster actuators on the missile.

6. On 20 April 1959, gyro canister, Serial No. 82, and servo canister, Serial No. 40, arrived from San Diego. Preliminary checks in the gyro lab indicate the following.

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Parameter	Rate Gain	Displacement Gain
Pitch	Satisfactory	Low
Yaw	Satisfactory	Satisfactory
Roll	Satisfactory	100 Percent High

Gyro Canister, Serial No. 52 was IR'd due to the pitch displacement gyro transfer function shift.

Servo Canister, Serial No. 40 has a burned harness in the programmer at J-301. This was caused by 28 VDC being present at J-301-Z instead of AC voltage.

7. On 21 April 1959, completed TVA 82599, Autopilot Airborne Harness Installation.

8. On 23 April 1959, Servo Canister, Serial No. 41 arrived from San Diego and Gyro Laboratory testing began.

9. On 24 April 1959, Servo Canister, Serial No. 41 was installed on the missile.

10. On 25 April 1959, ran the following portions of 7-94001, flight control checkout procedure:

    a. Booster pitch, yaw, and roll static gains

    b. Booster pitch and yaw thresholds

    c. Sustainer pitch and yaw thresholds

    d. Sustainer pitch and yaw static gain.

    e. Vernier pitch, yaw, and roll static gain.

    f. Vernier pitch and yaw engine thresholds.

11. On 27 April 1959, performed a frequency test. Booster engines looked satisfactory in the pitch plane, but some doubt exists concerning the yaw axis. B2 yaw had a greater amplitude than B1 yaw. Data will have to be plotted before a correct analysis can be made. Sustainer and vernier response appeared satisfactory. Servo canister, Serial No. 41 was used for this test.

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12. On 28 April 1959, frequency response was run on Servo Canister, Serial No. 40 and the data appeared satisfactory. Static gains for the booster engines were run. The data appeared satisfactory in comparison with data from Servo Canister, Serial No. 41.

13. On 29 April 1959, an autopilot blockhouse compatibility test was run. All testing was satisfactory. The missile flight control system and the blockhouse instrumentation are compatible. Completed frequency response on Servo Canister, Serial No. 40. Completed vernier static gains and results were satisfactory. Gyro Canister, Serial No. 35 and Servo Canister, Serial No. 40 are on the missile. These canisters will be used for the FAC Test. Servo Canister, Serial No. 41 is in the gyro lab.

14. On 30 April 1959, supported a FAC Test and had the following problem: The pitch emitter follower malfunctioned during the countdown. This condition prevented the nulling of the pitch displacement gyro. The problem seemed to be a broken lead in the gyro canister, but gyro laboratory tests proved that the emitter follower malfunctioned. This gyro canister was IR'd (IR 403024).

15. On 1 May 1959, aligned the booster engine per FTP-S-006 and TPS 8107. Aligned the sustainer engine per FTP-S-001 and the applicable DA. While aligning the sustainer engine it was impossible to offset the yaw engine position ≠ 0.5 degrees. The maximum offset that could be obtained in yaw axis was ≠ 0.17 degrees. A telephone call to the dynamics group indicated that this would be satisfactory for this flight.

16. On 4 May 1959, an AVO was submitted to Plans and Programs requesting a DA on FTP-S-001 Procedure for a ≠ 0.17 degree offset in sustainer yaw.

17. On 5 May 1959, Missile 9C was returned to the hangar area. It was discovered that B1 yaw actuator was left in during transportation to the hangar. There was no apparent damage to the actuator.

18. On 16 May 1959 to 30 August 1959, no activity or testing of the flight control system during this period. Missile 9C was in storage at the hangar area.

19. On 31 August 1959, the following prep sheets are to be worked and sold to inspection.

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Prep Sheet	No.	Date Sold
F/C Canister (Flight)	738	8 September 1959
F/C Canister (Spare)	746	8 September 1959
FAC Test	747	10 September 1959
P-2012 48" Disconnect	737	3 September 1959
A/P Blockh-use Compatibility	739	9 September 1959
Vernier Engine Alignment	740	3 September 1959
Booster Engine Alignment	742	14 September 1959
Sustainer Engine Alignment	741	14 September 1959
Polarity Test	---	

Applied power to the autopilot and guidance system and discovered that phase three power was not on the missile. The trouble was traced to umbilical P-2003 on the power distribution trailer. P-2003 was improperly mated and contained water. P-2003 was adjusted and dried out.

20. On 1 September 1959, the autopilot integrator could not be driven as needed. P-1001 was found to contain water and was out of adjustment. This corrected the yaw and roll integrator trouble but not the pitch. Previous trouble with the checkout trailer cable made a recheck of this source mandatory. This was not the case and after many checks it was descovered that the pitch integrator was bad. Servo canister, Serial No. 40 was installed on the missile and preliminary checks were made this date.

21. On 2 September 1959, flight control system testing is underway. The following tests were completed before trouble developed with a checkout trailer harness plug.

1. Engine thresholds

2. Booster No. 1, pitch, yaw, and roll static gains.

3. Booster No. 2, yaw and roll static gains.
   Booster No. 2, pitch static gain was not run because the transducer shaft could not be locked properly. The loose shaft was discovered when an attempt to adjust the transducer was made. IR 413950 was written against the B2 pitch actuator.

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22. On 3 September 1959, another B2 pitch actuator was installed and B2 pitch static gains were run. The following tests were completed.

    1. Integrator gains and limits for staging and pre-staging.

    2. Sustainer and vernier engine thresholds.

    3. Sustainer static gains.

    4. Vernier static gains.

    5. Vernier engine frequency response.

    6. Sustainer engine frequency response.

    7. Squib test.

23. On 4 September 1959, completed the following tests on spare servo canister, Serial No. 39.

    1. Booster static gains.

    2. Sustainer static gains.

    3. Vernier static gains.

    4. Integrator gains and limits for staging and pre-staging. Frequency response was not run because a welding job on the LO_2 tank was not completed. Plan to run frequency response 8 September 1959.

24. On 8 September 1959, the following tests were completed on spare servo canister, Serial No. 39.

    1. Booster frequency response.

    2. Sustainer frequency response.

    3. Vernier frequency response.

    4. Squib test.

    This completes the testing of the spare servo canister, Serial No. 39. Ninety five percent of the flight control blockhouse compatibility test has been completed. The only test remaining is the null detector check.

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25. On 9 September 1959, flight control blockhouse compatibility test completed per FTP-S-033.

26. On 10 September 1959, locking insert on J-1001 was broken. This happened during umbilical eject tests. The insert was replaced and all wiring through J-1001 was continuity checked. The flight control system satisfactorily supported a FAC Test. The only discrepancy was an unsatisfactory flight control/guidance loop test. Plug P-901 was not installed. P-901 was installed and satisfactory loop test performed.

27. On 14 September 1959, aligned the booster engines per procedure FTP-S-006, prep sheet 742.

28. On 17 September 1959, preparing the flight control system for the Atlas/Able IV FAC Test.

29. On 13 September 1959, flight control performance was satisfactory during the Atlas/Able IV FAC Test.

30. On 19 September 1959, gyro canister, Serial No. 52 and servo canister, Serial No. 39 was sent to the gyro laboratory to have the roll program set. While this was being accomplished it was discovered the roll rate gyro had no output. This was gyro canister, Serial No. 52. It was IR'd (IR 424034).

31. On 21 September 1959 the flight control system satisfactorily participated in the mock countdown.

32. On 22 September 1959, X-1 Day.

33. On 23 September 1959, spare gyro canister, Serial No. 39 and spare servo canister, Serial No. 39 arrived at the complex. During the FRF of Atlas/Able IV, all flight control systems tests during countdown were satisfactory.

<u>Hydraulic System</u>

Test number P2-3BH-01-09 was assigned to cover Hydraulics System preparations from missile arrival to launch. Significant events and difficulties noted during system preparation were as follows:

1. On 7 April 1959, booster and sustainer hydraulic reservoir charge lines were disconnected per BOI No. 06016.

   Filled and held the hydraulic system in accordance with FTP-H-001A.

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2. On 14 April 1959, IR No. 401573 was written against the sustainer engine hydraulic ground charge line (P/N 7-94123-429) due to deep cracks and chips. Removal and replacement will be accomplished at the complex.

3. On 14 April 1959, a hydraulic fill and bleed was performed in the hangar according to TPS 8022.

4. On 16 April 1959, sustainer engine hydraulic ground charge line (7-84123-429) was removed from the missile.

5. On 17 April 1959, a new sustainer engine hydraulic ground charge line (7-84123-429) was installed on the missile.

6. On 30 April 1959, completed fill and bleed on the hydraulic system per FTP-11-001A, and TPS 7979 with DA 219, and 278.

7. On 24 August 1959, a post-remate hydraulic system leak check was completed according to FTP-H-001A and TPS 453.

8. On 29 August 1959, a damaged tube was found at the Quad II staging disconnect in the sustainer hydraulic system. IR No. 413757 and BOI No. 08856 were written against it, however, there was no replacement in spares. The link was removed, pressure tested to 6000 psig, cleaned and reinstalled.

9. On 12 September 1959, completed fill and bleed on the hydraulic system according to FTP-H-001A and TPS 766 with DA 219 and 278.

10. During the FAC Test, P2-3C0-02-09 on 18 September 1959, an evaluation of the vernier solo hydraulic system was to be made by stopping the ground sustainer hydraulic pump at sustainer cutoff and observing the vernier hydraulic pressure decay. The pressure furnished from the precharged vernier hydraulic accumulators was expected to allow a slow decay in hydraulic pressure, thereby furnishing sufficient pressure for the maximum 5 second vernier solo period. However, there was an immediate sharp drop from 2730 psia to approximately 1250 psia. Engineering believed this drop to be too sharp to furnish the vernier engines sufficient hydraulic pressure for the vernier solo period. Their problem was under investigation and results of a later test were to be used to determine if there was a discrepancy in the vernier solo hydraulic system. However, no further tests were accomplished prior to the FRF on 22 September 1959.

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Launcher

Periodic tests and adjustments were performed to determine that the system operated in accordance with design specifications. A chronological listing of adjustments and test results is presented below:

Test	Date	Results
P2-3BN-02-09	4-22-59	Satisfactorily performed two holddown and release tests according to FTP-L-003B.
	8-25-59	Performed launcher release mechanism checkout according to FTP-L-008A and TPS 512.
	8-26-59	Performed launcher alignment according to FTP-L-001A.
	9-2-59	Performed launcher stabilization system checkout per FTP-L-011.
	9-3-59	The launcher snubbers were installed per FTP-L-008A and TPS 516.
	9-4-59	Checked out the "A" frame actuators per TPS-519.
	9-8-59	Checked out and adjusted the "rise-off" disconnect panel per FTP-L-012.
	9-8-59	A mechanical checkout of the special "C" tower was completed according to FTP-H-006.
P2-3BL-01-09	9-15-59	Performed a release signal test.
	9-16-59	Performed launcher shakedown per FTP-L-0C3B and TPS 522.
	9-17-59	Checked out the master holddown cylinders per FTP-L-004A
P2-3BL-02-09	9-17-59	Performed cold release per FTP-L-006. Time slopes for both holddown cylinders were not within specifications. There was considerable zero shift during the test.
P2-3BL-03-09	9-17-59	Satisfactorily performed cold release test per FTP-L-003B. Experienced considerable zero shift also.

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Missile Electrical System

System components received with Missile 9C at AMR were as follows:

Bendix Inverter, Serial No. R-15

Power Changeover Canister, Serial No. 010

System tests were performed as follows:

BJ-3BE-01-09, completed 8 April 1959, was a satisfactory missile electrical system test, performed in accordance with TPS 7834 utilizing test procedure 7-94070.

Significant events and difficulties encountered during system preparation are chronologically enumerated below.

1. On 10 April 1959, the system satisfactorily supported a dry run of the missile composite system test.

2. On 10 April 1959, the system satisfactorily supported a missile composite system test.

3. On 16 April 1959, an open BOI, No. 76715, was found on Inverter, Serial No. R-15. The inverter had been removed in San Diego for visual inspection and the BOI was not closed out. The requirements of BOI 76715 were complied with and satisfied by TPS 7834.

4. On 29 April 1959, a blockhouse functional test per TPS 7838 was completed satisfactorily.

5. On 30 April 1959, the system satisfactorily supported a flight acceptance composite test.

6. On 2 September 1959, a pull test of the autopilot inflight umbilical disconnect plug (P-2012) was performed per TPS 737. The pressure required for disconnect was 180 lbs. (specification is 100 $\pm$ 10 lbs). It was decided that the plug was acceptable for flight since it was impossible to pull along the plug axis due to mechanical interference and more force was required to separate it than during flight.

7. On 8 September 1959, missile blockhouse system compatibility was demonstrated per TPS 687 utilizing FTP-E-006. Results were satisfactory.

8. Satisfactory system performance was demonstrated during the flight acceptance composite test performed on 10 September 1959 and the Atlas/Able IV FAC Test on 18 September 1959.

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9. During the countdown review on 21 September 1959, the inverter frequency was observed to be steady at 403 to 404 cps. The frequency was adjusted to 400 cps and 115 V on 22 September 1959.

There were no further difficulties encountered in preparing this system for the flight readiness firing.

Pneumatic System

All significant events and tests concerning the pneumatic system on Missile 9C are listed chronologically below. Items listed cover the period from missile arrival to the attempted FRF.

1. On 9 April 1959, a leak check of the high pressure helium system was performed according to TPS 7828.

2. On 10 April 1959, the following tasks were performed:

    a. Leak check of LO_2 head PU sensing lines according to TPS 8048

    b. Leak check of Fuel Head PU sensing lines according to TPS 8052.

    c. Leak check of the PU manometer sensing line according to TPS 8050.

    d. Leak check of the booster separation manifold according to TPS 8054.

    e. Leak check of the fuel static PU sensing lines according to TPS 8053.

    f. Leak check of the LO_2 static PU sensing lines according to TPS 8049.

    g. Leak check of the propellant tank sensing lines according to TPS 8012.

3. On 11 April 1959, the missile was demated to change the sustainer control bottle and remove the sustainer LO_2 tank pressurization helium bottle and all associated plumbing. The sustainer tank helium bottle was deleted from this missile since a fiberglass flask was to be used for separation. The separation flask and hardware did not arrive in time to be installed at the hangar, therefore, installation was planned for the complex.

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4. On 17 April 1959, installation of the modified booster separation system was started.

5. On 20 April 1959, a leak check of the high pressure helium system was performed according to FTP-F-004A, paragraph VII, Item G-1 through 15 and TPS 7839.

6. Test P2-3BN-01-9, was a checkout and validation of the airborne pneumatic system performed according to FTP-F-002B and TPS 7843. The first attempt to perform this test was on 23 April 1959. Results were unsatisfactory due to improper functioning of the fuel airborne regulator. The second attempt was made on 24 April 1959. Results were again unsatisfactory due to improper functioning of the fuel airborne regulator. The third attempt was made the same day. Results were unsatisfactory due to the fuel regulator being set too high and cycling the relief valve. After the test it was discovered both regulators were venting at the sensing port bleeds. After conferring with the San Diego Pneumatics Design Group, both regulators were replaced. The fourth attempt was made on 25 April 1959, and results were satisfactory.

7. Test P2-3BN-04-09, was a LN2 shroud and transfer system checkout performed 30 April 1959, according to FTP-F-003A and TPS 7841. Results were satisfactory.

8. On 4 May 1959, a satisfactory leak check to 1000 psi was completed.

9. On 10 August 1959, the fuel and LO_2 airborne regulators were IR'd in favor of newer regulators. Reference SFTO 24.

10. On 10 August 1959, the LO_2 pressurizing duct bellows was inspected according to TPS 9241.

11. On 24 August 1959, an inspection was made of the intermediate bulkhead according to TPS 559. No visible damage was noted.

12. On 1 September 1959, the high pressure leak check of the airborne helium system was completed according to FTP-F-004A and TPS 509.

13. On 2 September 1959, an electro-mechanical check of the LO_2 boil-off valve was completed according to TPS 531.

During the leak check of the LO_2 low pressure helium duct, in accordance with FTP-F-004, a leak was found at the rise-off disconnect in Quad IV and was corrected.

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14. Test P2-3BF-01-09, on 3 September 1959, was a checkout and validation of the airborne pneumatic system according to FTP-F-002B and TPS 508. Results were satisfactory.

15. On 4 September 1959, a leak check of the booster separation system was performed according to FTP-F-004A and TPS 528.

    Also the checkout of the ground portion of the pneumatic system was completed according to FTP-F-002B.

16. On 9 September 1959, the ground LN_2 system was modified to "D" Series configuration.

17. During a 1000 psi leak check on the airborne pneumatic system, on 18 September 1959, valve 20 in the PCU was found to be sticking. The valve was IR'd replaced and checked out. The 1000 psi leak check was performed due to a heat exchanger cleaning and proof test.

Propellant Utilization System

Testing operations, significant events and difficulties encountered in preparing this system for the flight readiness firing are presented chronologically below.

1. On 8 April 1959, system wiring on the missile was checked in accordance with procedure 7-60614 and TPS 7896. Results were satisfactory.

2. On 9 April 1959, the constant flow valves were checked with satisfactory results.

3. On 20 April 1959, matched set, Serial No. 113 was received at the complex and installed on the missile.

4. On 23 April 1959, the EDO voltages were checked and found within specifications per procedure 7-94021.

5. On 23 April 1959, the head suppression valve servo control, leak, and functional checks, utilizing procedure FTP-U-003 and TPS 7978, were performed with satisfactory results.

6. On 25 April 1959, during manometer short tests, the fuel manometer relief valve was found to be leaking mercury, the "O" ring for the same unit failed, and the static pressure quick disconnect fitting on the fuel manometer also failed. After replacement of these components the short tests were completed satisfactorily.

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7. On 29 April 1959, the manometers were checked at 5 pressure point in accordance with test procedure 7-94021 utilizing mercury manometers. Results were satisfactory.

8. On 30 April 1959, the PU valve angle adjustments were completed in accordance with test procedure FTP-U-001A.

9. On 26 August 1959, matched set, Serial No. 208 was checked in the PU lab per test procedure FTP-U-011A. Results were satisfactory. Matched set, Serial No. 208 was assigned as the primary flight system and matched set, Serial No. 107 the backup system for Missile 9C.

10. On 2 September 1959, the head suppression valve servo control, leak, and functional checks, per procedure FTP-U-003, and TPS 764, were performed with satisfactory results.

11. On 3 September 1959, system wiring on the missile was checked out per procedure 60614 and TPS 830. The constant flow control valves were checked per procedure FTP-U-002A, with DA 399 and TPS 544 and the PU valve angle adjustments were completed per test procedure FTP-U-001A, with DA 398 and TPS 873. The backup set, matched set, Serial No. 107, was tested satisfactorily in the PU lab in Hangar J, AMR, per procedure FTP-U-011A.

12. On 4 September 1959, manometer pressure tests were satisfactory utilizing test procedure FTP-U-005A.

13. On 9 September 1959, manometer pressure tests, per procedure FTP-U-005A, were satisfactory and the reference mixture ratio was adjusted to 2.30/1 in accordance with test procedure FTP-U-007 with DA's 420 and 383 and TPS 546.

14. On 10 September 1959, satisfactory system performance was demonstrated during a flight acceptance composite test.

15. On 11 September 1959, the backup system (matched set, Serial No. 107) was satisfactorily tested in the PU Lab in Hangar J, per test procedure FTP-U-011A.

16. On 14 September 1959, the primary system (matched set, Serial No. 208) was removed from the missile and the backup system was installed.

17. On 15 September 1959, the PU valve angle adjustments in accordance with procedure FTP-U-001A with DA 398 and test prep sheet 1207, were completed.

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18. On 16 September 1959, manometer pressure testing, per procedure FTP-U-005A and TPS 1012 was completed with satisfactory results. The reference mixture ratio was adjusted to 2.30/1 in accordance with procedure FTP-U-007 with DAs 383 and 420 and TPS 1011. The system was then removed. The primary system, matched set, Serial No. 208, was installed on the missile.

19. On 17 September 1959, X-2 Day checks were performed utilizing procedure FTP-U-009. Results were satisfactory.

20. On 18 September 1959, satisfactory system performance was demonstrated during the Atlas/Able IV Flight Acceptance Composite Test.

21. On 21 September 1959, during a countdown review test, the error demodulator output voltage was observed to be -1.2 vdc with full propellant tanks. The system was removed and checked in the PU Lab in Hangar J. Investigation revealed the pressure fitting at the base of the LO_2 manometer was loose. All fittings were tightened and during subsequent tests, per procedure FTP-U-011A, the EDO voltages at test pressure points 26 and 27 were observed to be below specifications. The reference mixture ratio was readjusted to 2.25/1, the system retested and the results were the same. The backup set (Serial No. 107) was brought to the lab and system tests yielded identical results at a reference mixture ratio of 2.30/1. In accordance with instructions from the San Diego PU Design Group, the matched set, Serial No. 208 reference mixture ratio was readjusted to 2.30/1, both systems were pressurized to test point 26 pressures, and R222 (reference mixture ratio adjustment potentiometer), was adjusted until the EDO voltages were -2.2 vdc. Complete system tests were then performed on both systems per procedure FTP-U-011A. Results were satisfactory.

22. On 23 September 1959, matched set, Serial No. 208 was reinstalled on the missile. During reinstallation fuel was found in the fuel tank head pressure line at the manometer. Fuel was detanked from the missile, the line cleaned out, and the constant flow valve was replaced as contamination was suspected. The replacement constant flow valve was tested in accordance with procedure FTP-U-002A and found defective. Flow rate obtained was 12 ft^3/hr (specification is 3 to 5 ft^3/hr.) and the valve was replaced. The new valve was tested with satisfactory results per procedure FTP-U-002A.

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There were no further difficulties encountered in preparing this system for the flight readiness firing.

Missile/Launch Compatibility Tests

P2-3BN-03-09, completed 28 April 1959, was a successful Propellant Tanking Test.

P2-3BN-05-09, completed 30 April 1959, was a successful Flight Acceptance Composite Test.

P2-3BN-06-09, completed 4 September 1959, was a successful Fuel Tanking Test.

P2-3BN-07-09, completed 9 September 1959, was a satisfactory Propellant Tanking Test.

P2-3CO-01-09, completed 10 September 1959, was a successful Flight Acceptance Composite Test.

P2-3BN-08-09, completed 11 September 1959, was a successful Propellant Tanking Test.

P2-3CO-02-09, completed 18 September 1959, was a successful Atlas/Able IV Flight Acceptance Composite Test.

P2-3MO-01-09, completed 21 September 1959, was a successful FTF countdown review.

Propulsion System

Test Number P2-3BP-01-11 was assigned to cover Propulsion System preparation from receipt of missile to launch. Significant events, difficulties encountered, and system tests performed during system preparation are presented chronologically below:

1. On 6 April 1959, the vernier LO_2 domes were removed to check for contamination per BOI 06469.

2. On 7 April 1959, action was taken on the following items:

   a. The vernier LO_2 domes were re-installed, torqued, and inspected.
   b. The B2 high pressure fuel duct and booster gas generator fuel bootstrap line were removed for access to the RMI valve.

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c. Vernier chamber pressure switches were removed for a bench check. V1 picked up at 190 psi and dropped out at 180 psi. V2 picked up at 195 psi and dropped out at 165 psi.
d. The booster fuel jacket purge check valves were removed for a bench check.

3. On 8 April 1959, a leak check of the booster hot gas system was completed according to FTP-P-005 and TPS 8020, and the sustainer fuel injector purge check valves were re-installed after completion of the bench check.

4. On 9 April 1959, action was taken on the following items:

a. The booster fuel jacket purge check valves were re-installed. IR No. 401501 and No. 401502 were dispositioned to use as is until replacements are available.
b. A new vernier No. 1 LO_2 line was mocked, cleaned, pressure tested, and installed according to GMA 0761.
c. The sustainer main fuel system was leak-checked to 30 psig according to FTP-P-005 and TPS 8051.

5. On 10 April 1959, action was taken on the following items:

a. A leak check of vernier No. 1 engine was completed according to FTP-P-005 and TPS 8019.
b. The orifices in the vernier LO_2 and fuel inlet pressure instrumentation lines were checked. Both LO_2 orifices were satisfactory, but both fuel orifices were in backwards, and the V1 orifice had no "O" ring. The installation was IR'd and the orifices installed properly.
c. All accessible bolts in the apex flange were torque-checked and were within the proper torque range of 70 - 90 in/lb.
d. The missile was demated in the Hangar.

6. On 13 April 1959, action was taken on the following items:

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a. The RMI bellows was installed and then removed by IR No. 401540. A new bellows was drawn from spares.
b. IR's were written against both booster chambers (B1 - IR No. 401520, B2 - IR No. 401523) for dings in the tubes near the chamber exit. However, the chambers were satisfactory for use according to Rocketdyne and the IR's were dispositioned.

7. On 15 April 1959, the missile was erected on Complex 12.

8. On 17 April 1959, action was taken on the following items:

a. IR No. 401227 was written against the vernier LO_2 line, TVA 56579-9, due to interference with the sustainer pitch actuator.
b. The engine high pressure helium system and the ground helium supply line were leak-checked.
c. IR No. 401235 and No. 401233 were written against B1 and B2 fuel jacket purge check valves. These valves failed to pass the flow check at 50 psig, but were satisfactory at 500 psig. Rocketdyne decided to replace the valves.

9. On 20 April 1959, action was taken on the following items:

a. Completed installation of all fuel plumbing which was removed to permit access to the RMI valve.
b. The airborne half of the ground fuel start disconnect was found to be scored. IR No. 401247 was dispositioned by polishing the scored portion.
c. The main LO_2 system was leak-checked according to FTP-P-005. A leak was found at the boss on sustainer LO_2 flowmeter. The fitting was removed and no "O" ring was under it.
d. Poppets were removed from the fuel depletion shuttle valves according to GMA 6821.
e. The booster main fuel system was leak-checked according to FTP-P-005.

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FORM NO. A-783-2

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f. The HS servo fuel shuttle valve was checked according to Rocketdyne FSB R58-161.
g. The ground half of the ground fuel start disconnect was changed.

10. On 21 April 1959, action took place on the following items:

a. A leak check was made of the booster and sustainer opening and closing controls, the pre-valve controls, the gas generator LO_2 start system, and the vernier LO_2 and fuel systems according to FTP-P-005.
b. Rocketdyne ran a check of lube tank pressurizing valves according to Rocketdyne FSB R59-14.
c. An engine sequence test was performed with satisfactory results.
d. The interference between B1 pitch actuator and TVA 56579-7 vernier LO_2 line was corrected by rotating the actuator 180° according to TVA 56579-7.
e. An attempt was made to leak check the ground fuel start system according to FTP-P-005, but a bad leak was encountered at the Quad II disconnect. Investigation revealed the disconnect panel had been mated without a seal in the fuel start disconnect. A seal was subsequently added.
f. IR No. 402705 was written against the airborne half of the LO_2 fill and drain valve.

11. On 22 April 1959, the following items were completed:

a. Airborne half of the LO_2 fill and drain valve was replaced.
b. A leak check was performed on the sustainer hot gas system and the ground fuel start system according to FTP-P-005.
c. A functional check of the engine and valve heaters was performed according to FTP-P-005.
d. A functional check of the engine purge system was performed according to FTP-P-005. Booster gas generator LO_2, sustainer gas generator LO_2, and vernier LO_2 purges did not work. Investigation revealed the booster gas generator solenoid was inoperative, and the sustainer gas generator and vernier LO_2 purge lines were crossed at the staging disconnect. The

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defective solenoid was replaced, lines reconnected, and the operation was satisfactory.

e. Propulsion system leak checks according to FTP-P-005 and TPS 7977 were sold.

12. On 23 April 1959, action was taken on the following items:

a. Lube oil was pumped through the booster and sustainer lube systems. No leaks were found.

b. The torque on bolts connecting the booster gimbals to the bronze elbows was reduced from 275 - 300 in/lb to 125 - 150 in/lb according to Rocketdyne Failure Analysis Report No. 372351. The torque check was performed in accordance with TPS 8309.

c. The 0.031 inch orifice from the booster gas generator purge solenoid was left out when the new solenoid was installed. An orifice was installed but a leak was found between the valve and manifold and the "O" ring was replaced.

13. On 24 April 1959, the booster pumps were gas torqued to accomplish bleed of booster hydraulic pump and the new airborne half of the LO_2 fill and drain valve was leak-checked.

14. On 27 April 1959, the following items were accomplished:

a. The booster and sustainer thrust chambers were flushed in order to check ground and missile plumbing. No problems were encountered. The booster and sustainer gas generators and vernier engines were purged to keep the systems dry.

b. Two bolts were installed in the booster gas generator that had been lost in the hangar when the bootstrap line was removed.

15. On 28 April 1959, the sustainer main fuel system was pressurized to Sequence III during a propellant tanking test. No leaks were found.

16. On 29 April 1959, propulsion supported an integrated launch control test performed according to FTP-M-007A and TPS 642. Propulsion was unable to break vernier links while using red test box and had to resort to old procedure, FTP-M-007, to complete the test.

17. On 30 April 1959, a Flight Acceptance Composite Test was supported satisfactorily.

18. On 4 May 1959, the booster and sustainer gear boxes were preserved using Rocketdyne FSB R58-133B-EES as a reference. Residual fuel was drained from the B2 high pressure fuel duct and booster and sustainer thrust chambers. The three main chambers were flushed with trichlorethylene, purged dry, silica-gel installed, and sealed. Both gas generators and verniers were purged, silica-gel installed, and sealed. All vents and drains were sealed and all jam nuts on regs were locked.

19. On 5 May 1959, missile 9C was moved to Hangar Y for temporary storage.

20. On 10 June 1959, Rocketdyne performed a flush of the booster heat exchanger.

21. On 15 June 1959, the booster fuel pre-valve, RMI valve, and bellows were removed for inspection and X-ray.

22. On 27 July 1959, the missile was demated for modifications to the fuel staging valve.

23. On 3 August 1959, the fuel tank beef-up was completed through installation of pre-valve and leak checks.

24. On 6 August 1959, the LO_2 staging valve installation was in work, but the RMI valve was still a shortage.

25. On 17 August 1959, installation of the 7-0229-13 and -15 RMI fuel staging valves and the fuel stillwell plug was completed.

26. On 21 August 1959, a leak check of the sustainer main fuel system to 30 psig was performed according to FTP-P-005 and TPS 454.

27. On 27 August 1959, a zyglo check was made of the B2 turbine exhaust bellows. Results indicated four cracks in the convolutions. Investigation revealed bellows had been compressed by the hangar crew to install a new 19823-1100C seal to correct a leak at the Marmon clamp. Missile 9C will be demated at the complex to change the bellows.

28. On 28 August 1959, the following items were accomplished:

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a. Missile 9C was erected yesterday and demated this date to change the B2 turbine exhaust bellows.
b. A leak check was made of the fuel tank outlet flange and apex flange.
c. The igniter fuel system was leak-checked at 500 psi according to FTP-P-005. A leak was found above the pump and corrected.

29. On 29 August 1959, the following items were accomplished:

a. The B2 turbine exhaust bellows installation was completed and leak checked to 5 psi. A leak was discovered at the Marmon clamp and the 19823-1100C gasket had to be replaced. The installation was leak-checked again to 5 psi and was found to be satisfactory.
b. The main LO_2 system was leak-checked according to FTP-P-005. A leak was found at the joint between the sustainer LO_2 duct and RMI valve. Investigation revealed that all bolts in the flange were loose and they were tightened.
c. The vernier LO_2 and fuel systems were pressurized to 100 psi and joints which would be inaccessible after remate were checked.
d. All fittings on the booster pumps which would be inaccessible after remate were torque-checked.
e. Missile was remated.

30. On 31 August 1959, action was taken on the following items:

a. The ground and airborne halves of the ground fuel start rise-off disconnect were found to be damaged.
b. The vernier LO_2 domes were removed, checked for contamination and re-installed.

31. On 1 September 1959, the following items were completed:

a. The vernier engines were leak-checked according to FTP-P-005.
b. A new ground fuel start rise-off disconnect was installed.
c. The booster and sustainer main fuel system and LO_2 system were leak-checked satisfactorily according to FTP-P-005.

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32. On 2 September 1959, a leak check of the sustainer hot gas system and an end-to-end check of the engine purge system was performed.

33. On 3 September 1959, action was taken on the following items:

a. Satisfactory leak-checks were performed on the following systems according to FTP-P-005:

Vernier LO_2
Vernier Fuel
Gas Generator LO_2 Start
Ground Fuel Start

b. The fuel pre-valve pneumatic control lines were leak-checked satisfactorily.
c. An engine sequence was performed satisfactorily with the exception of the sustainer PU valve closed microswitch and the B2 main fuel valve closed microswitch which did not operate. The switches will be replaced.
d. The vernier LO_2 start tank pressurizing valve appeared to be leaking past the poppet. IR No. 413776 was written against it.

34. On 4 September 1959, the following action was taken:

a. The booster and sustainer gas generators were decontaminated according to pre-release TPS 995.
b. An IR was written against the vernier LO_2 start tank regulator due to excessive flow from the manual bleed.
c. An engine heater check was performed satisfactorily.

35. On 8 September 1959, the following items were accomplished:

a. The booster omega tie rod clearance was adjusted according to TPS 767.
b. The vernier engine LO_2 tank pressurizing package was leak-checked satisfactorily.
c. A slight leakage from the sustainer gas generator blade valve closing control solenoid was detected when the sustainer control regulator was pressurized. No action was taken at this time due to tanking schedule.

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36. On 9 September 1959, the propulsion system experienced no difficulties during LO_2 and fuel tanking.

37. On 10 September 1959, the following was accomplished:

    a. The propulsion system satisfactorily supported a Flight Acceptance Composite Test.
    b. The sustainer fuel purge solenoid was replaced due to an internal leakage problem.
    c. The engine control coil in the booster heat exchanger was hydrostated according to pre-release TPS 1093.

38. On 11 September 1959, the propulsion system experienced no difficulties during LO_2 and fuel tanking.

39. On 14 September 1959, the following was accomplished:

    a. The sustainer gas generator closing control solenoid was replaced.
    b. The torque on the fuel staging valve midriff bolts was checked according to TPS 1194. All bolts were found to be 30 - 35 in/lb.
    c. The fuel staging valve misalignment problem was discussed with the San Diego Propulsion Design Group and a decision was made to replace the 7-02229-15 half with a 27-21136-3 half. Removed B2 high pressure fuel ducting, ground fuel start line, booster gas generator, fuel bootstrap line and disconnected vernier LO_2 flex line for access to RMI valve, and the RMI valve was removed.
    d. The new aft section of the RMI bellows (27-21136-3) was IR'd for dings.
    e. The V1 fuel line was IR'd for a ding. The line was acceptable as is and will be checked after fuel tanking.

40. On 15 September 1959, the following was completed:

    a. The IR'd RMI bellows (27-21136-3) was approved for use and installed.
    b. All plumbing removed for access to the RMI bellows has been reconnected.
    c. The restrictors in the B1 LO_2 and fuel valve pneumatic lines were checked and found to be the proper size.
    d. The booster heat exchanger coil was hydrostated according to TPS 1206.

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41. On 16 September 1959, satisfactorily leak-checked the RMI valve, B2 high pressure fuel duct, ground fuel start line, and booster gas generator fuel bootstrap line.

42. On 17 September 1959, action was taken on the following:

   a. B1 and B2 gimbal assemblies were IR'd. B1 chamber will be lowered in order to remove the gimbal for repair. Rocketdyne cleaned the threads in the B2 thrust alignment slide lock bolt hole. Final adjustment on thrust alignment slide will be made when verification of setting is received from Rocketdyne, Canoga Park, California.
   b. The purge disconnect panel was lowered to check the disconnect which was pushed through the firewall. This disconnect panel was the one the vernier fuel tank vent line came through for the 25-second vernier tank installation. The disconnect was stuck together and had to be pried apart. The missile half was slightly damaged, but was polished and approved for use.

43. On 19 September 1959, the following was accomplished:

   a. The B1 gimbal was repaired, re-installed, and slides adjusted. The LO_2 and fuel ducts which were disconnected in order to lower the B1 chamber were connected and satisfactorily leak-checked.
   b. The firewall panel was repaired with epoxy and sprayed with aluminized paint.

44. On 22 September 1959, all X-1 Day and Precount propulsion checks were performed satisfactorily according to FTP-P-002A.

45. On 23 September 1959, the vernier LO_2 start tank regulator was replaced due to internal leakage.

46. On 24 September 1959, the sustainer control regulator could not be adjusted. The regulator would not hold setting and was replaced in the pre-count.

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Range Safety Command System

System components received with Missile 9C at AMR were as follows:

Range Safety Command Canister No. 1, Serial No. 101

Range Safety Command Canister No. 2, Serial No. 104

Range Safety Command Canister No. 1, Power Supply, Serial No. 35

Range Safety Command Canister No. 2, Power Supply, Serial No. 51

System tests were performed as follows:

BJ-3BD-01-09, completed 8 April 1959, was a satisfactory Range Safety Command System Test, performed per TPS 7835 utilizing test procedure 7-94073 and TVA 707036.

P2-3BD-01-09, completed 24 April 1959, was a satisfactory Range Safety Command System Test, performed per TPS 8145 utilizing test procedure 7-94073 and TVA 707036.

P2-3BD-02-09, completed 1 September 1959, was a satisfactory Range Safety Command System Test, performed per TPS 576 utilizing test procedure 7-94073 and TVA 707036.

Significant events and difficulties encountered during system preparation are chronologically enumerated below:

1. On 7 April 1959, the Range Safety Command System Test was delayed due to a defective R x 1 scale on the volt/ohm meter of the test equipment.

2. On 10 April 1959, the system satisfactorily supported a dry run of the Missile Composite System Test.

3. On 10 April 1959, the system satisfactorily supported a Missile Composite System Test.

4. On 24 April 1959, TPS 8152 was completed satisfactorily.

5. On 30 April 1959, the system unsatisfactorily supported a Flight Acceptance Composite Test. RSC Receiver No. 2 was inoperative throughout the test. Post-test investigation revealed a defective power supply. Performance of RSC Receiver No. 1 was satisfactory. A blockhouse compatibility test, per FTP-D-001A, was completed satisfactorily prior to the Flight Acceptance Composite Test.

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6. On 1 May 1959, power supply S/N 51 was IR'd on IR No. 402840. S/N 1 was installed as a replacement. A functional test with the AMR station was conducted satisfactorily.

7. On 4 September 1959, missile blockhouse compatibility was performed per TPS 541 utilizing FTP-D-001A. Results were satisfactory.

8. Satisfactory system performance was demonstrated during a Flight Acceptance Composite Test performed on 10 September 1959, and during the Atlas/Able IV FAC Test on 18 September 1959. System performance was also satisfactory during the mock countdown test on 21 September 1959.

There were no further difficulties encountered in preparing this system for the flight readiness firing.

Telemetry System

The telemetry system was activated on Missile 9C to checkout the system and to calibrate the booster, sustainer, and vernier engine positions, vernier chamber pressures, and sustainer main LO2 and fuel valves. The telemetry system was also activated to monitor LO2 and fuel tanking tests, FAC Tests, and the FRF. The test procedure used as a guide for performing telemetry tests was FTP-T-014. The telemetry power supply failed during test warm-up for BJ-3CO-01-09 and P2-301-00-09. The power supply was changed each time.

BJ-3BT-01-09, completed 7 April 1959, was the first telemetry systems test performed on Missile 9C at AMR. The purpose of this test was to check the status of the installed telemetry system. This test was satisfactory.

BJ-3BT-02-09, completed 8 April 1959, was a telemetry systems test to calibrate the vernier chamber pressures. This test was satisfactory.

BJ-3BT-03-09, completed 8 April 1959, was a telemetry systems test to monitor a dry run for a composite test. This test was satisfactory.

BJ-3CO-01-09, completed 10 April 1959, was a composite system test. During the telemetry warm-up to monitor this test, the telemetry power supply failed. The power supply was replaced and the telemetry system operated satisfactorily during the test.

P2-3BT-01-09, completed 20 April 1959, was a telemetry systems test to calibrate the vernier engine positions. This test was satisfactory.

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P2-3BT-02-09, completed 21 April 1959, was a telemetry calibration for B1 pitch and yaw. B1 pitch was satisfactory but B1 yaw was out of band.

P2-3BT-03-09, completed 21 April 1959, was a telemetry calibration of sustainer pitch and yaw positions. The calibration was satisfactory, however, the null position was off-center, therefore, the measurements will be repadded and the calibration re-run.

P2-3BT-04-09, completed 21 April 1959, was a telemetry calibration of P 529 D, S Main LO2 valve. This test was satisfactory.

P2-3BT-05-09, completed 23 April 1959, was a telemetry systems test to re-calibrate B1 yaw after repadding the subcarrier . This test was satisfactory.

P2-3BT-06-09, completed 30 April 1959, was a telemetry systems test to calibrate P 528 D, sustainer main fuel valve. This test was satisfactory.

P2-3BT-07-09, completed 28 August 1959, was a telemetry systems test to check the status of the telemetry system. Channels A and E were noisy but the system operated satisfactorily.

P2-3BT-08-09, completed 31 August 1959, was a telemetry calibration of sustainer yaw because this measurement had slipped out of band. Results were unsatisfactory as the calibration was non-linear.

P2-3BT-10-09, and P2-3BT-11-09, completed 2 September 1959, were telemetry systems tests to calibrate the sustainer yaw position. During Test 10-09 the engine was manually moved $\pm$ 3 degrees in the yaw plane. Test 11-09 was run to make a record while the sustainer was at null position. This test was unsatisfactory because the null position did not correspond to the calibration.

P2-3BT-12-09, completed 3 September 1959, was run to check the calibration of the sustainer yaw transducer. The results of this test were the same as for P2-3BT-10-09.

NOTE: Tests P2-3BT-10, 11, and 12-09, were performed in an effort to position the sustainer yaw transducer because of non-linearity, but after the results from these tests proved to be unsatisfactory, the circuit was repadded.

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P2-3BT-13-09, completed 4 September 1959 was a telemetry systems test to re-calibrate sustainer yaw. This test was satisfactory after the repadding.

P2-3BT-14-09, completed 14 September 1959, was a telemetry systems test to check the spare telemetry package, Serial Number 85245. This test was satisfactory.

P2-3BT-15-09, completed 15 September 1959, was a telemetry systems test performed to calibrate the second spare telemetry package, Serial No. 86239. This test was satisfactory.

P2-3BT-16-09, completed 21 September 1959, was a telemetry systems test using the autopilot to move the engines and recheck null positions and calibrate the sustainer pitch and yaw positions. This test was satisfactory.

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FILM REVIEW

A review of available film at the time of this report indicates that no external abnormalities were apparent until cutoff. During the cutoff sequence, an explosion was evident in the Quads I and II area of the engine compartment as evidenced by extrusion of flame from the obsolete umbilical disconnect panel on the Quad I skirt, immediately followed by clouds of white vapor issuing from under the thrust section. An LO_2 rich fire immediately enveloped the thrust section, eating through the Quad II skirt by approximately 9 seconds, and through the Quad III skirt by approximately 17 seconds. Between this time and the time that the missile began to fall, four explosions occurred within the flame at the base of the missile, each explosion being greater in magnitude than the preceding. At approximately 30 seconds, the missile began to lean toward the ramp and continued to fall oriented slightly west of parallel to the ramp. The final explosion of the missile appeared to occur slightly before the missile impacted on the ramp, at approximately 37.5 seconds. (See graph).

The following table lists events mentioned in this report. Times are based upon assumed camera speeds and therefore are approximate.

Event	Time in Secs. From BGG
First visable explosion	2.22
Flame through Quad II skirt	9.53
Flame through Quad III skirt	16.80
Second explosion	19.48
Third explosion	20.10
Fourth explosion	20.25
Fifth explosion	27.94
Msl started to fall	29.56
Final explosion	37.80

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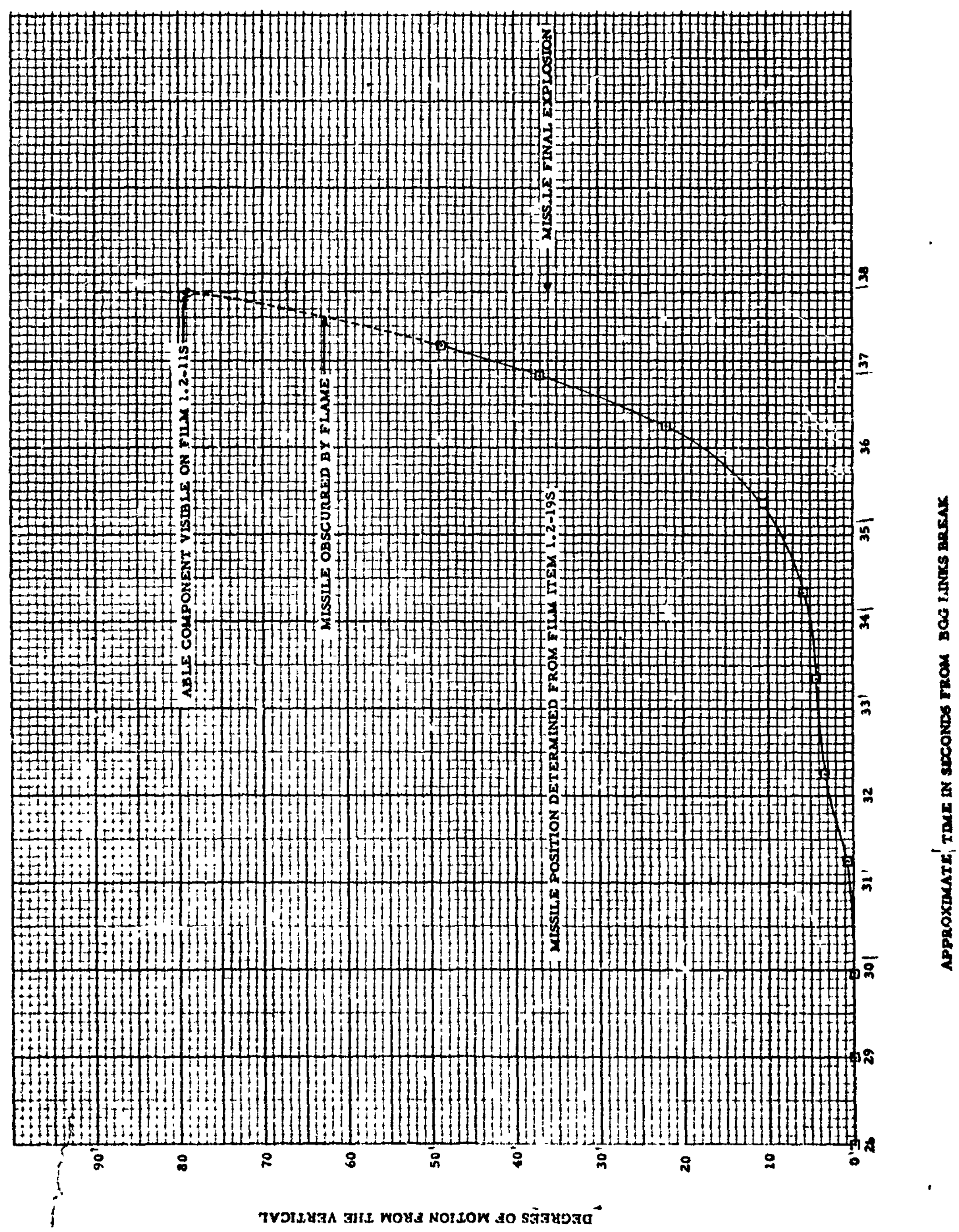
MISSILE ATTITUDE PRIOR TO DESTRUCTION
(from film review)



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Item No.	Camera Location	Type Camera (mm)	Color or B/W	Frame Speed (fps)	Film Quality For Viewing Purposes	Received and Reviewed
1.2-1S	12-2	16	Color	300	Satisfactory	Yes
1.2-2S	12-10	16	Color	300	Underexposed	Yes
1.2-3S	12-6	16	Color	300	Satisfactory	Yes
1.2-4S	East Launcher	16	Color	200		Camera & film destroyed
1.2-5S	West Launcher	16	Color	200	Satisfactory	Yes
1.2-6S	12-4	16	Color	96	Satisfactory	Yes
1.2-7S	12-2	16	Color	96		Not available for review
1.2-8S	12-6	16	Color	96	Satisfactory	Yes
1.2-9S	Ramp	16	Color	96		Camera & film destroyed
1.2-10S	12-6	16	Color	96	Satisfactory	Yes
1.2-11S	12-2	16	Color	96	Satisfactory	Yes
1.2-12S	12-10	16	Color	96	Satisfactory	Yes
1.2-13S	12-4	16	Color	96	Satisfactory	Yes
1.2-14S	12-9	16	Color	24		Camera not activated
1.2-15S	12-9	16	Color	24		Camera not activated
1.2-16S	12-9	35 Reduced to 16	Color	24	Satisfactory	Yes

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Item No.	Camera Location	Type Camera (mm)	Color or B/W	Frame Speed (fps)	Film Quality For Viewing Purposes	Received and Reviewed
1.2-17S	12-10	35 Reduced to 16	Color	24	Satisfactory	Yes
1.2-18S	12-2	35 Reduced to 16	Color	24	Satisfactory	Yes
1.2-19S	12-5	35 Reduced to 16	Color	24	Satisfactory	Yes
1.2-20S	Top of Gantry	35	Color	24		Camera & film destroyed
1.2-21S	12-5	35 Reduced to 16	B/W	1000	Not Satisfactory	Yes
1.2-22S	12-5	35 Reduced to 16	B/W	1000	Overexposed	Yes
1.2-23S	12-10	70 Reduced to 35	35% Color	30	Satisfactory	Yes
1.2-24S	12-2	70 Reduced to 35	Color	30	Satisfactory	Yes
1.2-25S	12-5	70 Reduced to 35	Color	30	Satisfactory	Yes

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Item No.	Camera Location	Type Camera (mm)	Color or B/W	Frame Speed (fps)	Film Quality For Viewing Purposes	Received For Reviewed
1.2-26S	12-3	70 Reduced to 35	Color	30	Satisfactory	Yes
1.2-27S	12-8	70	Color	30		Camera malfunctioned
1.2-28S	Ramp	70	Color	30		Camera & film destroyed
1.3-200S		16	Color		Satisfactory	Yes
1.3 4C		16	Color		Satisfactory	Yes

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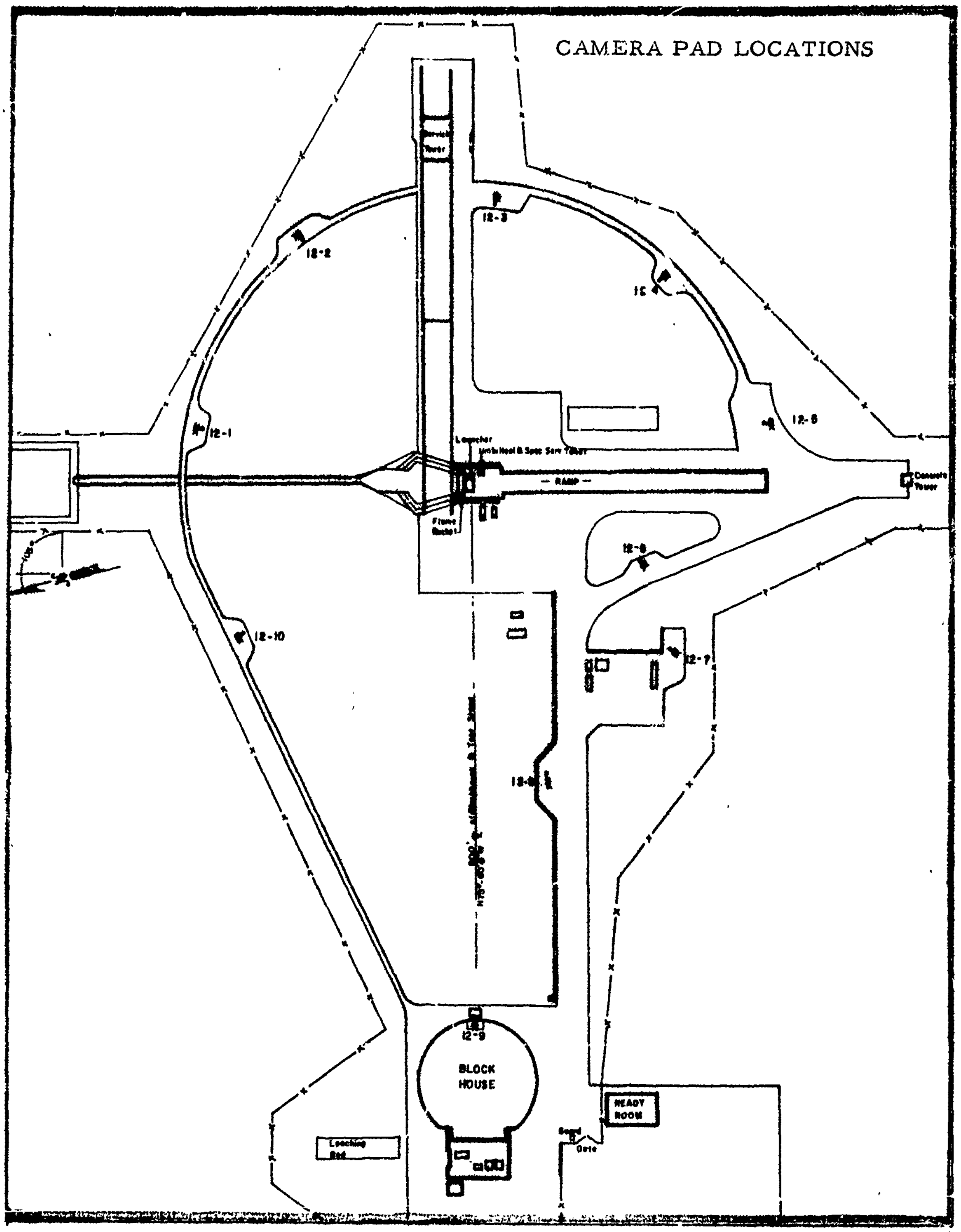

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Photos in this report were selected from motion picture items listed and the following items which were available at the time of publication.

Photos of the Sustainer Engine and/or the Launcher;

MT-59-43011	MT-59-43008
MT-59-43010	MT-59-42954
MT-59-42995	MT-59-79488.38
MT-59-42993	MT-59-79488.44
MT-59-42991	MT-59-79488.37
MT-59-42992	MT-59-79488.12
MT-59-42971	MT-59-79488.14
MT-59-43012	MT-59-79488.35
MT-59-43009	MT-59-79488.33
MT-59-43013	MT-59-79488.36
MT-59-42994	MT-59-79497.1
MT-59-42990	Thru
MT-59-43002	MT-59-79497.23

Photos of the Sustainer Engine in Hangar "J" and Disassembly of the Engine:

MT-59-79511.4

Thru

MT-59-79511.51

Special Photos of the Fuel Tank Apex, Vernier Fuel Tank Vent Line, and the Sustainer Pump Inlet Ducting;

MT-59-79871.2

Thru

MT-59-79871.11

Photos of Miscellaneous Components as Found:

MT-59-42928	MT-59-43024
MT-59-42938	MT-59-43021
MT-59-42929	MT-59-42984
MT-59-42937	MT-59-42983
MT-59-42939	MT-59-42985
MT-59-42940	MT-59-42924
MT-59-42941	MT-59-42980
MT-59-42972	MT-59-42936
	MT-59-42930

Photos of the Ramp and Ramp Area:

MT-59-42987	MT-59-42968
MT-59-42935	MT-59-42947
MT-59-42998	MT-59-42945
MT-59-42913	MT-59-42942
MT-59-43006	MT-59-42975
MT-59-42997	MT-59-42977
MT-59-42999	MT-59-42976
MT-59-42922	MT-59-43014
MT-59-42921	MT-59-42965
MT-59-42953	MT-59-42920
MT-59-42955	MT-59-43005
MT-59-42951	MT-59-42988

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Photos of the Ramp and Ramp Area:

MT-59-79497.24	MT-59-42914
MT-59-59019-12	MT-59-43004
MT-59-59019-16	MT-59-43007
MT-59-59019-17	MT-59-42967
MT-59-59019-19	MT-59-42966
MT-59-59019-20	MT-59-42964
MT-59-59019-23	MT-59-42996
MT-59-59019-24	MT-59-42961
MT-59-59019-5	MT-59-42934
MT-59-42916	MT-59-79488.42
MT-59-42919	MT-59-79488.4
MT-59-42912	MT-59-79488.2
MT-59-42963	MT-59-79488.6
MT-59-42915	MT-59-79488.8
MT-59-42933	MT-59-79488.10
MT-59-42925	MT-59-79488.23
MT-59-59019-27	MT-59-79488.24
MT-59-42918	MT-59-79488.43
MT-59-42917	MT-59-79488.35

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Photos of the Booster Chambers, LN2 Shroud, Helium Bottles, and General Area North of the Ramp:

MT-59-59019-28	MT-59-42946
MT-59-59019-26	MT-59-42969
MT-59-43003	MT-59-79488.15
MT-59-59019-22	MT-59-79488.11
MT-59-42970	

Photos of the Able Component:

MT-59-79488.3	MT-59-42962
MT-59-42959	MT-59-42960
MT-59-42958	MT-59-42956

Photos of the Ready Room, Parking Lot and General Area West of the Ramp:

MT-59-42979	MT-59-42943
MT-59-42978	MT-59-42989
MT-59-42973	MT-59-42974
MT-59-43018	MT-59-42982
MT-59-43023	MT-59-43022
MT-59-43019	MT-59-43020
MT-59-43001	MT-59-43016
MT-59-43000	MT-59-42981
MT-59-42944	MT-59-79488.7
MT-59-43017	MT-59-79488.9
MT-59-43015	MT-59-79488.18

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Photos of Able Umbilical Tower, Fuel Storage Area, and General Area East of the Ramp:

MT-59-42950	MT-59-79488.21
MT-59-42948	MT-59-79488.20
MT-59-42927	MT-59-79488.19
MT-59-42949	MT-59-79488.22
MT-59-59019-25	MT-59-79488.26
MT-59-42932	MT-59-59019.21
MT-59-79488.16	

Photos of the Entire Complex (Aerial):

MT-59-79488.5	MT-59-59019-1
MT-59-59019-6	MT-59-59019-18
MT-59-59019-10	MT-59-59019-2
MT-59-59019-11	MT-59-59019-15
MT-59-59019-14	MT-59-59019-8
MT-59-59019-13	MT-59-59019-7
MT-59-59019-3	MT-59-59019-9
MT-59-59019-4	

Photos of Assembled Hardware During Mop Up:

MT-59-79511.2	MT-59-79511.3
MT-59-79511.1	

Photo of Complex 11 Damage

MT-59-42931

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COUNTDOWN TIME VERSUS EVENTS

This test was planned for a 180 minute countdown with two planned holds, totaling 60 minutes. These holds were scheduled at T-60 minutes, for a 50 minute period and at T-7 minutes, for a 10 minute period.

The countdown was started at 0230 EST as planned. There were two unscheduled holds required in addition to the two scheduled holds and two test recycles resulting in a total countdown time of 463 minutes. The holds and recycles were as follows:

1. At -60 minutes, 0430 EST, for 50 minutes as planned in the countdown. The count was resumed at 0520 EST.

2. At -13 minutes, 0607 EST, for 153 minutes. Telemetry reception was lost at the ground station. The test was recycled to -70 minutes and the countdown was resumed at 0840 EST after replacement of the telemetry canister and telemeter power supply.

3. At -27 minutes, 0923 EST, for 10 minutes due to ice forming around the valve stem of the LA-1 outlet valve, preventing the valve from closing. The countdown was recycled to -30 minutes, the ice removed and the count resumed at 0933 EST

4. At -7 minutes, 0956 EST, for 10 minutes, as planned in the countdown. The countdown was resumed at 1006 EST.

The following notations were made by an observer in the blockhouse:

EST	COUNTDOWN TIME	COUNTDOWN PROCEDURE	EVENT
0215	Precount		Systems status check. All systems are ready to begin the countdown.
0230	T-180	T-180	Countdown started. Range safety command system test started.
0237	T-173	T-170	Range safety command system test completed satisfactorily.
0240	T-170	T-170	Electrical connection of destruct boxes started.
0300	T-150	T-135	Tower moving crew reported on station to prepare to move the tower. The complex area is in an amber condition.

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EST	COUNTDOWN TIME	COUNTDOWN PROCEDURE	EVENT
0315	T-135	T-120	Tower platforms are raised and locked.
0324	T-126	T-125	The hydraulics systems are at 2,000 psig.
0327	T-123	T-115	Permission to move service tower granted.
0329	T-121		Weather forecast - Winds, 15 to 18 knots with gust to 25 knots.
0333	T-117	T-117	Flight control system tests started.
0337	T-113		Gyro torquing test completed satisfactorily.
0343	T-107		Service tower secured in maintenance area.
0347	T-102	T-100	Flight control loop test preparation started.
0349	T-100	T-100	Guidance loop test preparation started.
0356	T-95	T-95	Start payload checks.
0357	T-94		Area cleared of all personnel except operational people.
0359	T-92	T-91	Flight control/guidance loop test preparations are complete.
0400	T-90	T-90	Loop test started.
0408	T-82		Loop test completed satisfactorily.
0412	T-78	T-80	Blockhouse and pad area - Red condition.
0424	T-66		Hydraulic oil draining from a bleed in Quad II. Hydraulics consider this normal.
0430	T-60	T-60	Holding at -60 minutes for 50 minutes as planned.

EST	COUNTDOWN TIME	COUNTDOWN PROCEDURE	EVENT
			The following two events occurred during the 50 minute hold: 1. The launcher booster unit 7,000 lb. bottle pressure switch would not cycle. It was decided to secure the pressure at the present pressure level, if the switch could not be fixed. 2. Leak discovered at LN_2 trailer. Trailer crew did not consider this leak serious and anticipated no trouble.
0520	T-60	T-60	Countdown resumed.
0529	T-51		Filling LO_2 heat exchanger.
0530	T-50		Started LO_2 chill down.
0543	T-37		Theodolite readings: Atlas $\frac{1}{2}$ inch South, Able $\frac{1}{2}$ inch South.
0550	T-30	T-30	Flight control system tests start.
0600	T-20	T-20	Range safety command test start. Flight control system torque test completed.
0607	T-13		Holding - Recycle to -70 minutes. Hold and recycle the result of failure of telemetry system. Estimate 150 minutes.
0609	T-70H		LO_2 detanking operations started.
0639	T-70H		LO_2 detanking operations completed.
0725	T-70H		Telemetry system malfunction. The result of telemetry power supply failure.
0744	T-70H		Telemetry reports the replacement power supply canister not transmitting booster, sustainer, and vernier cutoff signals.
0753	T-70H		Will not make another canister change. Booster, sustainer, and vernier cutoff signals will not be recorded via telemetry.

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EST	COUNTDOWN TIME	COUNTDOWN PROCEDURE	EVENT
0758	T-70H		Telemetry ground station reports satisfactory telemetry reception.
0803	T-70H		Installation of telemetry canister completed. Pod doors secured and preparations to move service tower underway.
0810	T-70H		System status check in preparation for resuming the countdown. Plan to resume in 30 minutes. LO_2 storage tank topped off.
0831	T-70H		Service tower secured in maintenance area.
0840	T-70		Countdown resumed.
0850	T-60		Scheduled 50 minute hold will not be used at this time.
0853	T-57	T-55	LO_2 tanking preparations started.
0900	T-50	T-50	Clearance given for LO_2 chill down. Clearance verified by the pad safety officer.
0904	T-46		LO_2 tanking started.
0915	T-35		Able checks started.
0919	T-31		Able checks completed. Able warm up will start at -30 minutes.
0920	T-30		Able warm up started.
0922	T-28		LO_2 pump LA outlet valve open causing a partial flow of LO_2 back into storage tank.
0923	T-27		Holding. Recycle to -30 minutes. Hold due to outlet valve of LO_2 pump LA. Frozen open. Valve would not close due to ice forming around valve stem. Ice the result of a slight LO_2 leak. LO_2 handling personnel thawed the ice.
0930	T-30H		Pad safety officer authorized LO_2 operations start.

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EST	COUNTDOWN TIME	COUNTDOWN PROCEDURE	EVENT
0933	T-30		Countdown resumed and LO_2 tanking operations are proceeding.
0939	T-24		Telemetry reports sustainer yaw signal is out of band. Will proceed as is since sustainer engine not gimbaled during an FRF range reports reading able telemetry.
0944	T-19	T-20	Able control system guidance checks start.
0954	T-9		Flight control system final countdown test completed.
0956	T-7H	T-7	Holding countdown as planned for 10 minutes.
1006	T-7	T-7	Countdown resumed.
1008	T-5	T-5	All communications switch to channel 1.
	T-4:30	T-4:30	Turning water systems "ON".
	T-4:15	T-4:15	Dumping LN_2.
	T-4:00	T-4:00	Missile to internal AC.
	T-3:55	T-3:55	System status check, all systems ready.
	T-3:15	T-3:15	Convair telemetry to internal power. Able telemetry to internal power.
	T-2:30	T-2:30	Able pressurization complete. Able to internal power.
	T-2:10	T-2:10	Securing LO_2 tanking.
	T-2:00	T-2:00	Flight pressurization start. Commands to internal power. Blast gages switch "ON".
	T-1:55	T-1:55	Telemetry to ready condition.
	T-1:45	T-1:45	Test-Off-Arm switch to "ARM". Engine preparation complete. Able power "READY". Able ready light "ON".

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EST	COUNTDOWN TIME	COUNTDOWN PROCEDURE	EVENT
	T-1:25	T-1:25	Remove arming safety pin.
	T-1:20	T-1:20	Range safety arm switch to "ARM".
	T-1:10	T-1:10	System status check: All systems "GO".
	T-0:60	T-0:60	Missile to internal DC. Pressurization to internal. Water full flow. Pad safety officer range ready switch "ON".
	T-0:40	T-0:40	Status check: All systems GO.
	T-0:26	T-0:26	Holding, momentarily, for LO_2 tanking.
	T-0:25	T-0:25	All recorders to fast. Vernier start.
1012: 41.33			Booster gas generator links break.

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OBSERVER'S REPORTS

Statements taken from blockhouse personnel who participated in the test reflect no unusual circumstances until just after a call of engine cutoff.

The first indication of an abnormal condition in the blockhouse was the sudden increase in temperature at the B2 fuel igniter valve (P 1674 T) reported by the chart watcher. He called for cutoff when this temperature indication suddenly increased to its upper limit.

The propellant tank pressure chart observer stated he was preparing to call for cutoff just as the temperature cutoff was called. At this point both tank pressures were at full scale, after which they dropped to zero. The pressurization panel operator said his first indication of trouble was a decrease in fuel tank pressure and an increase in LO2 tank pressure to full scale (30 psi). This apparently occurred after cutoff since the backup operator reported normal changeover to external at cutoff.

All statements indicate prompt corrective actions were taken by blockhouse personnel after the cutoff call.

A word-for-word transcript of the blockhouse voice tape appears on the following page. It should be noted that description of tank pressures and valve positions were observed on blockhouse instruments. As a result of the heavy fire in the engine compartment, landline instrumentation malfunctioned and several of the later readouts, after cutoff, are in error.

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COMPLETE TRANSCRIPT OF VOICE TAPE AFTER IGNITION

Time in Seconds Referenced To BCC Links Break	Callout	Called By
0	Mainstage	Unidentified
2.136	(Cutoff actually occurred here)	
4	Cut Off	Sounded like several people
5	We have cutoff	F. Eggers
6	Get skirt firex on	Sounded like several people
7	Skirt firex is on	J. Phillips
9	Main fuel valve is open	T. C. Chitty
12	Monitor nozzles on	J. E. Vevera
14	Tank pressures are gone	J. H. Sylvester
16	Monitor nozzles are on	T. J. Phillip
19	Tank pressures are gone. Norm, you get them?	J. H. Sylvester
	Go to ---	W. E. Huffman
21	Engine compartment temperature pegged out on the high side	K. K. Wilcox
24	Main fuel valve is still open	T. C. Chitty
27	Go to test off arm to test, Wick	W. E. Huffman
29	Lost LO2 tank pressure	T. Pianko
32	Fuel tank pressure gone	T. Pianko
35.5	She's falling	J. E. Vevera

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ROSTER OF PERSONNEL IN THE BLOCKHOUSE AND THEIR DUTY LOCATION

CONVAIR-ASTRONAUTICS

NAME	TITLE	DUTY LOCATION
Adams, A. A.	Electrical Engineer	Pad facility panel operator
Beebe, B. B.	Technician	RCC oscillograph operator
Bellemore, L.	Technician	Recorder operation observer
Carothers, R. D.	Lead Flight Control Engineer	Flight control recorder panel operator
Capo, R. V.	Data Operations Representative	Autopilot data representative
Carpenter, R. D.	Instrumentation Technician	RCC panel operator
Chitty, T. C.	Lead Instrumentation Engineer	Chart observer
Coker, V.	Instrumentation Engineer	Chart observer
Danner, B. C.	Assistant Test Conductor	Right side test conductor panel
Eggers, F.	Technician	Engine test panel
Gaudet, A. R.	Technician	Chart observer
Goldberg, G A.	Missile Electrical Engineer	Missile power panel operator
Greene, J. T.	Technician	Recorder operation observer
Gross, L. H.	Instrumentation Engineer	Gilmore weight system readout
Hall, G. W.	Range Safety Engineer	Range safety command panel operator
Hendricks, D. R.	Instrumentation Engineer	Instrumentation console

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NAME	TITLE	DUTY LOCATION
Hoffman, H.	Autopilot Engineer	Autopilot and hydraulic panel operator
Holley, W. L.	Technician	Oscillograph operator
Huffman, W. E.	Lead Propulsion Engineer	No. 1 periscope observer
Jackson, W. R.	Test Conductor	Operating test conductor's console
Kadlec, G. J.	Technician	Chart observer
Keatley, J. H.	Blockhouse Monitor	Sequencer readout
Knight, W. H.	Electrician	Blockhouse air conditioner
Lawrence, K. E.	Lead Electrical & R. F. Engineer	Monitoring missile power and range safety panels
Leffingwell, W.	Data Operations Representative	Gilmore weight monitor
Leonard, A. E.	Technician	Flight control recorder observer
Malewicz, K. B.	Technician	Power panel observer
Maloy, T. L.	Chief Test Conductor	Right side test conductor's console
Matthews, H. O.	Inspector	On standby in blockhouse
Morton, K. I.	Instrumentation lab technician	On standby in blockhouse
Neiman, N.	Pressurization Engineer	Pressurization panel operator
Padgett, J.	Complex Mechanical Engineer	LO_2 tanking panel operator
Phelps, C. N.	Assistant Foreman	TV console monitor operator
Phillipp, T. J.	Guidance Engineer	Guidance monitor set operator

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NAME	TITLE	DUTY LOCATION
Phillips, J. G.	Technician	Water panel operator
Phillips, R. M.	Liaison to Test Conductor	MOPIS tape recorder
Pianko, T.	Complex Mechanical Engineer	Monitor propellant tanking panel
Ray, N. R.	Autopilot Engineer	Autopilot recorder observer
Reed, O. H.	Assistant Test Conductor	Monitoring LO_2 tanking panel
Reid, W. A.	Propulsion Engineer	Chart observer
Ring, W. C.	Propulsion Engineer	Chart observer
Sheltman, R.	Inspection Supervisor	Inspection observer
Sylvester, J.	Lead Complex Electrical Engr.	Chart observer - pressurization
Taylor, R. E.	Technician	Telemetry panel operator
Teich, H. F.	Technician	Chart observer
Terhune, C. A.	Azusa Engineer	Azusa panel operator
Vevera, J. E.	Lead Complex Mechanical Engr.	No. 4 periscope observer
Wantz, B. H.	Technician	Flight control recorder observer
Wardman, J. M.	Complex Electrical Engineer	Behind pad facility panel
Wilcox, K. K.	Assistant Test Conductor	Chart observer

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BMD/STL

Lt. Col. E. A. Meyer, Jr.

Maj. R. H. Lengnick

Capt. R. E. Rae

Capt. D. Steelman

T/Sgt. G. W. McCormick

Blake, J. T.

Payne, R. E. (Dr.)

Hanrahan, T.

ROCKETDYNE

James, R. E.

Taylor, R. W.

GENERAL ELECTRIC (DSD)

Strieter, H. D.

STL - ABLE & AEROJET-GEN.

Bunch, B.

Blaisdell, J. D.

Ferguson, F.

Gleghorn, G

Hoffman, R.

Matus, J. A.

Pixley, N.

Pruett, L. B.

Schilling, W.

All available statements from blockhouse personnel appear on the following pages.

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STATEMENT BY J. D. BLAISDELL, ABLE CONTROL OPERATOR, SPACE TECHNOLOGY LABORATORIES:

In my position of Able Control during the FRF of Missile 9C I was located at the Able Control console which was located to the right and about six feet forward of the test conductor (the same location of the GE nose cone console when used). My observations during the FRF are tabulated in what I believe to be the correct order of events.

At T-1 minute 10 seconds, I gave the test conductor a "GO" report for the Able second stage systems.

At the announcement, "T-60 seconds and counting" I was in process of switching the Able electrical system from "Ready" back to "Hydraulic External", a position on the Able control console which removes all of the Able systems from internal battery power to external ground power. So this operation consisted of moving a 7-position rotary switch from position 7 back to position 3.

My next step was to switch the second stage telemetry from internal power to ground power, which consisted of positioning two toggle switches, the first switch being "telemetry ground power on" and the second switch being telemetry "external/internal" switch to "external".

The aforementioned switching operations were completed prior to T-45 seconds, since the Able guidance station will lose momentary lock on the Able missile during switching and requires a minimum of five seconds to re-acquire and be assured of locking on the bird.

Immediately upon the command "Cutoff" I switch the Able system to "Missile External" (position 2 on the rotary switch). This position allows all Able systems except hydraulics to be functioning and is a position in which I could hold the Able system for an additional forty minutes if necessary.

The logic behind switching the Able system to external power sources was to be given assurance that if the vibration of the second stage ejected the Able umbilical, the missile could not be damaged by the continuous operation of the systems until the batteries ran down. This method of operation has been adhered to on the Thor FRF's as the best possible system insurance.

I held the Able system in the aforementioned condition until my panel went dead at the forceful ejection of the umbilical when the missile fell.

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STATEMENT BY B. B. BEEBE, TECHNICIAN, RCC OSCILLOGRAPH OPERATOR:

At T-25 I turned on No. 1 and No. 2 and was observing RCC on No. 1. I noticed that it had started to oscillate and at that time someone said "Fire" so I glanced up at the TV monitor in the observation room. I observed flames coming from the thrust section and climbing up the north side of the missile.

STATEMENT BY L. BELLEMORE, TECHNICIAN, RECORDER OPERATION OBSERVER:

I was at my station, checking the recorders for inking, proper speed and timing when I felt the blast. I didn't have a headset on and didn't realize what happened until the power went off.

STATEMENT BY R. V. CAPO, DATA OPERATIONS, AUTOPILOT DATA REPRESENTATIVE:

I was recording time versus events during the countdown and was watching the television monitors at the time of ignition. At this time I heard 3 or 4 cutoffs called out and observed fire around the thrust section of the missile until loss of power.

STATEMENT BY R. D. CARPENTER, INSTRUMENTATION TECHNICIAN, RCC PANEL OPERATOR:

At mainstage I was observing the RCC system to determine any count that might occur.

During the period between mainstage and cutoff there were no counts registered on the binary counter. Immediately after engine shutdown however, I experienced a distinct impression of two more distinct engine surges at which time several counts were registered on all three of the binary counters. I was unable to get an accurate count due to power failure. I am quite sure that none of the three engines built up enough counts to give automatic RCC cutoff.

STATEMENT BY R. D. CAROTHERS, LEAD FLIGHT CONTROL ENGINEER, FLIGHT CONTROL RECORDER PANEL OPERATOR:

Autopilot performed most satisfactorily during countdown operation to all test signals injected. At ignition the booster engines gave a normal kick like any other normal start. About two seconds later, I heard cutoff called by two sources, the engines seemed to respond to cutoff like it normally has in the past. The reason I can say the start and stop of the engines were normal is because at ignition and cutoff the engines give a slight kick. These were normal kicks. Approximately two seconds after cutoff the engines were exercised by the integrators in the pitch and yaw axis. The pitch cycle appeared

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about normal through its complete cycle, but during the yaw cycle the engines moved in yaw following the output of the integrators plus had sharp spikes on the ramps. These ramps appeared to be about one degree spikes on the engine traces. Approximately seven seconds after cutoff was called I heard someone say the thrust section temperature indicator was against the stops. I heard someone say it was falling and then a large explosion occurred which destroyed all autopilot instrumentation. This explosion appeared about twelve seconds after cutoff was called.

STATEMENT BY T. C. CHITTY, LEAD INSTRUMENTATION ENGINEER, CHART OBSERVER:

During the FRF of 9C I was acting as chart watcher on U 1091 V, PU error demod voltage and P 1528 D, sustainer PU valve position. Both appeared normal at ignition. The PU valve began to come into control after the normal time delay. At the report of cutoff P 1528 D continued past the closed position and then reopened. I reported this reopening, but now attribute this indication to a failure in the power system to the PU canister. During the period between cutoff and the loss of the missile I noticed no personnel actions which were not indicative of a well-trained crew.

STATEMENT BY V. A. COKER, INSTRUMENTATION ENGINEER, CHART OPERATION OBSERVER:

I was observing strip charts for timing proper inking and speed when recorders were switched to fast at T-25 seconds.

I heard mainstage fire and approximately 10 seconds later heard cutoff called. A few seconds later I heard "It's falling" and a loud report which jarred the blockhouse. I did not see missile on TV.

STATEMENT BY B. C. DANNER, ASSISTANT TEST CONDUCTOR, RIGHT SIDE TEST CONDUCTOR'S PANEL:

My position as assistant test conductor placed me to the right side of the test conductor's panel. I observed normal entry into vernier start through release light at approximately 0 seconds. Still watching the test conductor's panel, I observed cutoff (all three red lights) at approximately 1 to 2 seconds after I saw release light indication on the function safe release panel. I observed that automatic cutoff came before a cutoff was called over the intercom. The test conductor did not manually depress the cutoff button.

I saw fire outside the skirt section at approximately four seconds on TV. I listened to the communications reports and saw detonation at what seemed 8-10 seconds after zero time.

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STATEMENT BY F. EGGERS, TECHNICIAN, ENGINE TEST PANEL:

At vernier start, received vernier start light. The vernier engine links broke, a vernier engine complete came on, booster and sustainer links broke and ignition complete light came on. Booster and sustainer gas generator links broke and main engine complete light came on. The gas generator blade valve open lights came on. Started to report mainstage when panel lights became erratic and I was unable to get a true reading.

I went to components and attempted to get test start light to get valve control after I received all cutoff lights because all valve lights were blinking open and close. At this time all electrical power went off.

I heard someone call mainstage when first gas generator links light went out. Someone yelled "Cutoff" and then someone yelled "She's falling".

STATEMENT BY F. H. FERGUSON, STL OBSERVER IN GLASS ENCLOSED ROOM:

I was observing TV monitors at time of vernier start. Cutoff was called over MOPS just prior to flame issuing from tailcan. The fire enveloped the Atlas stage and the vehicle toppled toward the umbilical tower. Then the monitors went dead. Right after this a heavy shock wave was felt in the blockhouse.

STATEMENT BY ARTHUR R. GAUDET, TECHNICIAN, CHART OBSERVER:

My position at mainstage of Missile 9C was at recorder MP 124 A and measurement P 1528 D main fuel valve.

At mainstage the PU valve opened fully to positive peg. I counted to six slowly to give PU valve time to come into control. As valve came into its limits I heard three cutoffs over MOPS system called. At what seemed a fraction of a second before this the PU valve began to close. At closed position I looked away from chart to camera No. 3. The thrust section seemed to be a mass of flame. I turned back to the chart at this time, the PU valve was coming open again. Engineer Tom Chitty stated to report this to the test conductor. He being my senior, I stood by and let him take over.

The PU valve was at or about 24° and oscillating slightly. Then came the explosion and all the recorders pegged negative.

STATEMENT BY G. A. GOLDBERG, MISSILE ELECTRICAL SYSTEM ENGINEER, MISSILE POWER PANEL OPERATOR:

-5 min. - inverter on
-4 min. - AC to internal, readings steady at 28 vdc, 398 cps, 115.4 vac

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-1 min. - DC to internal, readings steady at 29 vdc, 398 cps, 115.2 vac
-25 sec. - readings, $28\frac{1}{2}$ vdc, 398 cps, 115 vac
Cutoff plus 1-2 sec. - DC to external, AC to external, between cutoff and explosion, approximately 29 vdc, 398 cps, 115.4 vac (transients had scarcely died at explosion).

STATEMENT BY J. T. GREENE, TECHNICIAN, RECORDER OPERATION OBSERVER:

I was in the blockhouse at the time of the explosion checking the recorders for inking and timing. I was unable to see any of it but did hear the explosion which took place.

STATEMENT BY L. H. GROSS, INSTRUMENTATION ENGINEER, GILMORE WEIGHT SYSTEM READOUT:

During the terminal count I was standing in front of the purge panel between the fuel tanking panel and the pressurization panel. I monitored the Gilmore weight system visual readout, reading out the weights to John Padgett, who was tanking LO_2.

At T-20 seconds the visual weight readout automatically switched off so I looked at TV monitor No. 1 to watch ignition. I saw the verniers light and then the main engines. The smoke from the engines obscured my sight as I heard several people call "Cutoff". Immediately after cutoff someone called for skirt firex and water. The pressurization warning horn started blowing and Ted Pianko crossed behind me to look at the pressurization panel. I looked at the panel also and noted that the LO_2 tank pressure was pegged out at 30 psi. Norm Neiman, the pressure panel operator, was trying to reduce the pressure with his controls. The differential pressure meter suddenly went from +5 psi to 0 psi and the missile blew up immediately thereafter. Then all power went out except the blockhouse lights.

STATEMENT BY G. W. HALL, RANGE SAFETY SYSTEM ENGINEER, RANGE SAFETY COMMAND PANEL OPERATOR:

Everything appeared normal up to Cutoff. Just before loss of power the safe lights and arm lights blinked on and off.

STATEMENT BY D. R. HENDRICKS, INSTRUMENTATION ENGINEER, INSTRUMENTATION CONSOLE:

I was located at the landline instrumentation console. The first indication of trouble was when console power went off. At this time I turned all power switches off.

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STATEMENT BY H. HOFFMAN, AUTOPILOT ENGINEER, AUTOPILOT AND HYDRAULIC PANEL OPERATOR:

At the time of cutoff, all indications on the autopilot and hydraulic consoles were normal.

I noted that the pitch exercise was normal per movement of the eyeballs on the auxilliary autopilot console. I then looked at the hydraulic panel which was giving normal pressure indications in booster high and return pressure positions.

At this time my eyes were drawn away by the completely erratic movements of the eyeballs and flickering of lights on the autopilot console.

I then reached to cut off autopilot power but by that time both the autopilot and hydraulic consoles were completely dead.

STATEMENT BY W. L. HOLLEY, TECHNICIAN, OSCILLOGRAPH OPERATOR:

After engine start, I was observing actuation of snubber strain gauge measurements, noted oscillation of traces. Glanced up at TV monitor in observation room, saw fire coming from thrust section and up north side of missile. At this time power failed.

STATEMENT BY W. E. HUFFMAN, LEAD PROPULSION ENGINEER, NO. 1 PERISCOPE OBSERVER:

The engine start and shutdown sequencer appeared to be normal as indicated by the EA records. Cutoff was apparently initiated by the sustainer overspeed trip. The engine start as observed from No. 1 periscope appeared normal. Vernier ignition and subsequent main chamber ignition and mainstage operation also appeared normal. After approximately 2 seconds of mainstage, the engine shut down. Vernier cutoff was accompanied by the normal afterfire. At main engine cutoff a large fire appeared beneath the thrust section and spread onto the ramp. At this time instrumentation reported high engine compartment temperatures and the pressurization panel operator reported a loss of fuel tank pressure. I left the periscope momentarily to check the engine test panel and asked the operator to go to the components test position. I also requested that the test conductor put the test-off-arm switch in the test position. Upon returning to the periscope I observed that the missile had exploded and a large fire was burning on the ramp.

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STATEMENT BY W. R. JACKSON, TEST CONDUCTOR:

My observations following "Vernier Start Button Push" were focused on the test conductor's panel engine sequence lights and on the function safe-release panel lights. I observed "Main Engine Complete" green light on; immediately following, the horn sounded for release. Following the release horn I observed vernier, booster and sustainer red lights on indicating cutoff. Several callouts for firex water to be applied were made and a callout for all water was made. Report from the water panel was made that all water was applied. I also received cutoff commands from several observers but did not apply cutoff since I had observed that the cutoff lights were on and had received an observer report that the engines were cut off. Status reports of the missile and conditions of the missile systems were continually reported by all observers. Action to lower the LO_2 tank pressure and raise fuel tank pressure was taken although not reported on the communications system. Verification had been made that all action had been taken to satisfy previously given emergency instructions. After the explosion of the missile communication was established with the SRO on the green phone and communication with the PSO was established for emergency action.

STATEMENT BY R. E. JAMES, ROCKETDYNE FIELD SERVICE ENGINEERING REPRESENTATIVE, CHART OBSERVER:

I was watching booster Pc at ignition, and landline data indicated a normal condition from these parameters. I first heard cutoff initiated by the observer next to me on B1 igniter fuel ambient. At the same time a number of voices sounded cutoff over the PA system and the PCU operator announced that he could not control tank pressure. A few seconds after this, a propulsion engineer announced that test-off-arm to test was to be initiated by the test conductor.

Approximately 10 seconds after cutoff was initiated, I heard someone announce the missile was falling and at this instant the explosion occurred. EA's were examined in the blockhouse and all the valves were noted to be closing normally at cutoff.

STATEMENT BY G. J. KADLEC, TECHNICIAN, CHART OBSERVER:

I was watching three charts, the sustainer control, booster control and sustainer LO_2 reference regulator. All the regulators were as pre-set at the time of ignition. At the called cutoff all regulator pressures dropped to zero.

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STATEMENT BY J. H. KEATLEY, BLOCKHOUSE MONITOR, SEQUENCER READOUT:

At the time of the operation I was blockhouse monitor giving the count by the sequencer readout clock. The count proceeded normally until T-2 seconds when cutoff was heard, followed by the command to turn skirt firex on. Following this came numerous callouts from the instrumentation section. Confirmation was given that skirt firex was on. Another call-out from instrumentation that the fuel valve was still open was given. Someone called for monitor nozzles to be turned on. Someone asked for the test-off-arm switch to be turned off.

From TV monitor No. 3, from the time cutoff was heard, I noticed fire coming from the thrust section. It seemed so intense that none of the firex systems had any effect.

At about T+29 seconds someone said "There she goes" and at about T+36 seconds it exploded. The door blew open, the blockhouse roof rippled, and power went off.

STATEMENT BY W. H. KNIGHT, ELECTRICIAN, BLOCKHOUSE AIR CONDITIONER:

I was in the blockhouse on duty as electrician. I was to close outside door and cut off air conditioner. This was completed at -2:30. I saw on television monitor that the verniers ignited followed by a fire on the south side of the missile. Shortly I heard an explosion, and felt a jolt. I heard water called for on two occasions.

STATEMENT BY K. E. LAWRENCE, LEAD ELECTRICAL AND RF SYSTEMS ENGINEER, MONITOR MISSILE POWER AND RANGE SAFETY PANELS:

T-60 to T-35 sec. I was observing the missile power and range safety panels.

T-60 sec. range safety was observed to be armed and range safety ready light ON.

T-35 sec. missile power reading taken as 115 vac, 398 cps, 29 vdc.

T-26 sec. to cutoff all missile power readings continued steady and normal.

Cutoff - Observed missile power operator immediately switch DC and AC to external.

Cutoff to explosion - Heard remark "Fuel valve not closed". Observed that engine test panel sustainer, vernier and booster cutoff lights were dim and flashing on and off.

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Following explosion - All panel lights and communications were lost immediately.

STATEMENT BY W. A. LEFFINGWELL, DATA OPERATIONS, GILMORE WEIGHT MONITOR:

I was monitoring the Gilmore M176 load cell printer during this test. The load cell data appeared normal throughout the test. After cutoff, fire was visible around the base of the missile on TV, until loss of power at the time of the explosion.

STATEMENT BY A. E. LEONARD, TECHNICIAN, FLIGHT CONTROL RECORDER OBSERVER:

My station during the static was on the autopilot Sanborn rack No. 2. On ignition everything was normal. Then I heard someone say "Cutoff" over the head set, at which time the engine became very radical on the Sanborns. Then I heard someone say something about a fire and someone else say that the missile was falling. Then I heard the explosion.

STATEMENT BY H. O. MATTHEWS, CONVAIR-ASTRONAUTICS INSPECTOR:

I was in the blockhouse as on observer. Over the head set I heard "Vernier ignite", then "Mainstage". At about one second after mainstage I heard "Cutoff" then the call for water and then "Can't shut off the fuel". On the TV monitor at "Cutoff" the fire did not cut off. Then the fire started up the south side of the missile as the TV and MOPS all cut off. I heard a muffled blast and a slight quake shook the blockhouse. From cutoff to the explosion seemed about fifteen seconds. I did not see the falling of the missile on the TV.

STATEMENT BY J. A. MATUS, ABLE FUELING CONTROL, AEROJET-GENERAL:

The following is a report of the events observed by the writer commencing with T-2 seconds through the time of leaving the Complex 12 area.

At T-2 seconds I was seated at the Able propellant console when I heard someone say that the vernier engines had started. I turned to observe the monitoring TV receivers. I saw the vernier engines had been ignited. The flame from the vernier chambers was what I judged to be excessive. I heard a horn blow inside the blockhouse and someone said "Got cutoff". I saw a liquid pouring from the area of the thrust chamber. The fire increased in intensity as someone said "Firex on" and then "valve is still open". The fire at the base of the Atlas began to envelope the entire missile and flames reached the Able unit. The Atlas-Able slowly began to lean to the south.

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Just before it would have struck the ramp, the power failed. Someone also stated that the power had failed, but that they still had "440" (vac). There was a marked silence in the blockhouse as the persons at the various consoles worked quickly at them. The MOP communications system failed at the same time as the power. The air conditioning stopped but the lights remained on. The test conductor called for water on. I heard someone say that the water was down to six feet. All of the persons within my view remained composed. I remained in place for nearly an hour. The safety officer then authorized the guard to open the blockhouse door. I could hear the fire engines outside. We were permitted to leave about two hours later.

STATEMENT BY KENNETH I. MORTON, INSTRUMENTATION LAB TECHNICIAN, STANDBY IN BLOCKHOUSE:

During final minutes of countdown I was standing near the entrance door to blockhouse. From this point I was able to observe the TV monitors.

I could see that the engines fired up and ran for a few seconds. I heard someone on the Brown record rack call out "Cutoff". It appeared the engines did cut off okay.

I am not sure but I think I heard someone call out that there was a fire. A few seconds later I could see flames coming up to the vernier engines. This was visible for a few seconds and then there was a power failure (the TV monitors went dead).

About five seconds later an explosion was felt in the blockhouse. The Pan Am guard that was standing against the door was thrown into another man that was standing about 8 to 10 feet from the door.

From that point on we could tell nothing as to what was going on outside due to the power failure.

STATEMENT BY N. NEIMAN, PRESSURIZATION ENGINEER, PRESSURIZATION PANEL OPERATOR:

Immediately after engine start I heard cutoff. PCU went into emergency, fuel pressure dropped and LO_2 tank pressure pegged out against the high peg.

I pressed fuel raise and LO_2 lower buttons. Fuel raise had no effect and LO_2 lower lowered LO_2 tank pressure to 13 or 14 psi.

While pressing the buttons I looked up at monitor No. 2 (flame deflector). A large volume of fuel poured into the bucket from above and burst into flames. The flame bucket was burning violently (not engine exhaust) when the missile blew and power went out.

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STATEMENT BY C. N. PHELPS, ASSISTANT FOREMAN, TV CONSOLE MONITOR OPERATOR:

The first thing that I noticed was vernier start, which looked normal. Then mainstage for about 2 or 3 seconds, followed by flames from the thrust section and then cutoff. The flames continued up the side of the missile and then the explosion took place.

I remember hearing, after cutoff, that engine compartment temperature went off the scale. Someone yelled for firex and then a voice stating that the fuel fill and drain valve was separated.

At that moment the TV camera went dead from the explosion.

STATEMENT BY T. J. PHILLIPP, GUIDANCE ENGINEER, GUIDANCE MONITOR SET OPERATOR:

I was watching camera one when I saw first indication of a cutoff. Heard cutoff called out on intercom. Heard a call for firex. Heard on MOPS that main fuel valve was stuck open. Heard temperature measurement pegged out (over MOPS), not sure which one.

Immediately prior to blast concussion, noticed lights flash on the autopilot console, notably the three gyro ccurse heater lights. Also saw the rate beacon transmitter voltmeter jump up to 0.55 volts at this time, a higher value than I have seen previously in normal operation (this on guidance monitor set).

STATEMENT BY J. G. PHILLIPS, TECHNICIAN, WATER PANEL OPERATOR:

Watched on TV at water panel, very poor picture. Vernier start. Someone called mainstage. Turned on skirt firex. Engine compartment temperature rising. Engine compartment cooling on. At this point flame appeared at skirt in Quad I. Monitors on. Top surface on. Deluge on. Explosion. Panel control dead.

STATEMENT BY T. PIANKO, COMPLEX MECHANICAL SYSTEMS ENGINEER, PROPELLANT TANKING PANEL:

During this particular operation, my function was to back up the propellant tanking panel operator. After tanking was secured and a "GO" status was given at T-40 seconds, I moved over to the pneumatics panel to be in a position to help the panel operator if he required it. All the missile helium changeovers functioned properly. When the engines cutoff, the three changeover valves returned to their external position. Everything on the panel operated satisfactorily during the brief static. After the cutoff the PCU went into emergency. Both fuel and LO_2 tank pressures dropped together. The panel operator hit the fuel tank emergency raise

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and LO_2 tank emergency lower buttons with no effect. Shortly after this the missile exploded. Prior to the explosion I noticed fire and smoke covering the south side of the missile fuel tank.

STATEMENT BY L. B. PRUETT, AEROJET PROPULSION LAUNCH CONTROL PANEL (ABLE PROPULSION):

I turned all power off on my console when "Mainstage" was called over the loop. Then I turned to watch the TV monitor. I heard "Cutoff" called then saw a fire develop in the aft compartment. The fire appeared to propagate rapidly and appeared to be accelerated briefly by an explosion in the aft compartment. The tip of the flame was at about midpoint of the second stage when the above mentioned explosion occurred. The missile then fell towards the ramp. A detonation was heard and the TV monitor and all power went dead.

STATEMENT BY N. R. RAY, AUTOPILOT SYSTEM ENGINEER, AUTOPILOT RECORDER OBSERVER:

From vernier start until T-0 the sustainer and vernier engines were on zero pitch and yaw. At mainstage there were slight transient movements at the same three engines (which is normal). Engine movements were well within redline limits through cutoff and for about 12 seconds after cutoff, at which time the signals from the feedback transducers caused the Sanborn recorder pens to fluctuate drastically. Then the explosion occurred. This information was clearly visible on the recordings taken at the time.

STATEMENT BY O. H. REED, ASSISTANT TEST CONDUCTOR, MONITORING LO_2 TANKING PANEL:

During the latter part of the countdown from approximately T-50 minutes, I was standing behind the LO2 control panel operator monitoring final tanking of Missile 9C. No unusual occurrences were noted and final tanking was completed in accordance with the countdown plan. From vernier start at T-26 seconds, and until approximately T-2 seconds (mainstage), operation appeared normal as viewed through the television monitors. An instant later, "Cutoff" was heard over the intercom, then a statement was made, also over the intercom, that "engine compartment ambient temperature has pegged out". Looking at the television monitors at about the same time it was observed that a large flame was billowing from the engine compartment and up the outside of the missile. A very few seconds later the television screen was obliterated and a sharp blast was heard inside the blockhouse following detonation of the missile. The times stated above are approximate since the incident occurred in such a brief period of time it was not possible to be certain of the exact time or sequence of events.

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STATEMENT BY W. A. REID, PROPULSION ENGINEER, CHART OBSERVER:

Gas generator LO_2 start tank, ground fuel start tank and booster LO_2 regulator reference functions were within redline at engine start, regulated normally after start and tank vented normally at bootstrap.

STATEMENT BY W. C. RING, PROPULSION ENGINEER, CHART OBSERVER:

Countdown Function:

Monitor Propulsion System: VE LO_2 Reg Output
VE Fuel Reg Output
VE LO_2 Tank Pressure
VE Fuel Tank Pressure

Operation: All normal (well within redline).

STATEMENT BY R. E. SHELTMAN, INSPECTION ASSISTANT SUPERVISOR:

The following was observed during 9C attempted FRF:

I was in the blockhouse as an inspector observer, located approximately 10 feet behind the test conductor.

As observed on the TV monitors, the ignition and start cycle appeared to be normal. After approximately 2 seconds of mainstage, two observers called out "Cutoff" over the intercom.

Immediately upon cutoff there appeared to be a large amount of fire below V2 engine. Flame then engulfed the tank section. Firex was called for and initiated. At this time power was lost and all TV monitors and head sets went dead. This was followed by the sound of the missile exploding.

STATEMENT BY H. D. STRIETER, MISSILE ENGINEER, GENERAL ELECTRIC:

Normal countdown was noted when cutoff was heard. A microscopic time later, a report of a fire in the missile was overheard. The meters on the guidance monitor set were observed to become erratic and a very short time after, the blockhouse shook.

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STATEMENT BY J. H. SYLVESTER, LEAD COMPLEX ELECTRICAL SYSTEM ENGINEER, CHART OBSERVER - PRESSURIZATION:

Events observed during pressurization system chart watch:

Up to T-60 seconds (pressurization internal) all measurements were normal.

After pressurization internal, booster tank bottle pressure, and LO_2 and fuel tank pressures were within redline values, also control bottle pressures.

At approximately T-0 (+) LO_2 and fuel tank pressures appeared to go above redline, return within limits for an instant, go full scale, then dropped down to 0 psig.

Cutoff was called along with other calls as the pressures went to full scale.

It should be noted that the LO_2 and fuel tank pressures were unstable at all times from T-0 (+).

STATEMENT BY R. E. TAYLOR, TECHNICIAN, TELEMETRY PANEL OPERATOR:

After I heard mainstage and saw vernier cutoff, flames shot out around the booster separation ring. On the Quad IV and I side it looked like they shot straight out considerably further than the Quad II and III side. Instantly flames shot up the missile. At this time I looked down at the panel to see if telemetry was still on. Almost instantly the lights went out and I felt the concussion.

STATEMENT BY R. W. TAYLOR, RESPONSIBLE REPRESENTATIVE WS107A, ROCKETDYNE:

I was watching the sustainer Pc graphic recorder when I heard engine compartment temperature redline being called out. Sustainer Pc decay seemed to be normal at about the same time the chart observer on the PU valve position reported that the PU valve was not fully closed.

Looking over at the graphic recorder for the PU valve position, I saw it indicated an intermediate open position. Checking back to the sustainer, Pc trace indicated that probably the PU valve recording was reading erroneously. At this time fire was being reported by missile observers. The explosion occurred and the lights went out. Immediately upon return of lights I checked the EA's to find that sustainer overspeed trip had initiated cutoff. The rest of the time spent verifying engine sequence operation from the EA's.

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STATEMENT BY H. F. TEICH, TECHNICIAN, CHART OBSERVER:

I was assigned to watch the pressurization recorders. Jim Sylvester and I. I was watching the three recorders for the high pressure helium bottles. After going to internal the bottles stabilized at proper flight pressures. All above 3050 psi.

I do not know what the missile tanks did as Jim Sylvester was watching those. Right after mainstage the sustainer control bottle dropped to 0 psi in approximately half a second. At this I point I called for cutoff.

The booster control and booster tank pressure bottles started dropping at a very short interval after the sustainer bottles dropped.

Ken Wilcox, who was watching engine compartment temperatures, called for cutoff a split second before I did. He then reported that the engine compartment temperatures had pegged out and called for engine compartment cooling water.

Jim Sylvester called for cutoff at the same time Ken Wilcox did, reporting that tank pressures had dropped to zero.

I also heard Ted Pianko and Norm Neiman report the pressure panel in the emergency condition and report that tank pressures were dropping too fast to be held.

Jim Vevera reported from the periscope that the missile was falling. Right after I heard him report, there was a loud explosion which shook the blockhouse violently. I had braced myself against the recorder rack.

STATEMENT BY C. A. TERHUNE, AZUSA ENGINEER, AZUSA PANEL OPERATOR:

My function was to monitor as backup for telemetry panel. My system was Azusa. Both systems were in a "GO" condition and operating fairly normal.

I saw ignition. Someone said "Mainstage". I heard a roar and then the buzzer. Someone called cutoff, sequencer read +5 seconds. Tom Chitty kept saying that the main fuel valve was open. Another called fire. B. Huffman called to panel operator and then tried to crawl over panel to see while requesting test-off-arm switch to safe. I heard another call "There she goes, she's slipping".

STATEMENT BY J. E. VEVERA, LEAD COMPLEX MECHANICAL SYSTEM ENGINEER, PERISCOPE OBSERVER:

Ignition and mainstage appeared normal and immediately afterward, fire was observed first in Quad I and II area, then immediately in the Quad III and IV area. Skirt firex was called for and turned on and shortly thereafter, monitor nozzles were turned on when the flame enveloped the lower skirt section. At this time, a cutoff command was heard. Fire spread rapidly around the entire base of the missile and upward along the tank section in the Quad III and IV area. When this was observed, all firex systems were turned on and shortly thereafter, all electrical power was lost on the contractors facility control panel. Flame deflector water had been on at 33,000 GPM flow at the time specified in the Countdown. Flame progression was rapid and appeared to spread regardless of water coverage. Approximately ten or fifteen seconds after the fire was first observed, the missile slowly fell to the ramp, where first order detonation occurred and enveloped the entire area in black smoke and flame.

STATEMENT BY B. H. WANTZ, TECHNICIAN, FLIGHT CONTROL RECORDER OBSERVER:

My position during Countdown is at the Autopilot recorders. I was on No. 1 Sanborn during the remaining minutes of the Count.

What I saw and heard are as follows: I was watching for B1 and B2 ignition on the recorder paper. We received some signals which appeared to be ignition. I was not watching the TV cameras. Having a headset on, I heard the statement "It's falling over." Upon the reception of this information, I turned to the TV cameras and at the same instant, they lost their picture. Concussion followed the camera failure.

STATEMENT BY J. M. WARDMAN, COMPLEX MECHANICAL ENGINEER, BEHIND PAD FACILITY PANEL:

During static operation on missile 9C, I was on station behind the pad facility panel. No previous indication of any malfunction was observed prior to explosion, at which time we lost all power.

We were unable to activate any of the emergency power sources and therefore unable to control firex system.

STATEMENT BY K. K. WILCOX, ASSISTANT TEST CONDUCTOR:

My assignment during the terminal count and firing was to monitor the Engine Compartment Ambient Temperatures - P1673T, B1 Fuel Igniter Valve Temperature, P1674T, B2 Fuel Igniter Valve Temperature, and P1675T, Booster Engines Control Pneumatic Manifold

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Temperature. All are 0 - 400° F range. All was normal through Vernier Engine start at T-25 seconds, and ignition. Within a second or so after I heard "Main Stage" over the headset, P1674T pegged off scale at more than 400° F. As I keyed my mike to call "Cutoff" and as I called it, P1673T also pegged out, followed very shortly with the pegging of P1675T. I reported fire in the thrust section and immediately requested thrust section firex.

About this time, I heard numerous other calls of "Cutoff" and within a few seconds felt the shock wave of the explosion. I did not see any of the events on the TV monitors. After loss of power and communications, I proceeded to the Test Conductor's position to lend any assistance and find out the status.

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REDLINE VALUES VERSUS RECORDED DATA

Measurement No.	Description	Units	Prior To "START" Button Push		W/in 10 Sec. After "START" Button Push		During Ignition	
Propulsion			Redline Value	Test Value	Redline Value	Test Value	Redline Value	Test Value
P 1178 P	Gnd Fuel STR Tank Reg.	psig	800 ± 40	803				
P 1075 P	Gnd Fuel STR Tank	psig			760 Min.	803		
F 1125 P	B CTL Pneu Reg Out	psig	750 ± 25	750				
P 1026 P	B LO_2 Reg Ref Press	psig	520 ± 10	512				
P 1177 P	GG LO_2 Str. Tnk. Reg.	psig	500 ± 20	480				
P 1489 P	BGG LO_2 Valve Inlet	psig			500 ± 150	600		
P 1027 P	V Fuel Tank Press	psig			535 +40 -40	539		
P 1236 P	V Fuel Tank Reg	psig	535 ± 20	535				
P 1235 P	V LO_2 Tank Reg	psig	520 ± 20	522				
P 1030 P	V LO_2 Tank Press	psig			520 ± 40	524		
F 1142 P	S CTL Pneu Reg Out	psig	750 ± 20	748				
P 1344 P	S LO_2 Reg Ref Press	psig	808 ± 10	801***				
P 1324 T	Sus LO_2 Pump Brng	dgf	0 Min.	150*				
P 1528 D	PU Valve Position	deg					18.0 - 44.2 after 5 sec of eng. start	**

* Data pen not inking. Pen was inking prior and after this value
** Not Applicable
*** Time Extrapolated

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REDLINE VALUES VERSUS RECORDED DATA

Measure-Ment No.	Description		Prior To "START" Button Push		W/in 10 Sec. After "START" Button Push		During Ignition	
Autopilot		Units	Redline Value	Test Value	Redline Value	Test Value	Redline Value	Test Value
H 5060 P	Sus Hyd Inlet Press at Msl	psig	2000 + 200 -0	2200	2000 + 200 -0	2200		
H 5046 P	Booster Hyd Inlet Press at Msl	psig	2000 + 200	2000	2000 + 200	2000		
	Met. Booster & Sus Hyd Return	psig	20 min. 95 max	60	20 min. 95 max.	60	20 min. 95 max.	60
S 1107 V	B1 Pch Actr Fdbk	deg	< 0.6	0	< 0.6	0	< 0.6	.14
S 1108 V	B2 Pch Actr Fdbk	deg	< 0.6	0	< 0.6	0	< 0.6	.31
S 1128 V	B1 Yaw Actr Fdbk	deg	< 0.6	0	< 0.6	0	< 0.6	.28
S 1129 V	B2 Yaw Actr Fdbk	deg	< 0.6	0	< 0.6	0	< 0.6	.20
S 1216 V	S Pch Actr Fdbk	deg	< 0.6	0	< 0.6	0	< 0.6	.13
S 1217 V	S Yaw Actr Fdbk	deg	< 0.6	0	< 0.6	0	< 0.6	.14
Missile Power								
	Missile Power	vdc	26 - 30	28.5			26 - 30	28.5
		vac	113 - 117	115			113 - 117	115
		cps	396 - 404	398			396 - 404	398
			Battery Time 5 Min. Max.	Satis.				
Range Safety and Tracking								
		vdc	25.2 min.	Satis.				
			Battery Time 8 Min. Max.	Satis.				

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FORM NO. A-703-2

CONFIDENTIAL

REDLINE VALUES VERSUS RECORDED DATA

Measurement No.	Description	Units	Prior To "START" Push Button: Redline Value	Prior To "START" Push Button: Test Value	W/in 10 Sec After "START" Button Push: Redline Value	W/in 10 Sec After "START" Button Push: Test Value	During Ignition: Redline Value	During Ignition: Test Value
Pressurization								
F 1003 P	Fuel Tank He Press	psig	57.0 - 62.0	59.0	57.0 - 62.0	59.0	57.0 - 62.0	57.9
F 1001 P	LO2 Tank He Press	psig	24 - 28	27.1	24 - 28	27.1	18 - 28	24.8
			Immediately Prior to Switch to Internal					
F 1246 P	Tnk Press Btl Outlet Press	psig	2500 - 3200	3096			Not less than 1000	3061
F 1121 P	Booster Controls Bottle. If Booster Btl Press dropsbe-low 1000- cutoff	psig	2500 - 3200	3074			Not less than 1000	3028
F 1145 P	Sustainer Controls Bottle	psig	2500 - 3200	3080			Not less than 1000	2863

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REDLINE VALUES VERSUS RECORDED DATA

Measurement No.	Description	Units	Prior To "START" Button Push: Redline Value	Prior To "START" Button Push: Test Value	W/in 10 Sec. After "START" Button Push: Redline Value	W/in 10 Sec. After "START" Button Push: Test Value	During Ignition: Redline Value	During Ignition: Test Value
Telemetry								
	Battery Time 20 Min. Max		Satisfactory					
Complex Water								
	Flame Deflecter Water Supply	gpm	27,000 min.	30,000				
	Prim. Mani. Press.	psig	70 min.					
Prop. Load and Util. System								
	Tanking	lbs.	Load cell reading @ 95% LO2 + 7450 lbs ± 300 lbs in Seq III Press	7600				
	EDO Output	volts	.03 ± 0.9	-0.13				
			LO2 Emerg. overfill lt. must be off	Light Off				
			Fuel over-fill level lt. must be off in Seq III	Light Off				

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TEST CONSTANTS

Barometric Pressure	30.050 In Hg
Temperature	83.2°F
Relative Humidity	71 Percent
Winds	NNE at 12 Knots
Booster Mainstage Duration	0.675 Sec
Sustainer Mainstage Duration	0.525 Sec
Fuel Rating @ 84°F	43.52° API
Fuel Density	49.8 lb/ft^3
LO2 Purity	99.6 Percent
LO2 Density	70.22 lb/ft^3
B1 Thrust Chamber Throat Area	205.94 In^2
B2 Thrust Chamber Throat Area	206.15 In^2
Sustainer Chamber Throat Area	66.882 In^2
BGG Links Break	1012:41.33 EST
BGG Links Break to Booster Cutoff	2.18 Sec
BGG Links Break to Sustainer Cutoff	2.15 Sec
BGG Links Break to Vernier Cutoff	2.16 Sec

Surface weather data were obtained from the PAA Cape Weather bureau for 1012 EST. Test zero time was referenced to BGG Links Break at 1012:41.33. This was AMR test 2944.

Booster and sustainer mainstage duration is defined as the time from 90 percent of thrust chamber pressure on the rise to 90 percent of thrust chamber pressure on decay. Booster turbopump duration is defined as the time from 90 percent maximum pressure on the rise to 90 percent on decay of the booster gas generator chamber.

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ATLAS
SERIAL NUMBERS OF SYSTEM COMPONENTS

Azusa Transponder System, Serial No. 204

Range Safety Command System

Range Safety Command Canister No. 1, Serial No. 101
Range Safety Command Canister No. 2, Serial No. 104
Range Safety Command Canister No. 1, Power Supply, Serial No. 35
Range Safety Command Canister No. 2, Power Supply, Serial No. 1

Propulsion System

Sustainer Engine, Serial No. NA 222024
Booster Engine, Serial No. NA 112024
Vernier No. 1, Serial No. NA 332503
Vernier No. 2, Serial No. NA 332048

Electrical System

Missile Main Battery, Serial No. 115
Bendix Inverter, Serial No. R-15
Power Changeover Canister, Serial No. 10

GE Guidance System

Decoder, Serial No. 19 CG
Pulse Beacon, Serial No. 12 CG
Rate Beacon, Serial No. 11 CG

Telemetry System

Telemeter RF No. 1, Serial No. 86245
Telemeter RF No. 1, Serial No. 16
Telemeter Transducer Power Supply, Serial No. 7
Accessory Package, Serial No. 7

Flight Control System

Gyro Canister, Serial No. 35
Servo Canister, Serial No. 40
Programmer, Serial No. 104
Stabilization Filters, Serial No. 35

Propellant Utilization System, Serial No. 208

LO2 Manometer, Serial No. 208
Fuel Manometer, Serial No. 208
Computer Comparator, Serial No. 39

Instrumentation Gyro, Serial No. 509

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MISSILE CONFIGURATION

Atlas Missile 9C, assigned as the first stage of the four stage Atlas/Able IV lunar satellite project, was a modification of the standard Series "C" configuration.

As the first stage vehicle this missile received the following major modifications:

Removed standard nose cone adapter and replaced with an Atlas/Able IV adapter for attaching and releasing the second stage.

Revised blast shield and insulation for forward bulkhead of LO2 tank.

Removed 25 second vernier tanks and associated tubing and installed 5 second vernier tanks and tubing.

Removed retro rocket fairings, Azusa antenna boom, vernier solo hydraulic system, GE impact predictor system and photoflash installation.

Modified autopilot canisters, LO2 tank boiloff valve and LO2 tank sensing line.

The second stage, a 7.8K lb liquid propellant Aerojet rocket (without propellants aboard) was mated with Missile 9C for the FRF. The third stage and payload were not aboard.

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DOCUMENTATION OF MISSILE CONFIGURATION CHANGES FROM PRIOR TO MODIFICATION UNTIL LOSS

Listed below are engineering changes authorized on CIC 32994, the modification authority to create the Atlas-Able 4B configuration of Missile 9C. The engineering for this modification was complete at the time of shipment to AMR. At that time, there was no additional planning due for this CIC.

Also listed are all TVA's for Missile 9C modification. The listings with indicated check marks were tasks that were AMR responsibility and planning card numbers are listed. All other listings were factory tasks.

Finally, all AMR generated TVA's effective against the missile are shown.

CIC 32994-556-3 and Shop Task

1. Modify autopilot canisters for Able-4

Engineering Changes

Dwg. No.	Change Letter	ECS Code
7-41860	E	FRC
7-41022	T	FRC
7-41011	AM	FRC
7-41008	AH	FRC
7-41015	AD	FRC
7-41899	B	FRC
7-41026	K	FRC
7-60002	BV	FRC

Planning Received at AMR

1. None

As indicated by Engineering Change Schedule, no tasks were transferred to AMR being (FRC) Factory Responsibility.

CIC 32994-541-3 and Shop Task

1. Remove nose cone adapter.

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2. Remove Acoustica stillwell installation in LO_2 tank and install caps for outlets in tank.

3. Remove LO_2 pre-valve and replace with adapter, after static test and prior to flight.

4. Remove fairings at forward and aft end of GE impact predictor antenna, grind off antenna weldments and install cover to close waveguide opening in aft cableway.

5. Remove wiring tunnel between forward fairing of B2 pod and nose cone adapter and grind off support brackets.

6. Add fairings and support brackets for relocating autopilot rate gyro similar to WS 117L missiles.

7. Replace existing pod nose fairings with dural fairings similar to 10B fairings.

8. Remove retro rocket fairings and add plate to close opening in pod door.

9. Revise blast shield and insulation for forward bulkhead of LO_2 tank.

10. Relocate Azusa transponder antenna to Quad III using a series B boom. Provide welded bracket on fuel tank for forward antenna boom strut attachment and remove present boom.

Engineering Changes

Dwg No.	Change	ECS Code
7-70005	TVA 78357	FRC
7-70005	94393A	FRC
7-70005	94394A	FRC
7-70005	94391	FRC
7-70005	94392	FRC
7-70005	94398	FRC
7-70005	94469	FRC
7-70005	94395	FRC
7-70005	88927	FRC

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Dwg No		Change	ECS Code
7-70005		94497	FRC
7-07779		D/C A	FRC
7-70005	TVA	94497B	FRC
7-07779		82440	FRC
7-07779		82439	FRC
7-70005		94585A	FRC
7-70005		94586A	FRC
7-70005		94469A	FRC

Planning Received at AMR

1. 7-70005-560-A
2. 7-70005-520-A

CIC 32994-541-5 and Shop Task

1. Remove retro rockets and GE nose cone.
2. Modify 1133 thrust structure ring to permit removal of Azusa antenna boom.

Engineering Changes

Dwg No		Change	ECS Code
7-00009	TVA	94485	FRC
7-77101		94496	FRC

Planning Received at AMR

1. 7-70005-560-A
2. 7-70005-520-A

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CIC 32994-541-7

1. Prepare Specification Control drawing to show modification to Lockheed type nose umbilical tower on AFMTC 12 as required for umbilical service to Able IV.

2. Provide safety catch not installed on umbilical tower to catch electrical propellant lines after ejection.

Engineering Changes

Dwg No	Change	ECS Code
7-04392	New	FRC
7-04392	A	FRC

Planning Received at AMR

1. 7-70005-560-A

2. 7-70005-520-A

CIC 32994-537-3 and Shop Task

1. Remove 25 sec. vernier tank and associated tubing and install 5 sec. vernier tank and tubing.

Engineering Changes

Dwg No	Change Letter	ECS Code
7-22107	GMA 2605	ACR-FRC
7-29073	2606	ACR-FRC
7-29073	2707	ACR-FRC
7-29083	2608	ACR-FRC
7-22107	2609	ACR-FRC
7-29073	2610	ACR-FRC
7-29083	2611	ACR-FRC
7-22109	2641A	ACR-FRC
7-22109	2650A	ACR-FRC

Dwg No	Change Letter	ECS Code
7-22237	TVA 56579C	FRC
7-22236	56582B	FRC

No planning was received at AMR.

All engineering changes were coded as factory responsibility.

CIC 32994-535-3 and Shop Task

1. Revise existing PU tubing to be compatible with STL adapter.

2. Revise existing PU tubing at rate gyro, Station 670.0.

Engineering Changes

Dwg No	Change Letter	ECS Code
7-43028	TVA 89228A	FRC
7-43028	89237A ("A" change cancels FRC)	

No planning was received at AMR. All engineering changes were coded as factory responsibility.

CIC 32994-535-5 and Shop Task

1. Modify LO_2 tank boiloff valve installation to be compatible with STL adapter and blast shield.

2. Revise air conditioning ducts and insulation to reflect canister relocations.

3. Modify ambient bottle installation to reduce weight.

4. Modify LO_2 tank sensing line at pod nose fairing and at rate gyro installation at Station 670.0.

5. Possible removal of entire second stage pressurization system.

6. Prepare TVA to install 4-inch diameter air cooling line, including manual damper valve from launcher pod cooling stub up to Station 117 on service tower.

7. Revise air conditioning ducts and insulation to reflect canister relocations.

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Engineering Changes

Dwg No	Change Letter	ECS Code
7-87105	TVA 95126	no ECS
7-81132	95128	no ECS
7-87102	78254A	no ECS
7-81100	78264	FRC
7-81100	89319B	FRC
7-96109	53707	Plant Engineering Responsibility
7-81132	78263	FRC
7-87813	78256	FRC

Planning Received at AMR

Supplementary Planning Card	Description
7-96109-520-A	Prior to 9C flight
7-96109-520-B	After 9C flight
7-81100-550-A	

CIC 32994-535-7

1. Service tower modification as required to support Able IV.
2. Revise existing stretch sling.

Engineering Changes

Dwg No	Letter Change	ECS Code
7-98027	B change	Engineering responsibility plan for inspection only
7-91099	E/O C	" "
7-91170	D/C A-1	" "
7-91144	New	" "
7-91060	E/O S-1	FRC

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Planning Received at AMR

Supplementary Planning Card	Description
7-96109-517-B	Modify service tower inspection verification only
7-91060-503-D	Stretch sling modification

CIC 32994-535-9 and Shop Task

1. Remove partial APS back-up system comprising air motor, pump, 1st and 2nd stage regulators, relief valve restrictor and associated plumbing. Rework airmotor bracket to mount additional accumulator and revise plumbing accordingly.

Engineering Changes

Dwg No	Letter Change	ECS Code
7-84200	TVA 78050	FRC
7-22870	TVA 81490	FRC - Plant 2 responsibility
7-84126	TVA 64055A	FRC - Plant 2 responsibility

No planning was received at AMR.

Station 03 OIL was received 4-13-59 with on planning card logged:

1. 7-23112-533-G (TVA 78050)

CIC 32994-551-5 (No Shop Task)

1. Prepare modification and extension requirements for range safety command subsystem to be compatible with STL destruct system.

No drawing summaries.

No planning was received at AMR.

CIC 32994-549-3-5 and Shop Task

1. Revise telemetry harnesses, transducer, and associated bracketry installations to reflect data requirements for Able IV.

2. Relocate axial accelerometer, revise wiring and harnesses involved in the guidance canister, change or reroute wires for Azusa transponder relocation.

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Engineering Changes

Dwg No	Change Letter	ECS Code
7-12091	E/O AC	FRC
7-12220	E/O S	FRC
7-12202	E/O H	FRC
7-12204	E/O H	FRC
7-11403	E/O E	FRC
7-11333	E/O R	FRC
7-11339	E/O C	FRC
7-11658	E/O L	FRC
7-12229	E/O B	FRC
7-12233	E/O E	FRC
7-12236	E/O B	FRC
7-12217	E/O E	FRC
7-12218	E/O N	FRC
27-11235	E/O B	FRC
7-17747	E/O B	FRC
7-12654	TVA 94989	FRC
7-12653	94988	FRC
7-17748	94987	FRC
7-12094	105435	FRC
7-12506	105434	FRC
7-11040	94991	FRC
7-11415	105467A	FRC

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Engineering Changes

Dwg. No.	Change Letter	ECS Code
7-11416	New	FRC
7-11417	New	FRC
7-11418	New	FRC
7-11418	New	FRC
7-11419	New	FRC
7-11420	New	FRC
7-11421	New	FRC
7-11422	New	FRC
7-11423	New	FRC
7-11424	New	FRC
7-11425	New	FRC
7-11426	New	FRC
7-11349	TVA 105432	FRC
7-12500	105433	FRC
7-12099	105454	FRC
7-11398	105431	FRC
7-11377	105268	FRC
7-11375	105455 A	FRC
7-12107	GMA 2627 A	FRC
7-12098	TVA 95000 B	FRC
7-12107	TVA 105472	FRC
7-12092	105445	FRC

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Engineering Changes

Dwg. No.	Change Letter	ECS Code
7-12081	TVA 105476 A	FRC
7-12080	105475	FRC
7-23113	GMA 2637	FRC
7-12207	D/C H	FRC
7-12206	D/C F	FRC
7-12210	D/C L	FRC
7-12211	D/C H	FRC
7-11987	TVA 105483	FRC
7-11356	107130	FRC
7-11417	107129	FRC
7-11424	107132	FRC
7-16911	81190	FRC
7-16912	105500	FRC
7-11416	107097	FRC
7-17764	88962	FRC
7-12096	88961	FRC
7-11363	107098	FRC
7-11416	107125 A	FRC
7-11424	107115	FRC
7-11426	105460	FRC

No planning was received at AMR.

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CIC 32994-545-5

Revise launch control circuitry to 1 telemeter package and 1 range safety command package.

Engineering Changes

Dwg. No.	Letter Change	ECS Code
7-69064	TVA 107174	Site responsibility
7-69066	82411	Site responsibility
7-69070	107180	Site responsibility
7-65583	62448	Site responsibility
7-68126	94722	Site responsibility
7-65782	D/C C	Site responsibility
7-65783	TVA 110518	Site responsibility
7-68324	108800	Site responsibility
7-69097	108801	Site responsibility

Planning Received at AMR

1. 7-69064-558-D
2. 7-69065-558-E
3. 7-69056-559-D
4. 7-69056-559-E
5. 7-69224-560-D
6. 7-69224-560-E
7. 7-69070-559-K
8. 7-69070-559-L
9. 7-68126-599-A
10. 7-68324-552-E

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CIC 32994-545-7 and Shop Task

1. Remove GE impact predictor system: canisters, mounts, antenna, and harnesses.

2. Revise RSC harnesses to reflect STL requirements.

3. Relocate rate gyro and revise autopilot harnesses.

4. Remove photoflash installation and harnessing.

5. Relocate GE guidance canisters, interchange antennas, revise harnesses, relocate Azusa transponder and revise its harnesses and delete existing Azusa antenna installation and waveguide.

Engineering Changes

Dwg. No.	Letter Change	ECS Code
7-00009	TVA 104285	FRC
7-60002	104288	FRC
7-60017	50887	FRC
7-60018	50392	FRC
7-64775	89738 B	FRC
7-64774	88739	FRC
7-64900	89742 C	FRC
7-64913	89740	FRC
7-67790	89741 A	FRC
7-64051	94572	FRC
7-60002	94592 B	FRC
7-36220	94575 A	FRC
7-60002	94578 B	FRC
7-60611	94579 B	FRC

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Engineering Changes

Dwg. No.	Letter Change	ECS Code
7-60016	TVA 94577	FRC
7-60603	94606 A	FRC
7-64901	94581 A	FRC
7-64759	94582	FRC
7-64899	94583	FRC
7-60002	94591 A	FRC
7-67786	94587	FRC
7-60017	9471 A	FRC
7-60002	88783	FRC

Planning Received at AMR

1. 7-64061-1-A
2. 7-35376-502-A

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TEMPORARY VARIATION AUTHORIZATION
(FACTORY TASKS)

TVA or Mod Dwg	Dwg. Against	Title	Date Logged	Effective	Remarks
New Dwg	7-04392	Tower-Second Stage Service, AMR 12	1-10-59	7-54-9	Modifies existing tower 7-04390: Spec cont. dwg.
Dwg Chg B	7-98027	Modification of service tower AFMTC 12 for Multi-Stage Missile 7-96109-517-B	1-13-59	7-54-9	Dwg. revised to show service tower modification
TVA 94393	7-70005	Body Assembly	1-16-59	7-54-9	Fairing assy 7-73655-803 removed. TVA fairing assy. created to reduce wt.
TVA 94394	7-70005	Body Assembly 7-70005-520-A	1-16-59	7-54-9	Removes nose sep. sys. Retro rocket instl. range ant. instl. tunnel instl.
TVA 78357	7-70005	Body Assembly 7-70005-560-A	1-16-59	7-54-9	Replaces 7-02251 valve assy.
TVA 94391	7-70005	Body Assembly	1-16-59	7-54-9	Removes 7-73107-1 stillwell instl. P/U sys. from LO2 tank
TVA 94392	7-70005	Body Assembly	1-16-59	7-54-9	Installs shielding to provide blast prot.
TVA 94398	7-70005	Body Assembly	1-19-59	7-54-9	Cover added for waveguide
TVA 94469	7-70005	Body Assembly	1-19-59	7-54-9	Adds brkts to permit instl. of rate gyro

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CONVAIR ASTRONAUTICS

TVA or Mod Dwg	Dwg. Against	Title	Date Logged	Effective	Remarks
TVA 94395	7-70005	Body Assembly	1-19-59	7-54-9	Cover added where Retro Rocket fairing was removed
Dwg Chg M	7-65107	Diagram-Schematic, Test Cond. Launch Control	1-19-59	7-10-9	Ready signal added
Dwg Chg B	7-65782	Diagram-Schematic Umbil. Control	1-19-59	7-10-9	Added 2" eject signal take off (eject signal)
Dwg Chg EO B	7-65783	Diagram-Wiring Umb. Control	1-19-59	7-10-9	Revised Wiring to Supply 2" Isolated
Dwg Chg EO D	7-68324	Control Box - Umbilical 7-68324-552-#	1-19-59	7-10-9	N/A coverage for 7-65783
Dwg Chg A	7-68776	Test Conductors Console AFMTC	1-19-59	7-88-8	Change nose cone ready light to nose cone or second stage ready
Dwg Chg EO P	7-68799	Diagram-Schematic Tabulation AFMTC 12	1-19-59	7-10-9	Add the "B" change of 7-68324
Dwg Chg EO "AV"	7-69097	Equipment instl - Elect-Ground AFMTC 12	7-19-59	7-10-9	N/A coverage for 7-68324
Dwg Chg EO J	7-69517	Modification - Tab - Drawing AFMTC	7-19-59	7-88-9	N/A coverage for 7-68776
TVA 104288	7-60002	Equip. Inst. - Electrical & Electronic Airborne	7-26-59	7-54-9	Removes radio, rate beacon, pulse beacon waveguide & photo, programmer inst.

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TVA or Mod Dwg	Dwg. Against	Title	Date Logged	Effective	Remarks
TVA 104285	7-00009	Missile Assembly 7-64061-1-A	1-26-9	7-54-9	Removes photoflash equip. instl.
TVA 50892	7-60018	Harness Instl. - Cable-ways & Misc.	1-26-9	7-54-9	Harness deletion
TVA 50887	7-60017	Harness Instl. - Elec. Pod II	1-26-9	7-54-9	Harnesses deleted
TVA 89319	7-81100	General Arrangement - Pressurization System	1-26-9	7-54-9	Ambient Helium Bottle replaced by lightweight bottle 550 A Add -23 tube
TVA 53707	7-96109	Service Tower - Missile 7-96109-520-A	1-27-9	7-82-8	Provides air cooling system
TVA 89738	7-64775	Harness-Power Umbil. Recep. to Comp.	1-27-9	7-54-9	Range Safety Command revision
TVA 89739	7-64774	Harness-LO2 Boiloff Valve to Fairing Disconnect	1-28-9	7-54-9	Removes straight plug and installs right angle plug
TVA 50894	7-20204	Liquid Oxygen System Inst.	1-29-9	7-54-9	Removes 25 sec. tank and installs 5 sec. tank
TVA 89281	7-20205	Fuel System Instl.	1-29-9	7-54-9	Removes 25 sec. tank and installs 5 sec. tank
TVA EC Gr. Rel.	7-91060	Stretch Sling Instl. 7-91060-503-D	1-29-9	7-82-9	Provides stretch sling 503D Rsk 3 to 805
New Dwg	7-91144	Spreader Bar-Stretch Sling	1-29-9	7-82-8	Detail part for sling
New Dwg	7-91170	Cable Assy - Stretch Sling	1-29-9	7-82-8	Detail part for sling

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TVA or Mod Dwg	Dwg. Against	Title	Date Logged	Effective	Remarks
EO Gr Rel	7-91094	Cable - Stretch sling	1-29-9	7-82-9	Detail part for sling
TVA 32411	7-69056	Relay Box #1, Sec. Dist. Ctr. 7-69056-559-D -E	1-30-9	7-10-9	Revised wiring diag. (769612-1)
TVA 107174	7-69064	Console Cont. Telemeter 7-69064-558-D -E	1-30-9	7-88-8	Revised wiring diag. (765534)
TVA 107180	7-69070	Interconnecting Box - Tlm 7-69070-559-K, -L	1-30-9	7-10-9	Revised wiring diag. (7-65540-3)
TVA 105467	7-11040	Instrumentation Instl - 2nd Stage	2-2-59	7-54-9	Add meas. P28P & P29P
TVA 94988	7-12654	Transducer Instl-Orifice, Helium & Liq. Oxygen	2-2-59	7-54-9	Delete Meas. MTS F65P, F146T & F147P
TVA 94987	7-12653	Transducer Instl-Orifice, Helium Fuel Tank	2-2-59	7-54-9	Delete Meas. MTS F17T, F34P, & F212P
TVA 94989	7-17747	Panel Instl - Instrumentation Quad III Nacelle	2-2-59	7-54-9	Delete Meas. F260P
TVA 94991	7-12506	Transducer Instl - High Intensity Silicon Cells	2-2-59	7-54-9	Delete Meas. M77X
TVA 105434	7-12094	Transducer Instl - Speed "B" Pump	2-2-59	7-54-9	Deletes Meas. P83B & Use P83B Transducer for Meas. P84B
TVA 105435	7-17748	Transducer Instl - TK Helium Bottle Sus.	2-2-59	7-54-9	Delete Meas. F261P

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TVA or Mod Dwg	Dwg. Against	Title	Date Logged	Effective	Remarks
GMA 2611	7-29083	Tank Instl - Start Vern. Oxide	2-2-59	7-54-9	To accommodate instru for 5 sec. Tanks
GMA 2610	7-29073	Tank instl - Start Vern. Fuel	2-2-59	7-54-9	To accommodate instru for 5 sec. Tanks
GMA 2609	7-22107	Vernier Engine Instl	2-2-59	7-54-9	To add constant bleed in PU Regulators
GMA 2608	7-29083	Tank Inst - Start Vernier Oxide	2-2-59	7-54-9	To bring 5 sec. tank instl. up to date
GMA 2607	7-29073	Tank Instl - Start Vernier Fuel	2-2-59	7-54-9	To reduce high surges due to press of to vernier fuel start sys. 5 sec. tank
GMA 2606	7-29073	Tank Instl Start Vernier Fuel	2-2-59	7-54-9	Bring 5 sec. tank instl up to date
GMA 2605	7-22107	Vernier Engine Instl	2-2-59	7-54-9	To convert from 25 sec. to 5 sec. tanks
GMA 89228	7-43028	Tubing Cystl. - Prop. Utiliz.	2-2-59	7-54-9	To permit instl of rate gyro
94485	7-00009	Missile Assembly	2-2-59	7-54-9	Remove retro rockets & RYX-2 Nose Cone
TVA 89740	7-64913	Harness - Cableway, permanent splice pod #2 Components	2-2-59	7-54-9	Disconnect Plug P19 from retro rocket
TVA 89741	7-67790	Harness - Propulsion permanent splice to sustainer components	2-2-59	7-54-9	Wiring revision to Rocketdyne cable

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TVA or Mod Dwg	Dwg. Against	Title	Date Logged	Effective	Remarks
TVA 89742	7-64900	Harness - Autopilot umbilical to components	2-2-59	7-54-9	Wiring revision to Rocketdyne cable
TVA 78254A	7-87102	Bottle Instl - Helium Refrig.	2-3-9	7-54-9	Replace steel bottle with Titanium
TVA 95128	7-81132	Line Instl - Tank press. Sensing	2-3-59	7-54-9	Sensing line revised for rate beacon gyro canister
TVA 89319A	7-81100	General Arrange. - Press. Sys. 7-81100-550-A	2-3-59	7-54-9	Revised sys to accommodate Ambient Helium Bottle chg. & addition of blast shield
TVA 95126	7-87105	Tubing instl. - Engine Controls	2-3-59	7-54-9	Revise tubing to reflect 5 sec. Vernier Tanks & Revision of 2nd Stage Ambient Cont. Bottle
TVA [illegible]8297	7-70005	Body Assembly	2-3-59	7-54-9	Remove Pod Nose Fairing Fitting (7-73213)
GMA 2627	7-22107	Vernier Engine Instl	2-3-59	7-54-9	Replace Rocketdyne Instrumentations with Convair instrumentation (Meas. P28P & P29P)
TVA 94592	7-60002	Equipment Instl. - Electrical and Electronic Airborne	2-3-59	7-54-9	Addition of Able Disconnect
TVA 94572	7-64051	Bracket Inst - Electrical and Electronic Equip. Airborne	2-3-59	7-54-9	Add Able Start Relay

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TVA or Mod Dwg	Dwg. Against	Title	Date Logged	Effective	Remarks
TVA 53707	7-96109	Service Tower - Missile 7-96109-520-B	2-3-59	7-82-8	Provide air cooling for Able Section
TVA 105431	7-11398	Panel Assy. Patch Signal Dist. Box Quad III	2-4-59	7-54-9	Rework Wiring & Jumpers
TVA 105455	7-11375	Harness Instl - Instru. Stag II	2-4-59	7-54-9	Delete Unused Telemetry Harnesses
TVA 105432	7-11349	Diagram - Wiring Series C Flight	2-4-59	7-54-9	Revise #1 and #2 Telemetry Harnesses
105433	7-12500	Distribution Box instl. Pod II	2-4-59	7-54-9	Revise Panel Assembly
105268	7-11377	Harness Instl. Instru. Stage I	2-4-59	7-54-9	Tie Back Plugs P3073 & P3083
105454	7-12099	Box Instl. - Signal Dist. Pod I	2-4-59	7-54-9	Revise Panel Assembly
New Dwg	7-11425	Diag. Circuit, Signal Dist. Box Pod I C-9	2-4-59	7-54-9	Add New Meas. for 9-C
New Dwg	7-11424	Panel Assy. - Patch Junction Box Pod II C-9	2-4-9	7-54-9	Revise Junction Box to Accom. New Measurement
New Dwg.	7-11418	Diagram - Circuit Channel 1-9 #1 Tlm Sys. C-9	2-4-59	7-54-9	Circuit Diag. for New Tlm #1 Measurement
New Dwg.	7-11417	Harness Pod I Distr. Box to Lower Ladder C-9	2-4-59	7-54-9	Revise Distr. Box to Accom. New Measurement

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TVA or Mod Dwg	Dwg. Against	Title	Date Logged	Effective	Remarks
New Dwg.	7-11415	Harness Pod I Distr. Box to Upper Ladder C-9	2-4-59	7-54-9	Revise Distr. Box to Accom. New Measurement
New Dwg.	7-11423	Diag. Cht. Distr. Box Pod II C-9	2-4-59	7-54-9	Circuit Diag. Revisions for Distribution Box
New Dwg.	7-11422	Diag. Cht. Channel C #1 Telemetry System C-9	2-4-59	7-54-9	Circuit Diag. Revisions
New Dwg.	7-11421	Diag. Cht. Channel A #1 Telemetry System C-9	2-4-59	7-54-9	Circuit Diag. Revisions
New Dwg.	7-11420	Diag. Cht. Channel 13 #1 Telemetry System C-9	2-4-59	7-54-9	Circuit Diag. Revisions
New Dwg.	7-11419	Diag. Ckt Channel 10, 11, 12, E #1 Telemetry System C-9	2-4-59	7-54-9	Circuit Diag. Revisions
New Dwg.	7-11418	Diag. Ckt. Channel 1-9 #1 Telemetry System C-9	2-4-59	7-54-9	Circuit Diag. Revisions
New Dwg.	7-11416	Harness C-9 #1 Telemeter to Miscellaneous	2-4-59	7-54-9	Harness Revisions to Accom. New Measurement
New Dwg.	7-11426	Panel Assy - C-9 Patch Signal Distr Box Pod 1	2-4-59	7-54-9	Revise Signal Distr. Box to Accom. New Measurement
TVA 89738A	7-64775	Harness Power Umbilical Receptacle to Components	2-5-59	7-54-9	Revision of receptacles to Range Safety Command
TVA 94575	7-36220	Waveguide Instl Guidance Mod III	2-5-59	7-54-9	Guidance equipment transferred to Pod II

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TVA or Mod Dwg	Dwg. Against	Title	Date Logged	Effective	Remarks
TVA 95000	7-12098	Transducer Instl. Press Vibration	2-5-59	7-54-9	Replace Meas. U21P & U22P with Meas. U80P & U81P
TVA 105445	7-12092	Transducer Instl. Press LO2 Tank	2-5-59	7-54-9	Relocate F1P & F1001P
TVA 105472	7-12107	Switch Instl. Power Changeover	2-5-59	7-54-9	Remove 7-12107-1 Instl.
TVA 105476	7-12081	Transducer Instl. lower Instrumentation Box	2-5-59	7-54-9	Delete Meas. P39P
TVA 105475	7-12080	Transducer Instl. Upper Instrumentation Box	2-5-59	7-54-9	Delete Meas. P40P & P41P
TVA 62448	7-65583	Diag. Wiring Console Control Boom Nose Cone 7-69224-560-D, -E	2-5-59	7-88-8	Remove Interlock Ckt of GE Nose Cone System
GMA 2637	7-23113	Pump Instl. Booster	2-5-59	7-54-9	Deletion of Meas. P39P
EO AG	7-12091	Canister Instl. TLM Pod II	2-5-59	7-54-9	Deletion of #2 TLM Sys.
EO S	7-12220	TLM Unit #2 Airborne	2-5-59	7-54-9	Deletion of #2 TLM Sys.
EO H	7-12202	Amplifier & Filter Assy. TLM	2-5-59	7-54-9	Deletion of #2 TLM Sys.
EO H	7-12204	Dummy Plug for Inp[illegible] Limiter Telemetry	2-5-59	7-54-9	Deletion of #2 TLM Sys.

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TVA or Mod Dwg	Dwg. Against	Title	Date Logged	Effective	Remarks
EO E	7-11403	Multivibrator Oscillator	2-5-59	7-54-9	Deletion of #2 TLM Sys.
EO R	7-11333	Assembly Telemetering Filter Band Pass Unit	2-5-59	7-54-9	Deletion of #2 TLM Sys.
EO C	7-11339	Relay Telemetering Cross-over Channel	2-5-59	7-54-9	Deletion of #2 TLM Sys.
EO L	7-11658	Matching Unit Cathode Follower	2-5-59	7-54-9	Deletion of #2 TLM Sys.
EO B	7-12229	Filter Assy - Right & Left Hand	2-5-59	7-54-9	Deletion of #2 TLM Sys.
EO E	7-12233	Replacement Assy - Commutator	2-5-59	7-54-9	Deletion of #2 TLM Sys.
EO B	7-12236	Commutator Assy 1/8 RPS	2-5-59	7-54-9	Deletion of #2 TLM Sys.
EO E	7-12217	Commutator Assy Connector TLM #2 5 RPS Channels 12 & 13	2-5-59	7-54-9	Deletion of #2 TLM Sys.
EO N	7-12218	Commutator Assy. Connector TLM #2 10 RPS Channels A & C	2-5-59	7-54-9	Deletion of #2 TLM Sys.
EO B	27-11235	Low Pass Filter LH Mounting Assembly	2-5-59	7-54-9	Deletion of #2 TLM Sys.
TVA 94496	7-77101	Cyl. Assy-Booster Section Thrust	2-5-59	7-54-9	To Accommodate Relocation of of Azusa Boom

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TVA or Mod Dwg	Dwg. Against	Title	Date Logged	Effective	Remarks
TVA 105455A	7-11375	Harness Instl. - Instru. Stage II	2-6-59	7-54-9	Tie Back Unused TLM Harnesses
Dwg Chg L	7-12210	TLM No. 1 Unit Airborne	2-6-59	7-54-9	Various Meas. Removed & New Measurements Added
Dwg Chg H	7-12207	Commutator Assy - Connector TLM #1 5 RPS Channels 12 & 13	2-6-59	7-54-9	Created New Assembly Adding Resistors
Dwg Chg H	7-12211	Terminal Patch Board	2-6-59	7-54-9	Created -809 for Missile 9C
Dwg Chg F	7-12206	Commutator Assy Connector TLM #2 RPS Channels 10 & 11	2-6-59	7-54-9	Created -801 Adding Diodes for Missile 9C
TVA 78050	7-84200	Actuator Assy - Hydraulic Booster	2-6-59	7-54-9	Increase Actuator Orifice Size to Insure Dynamic Stability and Control
TVA 89741A	7-67790	Harness - Propulsion permanent Splices to Sustainer Components	2-6-59	7-54-9	Additional Wiring Revisions to Rocketdyne Cable
TVA 89742A	7-64900	Harness - Autopilot Umbilical to Components	2-6-59	7-54-9	Additional Wiring Revisions to Rocketdyne Cable
TVA 94577	7-60016	Harness Instl - Electrical Pod I	2-6-59	7-54-9	Azusa Transponder Moved to Pod 2
TVA 94578	7-60002	Equipment Instl. Electrical & Electronic, Airborne 7-35376-502-A	2-6-59	7-54-9	Azusa Antenna Moved to Quad III

TVA or Mod Dwg	Dwg Against	Title	Date Logged	Effective	Remarks
TVA 94579	7-60611	Diagram-Circuit, Azusa Transponder Airborne	2-6-59	7-54-9	Azusa Transponder Moved to Pod 2
TVA 105483	7-11987	Transducer Instl. Axial Accelero.	2-9-59	7-54-9	Relocate Meas. U101A
TVA 94581	7-64901	Harness - Guidance Umbilical to Components	2-9-59	7-54-9	Remove Wires Not Req'd. in Guidance (Relocated)
TVA Sht. 4 94592A	7-60002	Equip. Instl. Electrical & Electronic Airborne	2-9-59	7-54-9	Unit Moved to Clear Mech. Interference
TVA 94582	7-64759	Harness - Tlm Umbilical J3001 to Components	2-9-59	7-54-9	Remove Wires not Req'd in Guidance (relocated)
TVA 94583	7-64899	Harness - Permanent splices, Pod 1 to Permanent Splices Pod 2	2-9-59	7-54-9	Remove Wires not Req'd in Guidance (relocated)
TVA 94591	7-60002	Equip. Instl - Electrical & Electronic Airborne	2-9-59	7-54-9	Remove splices - interference with Mod Waveguide
TVA 94606	7-60603	Guidance System Airborne	2-9-59	7-54-9	Guidance Moved to Pod II
New Dwg	7-07779	Stub Tank - Fwd Bhd Test Able 4B	2-9-59	7-54-9	Create New Fwd Blkd
GMA 2627A	7-22107	Vernier Engine - Instl.	2-10-59	7-54-9	"A" Chg. Adds Alte[illegible]ate Transducer
GMA 2641	7-22109	Sustainer Engine Instl	2-10-59	7-54-9	Adds Reliable Propellant Depletion Signal for Upper Stage

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TVA or Mod Dwg	Dwg Against	Title	Date Logged	Effective	Remarks
TVA 74591A	7-60002	Equip. Instl - Electrical & Electronic Airborne	2-11-59	7-54-9	Interference with Modified Waveguide
TVA 94579A	7-60611	Diag Ckt, Azusa Transponder Airborne	2-11-59	7-54-9	Azusa Transponder Moved to Pod 2 Corrected Cableway Callout
TVA 94575A	7-36220	Waveguide Instl - Guidance Mod III	2-11-59	7-54-9	Sht. 1 rewritten for Clarity
Dwg Chg A	7-07779	Stub Tank Fwd Blkd Test Able 4B	2-11-59	7-54-9	Revised New Fwd Blkd.
TVA 94497	7-70005	Body Assembly	2-11-59	7-54-9	Relocated Azusa Boom
TVA 94469A	7-70005	Body Assembly	2-12-59	7-54-9	"A" Change Adds Callout to B/M
TVA 78050A	7-84200	Actuator Assy - Hyd. Booster	2-13-59	7-54-9 & 6	"A" Change Gives Installation Instructions
TVA 105467A	7-11040	Instru. Instl. - Second Stage	2-16-59	7-54-9	"A" Change Makes Minor Corrections
TVA 89855A	7-94065	TLM Instr - Sub System Functional Checkout Procedure	2-16-59	7-54-9	"A" Change Cancels - Replaced by TVA 167033
TVA 107033	7-94065	TLM Instru - Sub System Functional Checkout Procedure	2-16-59	7-54-9	To designate Meas. Requiring Functional Checkout

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TVA or Mod Dwg	Dwg Against	Title	Date Logged	Effective	Remarks
TVA 78257	7-87813	Air Cooli~g Instl - Pod	2-16-59	7-54-9	Air Cooling Duct Change Required Due to Canister Location
TVA 78263	7-81122	Line Instl - Tank Press. Sensing 7-81132-500-E	2-16-59	7-54-9	Present Tubing will not Fit Aerojet Adapter
TVA 94607	7-67803	Harness Permanent Splices to Phase Disconnect	2-10-59	8-9 & -11 7-54-9	To provide seal against Moisture
TVA 94924	7-94074	XSM-65C Tlm Sys Checkout Procedure	2-18-59	7-54-9	Delete Checkout of TLM #2
TVA 89742C	7-64900	Harness Autopilot Umbilical to Components	2-19-59	7-54-9	"C" Chg Ties Back Connection to P15 "A"
TVA 89791B	7-67790	Harness - Propulsion, Perm. Splices to Sustainer Components	2-19-59	7-54-9	"B" Chg Ties Back Connection to P15 "B"
TVA 94581A	7-64901	Harness - Guidance Umbilical to Components	2-19-59	7-54-9	"A" Chg. Cancels - See TVA 94579B
TVA 94587	7-67786	Harness - Autopilot Perm. Splices to Sustainer Components	2-19-59	7-54-9	APA System Modified
TVA 94741	7-60017	Harness Instl - Pod II	2-19-59	7-54-9	#2 TLM System Removed
TVA 94579B	7-64901	Harness - Guidance Umbilical to Components	2-19-59	7-54-9	TVA was Written Against 7-60611 Info From TVA 94581 Incorporated Here

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TVA or Mod Dwg	Dwg Against	Title	Date Logged	Effective	Remarks
TVA 107129	7-11417	Harness - Pod 1 Distr. Box to Lower Ladder, C-9	2-19-59	7-54-9	To Remove Redundant Wiring
TVA 107132	7-11424	Panel Assy - Patch, Junction Box to Pod II, C-9	2-19-59	7-54-9	To Correct Patching Error
TVA 107130	7-11356	Harness - Distr. Box to Upper Ladder	2-19-59	7-54-9	To Remove Redundant Wiring
TVA 81190	7-16912	Transducer Instl. Vernier Fuel Tank	2-19-59	7-54-9	Add Meas. for 5 sec. start Tanks
GMA 2641A	7-22109	Sustainer Engine Instl.	2-19-59	7-54-9	"A" Chg. Cancels GMA - Replaced by GMA 2650
GMA 1433A	7-60002	Equip. Instl Airborne Electrical	2-19-59	10 & on 7-54-3, 8	"A" change Deletes 9C Eff.
GMA 1434A	7-60002	Equip Inst Airborne	2-19-59	7-54-3, 8 10 & on	"A Change Deletes 9C Eff
TVA 81490	7-22870	Support Assy - Track, Quad II	2-19-59	7-54-9	Provide Mounting for Additional Accumulator in APS Backup System
TVA 64055	7-84126	General Arrang. Hyd. Sys. C Series	2-19-59	7-54-9	Decrease Weight of APS Backup Sys and provide for 5 sec. vernier tanks
TVA 107037	7-94072	Missile Composite System Checkout Procedure	2-20-59	7-54-9	Make Procedure Compatible With configuration of Missile
TVA 94675	7-16908	Transducer Instl - Temp. Sus. Gas Generator Disc.	2-21-59	7-54-9	Preffered Transducer Not Available.

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TVA or Mod Dwg	Dwg Against	Title	Date Logged	Effective	Remarks
TVA 94674	7-12115	Transducer Instl - Temp. Turb. Inlet Box	2-21-59	7-54-9	Preferred Transducer Not Avail.
TVA 98264	7-81160	Gen. Arrang. Press System	2-23-59	7-54-9	Ambient Bottle Interference
TVA 89237	7-43010	Tubing Instl - PU	2-26-59	7-54-9	Change from 25 to 5 sec. Vernier Start Tanks
GMA 2650A	7-22109	Sustainer Engine Instl.	2-26-59	7-54-9	Replaces GMA 2641 to Provide Reliable Prop. Depletion Sig. for Upper Stage
TVA 64055A	7-84126	Gen. Arrang. Hyd. Sys. "C" Series	2-26-59	7-54-9	"A" Change Corrects Dash No. Callout
TVA 107097	7-11416	Harness C9 No. 1 Tlm to Miscellaneous	2-26-59	7-54-9	To Correct Wiring Error
TVA 107098	7-11363	Sustainer - Instru. Box to Sustainer Instruments	2-26-59	7-54-9	Relocation of F-145P Meas.
TVA 88962	7-17764	Transducer Instl Press Helium Bottle Sus.	2-26-59	7-54-9	Reroutes Tubing
TVA 99961	7-12096	Transducer Instl -5 Ctl Helium Bottle Disch.	2-26-59	7-54-9	Adds Tubing for New Meas.
TVA 95000A	7-12098	Transducer Instl - Press Vibration	2-26-59	7-54-9	"A" Change Corrects Pin Call-outs
TVA 107033A	7-94065	TLM Instru Sub Sys. Functional Checkout Procedure	2-26-59	7-54-9	"A" Change Deletes Index #78 From Landline

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TVA or Mod Dwg	Dwg Against	Title	Date Logged	Effective	Remarks
TVA 104397	7-94065	TLM Instru Sub Sys Functional Checkout Procedure	2-27-59	7-54-9	Provides Special Procedure for Meas. P28D & P29D
TVA 107037A	7-94072	Missile Composite System Checkout Procedure	2-27-59	7-54-9	Correct TVA to Agree With Changed Configuration
TVA 94592B	7-60002	Equip Instl - Electrical & Electronic Airborne	3-3-59	7-54-9	"B" Change Removes Unnecessary Fairleads
TVA 94696A	7-60603	Circuit Diag. Guidance System Airborne	3-3-59	7-54-9	"A" Change Corrects Pin Call-outs
TVA 94741A	7-60017	Harness Instl - Pod II	3-3-59	7-54-9	"A" Change Corrects Harness Dash Number
TVA 94722	7-68126	Console Control Hydraulic 7-68126-599-A	3-4-59	7-88-9	Provide Console Control Panel for Missile 9C Launch
TVA 94933	7-94023	XSM-65C Missile Prop. Sys. Checkout Procedure	3-5-59	7-54-9	Allows Faster Valve Operation
TVA 88783	7-60002	Equip Instl - Electrical & Electronic Airborne	3-6-59	7-54-9	ARM Switch #3 Not Used
TVA 107043	7-94070	Missile Elec Sys Checkout Procedure	3-9-59	7-54-9	Omit Checkhout Procedure for #2 Tlm
TVA 107125	7-11416	Harness C-9 #1 TLM to Miscellaneous	3-9-59	7-54-9	Grd. Spares on Chg. #17 & E19
TVA 105460	7-11426	Panel Assy - C-9 Patch Sig Dist Box, Pod 1	3-9-59	7-54-9	To complete circuit for Meas. E51V, E28V and P528D

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TVA or Mod Dwg	Dwg Against	Title	Date Logged	Effective	Remarks
TVA 107115	7-11424	Panel Assy - Patch, Junction Box Pod II C-9	3-3-59	7-54-9	Provide 0.8V to Sustainer Area

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OPEN IR'S AND BOI'S UPON ARRIVAL AT AMR

	UNACCOMPLISHED TASK
BOI 29632	Remove fuel disconnect valve (Engr. request)
BOI 76715	Retest inverter (Ref. IR 375625)
F & C IR 375627	27-08115-1 (Titanium bottle)
F & C IR 375628	27-08115-7 (Titanium bottle)
AF Disc. 88E	No sustainer cutoff discrete signal during composite test
AF Disc. 89E	Excessive switching transients during programmer switching functions
AF Disc. 91E	No test conducted to evaluate the validity of SCO to payload interface

TVA'S ISSUED AT ATLANTIC MISSILE RANGE

TVA	PRINT	TOTAL EFFECTIVITY	DATE	DESCRIPTION
85176	7-29152	7-54-4, -5, -7, -9, -11, (-8)A	1/21/59	Removed plumbing to LO_2 pre-valve prior to flight. (Accomplish with TVA 85178)
85178	7-73000	7-54-4, -5, -7, -8, -9, -11	1/21/59	Removed actuator from LO_2 pre-valve prior to flight.
93627	7-84002	7-54-9	4/24/59	Rotated 7-84200-5 B1 pitch actuator 180° to correct interference with LO_2 start tank installation.
93648	7-81100	7-54-9	4/17/59	Originated by San Diego pneumatic design group. Rotated LO_2 boil-off valve to correct interference with STL adapter.
93649	7-81100	7-54-9	4/17/59	Modified heat shield for boil-off valve due to interference with STL adapter. (Ref: TVA 93648)
93650-A	7-81100	7-54-9	4/17/59	Same type as TVA 93649. Cancelled 4/23/59
94369	7-70005	7-54-9	4/27/59	Plugs end of stillwell pipe to prevent vortex in sustainer engine fuel plumbing. NOTE: INVESTIGATION OF MISSILE PARTS AFTER EXPLOSION SHOWS PLUG INTACT IN STILLWELL PIPE.
3378	7-00009	7-54-9	8/25/59	Task is to paint Roman No's I, I, III, and IV, to mark each quad for (and requested by) STL.
2604-A	7-00009	7-54-8-9	7/10/59	Reason: Removed existing solid bolts and added fail-safe bolts in separation fittings as per CIC-35030.

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TVA	PRINT	TOTAL EFFECTIVITY	DATE	DESCRIPTION
2729	27-72880	7-54-9	7/30/59	Reason: This is a paper shuffle - identifying external fuel outlet ring made per basic drawing which is to the same configuration as TVA 94473-7 ring.
4104-B	7-73001	7-54-9	8/31/59	Reason: Added 5 patches to LO_2 tank skin on damaged areas per IR 413769.
8703	7-43028	7-54-9	9/11/59	Reason: Remocked existing 7-43028-107 and -111 tubing so that tubing could be secured to nose adapter.
8702	7-81132	7-54-9	9/11/59	Reason: Deleted TVA 78263-7 tube and -9 tube because existing tubing suited the Aerojet adapter.
8708	27-77105	7-54-9	9/14/59	Reason: Added cable clamps to existing cable assembly on sustainer engine to take up slack.
93628	7-87002	7-54-9	4/13/59	Reason: Fabricated aluminum washer to take up gap so that 7-81657-7 nut on helium bottle shroud would not bottom out.
85247	7-77210	7-54-9	5/7/59	Reason: Added a -7 cap to damaged hat section per IR 402941.
2611	7-20205	7-54-8, -9, -11	7/11/59	Reason: Changed length of bolts due to addition of support structure on fuel valve. (Instrumentation bracket)
2599	7-77283	7-54-8, -9, -11	7/9/59	Reason: Removed latches and springs from LN_2 door. A beefed-up spring used in place of removed one to insure door closing properly.
2598-A	7-77279	7-54-8, -9, -11	7/9/59	Reason: Removed latches and springs from Firex door. A beefed-up spring used in place of removed one to insure door closing properly.

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TVA	PRINT	TOTAL EFFECTIVITY	DATE	DESCRIPTION
2583-A	7-77280	7-54-8, -9, -11	7/7/59	Reason: Added beefed-up spring to hot air duct door.
93620	7-16911	7-54-9	4/13/59	Reason: Relocated transducer installation due to removal of sustainer helium bottle.
85513-B	7-81133	7-54-3, -8, -9	6/25/59	Reason: Disconnect 7-81133-37 tube at MS 21905-8C tee, and cap tee with MS 21914-8C. To remove possible leakage in system. The -37 tube not required for existing pressurization system configuration. (see TVA 2511A)
2511-A	7-81100	7-54-8, -9	6/25/59	Reason: Remove 7-08330-1, -3 disconnects. Remove 7-81133-37 and -53 tube assemblies on Quad IV. Unused lines and disconnects removed from missile. (see TVA 85513-B)
85231	7-81100	7-54-9	5/8/59	Reason: Trim TVA 89319-37 as shown on TVA 85231 to remove interference with TVA 89319-27. Added TVA 85231-7 tab. To provide proper LO_2 boil-off protection after rotation.
2550-A	7-20204	7-54-8, -9, -11	6/30/59	Installs redesigned oxidizer staging valve.
3295	7-20205	7-54-9	8/12/59	Delete requirements of TVA 2081
3317	7-81100	7-54-9-11	8/17/59	Create pressurization fitting. To change booster operation fitting.
8709	7-20205	7-54-9	9/14/59	Replacement of booster fuel staging valve, aft section, with Convair-designed section.
85194-B	7-87932	7-54-8, -9, -11	4/29/59	Extended tubing to permit Marmon clamp to clear fireshield.

TVA	PRINT	TOTAL EFFECTIVITY	DATE	DESCRIPTION
93625	7-81597	7-54-9	4/13/59	Replaces post not available at AMR.
93633-A	7-43028	7-54-9	4/20/59	To permit replacement of pneumatic regulator without detanking fuel.
93721	7-81124	7-54-9	4/27/59	To provide LO_2 overboard vent line.
85119-A	7-23117	7-54-3, -4, -5, -7, -8, -9, -11	12/14/58	To specify location compatible with vibration level requirements.
93641-A	7-16911	7-54-9	4/6/59	To install bleed valve to allow filling of start tank.
GMA 1662-A	7-22109	7-54-3, -4, -5, -7, -9	2/5/59	Modify sustainer engine junction box assembly per drawing 18-150018 dated 11/20/58. To keep ground cutoff signals from feeding back into the autopilot system. GMA 1662-B cancelled -5, -7, and -9 and referenced San Diego GMA 2619.
2619	7-22109	7-54-5, -7, -8, -9, -11	1/21/59	Modify sustainer engine assembly per Rocketdyne MOD. INST. R 469-66 dated 1/20/59. Reason same as GMA 1662A.
0761-C	7-22107	7-32-3, -5, -8 through -12 & 7-54-9	8/17/59	Modify vernier engine tube assembly to avoid interference with vernier heat shield. "D" change added 7-54-11 effectivity.
6821	7-22109	7-54-9	4/15/59	Modifies Rocketdyne fuel deflection switch shuttle valves to improve airborne reliability of shuttle valves.
1796-C	7-11020	7-54-4, -5, -8, -9, -11	1/13/59	Modifies instrumentation installation per Rocketdyne FSB R-58-79 WAK, dated 6/19/58, to correct instrumentation malfunction.

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GMA	PRINT	TOTAL EFFECTIVITY	DATE	DESCRIPTION
10802-A	7-20204	7-54-8, -9, -11	6/24/59	Modifies vernier engine LO_2 vent tube. To prevent frosting of missile launcher stabilizer cylinder.
6856	7-22109	7-54-9, -11	8/19/59	Fuel injector purge check valve design inadequate.
TVA				
3299	7-67790	9C	8/15/59	Removed crossover wire installed on fuel depletion switch (TVA 89741). Directed by SFTO 68.
71008-A	7-45809	9C	8/20/59	Removed No. 1 destruct packages.
82599	7-60602	9C	4/6/59	Revises harness in conjunction with programmer staging, roll gain changes, etc. Ref: CIC 34015
85240	7-60604	9C	5/3/59	Provide ABIE umbilical eject circuit.
85237	7-65188	Pad 12	5/2/59	Provide ABIE umbilical eject circuit.
85239	7-65188	Pad 12	5/3/59	Provide ABIE umbilical eject circuit.
85563	7-60188	3, 4, 5, 7, 9, 11	11/15/58	Provide circuit for 42-inch separation signal.
A8724	7-16293	9C	9/18/59	To add a temperature transducer near the Azusa canister to insure that cooling air was entering the pod. Ref: Capsan 9-171, dated 9/15/59, and FT 4628, dated 9/17/59.
1703	7-60604	7, 9, 11C	2/18/59	To insure that P26 motion limit cutoff connector is not reconnected prior to launch. (WAP 8569) Added flag to connector.
2719	7-36216	9C, 15, 17, 18, 22, 26, 28D	7/28/59	Remove material from cover on RSC power supply to facilitate battery mounting.

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TVA	PRINT	TOTAL EFFECTIVITY	DATE	DESCRIPTION
4128	7-43016	9C	9/3/59	Deletes requirement for re-route of PU tubing due to Azusa antenna installation. (Azusa installation was relocated).
1707	7-11387	5, 7, 8, 9C	2/12/59	Adds isolation for transducers in thrust section to prevent loss of excitation in event of short.
83893	7-11396	5, 7, 9C	2/12/59	Adds isolation for transducers in thrust section to prevent loss of excitation in event of short.
83894	7-11395	5, 7, 9C	2/12/59	Adds isolation for transducers in thrust section to prevent loss of excitation in event of short.
83896	7-11396	5, 7, 8, 9C	2/12/59	Adds isolation for transducers in thrust section to prevent loss of excitation in event of short.
1924	7-64919	8, 9, 11C	4/3/59	Pot Propellant Utilization connector P106 to prevent water shorting.
8717	7-11398	9C	9/16/59	Move measurement on A51 to A53 due to bad wire in distribution box.
83686	7-11987	3, 4, 5, 8, 9, 11, 12C	7/24/59	Re-orient vibrotron accelerometer. Print installed this reversed.
93466	7-12115	9C	4/10/59	Add new type transducer for P17T thrust section temperature.
93617	7-17764	9C	4/13/59	Remove transducer for F1248P, Sustainer Tank Bottle Pressure, due to bottle being removed.
93618	7-12655	9C	4/13/59	Remove transducer for F248P, F249T, and F1249T due to sustainer tank bottle being removed.

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TVA	PRINT	TOTAL EFFECTIVITY	DATE	DESCRIPTION
93719	7-11396	9C	4/27/59	Ground segment for former F248P.
93720	7-11395	9C	4/27/59	Ground segment for former F249T.
93620	7-16911	9C	4/13/59	Relocate transducer for P1027P and P1336P due to removal of sustainer tank helium bottle.

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INSPECTION REJECTIONS HISTORY

The following Inspection Rejections were written at AMR against Missile 9C. Disposition of these injections were as listed.

Date	I.R. No.	Part Number	Name	Discrepancy	Fix	Date
3-2-59	361276	7-04380	Transducer Assembly	Out of Tolerance	OK as is	3-3-59
4-6-59	401174	350455	Vernier LO2 Dome Seal V-1 and V-2	Non-Reusable Item	Replace Seal Scrape Old Part	4-6-59
4-7-59	401175	7-01479-1	Vernier LO2 Flow-meter (P-1042-R)	Flowmeter Pickup Reads Open	Remove and Re-place Pickup Coil	4-7-59
4-7-59	401186	TVA 95000-13	Tube Assembly	Tube Flare is Pitted and Scored	Replace Tube Scrap Old Part	4-13-59
4-7-59	401189	7-16262	Harness Assembly	Harness Pins Revers-ed to Meas. P-1674-T	Use as is Re-verse Complex Wiring to Correct	*
4-7-59	401193	4529-43391-65	Tube Assembly	Tube Improperly Mocked Up	Replace by GMA 0761-C Tube	4-11-59*
4-8-59	401168	7-08218-3	Fuel Tank Pressuriza-tion Relief Valve	Leaking Around Adjust Screw	Replace-Return Old Valve to S.D. for Evalu-ation	4-10-59
4-8-59	401167	7-01479-1	Vernier LO2 Flow-meter (P-1042-R)	Flowmeter Pickup Reads Open	Replace-Return to S.D. for Re-pair	4-10-59
4-8-59	401151	TVA 73910-7	Staging Disconnect	Scored-Unable to	Repair @ Machine Shop-Reinstall on 9C	4-10-59

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Date	I.R. No.	Part Number	Name	Discrepancy	Fix	Date
4-8-59	372227	7-77267 -514	Fireshield Assembly	7-77913-21 and 23 Panels Cut Too Short	Install Fire-shield Strips Too Close Gap	4-13-59
4-8-59	401195	7-11417	Harness	P-101 of 7-11417 Harness Not Wired per Blueprint	To Blueprint Configuration	4-13-59
4-8-59	401262	7-81501-13	Fuel Pressure "Y" Duct	Duct Mutilated @ A/B Fuel Press Relief Valve	Replace-Return to S.D. For Evaluation	4-10-59
4-9-59	401501	9512-948371	Check Valve	B-2 Fuel Purge Check Valve Leaking out of Specification	OK as is	4-9-59
4-9-59	401502	9512-948371	Check Valve	B-1 Fuel Purge Check Valve Leaking out of Specification	OK as is	4-9-59
4-9-49	401507	7-43025-3	Surge Tank	Toroseal Distorted Inside 7-43557-7 Orifice	Replace-Return to S.D. For Failure Analysis	4-14-59
4-10-59	401520	9512-41203-51	Tubular Thrust Chamber	B-1 Thrust Chamber Tube Has Dent in Outer Surface	OK as is	4-14-59
4-10-59	401523	9412-41203-61	Tubular Thrust Chamber	B-2 Thrust Chamber 3 Tubes Have Small Dents	OK as is	4-14-59
4-10-59	401526	7-16910-25	V-1 Orifice Plug	Plug Not Installed Per Blueprint and "O" Ring Missing	Install Per Blueprint	4-13-59

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Date	IR No.	Part Number	Name	Discrepancy	Fix	Date
4-10-59	[illegible]531	7-11840-813	Tlm Power Supply	No Output During Composite Test 7-94072	Replace, Return to S.D. for repair	4-14-59
4-13-59	401525	7-16910-25	V2 Orifice Plug	Plug not installed	Install per blueprint	4-13-59
4-13-59	401535	7-81597	Brace	Brace bent and twisted, demate	Scrap, replace with TVA 93625-7	4-15-59
4-13-59	4-1537	7-08332-3	Coupling	Staging disc. coupling has cuts and dents	Scrap, replace	4-14-59
4-13-59	4-1540	7-02229-3	Fuel Bellows	Gouged and dented	Return to S.D. for disposition	4-21-59
4-13-59	401546	7-77732-7	Support roller	Distorted and cracked	Weld crack, straighten support, re-install per blueprint	4-21-59
4-13-59	401548	TVA 941267-7	Tube Assembly	Blowing leak from under sleeve	Scrap, defective part. Rework tube assembly per TVA 95126-7	4-16-59
4-14-59	401551	27-08115-7	He storage sphere	Weld repair in excess of 25 per cent of weld area. Ref. SANM 018, 3-19-59	Return to S.D. Att. J.D. Mann, Chief of Insp.	4-17-59
4-14-59	401573	7-81103	Duct Installation	7-81501 Y Press duct misaligned with fuel A/B Press relief valve	Check for leakage, if no leakage evident, ok for use	4-20-59

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Date	I.R. No.	Part Number	Name	Discrepancy	Fix	Date
4-14-59	401273	7-84123-429	Tube Assy	Sus. Hyd. Press Tube Has Imperfections	Scrap-Replace With New Tube	4-21-59
4-14-59	401574	7-08217-3	Regulator	$\frac{1}{4}$" Balance Line Fact-tory Sealed and Bubble Leaks	Remove Line for Insp. of Fitt-ings Leak Check If no Leakage OK as is	4-21-59
4-14-59	401583	27-08115-1	He Storage Sphere	Weld Repair in Excess of Weld By 25 Percent Ref. SANM-018 3-19-59	Return to S.D. Att. J. D. Mann, Chief of Insp.	4-22-59
4-17-59	401233	9412-948371	Check Valve	B-2 Purge Check Valve Will Not Seat	Return to Roc-ketdyne for Re-pair-Replace With Idnetical Part	4-22-59
4-17-59	401235	9412-948371	Check Valve	B-1 Purge Check Valve Will Not Seat	Return to Roc-ketdyne- Re-place With Identical Part	4-22-59
4-20-59	370469	7-01413-7	Transducer	Vibrotron Acceleration Transducer Has Weak Output	Route to S.D. Tlm Lab for Repair Replace With New Part	5-12-59
4-20-59	401245	7-01403-5	Transducer	Meas. No. F 1121 P Reads Open	Return to S.D. for Repair	4-25-59
4-20-59	401243	TVA 95026-9	Tube Assembly	Tube Leaking @ MS Sleeve	Scrap-Remock New-9 Tube Leak Check	4-22-59

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Date	I.R. No.	Part Number	Name	Discrepancy	Fix	Date
4-20-59	401247	7-02241-1	Disconnect Coupling	Fuel Start Tank A/B Disconnect Coupling is Scored	Polish Scored Area. OK for Use	4-22-59
4-21-59	402707	TVA 53703-21	Turnbuckle Support	Turnbuckle Has Stripped Threads and Broken From Support	Remove Broken Turnbuckle From Support. Fabricate (2) -11 Turnbuckles per TVA	4-23-59
4-21-59	401049	7-16270-1	Harness	Harness Wires @ P-4100 Pulled Out of Potting	Rewire Plug and Permanent Splice Into Harness	4-21-59
4-21-59	371351	7-08234-13	Valve, Shutoff	Leaks Internally	Replace-Route to S.D. For Failure Analysis	4-27-59
4-21-59	402708	7-08334	Flex Duct	Dented	Scrap-Replace With Like Item	4-27-59
4-21-59	402710	7-84200-5	B-1 Pitch Actuator	Installed 180° Out From B/P Configuration	Instlation OK to Eng. Check-out Hyd Circuit per TVA 93627	4-21-59
4-22-59	402512	7-08278-15	Flex Hose	B-1 Pitch Actuator Flex Hose Bent and Twisted	Scrap Replace New Part	4-23-59
4-22-59	402509	7-23237-7	Gasket	Fill and Cover One Time Use Only	Scrap	4-22-59

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Date	I.R. No.	Part Number	Name	Discrepancy	Fix	Date
4-23-59	402715	7-08217-3	S/N 50 Regulator	Fuel Reg Set Too High	Return to S.D. For Failure Analysis	4-25-59
4-23-59	402803	7-43021-813	LO2 Probe	Reads "Open"	Return to S.D. for Repair	5-1-59
4-24-59	402806	7-08217-3	S/N 3 Regulator	Fuel Reg Set Too High	Return to S.D. for Rework	4-27-59
4-24-59	402812	7-08217-3	S/N 7 Regulator	Fuel Reg Set Too High	Return to S.D. for Repair	4-29-59
4-24-59	402813	7-08216-3	S/N 47 Regulator	LO2 Tank Press Reg is Erratic	Return to S.D. for Repair	4-29-59
4-25-59	402815	7-43011-504	Manometer, Fuel	Leaks @ 5 PSI @ Vent Valve	Replace Vent Valve Send to Lab for Sys. Test	5-13-59
4-27-59	402817	7-43021-811	Probe LO2	Misidentified as 811	Reidentify as 813 Instead of 811	4-29-59
4-27-59	402818	7-73001-109	LO2 Tank Skin	Dented and Scratched	OK as is	4-28-59
4-29-59	402831	7-87932-7	Tube Assembly	-7 Drain Tube is not Long Engough to Reach Disconnect Coupling	Repair per TVA 84194	8-6-59
4-30-59	402837	GMA 54	P 3002 Umbilical Face Plate	Cracked	Remove and Replace	8-6-59
4-30-9	402836	27-85333-7	Manifold	Manifold Nipple Dented and Galled	Scrap Replace	8-5-59

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Date	I.R. No.	Part Number	Name	Discrepancy	Fix	Date
4-30-59	403835	7-01737-1	P 29 P Transducer	Connector on Transducer is Loose Unable to Tighten	Replace Return I.R.'d Part to S.D. for Repair	5-8-59
5-1-59	402840	7-36110-1	RSC Power Supply	No Output	Return to S.D. for Rework Replace with Like Item	5-5-59
5-6-59	402941	7-77210-41	Corrugation	-41 Panel Has 16 Corrugations Bent	Repair per TVA 85247	5-13-59
5-6-59	402940	7-43021-813	Harness	Wires to LO2 Overfill Probe Cut for Fitting STL Fairing Assembly	Return to Original Configuration After STL Nose Fitting	5-24-59
5-6-59	402809	7-01687-7	P 1006 P Transducer	Transducer Output Does not Respond to Curve	Replace Return to S.D. for Repair	5-6-59
5-12-59	404745	7-77266-127	Panel Assembly	Panel Assembly Drained to Wrong Configuration for 7-77289-3 Boot Installation	Plug, misdrilled holes. Redrill holes per blueprint	5-14-59
6-10-59	406082	7-73667-1	Clamp Assembly	Canister Clamp Cracked at Hinged Segment	Replace Scrap	6-11-59
6-10-59	406081	7-73667-1	Clamp Assembly	Canister Clamp Cracked at Hinged Segment	Replace Scrap	6-18-59
6-10-59	406080	7-73667-1	Clamp Assembly	Canister Clamp Cracked at Hinged Segment	Replace Scrap	6-18-59

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Date	I.R. No.	Part Number	Name	Discrepancy	Fix	Date
6-10-59	406090	7-73667-1	Clamp Assembly	Canister Clamp Cracked at Hinged Segment	Replace Scrap	6-18-59
6-10-59	406078	7-73667-1	Clamp Assembly	Canister Clamp Cracked at Hinged Segment	Replace Scrap	6-18-59
6-10-59	406077	7-73667-1	Clamp Assembly	Canister Clamp Cracked at Hinged Segment	Replace Scrap	6-18-59
6-10-59	406077	7-73667-1	Clamp Assembly	Canister Clamp Cracked at Hinged Segment	Replace Scrap	6-18-59
6-10-59	406073	7-73667-1	Clamp Assembly	Same as Above @ Hinge	Replace Scrap	6-18-59
6-10-59	406072	7-73667-1	Clamp Assembly	Cracked @ Hinge	Replace Scrap	6-18-59
6-10-59	406071	7-73667-1	Clamp Assembly	Cracked @ Hinge	Replace Scrap	6-18-59
6-10-59	406038	7-73667-1	Clamp Assembly	Cracked @ Hinge	Replace Scrap	6-18-59
7-29-59	429260	7-12052	Separation Transducer	Wire on Spool Unwound and Kinked	Replace Return to S.D.	8-1-59
7-29-59	429259	7-77269-105	Radiation Boot	B-1 Boot Saturated With Hyd Fluid	Clean Boot OK for FRF	7-29-59
8-2-59	413686	7-12210-807	Tlm Canister	No. R.F. Output	Replace TAV-4 TAV-5 and Retune	9-3-59
8-3-59	429268	7-45815	Bushing	Cracked	Strap Replace	8-5-59
8-3-59	429275	7-73667-1	Clamp, Assembly	Pods 1 and 11 Clamps are not Satisfactory Due to Cracking	Replace With Later Date Clamps	8-11-59

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Date	I.R. No.	Part Number	Name	Discrepancy	Fix	Date
8-5-59	413398	7-23237-55	Gasket	Crushed	Remove Scrap Replace With Identical Item	8-5-59
8-5-59	413397	7-23237-17	Gasket	Crushed	Remove Scrap Replace With Identical Item	8-5-59
8-5-59	413396	7-23237-17	Gasket	Crushed	Remove Scrap Replace With Identical Item	8-5-59
8-6-59	413366	TVA 93633-11	Manifold	Threads Stripped out of Manifold	Remove Scrap Fabricate New Part per TVA	8-10-59
8-6 59	429262	TVA 89319-27	Cover Half Assembly	Cutout is not per TVA and Cover is Cracked	Cut Cover Cut-out to Clear Vent Valve. Patch Cracks With Epoxy	8-10-59
8-10-59	429265	7-08216-3	Regulator LO2	Remove per TWX SFTO 24	Return to S.D. for Further Disposition	8-12-59
8-10-59	429264	TVA 83319-35	Cover	Hole is Mislocated and Interferes With Boiloff Valve Connector Also 85231-7 Tab is Improperly Located	Elongate Hole to Clear Connector Relocate -7 Tab to Cover Valve Weld a 3/4" Tab to -37 as Shown	8-11-59
8-10-59	429266	7-08217-3	Regulator, Fuel	Remove per TWX SFTO-24	Return to S.D. for Further Disposition	8-13-59

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Date	I.R. No.	Part Number	Name	Discrepancy	Fix	Date
8-4-59	429261	7-22232-5	Line Assembly	Sus. Fuel Inlet Bellows is Bent	Replace Return to S.D.	8-21-59
8-12-59	429853	7-23237-9	Gasket	Crushed	Scrap Replace	8-13-59
8-12-59	429854	7-23237-21	Gasket	Crushed	Scrap Replace	8-13-59
8-13-59	421021	7-23237-7	Gasket	Crushed	Scrap Replace	8-18-59
8-13-59	421020	7-23237-45	Gasket	Crushed	Scrap Replace	8-17-59
8-13-59	421019	7-23237-51	Gasket	Crushed	Scrap Replace	8-17-59
8-14-59	421001	7-23520-7	Gasket	Crushed	Scrap Replace	8-17-59
8-17-59	413408	7-81108	Coupling Installation	Holes Misligned Coupling not Installed per Blueprint	Accep to Eng.	8-17-59
8-17-59	429800	TVA 93620-15	Tube	Cannot Connect Tube Without Excessive Strain	Scrap Remock New Tube	8-19-59
8-18-59	438662	19823-1100-C	Gasket	Leakage Around Casket During Heat Exchanger Leak Checks	Scrap Replace With Identical Part	8-25-59
8-19-59	413409	M 266	Check Valve	LO2 Check Valve Leaking During FTP P-005	Route to Mech Lab for Repair Install New Part for 9C	8-26-59
8-19-59	424866	M-266	Check Valve	Same as Above	Same as Above	8-26-59

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Date	I.R. No.	Part Number	Name	Discrepancy	Fix	Date
8-22-59	421266	7-06380-3	RSC Battery	Battery Has (2) Cycles Operating Times	OK for Test Use Only	8-24-59
8-25-59	421434	GMA-54	Umbilical Recep	Face Plate of J-3001 is Cracked	Scrap, Replace per Blueprint	8-26-59
8-25-59	421428	7-77269-105	Boot Assembly	B-2 Boot Does Not Have Openings for Retainer Clamps	Slit Boot For Installation of Clamp	8-26-59
8-26-59	421312	7-08219-1	Pressure Gage	Vernier Accum. Gage Will not Zero	Scrap, Replace With New Part	8-31-59
8-27-59	421236	GMA 0761-7	Tube Assembly	V2 Tube Hits Vernier Fairing When Eng is Gimbaled	Trim 7-76326-101 & 7-76918-7 for clearance	9-4-59
8-27-59	421235	7-77269-105	Radiation Boot	B2 Boot Has A One Inch Dia. Hole	Patch with Identical Material	8-28-59
3-27-59	421234	GMA 0761-7	Tube Assembly	Tube Hits V1 Fairing When Eng. is Gimbaled	Trim Material From 7-76326-101 and 7-76918-7 as Req to Clear	9-4-59
8-27-59	421233	7-20441-242	Tube Assembly	Scratched	OK for Use	8-28-59
8-27-59	413769	7-73001	Tank Structure	(6) Scratches and Dents in LO2 Tank	Rework per TVA 4104-B	9-5-59
8-27-59	421232	7-20441-245	Tube Assembly	Scratched	OK for Use	8-31-59

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Date	I.R. No.	Part Number	Name	Discrepancy	Fix	Date
8-28-59	413760	7-94501-833	Hydraulic Actuator	P-701 on Sus. Pitch Actuator Collects Moisture Causing Poor Signal	Dry With Gn2 Blast Pot and Test	8-31-59
8-28-59	413759	7-94501-831	Hydraulic Actuator	P-703 on Sus Yaw Actuator Collects Moisture Causing Poor Signal	Same as Above	8-31-59
8-28-59	413753	9529-44019-21	Flex Duct	B-2 Turbine Duct Volutes Have (5) Cracks and Dents	Remove and Replace Duct-X-Ray Removed Duct	8-31-59
8-28-59	413756	TVA 87359-11	Shock Absorber	Shock Absorber Has Broken Wire on Strain Gage Meas. L-1382-S	Replace With Like Part Return to S.D. for Repair	9-3-59
8-28-59	413755	27-62303	Clamp	Lanyard Clip Broken from Clamp for P-2012	Replace Scrap	9-3-59
8-29-59	413757	7-94123-429	Tube	Hyd. Tube Cut in Bend Radius	Pressure Test to 6,000 PSI Clean and Re-install if no Leaks or Cracks Occur	8-29-59
8-31-59	413933	7-84200-5	Actuator	B-1 Pitch Actuator Servo Valve Hitting LO2 Tank Start Line	Rework to TVA 93627	9-2-59
8-31-59	413927	7-02241	Fuel Disc. Valve	Four (4) Scratches on Valve Sealing Surface	Replace-Return to S.D. for Disposition	9-10-59

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Date	I.R. No.	Part Number	Name	Discrepancy	Fix	Date
8-31-59	413924	350455	Seals	Two (2) Vernier Engine Dome Seals Damaged	Replace-Scrap	9-2-59
8-31-59	413922	7-06346-5	Plug	P-2012 is Scored	OK to Use	8-31-59
8-31-59	413921	252-21001-1	Coupling Fuel Sensing	Nicked	Replace-Return to S.D. for Disposition	9-3-59
8-31-59	413919	7-02241-1	Disconnect	Bent Broken	Scrap-Replace	9-3-59
9-1-59	413945	7-77913-21	Panel	Heat Shield Panel Has Eleven Cracks	Stop Drill Cracks	9-4-59
9-2-59	413948	7-43021-811	Transducer	Probe Connection Not Acceptable	Replace-Route to S.D. for Repair	9-17-59
9-2-59	413950	7-94200-5	Actuator	B-2 Pitch Actuator Transducer Will not adjust	Replace-Route to S.D. for Failure Analysis	9-4-59
9-3-59	413572	109422-1	Amplifier Assembly TAV-4	Tlm. Cannister Has Low Output and is Unstable	Replace-Return to S.D.	9-16-59
9-3-59	413573	1026672-1	Amplifier Assembly TAV-5	Same as Above	Same as Above	9-16-59
9-3-59	413773	7-76152-1	Boom, Azusa	Not Per Blueprint 7-73108 Zone A-5	Replace Route to S.D.	9-10-59
9-3-59	413774	1-SE-3	Microswitch	B-2 Main Fuel Valve Stuck in Closed Pos.	Scrap-Replace with Identical Part	9-9-59

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Date	I.R. No.	Part Number	Name	Discrepancy	Fix	Date
9-3-59	413776	20120-5	Valve, Vent and Pressure	Internal Leakage	Replace With Like Item-Return to Rocketdyne for Repair	9-5-59
9-3-59	413777	TVA 94497-801	Boom, Bulkhead	-801 Bulkhead Holes do not Mate With 7 73108 Boom Installation	Remove Small Amount of Material From Nut so Bolt can be Installed	9-3-59
9-4-59	413571	7-12210-807	Tlm Canister	Shielding on Coax is Frayed	Scrap-Replace With like Item	9-4-59
9-4-59	413778	550278	Pneu. Regulator	LO2 Vernier Tank Press. Reg Leaking Externally	Replace-Return to Rocketdyne for Repair	9-10-59
9-4-59	413779	7-73001-113	Tank Skin	Spot Weld "Raised" Condition	OK as is	9-4-59
9-4-59	413787	TVA 4104-7	Patch	LO2 Tank Patch Leaks @ Spotweld	Re Heli-Arc Defective Spot and Press. Test	9-5-59
9-9-59	413812	7-64900	Harness Assembly	Umbilical Lock Mech Broken in Umbilical Assembly	Remove and Replace With Like Item Re-Pot and Ring Out	9-11-59
9-10-59	413817	7-20441-245	Tube Purge	V2 Eng Tube is Dented	OK as is	9-11-59
9-11-59	413830	7-01741-9	Transducer Assembly	Pin "A" on Meas. P-17-T is Broken	Resolder Pin "A" and Repot	9-14-59

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Date	I.R. No.	Part Number	Name	Discrepancy	Fix	Date
9-11-59	413834	7-06392-3	Receptacle Umbilical	Open Wire on Pin 94 of J-1007	Repair Re-assemble Pot-Ring Out per Blueprint	9-17-59
9-12-59	413835	TVA 89319-27	Heat Shield	Heat Shield Riding Against STL Able IV Transition Section	OK as is	9-12-59
9-12-59	413836	TVA 94392-7	Heat Shield	Cracked at Mounting Bolts	OK as is	9-12-59
9-14-59	413838	200583	Solenoid	GG Closing Control Solenoid Leaking Internally	Replace-Return to Rocketdyne for Repair	9-17-59
9-14-59	413842	1134	Transducer	Meas. No. U 80 P Reads Open	Replace-Return to S.D. for Repair	9-19-59
9-14-59	413843	A 320 T	Accelerometer	B-1 Accelerometer is out of Calibration	Replace-Return to Rocketdyne for Calibration	9-19-59
9-14-59	413844	A 320 T	Accelerometer	B-2 Accelerometer is out of Calibration	Same as Above	9-19-59
9-14-59	413845	A 320 T	Same as Above	Sus Accelerometer is out of Calibration	Same as Above	9-19-59
9-15-59	413847	27-21136-3	RMI Bellows	Three Dents	OK as is	9-15-59
9-15-59	421938	27-08562-3	Pressure Gauge	Out of Tolerance	Replace-Route to S.D. for Repair	9-16-59

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Date	I.R. No.	Part Number	Name	Discrepancy	Fix	Date
9-15-59	421939	4529-43391-57	Tube Assembly	Dented	If Leak Checks OK @ 535 PSI Tube OK as is	9-15-59
9-16-59	421942	802244	Solenoid Valve	Leaking out Vent Port	Replace-Route to Lab for Repair	9-22-59
9-16-59	431943	7-77899-13	Panel	Crushed and Cracked	Repair to Blue-print Configuration by use of Epoxy and Glass as Req.	9-19-59
9-17-59	421945	9412-42065	Gimbal Assembly	B-1 Engine Thrust Alignment Slide Lock Bolt Sheared	Remove and Replace	9-19-59
9-17-59	421944	9412-42065	Same as Above	B-2 Engine Thrust Alignment Slide Lock Bolt Stripped	Remove and Replace	
9-17-59	421891	9412-45094B	Relief Valve, Low Pressure	Internal Leakage	Replace-Return to Rocketdyne for Repair	9-18-59
9-18-59	421948	9512-43006	Bleed Valve	Internal Leakage	Same as Above	9-18-59
9-18-59	421801	TVA 93466	Plug	Broken Male Pin "A" on Plug 3070	By Pass Plug With Permanent Splices	9-21-59
9-22-59	421863	26-10002-1	Azusa Transponder	Transponder Has Phase Lag Loss and Lack of Coherance	Reworked @ ASC and Retained as Spare Unit	9-28-59

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Date	I.R. No.	Part Number	Name	Discrepancy	Fix	Date
9-23-59	421895	7-01687-15	Transducer	P 1049 P is Shorted to Ground Internally	Replace Return to S.D.	9-23-59
9-22-59	421865	7-01638-1	Transducer Gyro	Gyro Uncaging System is Inoperative	Replace With Like Item After FRF	Open
9-23-59	421811	5912-59052	Vernier LO2 Start Pneumatic Reg	Was Leaking	Remove and Replace	9-23-59

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BOI'S

The following are Break of Inspections on Missile 9C taken from official inspection records:

DATE	BOI NO.	REASON	COMPLETION DATE
2/18/59	29632	Remove 7-02229-3 Fuel Disconnect Valve for Shipment of 9-C	4/20/59
3/24/59	76715	Remove 7-06349-5 Inverter For Visual Checks	4/22/59
4/5/59	06461	Open 7-73636 Pod I Doors for Receiving Inspection	4/29/59
4/5/59	06462	Open 7-73638 Pod II Doors for Receiving Inspection	4/29/59
4/6/59	06464	Send 7641017G-1 Pulse Beacon to Lab for Checks	4/29/59
4/6/59	06465	Send 7641021G-1 Rate Beacon to Lab for Checks	4/29/59
4/6/59	06466	Send 7641009G-1 Decoder to Lab for Checks	4/14/59
4/6/59	06467	7-12210-807 Telemetry Package Removed to Check Out Spare Package	5/1/59
4/6/59	06468	Remove 7-73635-805 Pod Door for Access to GE Pulse Beacon	4/15/59
4/6/59	06469	Remove 9512-41062-41 V1 and V2 LO2 Domes to Check for Contamination	4/18/59
4/6/59	06470	Remove PS-1 Aljak for RF No. 1 Checkout	4/7/59
4/6/59	06472	Disconnect P-710 for Continuity Check	4/6/59
4/6/59	06473	Disconnect 7-81105-185 and 225 A/B LO2 and Fuel Reg. Inlet Lines for Leak Check	4/21/59
4/6/59	06463	Tube Assembly Disconnected From Sustainer Head Suppression Servo Controller For Safety	9/22/59

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DATE	BOI NO.	REASON	COMPLETION DATE
4/6/59	06471	Remove Doghouse 7-77203 Door for Electrical Control Checks	8/27/59
4/7/59	06016	7-84123-37 Sustainer Hydraulic Reservoir Charge Lines Disconnected. Hydraulic System Operative.	9/14/59
4/7/59	06475	Disconnect 7-87105-63 Line to Prevent Back Pressure on Changeover Valve	9/16/59
4/7/59	11351	Remove TVA 89319-27 Fairing to Rework TVA 93649	9/10/59
4/7/59	06008	Disconnect 7-87105-155 Engine Control Pneumatic Line for Leak Check	8/21/59
4/7/59	06009	Remove RF No. 1 Power Supply (7-11840-813) to Check Out Spare Can	4/16/59
4/7/59	06010	Remove 7-73659-17 and -19 Farings for Installation of Azusa Boom	4/29/59
4/7/59	06011	Remove 9529-48022 Fuel Duct for Access to RMI Bellows	4/17/59
4/7/59	06012	Remove 3858-200 V1 and V2 Chamber Pressure Switches for Functional Check	4/10/59
4/7/59	06013	Remove 9529-43037-A Bootstrap Assembly to Work Fuel Bellows	4/20/59
4/7/59	06014	Remove 7-01633-1 Helium Temperature Transducer to Work Fuel Bellows	4/20/59
4/7/59	06018	Disconnect 7-84501-501 and -502 Sustainer Actuators to Run Hydraulic Checks	4/29/59
4/7/59	06019	Remove 9512-948371 B1 and B2 Fuel Jacket Check Valves for Flow and Leak Check	4/9/59
4/7/59	06021	Remove 7-73711-1 and -7, 7-73710-3, 7-72163-1 Fairings to Work FTP-F-004-A	4/14/59
4/7/59	06015	Disconnect TLM power supply plugs 10 and 11 to run TLM checkout	4/27/59

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CONVAIR ASTRONAUTICS

DATE	BOI NO.	REASON	COMPLETION DATE
4/7/59	06022	Remove 7-75712-11 and 7-73707-1 Cableway Fairings for Ringout	4/14/59
4/7/59	06023	Disconnect P-3012 for Troubleshooting	4/9/59
4/7/59	06025	Remove 7-77101-189 Inspection Door to Facilitate High Pressure Leak Check	4/14/59
4/7/59	06027	Remove 7-41011-949 Autopilot Programmer For Lab Checkout	4/14/59
4/7/59	06026	Remove 7-41744-803 Gyro Canister for Lab Checkout	4/8/59
4/8/59	06628	Open 7-12500-39 Signal Distribution Box for Telemetry Troublshooting	4/14/59
4/8/59	06629	Remove 7-11960-805 Telemetry Accessory Package to Test Spare Can	4/29/59
4/8/59	06630	Remove 7-76404-11 Fairing to Work P/C 7-11981-04	4/14/59
4/8/59	06631	Disconnect B1 and B2 Pitch and Yaw Actuator Cannon Plugs to Run Hydraulic Checks	4/9/59
4/8/59	06634	Remove 7-76326 V2 Engine Fairing to Run Propulsion Leak Checks	5/1/59
4/9/59	06636	Remove 7-08218-3 Fuel Relief Valve for Leakage Ref. IR-401168	4/14/59
4/9/59	06641	Disconnect PU Sensing Tube 7-43028-33 and Remove 7-43557-7 Adapter to Replace Gasket in Adapter	4/9/59
4/9/59	06642	Remove 7-43389-7 Mercury Trap to Repair Leak Ref. BOI 06641	4/9/59
4/9/59	06643	Remove 7-77232-502 Disconnect Panel Fairing for Leak Checks	4/10/59
4/10/59	04960	Remove 26-10002-1 Azusa Transponder to Send to Lab for Power Check	4/16/59

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DATE	BOI NO.	REASON	COMPLETION DATE
4/10/59	06645	Remove TVA 56579-11 Vernier Start Tank LO2 Vent Tube for Cleaning	4/10/59
4/10/59	06646	Remove 7-11840-813 Transverter Power Supply (No output) Rev. IR 401531	4/14/59
4/10/59	06647	Remove 7-77203 and 7-76404-11 Doghouse Door and Fairing for Demate	4/14/59
4/10/59	06648	Disconnect Plugs 2011-2013-3042-3044 for Demate	4/14/59
4/10/59	06649	Remove 7-76441 Aft Cableway Fairing for Demate	4/14/59
4/10/59	08947	Remove 7-36182 Waveguide for Demate	4/10/59
4/10/59	06651	Disconnect 7-29152 LO2 Pre-valve Control Hoses for Demating	4/14/59
4/10/59	06652	Disconnect Tank Sensing Lines Per FTP-A-002 for Demating	4/27/59
4/10/59	06653	Remove 7-35229 and 7-76152 Azusa Boom and Antenna for Demate	4/23/59
4/10/59	06654	Remove 7-77101-189 Inspection Plate for Demate	4/14/59
4/10/59	06655	Remove 7-92034 Sustainer Transport Link for Demate	4/14/59
4/13/59	06662	Remove 27-08115-7 Sustainer Control Bottle Per IR-375628	4/13/59
4/13/59	06659	Remove 27-08115-1 Helium Sphere to Replace With -7 Sphere	4/21/59
4/13/59	06663	Remove 500178 Sustainer Engine Relay Box for Government Modification Authorization	4/13/59
4/13/59	04961	Remove 7-08239 Helium Shutoff Valve and 7-08234-13 Relief Valve Per TVA 94638	4/20/59

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CONVAIR ASTRONAUTICS

DATE	BOI NO.	REASON	COMPLETION DATE
4/13/59	06666	Disconnect 7-77230-8 Fairing to Work IR 401262 Fuel "Y" Duct Replacement	4/16/59
4/13/59	06667	Remove 7-81105 Sustainer Helium Listed Parts Per TVA 94638	4/20/59
4/13/59	06668	Remove 7-41008-851 Gyro Canister for Lab Checkout	4/29/59
4/16/59	11345	Remove 26-10002-1 Azusa Canister to Send to Lab for Check	4/23/59
4/16/59	11348	Disconnect Plug 11 on 7-11680-809 Telemetry Power Supply for Voltage Checks	5/1/59
4/16/59	11347	Disconnect Plug 21 on 7-11840-813 Telemetry Power Supply for Voltage Checks	5/1/59
4/17/59	11350	Disconnect Plug 19 on Helium Change-over Valve for FTP-F-004-A Leak Checks	4/27/59
4/20/59	11357	Disconnect Plug 3026 to Check Voltages on Measurement U-101-A	4/29/59
4/20/59	11359	Remove 7-08259-11 Sustainer Hydraulic Flow Limiters to Work TVA 88487	5/1/59
4/20/59	11361	Remove TVA 56579-7 LO2 Line to Install B-1 Pitch Actuator Ref. IR 401227	4/22/59
4/22/59	11362	Open 7-12500 Instrumentation Box to Investigate TVA 93618 Rework	4/30/59
4/22/59	11363	Remove 7-12567-3 Sustainer Instrumentation Box Cover to Investigate TVA 93618 Rework	4/30/59
4/23/59	11366	Open 7-12046-21 Padder Box to Check Condenser for Measurement P-65-D	4/23/59
4/23/59	11367	Remove Plug 402 From Azusa Can to Run 7-94078 Procedure Checkout	5/1/59
4/23/59	11368	Remove Azusa Boom Antenna Kit 7-73108 TVA 93623 Per AVO for 7D	9/14/59

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DATE	BOI NO.	REASON	COMPLETION DATE
4/24/59	11370	Remove 7-73708-1 Fairing to Run Range Safety Command System Check	4/27/59
4/24/59	11369	Remove 7-73707-1 Fairing to Run Range Safety Command System Check	4/27/59
4/25/59	11371	Remove 7-41011-947 Programmer to Install Backup for Checkout	4/29/59
4/25/59	11373	Remove 7-75712-11, 7-73707-1, and 7-73708-1 Fairings to Replace LO2 Probe Per IR 402803	4/27/59
4/25/59	11372	Remove PU Canister Serial No. 39 from Flight Shell and Installed in Test Shell	9/15/59
4/27/59	11290	Disconnect Plug 706 from 7-64380-813 Power Changeover for Frequency Checks	4/27/59
4/29/59	11375	Remove 7-41011-955 Programmer Backup Can to Send to Lab	4/29/59
4/29/59	11295	Disconnect Plug 26 to Run Integrated Launch Test	4/29/59
4/29/59	11299	Open 7-73638 Pod Doors for Checkout Operations	5/4/59
4/29/59	11301	Remove 7-73707-1 and 7-73708-1 Cable Fairing to Connect Able Harness for Test	4/30/59
4/30/59	11304	Remove 7-41028-851 Flight Gyro to Install Backup	8/24/59
4/30/59	11307	Remove 7-77228-510 and -511, 7-77203-35 and -36 to Install Trailer Handling Fittings	8/9/59
4/30/59	11305	Disconnect P-15 Holddown Release Control and P-26 Motion Limit Plug for FAC Test	4/30/59
5/1/59	11312	Remove 7-75102-81, 7-75716-7 Fairing Assembly to Install Nose Handling Fixture	9/11/59

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DATE	BOI NO.	REASON	COMPLETION DATE
5/6/59	05317	Remove 7-75102-23 Nose Adapter for Fitting of STL Fairing	8/16/59
5/6/59	05316	Remove 7-75705-7 Fairing from Adapter for STL Fairing Fit	5/8/59
5/6/59	05320	Remove 7-81132-7 Tube for STL Fairing Fit Ref. TPS 8467	8/18/59
5/6/59	05319	Remove 7-43028-111 Tube to Work STL Fairing Fit	8/18/59
5/6/59	05318	Remove 7-73707-10 and 7-73708-10 Fairing to Work STL Fairing Fit	5/8/59
5/7/59	05321	Booster Pitch and Yaw Actuators Removed and Transport Links Installed	8/27/59
5/13/59	05940	Remove 7-73217-13 Harness Covers for PAFB Air Force Show	8/24/59
6/10/59	08042	Remove 7-36000-811 Range Safety Command Canister for Lab Purging	8/21/59
6/10/59	05964	Remove 7-12210-807 Telemetry Canister for Mount Clamp Inspection	8/20/59
6/10/59	05965	Remove 7-11960-805 Telemetry Accessory Package for Mount Clamp Inspection	8/20/59
6/10/59	05966	Remove 7-36000-811 Range Safety Command Canister (Duplicate: Ref. BOI 08042 above)	
6/10/59	05967	Remove 26-10002-1 Azusa Transponder to inspect mounting clamps	8/20/59
6/10/59	05968	Remove 7-11860-809 Transducer Power Supply to inspect mounting clamps	8/20/59
6/10/59	05968	Remove 7-11840-813 Transducer Power Supply to inspect mounting clamps	8/20/59
6/10/59	08041	Remove Autopilot Programmer Serial No. 40 for Lab Work (Purge)	8/26/59

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DATE	BOI NO.	REASON	COMPLETION DATE
6/10/59	05971	Open Pod Doors 7-72110 for Access. Inspection of Canister Mounting Clamps	8/27/59
6/10/59	05970	Open Pod Doors 7-72126 for Access. Inspection of Canister Mounting Clamps	8/27/59
6/12/59	08047	Remove Ten 7-77703-7 and Ten 7-77703-8 Fairings to Inspect Separate Fitting Pin Interference	6/17/59
6/12/59	08048	Remove 9529-48022 B2 Fuel Pressurization Duct for RMI Valve Removal	8/11/59
6/12/59	08049	Remove 9529-43037 Ground Fuel Start Line to Facilitate RMI Valve Removal	8/11/59
6/12/59	08050	Remove 7-01633-1 Helium Bottle Transducer for RMI Valve Removal	8/3/59
6/12/59	08051	Remove 7-02229-3 RMI Bellows for X-Ray Inspection	8/17/59
6/12/59	08054	Remove 7-23524-1 Protective Ring to Facilitate Removal of RMI	8/3/59
6/12/59	08055	Remove 7-C2229-5 RMI Valve for X-Ray Inspection	8/17/59
6/12/59	08056	Remove 7-02287-1 Fuel Pre-valve for X-Ray Inspection	8/6/59
6/12/59	08057	Remove Support Plate P/N 7-73438-13 to Remove Pre-valve	8/6/59
6/15/59	11087	Remove 7-22237-45 V2 Oxidizer Supply Line to Inspect for Fuel Entering Line	8/11/59
6/23/59	08077	Remove 7-64303-1 Waveguide Per SANCAP 6-443 (San Diego Rework)	8/10/59
7/8/59	11092	Remove 7-64794-805 Harness to Support FRF on Missile 8-C	8/18/59
7/12/59	10909	Remove 7-76325-511 Fairing to Inspect Mount Bolts	7/15/59

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DATE	BOI NO.	REASON	COMPLETION DATE
7/15/59	08170	Remove 3858-200 V1 Chamber Pressurization Switch to Support Missile 8-C	8/6/59
7/27/59	12629	Disconnect Plugs 3044, 3042, 2011, 2013 2012 to Facilitate Demate	8/17/59
7/27/59	12630	Remove (13) pieces of 7-76441 Cableway Fairings for Demate	8/20/59
7/27/59	10233	Remove Four Pod Doors to Facilitate Demate of Missile	8/27/59
7/27/59	12632	Disconnect 7-29152-15 and -17 L02 Pre-valve Controls Flex Hoses for Demate	8/17/59
7/27/59	12633	Remove (2) 7-77203 Booster Nacelle Doors for Demate	8/17/59
7/27/59	12634	Disconnect 7-81132-15 Fuel and 7-81132 L02 Sensing Lines for Demate	8/18/59
7/27/59	10234	Remove Skirt Inspection Doors to Facilitate Demate	8/18/59
7/27/59	10235	Remove 7-73231-1 Fairing to Facilitate Installation of Stretch Fixture	8/20/59
7/27/59	10236	Remove 7-45429 Separate Fittings Staging Halves to Install Stretch Fixture	8/17/59
7/27/59	10237	Disconnect J-609 Autopilot Riseoff Connector to Install Stretch Fixture	8/17/59
7/28/59	12635	Remove 7-22781 L02 Staging Valve Fairing to Work TVA 2550	8/17/59
7/28/59	12636	Remove 7-23723 L02 Staging Valve Fairing to Work TVA 2550	8/6/59
7/29/59	12553	Remove 7-01649-1 Transducer for Facilitate TVA 2550 Rework	8/6/59
7/29/59	12554	Remove 7-76326-77 Fairing to Remove Vent Tube Per Government Modification Authorization 10802	8/5/59

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DATE	BOI NO.	REASON	COMPLETION DATE
8/2/59	08898	Remove 27-08562-3 Pressure Gage Accumulator Pneumatic Change for Calibration	8/9/59
8/3/59	12559	Remove all Pod Canister Clamps Per IR 429275	8/11/59
8/3/59	12558	Remove 7-45985 Shock Absorbers (2) to Rework Per Planning Card 7-77104-510	8/24/59
8/3/59	10239	Remove 7-73226-1 Fairing to Measure Bellows Per Test Prep Sheet 9241	8/3/59
8/3/59	12563	Remove 7-77233 Fairing to Work Planning Card 7-81008-5 "B" and TVA 7-81008	8/18/59
8/3/59	10240	Remove 7-76744-9 Shield to Measure Bellows Per Test Prep Sheet 9241	8/3/59
8/3/59	12564	Remove 7-81450-1 Duct to Work TVA 81331 and Planning Card 7-81008-5 "B"	8/21/59
8/4/59	12328	Remove 7-84200-5 Booster Actuator to Support Missile 11-C	8/7/59
8/4/59	10241	Remove 7-64380-813 Switch Canister to Replace Clamps	8/22/59
8/4/59	10242	Remove 7-06349-5 Inverter to Replace Clamps	8/20/59
8/4/59	12565	Remove 7-22232-5 Fuel Line Assembly for Replacement Ref. IR 429261	8/21/59
8/5/59	12329	Remove 7-20205-7 Fuel Drain Valve to Remove Another IR'd Part	8/20/59
8/5/59	12330	Remove 7641094G-9 Rate Beacon to Work Test Prep Sheet 9435	8/25/59
8/5/59	12331	Remove 1954 Rate Beacon Mounting Rack to Work Test Prep Sheet 9435	8/5/59
8/6/59	12567	Remove TVA 89228-11 and -9 Pneumatic Lines to Work TVA 93633	8/6/59
8/6/59	12335	Remove V-2 Transducer 7-01737-1 Serial No. 7171 Measurement P 29 P for IR 402835	9/1/59

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DATE	BOI NO.	REASON	COMPLETION DATE
8/10/59	12345	Remove Regulator 7-08216-3 Serial No. 33 Per TWX SFTO 24. Replace Regulator 7-08216-3 Serial No. 52	8/26/59
8/10/59	12346	Remove and Replace 7-08217-3 Fuel Regulator Per TWX SFTO 24	8/21/59
8/11/59	12349	Remove 1J23V12-3 Disconnect for Cleaning	8/11/59
8/13/59	12569	Remove 7-77875-7 Thrust Ring Shear Bolts to Work IR 438808	8/18/59
8/13/59	10249	Remove 7-02281-1 Sustainer Fuel Pre-valve to Work TVA 94369	8/13/59
8/13/59	004865	Remove V1 and V2 Engine LO2 Domes to Check for Contamination	8/31/59
8/13/59	12351	Remove (2) 7-73656-7 Fairings Per Attached AVO	9/14/59
8/14/59	12357	Remove 7-73657-7 and -8 V1 Fairing to Work Planning Card 7-23030-503 "A"	8/17/59
8/14/59	12356	Remove 7-73657-7 and -8 V2 Fairing to Work Planning Card 7-23030-503 "A"	8/17/59
8/14/59	12353	Remove 7-45429 Separate Fittings to Work Planning Card 7-23030-503 "A"	8/17/59
8/17/59	12570	Remove 7-76854-7 Plug to Install Hose Per Test Prep Sheet 197	8/17/59
8/17/59	12571	Remove 7-23368-55 Tube Assembly to Accomplish Test Prep Sheet 197	8/17/59
8/17/59	12572	Remove Booster Boot per attached AVO	8/26/59
8/17/59	12359	Remove TVA 93620-15 tube per IR 429800	8/18/59
8/17/59	12361	Disconnect 7-23539-11 drain tube to work IR 438662	8/19/59
8/18/59	12362	Disconnect (2) 7-23456-7 braces to facilitate IR 438662	8/19/59
8/18/59	12360	Remove 19823-1100C Gasket per IR 438662	8/19/59
8/18/59	12573	Remove 7-87105-153 tube assembly to perform FTP-P-005	8/20/59

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DATE	BOI NO.	REASON	COMPLETION DATE
8/18/59	12574	Disconnect 7-20441 Tubes to Accomplish FTP-P-005	8/20/59
8/18/59	07993	Remove 7-36110 Cover from Range Safety Command Set No. 104 to Work TVA 2719	8/18/59
8/18/59	12576	Remove 7-36110 Cover from Range Safety Command Set No. 101 to Work TVA 2719	8/19/59
8/19/59	10482	Remove M-266 Sustainer Purge Check Valve for Leak Test of Valve	8/20/59
8/19/59	10485	Remove AN 905-6 Plug from 9529-13021 Duct to Accomplish FTP-P-005	8/20/59
8/19/59	10484	Remove AN 905-6 Plug from 9529-48031-3 to Accomplish FTP-P-005	8/20/59
8/19/59	10483	Remove AN 905-6 Plug from 7-22232-43 Duct to Accomplish FTP-P-005	8/20/59
8/20/59	07995	Remove 7-84501-829 Serial No. 52 Sustainer Pitch Actuator Per AVO	8/20/59
8/20/59	07996	Remove 7-77228-501 and -511 Access Doors to Accomplish Pre-release Test Prep Sheet	8/24/59
8/20/59	10488	J-3 Loose in Canister. Remove R/B Canister and Send to GE Lab Per F&C 421306	8/25/59
8/20/59	10486	Disconnect Pulse Beacon Plug 3P1 to Ring Out Per Test Prep Sheet 379	8/21/59
8/20/59	10487	Disconnect Decoder Plugs 5A2P7 and 5A1P1 to Ring Out Per Test Prep Sheet 379	8/21/59
8/20/59	07994	Remove Signal Distribution Box P/N 7-12500-511 To Work TVA's 83893A, 83894A, 83896A, 93720 and 93719	8/21/59
8/21/59	07999	Remove Pod 2 Doghouse 7-77203 Door to Work Test Prep Sheet 528	8/21/59
8/21/59	08001	Remove 9512-45181-43 Tube to Perform Test Prep Sheet 454 Leak Checks	8/24/59

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DATE	BOI NO.	REASON	COMPLETION DATE
8/21/59	08002	Remove 7-43549-9 Probe Assembly to Accomplish Test Prep Sheet dated 8-20-59. Inspection of Intermediate Bulkhead	8/21/59
8/21/59	10271	Remove 7-87105-153 Tube, 9571-59001-73 Tube, MS 21914-4 Cap From 7-22234-43, AN 509 Plugs from 9529-13021 and 9529-48031 Ducts to Accomplish FTP-P-005	8/21/59
8/21/59	08007	Remove 7-73218-13 Access Door to Accomplish Pre-release Test Prep Sheet Inspection Intermediate Bulkhead	8/21/59
8/21/59	08003	Remove TVA 94392-7 Door to Accomplish Pre-release Test Prep Sheet. Inspection Intermediate Bulkhead	8/24/59
8/21/59	08009	Disconnect TVA 56582-75 and 11 Tubes to Accomplish FTP-P-005 Leak Check	8/21/59
8/24/59	08010	Remove 7-73226-1 Fairing to Facilitate Test Prep Sheet 319	8/24/59
8/24/59	000203	Remove 7-76326-515-04 Fairing to Facilitate FTP 319	8/24/59
8/25/59	08012	Remove 7-77234-8 Fairing to Facilitate Planning Card 7-81007-803	8/26/59
8/25/59	08022	Remove TVA 81190-9 and -11 Tubing to Facilitate TVA 93641	9/2/59
8/26/59	08013	Remove 7-76865 Mounting Plate and 7-76404-11 Fairing. Remove Face Plate on J3001 and J3002. Ref. IR's 402837 and 421434	8/26/59
8/26/59	08017	Remove Sustainer and Vernier Accumulator Gages and Air Flask Gage for Calibration	9/15/59
8/26/59	08018	Remove LO2 Pressure Switch Serial No. 009 For Calibration. Install Serial No. 063	8/26/59
8/27/59	08025	Remove 7-77228 Aft Door Handling Fitting Covers for Missile Erection	9/3/59

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CONVAIR ASTRONAUTICS

DATE	BOI NO.	REASON	COMPLETION DATE
8/27/59	08024	Remove V1 Fairings Prior to Transport to Complex	9/3/59
8/27/59	10457	Remove 7-76203 Doghouse Doors to Facilitate FTP-5-1-2 (X-1 Launch)	Open
8/27/59	10458	Remove 7-76404-11 Fairings to Facilitate FTP-5-1-2	9/8/59
8/27/59	10459	Disconnect 2012, 2011, 2013, 3042, 3044 Plugs to Facilitate FTP 5-1-2	8/29/59
8/27/59	10460	Remove 7-73659 Belly Band Fairing to Facilitate FTP 5-1-2	9/8/59
8/27/59	10462	Open 7-76458-1 Pod I and II Access Doors to Facilitate FTP 5-1-2 (X Day Launch)	Open
8/28/59	08830	Remove Clamp 27-62303 Ref. IR 413755	Open
8/28/59	08831	Remove 7-76326 V1 and V2 Fairings for Demate FTP 5-1-2	9/18/59
8/28/59	08832	Remove 7-73647-7 Fairing for Demate FTP 5-1-2	9/8/59
8/28/59	08833	Remove 7-23528 Sustainer Lube Oil Drain Line for Access in Thrust Section	9/22/59
8/28/59	08834	Remove (2) Access Doors to Facilitate Demate FTP 5-1-2	9/3/59
8/28/59	08835	Remove (10) Bolts for Demate FTP 5-1-2	9/9/59
8/28/59	08836	Remove and Replace Bellows Per IP 413753	8/29/59
8/28/59	08839	Disconnect Boost Heat Exchanger to Facilitate Replacement of B-2 Turbine Bellows	8/31/59
8/28/59	08841	Remove Waveguide Section to Connect Flex Waveguide to Guidance Cans in Pod II for System Test Per Procedure 7-94030	9/4/59
8/28/59	08843	Disconnect P-1-1, P-1-2, P-1-3, P-1-4 Plugs to Trouble shoot Telemetry System	9/9/59

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DATE	BOI NO.	REASON	COMPLETION DATE
8/28/59	08844	Remove (2) 7-23236, 7-23242, 7-23280-2 Supports to Work IR 413753	8/29/59
8/28/59	08845	Replace B-1 Snubber Per IR 413756, B-II to be Bled.	9/3/59
8/28/59	08846	Disconnect 7-81133-31 LO2 Line for Leak Checks Per Pre-release Test Prep Sheet	9/3/59
8/28/59	08848	Open P16-1 on Telemetry Accessory No. 1 for Readout Per Test Prep Sheet 8216	9/9/59
8/29/59	08849	Disconnect 7-84123-9 Booster Reserve Pressure Line to Facilitate System Check Test Prep Sheet 664	9/14/59
8/29/59	08850	Disconnect Plugs to Ring Out Propellant Utilization System Per Pre-release Test Prep Sheet	9/11/59
8/29/59	08853	Disconnect 7-87105-155 Tube to Facilitate Propulsion Check Leak Checks FTP-P-005	9/22/59
8/29/59	08878	Disconnect 7-23289-73 Tube to Leak Check Fuel Start Staging Disconnect Per Pre-release Test Prep Sheet	8/29/59
8/29/59	08854	Disconnect TVA 93620-15 Tube to Facilitate Propulsion Leak Check Per FTP-P-005	9/22/59
8/29/59	08855	Disconnect TVA 56582-11 Tube Assembly to Pressurize Vernier Fuel System for Leak Checks FTP-P-005	8/29/59
8/29/59	08856	Remove 7-84123-429 Tube Assembly for Pressure Test Per IR 413757	9/4/59
8/29/59	08879	Disconnect P-2012 Plug to Facilitate FTP 5-1-2	9/4/59
8/31/59	08858	Disconnect 7-81105-185 Fuel Line to Perform FTP F-004-A	9/3/59
8/31/59	08857	Remove 7-81105-225 LO2 Line to Work FTP F-004-A	9/3/59

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CONVAIR ASTRONAUTICS

DATE	BOI NO.	REASON	COMPLETION DATE
8/31/59	08861	Remove Airborne Disconnect Serial No. 29 Per IR 413919	9/2/59
8/31/59	08860	Remove 7-77231 Fairing to Work Removal Fuel (Ground) Start Disconnect Ref. IR 413919	9/2/59
8/31/59	08863	Remove 7-08223 Fuel Tank Sensing Disconnect S/N 114. Ref. IR 413919	9/2/59
8/31/59	08928	Remove 7-08225-5 Coupling to Replace Per IR 413921	9/2/59
8/31/59	08883	Remove 3858-200 V1 Chamber Pressure Switch to Check Per FTP P-005-A	8/31/59
8/31/59	08884	Remove Screws to Perform Range Safety Command System Check Per Test Procedure 7-94073	9/10/59
8/31/59	08929	Open 7-73637-9, 7-73628-25 Pod Doors to Work Pre-release Test Prep Sheet	8/31/59
8/31/59	08864	Remove 9512-41086 LO2 Domes to Check for Contamination	8/31/59
8/31/59	08889	Disconnect 7-04267-1 Quick Disconnect to Prevent Damage During F-004-A Leak Checks	9/11/59
8/31/59	08888	Disconnect P 3066 to Trouble Shoot Telemetry	9/1/59
8/31/59	08865	Remove 7-64302-1, -007 Wave Guide to Facilitate Electrical System Check	9/3/59
8/31/59	08866	Disconnect P-101, P-102, P-103, P-104 P-901, P-201, P-203 Plugs to Facilitate Autopilot System Check	9/10/59
8/31/59	08867	Install 7-11040 Transducer Per TVA 105467-9	9/1/59
9/1/59	08871	Install 7-12210-807 RF No. 1 Backup Can for System Checks	9/14/59

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CONVAIR ASTRONAUTICS

DATE	BOI NO.	REASON	COMPLETION DATE
9/1/59	08869	Remove 7-81132-7 Tube Assembly to Perform Leak Test Per FTP-F-004-A	9/3/59
9/1/59	08870	Remove 7-73707-1, 7-75712-11 Fairing to Remock LO2 Tank Sensing Tubes Per TVA 78263A	9/12/59
9/1/59	08872	Open 7-12100 Booster Instrumentation Box to Pressure Calibrate Per Test Prep Sheet 660	9/8/59
9/1/59	08873	Open 7-12568-805 Sustainer Instrumentation Box to Pressure Calibrate Per Test Prep Sheet 660	9/1/59
9/1/59	08895	Remove 7-41011-955 Serial No. 41 Servo Can, Send to Lab and San Diego for Modification	9/4/59
9/2/59	08896	Remove 7-77232-8 Disconnect Fairing to Check Airborne Disconnects Per TVA 81331-7	9/2/59
9/2/59	08897	Remove 7-81132-13 Fuel Tank Sensing Line Per FTP F-004-A	9/3/59
9/2/59	08900	Disconnect Plug No. 21 for Trouble Shoot Telemetry System	9/9/59
9/2/59	08902	Remove all Rough Combustion Cutoff Air-borne Cannon Plugs to Troubleshoot System	9/19/59
9/2/59	08903	Remove 7-84200-5 Actuator B-2 Pitch Serial No. 189 Per IR 413950	9/3/59
9/3/59	08905	Open 7-12046-21 Padder Box to Trouble-Shoot Telemetry System	9/15/59
9/3/59	08933	Remove 20120-475 LO2 Tank Pressure and Vent Valve Per IR 413116	9/10/59
9/3/59	08934	Remove 1-SE3 Microswitch Per IR 413774	9/4/59

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DATE	BOI NO.	REASON	COMPLETION DATE
9/3/59	08935	Remove 1-SE3 Microswitch Per IR 413775	9/4/59
9/3/59	08938	Remove P-89 on Pneumatic Manifold Sustainer Engine to Facilitate Auto-pilot System Test 7-94001	9/9/59
9/3/59	08901	Remove 7-43021-809 LO2 Overfill Probe Per IR 413948	9/8/59
9/3/59	10470	Remove 7-84119-501 V1, V2 Fairings to Facilitate Autopilot System Test 7-94001	9/10/59
9/4/59	08942	Replace Pneumatic Regulator Serial No. 097 to Accomplish IR 413778	9/8/59
9/4/59	08939	Remove 7-41011-955 Servo Can Serial No. 40 for Lab Calibration	9/14/59
9/4/59	08940	Remove 7-41015-911 Gyro Can Serial No. 35 for Lab Calibration	9/14/59
9/4/59	08944	Open Distribution Box to Troubleshoot P-3036 Per TVA 1707	9/17/59
9/4/59	10471	Remove 7-35228-7 Antenna Cover Plate to Work FTP 7-94078	9/8/59
9/4/59	08945	Disconnect 7-43028-111, 7-12098-45, -47, -51, -49, 7-43028-11, -19, -41, -87, Tube Assemblys to Perform Leak Check Per FTP-F-004-A	9/8/59
9/4/59	08946	Plug P-1610 Disconnected at Azusa Can to Check Power Output of Can For System Test	9/8/59
9/8/59	08948	Disconnect 7-43028-15, -17, -19 Line to Perform FTP F-004-A	9/8/59
9/8/59	08952	Disconnect P-192, 193, 89, 168, 169, 68, 183 Plugs to Accomplish Integrated Launch Test Per FTP M-007-A	9/10/59

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CONVAIR ASTRONAUTICS

DATE	BOI NO.	REASON	COMPLETION DATE
9/8/59	08949	Remove Fuel and LO2 Duct Bellows Fairing Per Prep Sheet 511	9/8/59
9/8/59	08950	Remove 7-73226-1 LO2 Butterfly Valve Per Prep Sheet 511	9/8/59
9/8/59	08951	Remove 7-73224-7 Fuel Butterfly Valve Per Prep Sheet 511	9/8/59
9/9/59	08958	Remove Q 114A22, Q113A22 Wire LO2 Probe for Trouble Shoot	9/11/59
9/10/59	08965	Disconnect P 26 to Facilitate FACT	9/10/59
9/10/59	08966	Remove Address Plug P/N 7220102-G1 From Guidance Decoder for FACT	9/16/59
9/10/59	08967	Remove 7-43208-171, -109, -107, 7-81132-7 Tubes and 7-43021-803, 7-64774-01 Harness to Facilitate Nose Adapter Removal Per Planning Card 7-70005-520A	9/11/59
9/11/59	08981	Disconnect 7-87105-153 Tube, Alcohol Clean and GN2 Purge Per Pre-release Test Prep Sheet	9/17/59
9/11/59	08984	Disconnect Plug 3015 and Open Cover Per STL Harness Ringout to M-120-D	9/17/59
9/11/59	08987	Remove 7-01741-9 Transducer Serial No. 476 Per IR 413830	9/14/59
9/11/59	08988	Remove 7-01676-1 Transducer Serial No. 20 Per IR 413831	9/12/59
9/11/59	08989	Remove Face Plate on J-3002 Per IR 413832	9/21/59
9/14/59	09028	Remove Solenoid Serial No. 1443, Replace Solenoid Serial No. 2755 Per IR 413838	9/16/59
9/14/59	08993	Remove P-1007 Face Plate to Work IR 413834	9/16/59

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DATE	BOI NO.	REASON	COMPLETION DATE
9/14/59	08974	Remove Transducer Serial No. -239, Replace Transducer Serial No. -31 Per IR 413842	9/15/59
9/14/59	08975	Disconnect 7-84123-9, -37 Booster and Sustainer Hydraulic Charge Lines for System Checks	9/22/59
9/14/59	09031	Remove 27-77000-11 Sustainer Engine Rad. Boot to Work TVA	9/23/59
9/14/59	08976	Remove Transducers Serial No. 3068, 3056 3077 Per IR's 413845, 413844, 413843	9/19/59
9/14/59	08998	Remove 9529-48022C High Pressure Fuel to Facilitate TVA 8709	9/16/59
9/14/59	08999	Remove 7-02268-1 Ground Fuel Start Line to Facilitate TVA 8709	9/16/59
9/14/59	09000	Remove 7-02319, 7-02322, 7-02321 Vernier Fuel and LO2 Flex Lines to Work TVA 8709	9/16/59
9/14/59	09001	Remove R-20504 Boot Strap Line to Facilitate TVA 8709	9/16/59
9/14/59	09002	Remove 7-016331-1 Serial No. 56 Transducer to Facilitate TVA 8709	9/17/59
9/14/59	08977	Remove and Replace Per TVA 8709. Remove 7-02229-13, -15 (Serial No. 125, Serial No. 904-0018) Replace 27-21136-3 Serial No. 735, Serial No. 125	9/16/59
9/15/59	09004	Remove 7-08282-13 Helium Charge Line to to Work Test Prep Sheet 528	9/15/59
9/15/59	09006	Remove Telemetry Can Serial No. 86239 for Checkout, Install Can Serial No. 86245	9/18/59
9/15/59	09007	Disconnect 7-08410-25, -29 Tubes to Accomplish Pre-release Check of Booster Heat Exchanger	9/17/59

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DATE	BOI NO.	REASON	COMPLETION DATE
9/15/59	09008	Disconnect Plugs 3084 and 3085 to Troubleshoot Measurement No. P 389	9/17/59
9/15/59	09009	Remove Flight Can Serial No. 39, Install Backup Can Serial No. 28 Per Test Prep Sheet 1012	9/18/59
9/15/59	09005	Remove 27-08562 Pressure Gage for Calibration	9/16/59
9/16/59	09010	Remove 7-08282-13 Helium Charge Line to Pressure Check Booster Separate Bottle	9/16/59
9/16/59	09014	Remove 7-12087-127 Signal Distribution Box Cover to Troubleshoot Telemetry	9/17/59
9/17/59	09034	Remove 7-76857-23 and 7-76854-11 LO2 and Fuel Tank Pressure Boss Caps to Go on Tower Pressure	9/18/59
9/17/59	09017	Disconnect P-34 to Facilitate FACTS Test	9/18/59
9/17/59	09033	Close Butterfly LO2 7-08233-9, Fuel 7-08233-11 to Go on Tower Pressure to Check Heat Exchanger Per Pre-release Test Prep Sheet	9/18/59
9/17/59	09035	Remove B1 Gimbal Block 9512-42065 to Inspect and Repair Per IR 421945	9/19/59
9/17/59	09036	Remove B2 Gimbal Block 9512-42065 to Repair Per IR 421944	9/19/59
9/17/59	09040	Disconnect "B" Nuts on Tubes 7-81133-39 and 27 to Leak Check per pre-release Test Prep Sheet - Heat Exchanger	9/18/59
9/17/59	08778	Remove Valve 9512-45094B to Replace Valve Per IR 421891	9/19/59
9/18/59	09045	Remove 7-73226 Fairing to Install Fairing 7-73707-1	9/18/59
9/18/59	09046	Remove Cover on Box 7-11420 and Plug 3066 to Troubleshoot Measurement P-17-T	9/22/59

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CONVAIR ASTRONAUTICS

DATE	BOI NO.	REASON	COMPLETION DATE
9/18/59	09047	Remove Engine Bleed Valve 9512-43006 to Be Replaced Per IR 421948	9/18/59
9/18/59	09048	Remove Engine Fairing V2 7-76326 to Facilitate Working IR 421948	9/19/59
9/18/59	08781	Remove Servo 7-41011-961, Serial No. 39 for Lab Rework. Replace Servo Serial No. 40	9/22/59
9/18/59	08780	Remove Gyro 7-41015-899, Serial No. 52 for Lab Rework. Replace Gyro Serial No. 35	9/22/59
9/18/59	09050	Disconnect 3070 For Rework Per TVA 93466	9/21/59
9/18/59	08782	Remove 9529-48029 LO2, Duct B1 and 9529-48018 Fuel, Duct B1 to Facilitate IR 421945	9/19/59
9/18/59	08874	Remove 7-12100 Box to Troubleshoot Measurement H-33-P	9/22/59
9/19/59	09051	Disconnect Measurement F-1001-P to Run Pressure Calibration	9/19/59
9/21/59	08785	Disconnect P-10, and P-21 to Make Load Battery Check	9/21/59
9/21/59	08875	Remove 7-43011 and 7-43012 Manometers to Lab Checks	9/23/59
9/21/59	08788	Remove P-50 Sustainer Overspeed Trip to Perform FTP-E-016	9/21/59
9/21/59	08876	Open 7-72126 and 7-72110 Pod Doors for Missile Checkout	Open
9/21/59	08877	Remove 26-10002-1 Azusa Can to Send to Lab	9/22/59
9/21/59	08789	Remove 7-43040-817 PU Can for Functional Check Per FTP-U-011	9/23/59

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DATE	BOI NO.	REASON	COMPLETION DATE
9/22/59	08793	Remove 7-35228-7 Azusa Antenna Cover Plate to Check New Canister	9/22/59
9/22/59	08794	Remove 7-01638-1 Plug 134 to Check Gyro Signal on Telemetry System	9/22/59
9/22/59	08796	Remove P-27E01 on Measurement P-1333-R Per FTP X-012-A	9/22/59
9/23/59	08798	Open B1 Boot for Access to Thrust Section	9/23/59
9/23/59	08801	Remove Plug 4548 on Measurement P-1049-P Per FTP-X-012-A	9/23/59
9/23/59	08803	Remove 7-76326 V1 Fairing to Trouble-shoot Measurement P-1049-P	9/23/59
9/23/59	08804	Remove 7-01687-15 Transducer Measurement P-1049-P Per IR 421895	9/23/59
9/23/59	08807	Remove 7-04314 PU Flow Valve Per IR 421810	9/23/59
9/23/59	08806	Remove 7-43025-3 Surge Tank for Cleaning (Contaminated)	9/23/59
9/23/59	08808	Remove 7-43028-67-69-87 Tubes for Cleaning	9/23/59
9/23/59	08809	Remove TVA 9500-17 Tube for Cleaning Ref. IR 421809	9/23/59
9/23/59	08811	Remove 9512-59052 Vernier LO2 Start Tank Regulator Per IR 421811	9/23/59
9/23/59	08816	Remove 9512-59052 Sustainer Control Regulator Per IR 421892	9/23/59
9/24/59	08818	Remove 7-12210-807 Telemetry Package Due to Failure In Test FTP J-001-B	9/24/59
9/24/59	08819	Remove 7-11840-813 Telemetry Power Supply Due to Failure In Test FTP-J-001-A	9/24/59

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OPEN PAPER WORK

The following are open paper work items against Missile 9C taken from official inspection records.

TVA'S

TVA-85176 - Remove 7-29152-1 and -5 LO2 Pre-valve Installation Prior to Flight.

TVA-85178 - Remove 7-02251 Pre-valve Actuator Prior to Flight.

TVA-1703 - Install Motion Limit P-26 Red Streamer Prior to Flight.

Copy of TVA's above are filed under TVA Logs.

TPS

TPS-545 - Logged on Page 5 Index
PU Functional Checkout - Awaiting Deviation Document to Procedure.

TPS-575 - Logged on Page 6 Index
Red Destruct Box Checkout - Not Accomplished.

TPS-688 - Logged on Page 6 Index
Booster Separation Valve Checkout - Not Accomplished.

OIL

Power Supply	7-11861-501	03
Battery Range	7-36100-551	02
Battery Range	7-36100-552	02
Destruct Unit	7-45809-501	01
Inverter	7-60002-519	02
Valve Installation	7-70005-560	A
Battery Instl. Transverter	7-11841-501	03
Cable Installation	7-11375-509	01

BOI'S

10457	(2) 7-76203 Dog House Doors	Page 7 Index Log
10462	Umbilical Access Doors	Page 7 Index Log

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BOI'S (Cont'd)

08830	27-62303 Autopilot Disconnect Clamp	Page 7 Index Log
08876	Pod I and II Access Doors	Page 10 Index Log

IR'S

821865	Instrumentation Gyro - Caging System Inoperative Disposition Replace and Repair After Static. Logged on Page 9

Planned Out Cards

7-43016-501	"F"	P/O Per TVA-93321-A	9/23/59
7-45809-502	"A"	P/O Per TVA-89825-A	9/16/59
TVA-81989-500	"A"	P/O Per TVA-4128	9/4/59
TVA-81990-500	"A"	P/O Per TVA-4128	9/4/59
7-60018-531	"B"	P/O Per TVA's 94988 and 105455 A	5/4/59
7-77101-543	"P"	P/O Per TPS-9226	8/4/59
7-65051-1	"A"	Logged In and Out	4/8/59
7-73229-502	01	P/O Per TVA-94497	4/6/59
7-45000-1	05	P/O Per TVA-94394	4/6/59
7-64061-1	02	P/O Per TVA-94394	4/6/59
7-20205-515	K	P/O Per TVA-2611	4/16/59
27-72278-1	A	P/O Per 01 and E Accomplished Task	
27-72278-1	B	P/O Per TVA-2729	7/31/59
7-73001-559	C	P/O Per Supp "D"	
7-73001-559	D	P/O "D" Cancels "C"	
7-20205-515	L	P/O Per TVA-3295	
7-20205-511	K	P/O Per TVA-3295	8/17/59

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Planned Out Cards (Cont'd)

7-81132-500	E	P/O Per TVA-8702	9/15/59
7-45809-502	01	P/O Per TVA-89825-A	9/11/59
TVA-93650		P/O Per "A" Revision	4/24/59
TVA-2599		P/O Per "B" Revision	8/5/59
TVA-2604-A		P/O Per 7-23030-503-A	8/20/59

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COMPLEX 12 OPEN PAPER

TPS

TPS-8387	Propulsion (Acid) Line Cleaning and Leak Check
TPS-514	Launcher Pin Retraction Check

BOI's

Chalco EWO Rework in Transfer Room

10607	
10610	
10329	
11332	Service Tower Repair
10586	Air Condition Unit Thermo Gage
10328	Remove Umbilical Tower
08814	TVA-3300 Plug on Keko Unit
08813	TV Camera, West End of Ramp

TVA's

1036B	Site AMR - 12
83612-A	Supp. Launch Ret.
1022-A	Circuit Dia. Launch Cont.
4110	Launcher Installation
3375	Facility Power Diagram Circuit

OIL

7-46000-501	"A"	Head Suppression Servo Checkout Set

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FORM NO. A-783-2

CONFIDENTIAL

SECTION IV

ADDENDUM

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FORM NO. A-702-2

CONFIDENTIAL

CONVAIR ASTRONAUTICS

ADDENDUM TO REPORT NO. FTA 6182, REVISION A
MISSILE 9C FAILURE

To: Holders of Report No. FTA 6182, Revision A

Subject: Sustainer LO2 Inlet Ducting

The following material was compiled by Convair-Astronautics in San Diego to indicate the essential design considerations and development which went into the bellows configuration and is included in this addendum for information purposes.

The Marmon joint or the Solar joint used in the sustainer LO2 inlet duct configuration has a burst pressure specification of 242 psi. A review of all available data on Marmon joints is listed as follows:

1. P/N 7-02247-1 burst at 252 psi with water in a line assembly that had previously passed complete vibration tests of 2 and 5-g sweeps plus 5-minute dwells at several resonant frequencies up to 5 g's. This assembly also underwent a life test of 1000 maximum amplitude flexures prior to the burst test. (Convair Report 7A1230).
2. P/N 7-02247-3 burst at 270 psi using water on a new unit (Marmon Report 1329).
3. P/N 7-02247-1 burst at 340 psi using water on a new unit (Marmon Report 1328).
4. P/N 7-02247-1 burst at 350 psi using LN2 on a virtually new unit. The Convair report is now in writing, as the test was conducted on 4 October 1959.

Making allowance for the warm temperature on the above tests, (joint materials are about 25% stronger at reduced temperatures) it can be concluded that the burst pressure, steady-state, of a Marmon joint is 300 to 350 psi.

It is generally recognized that a structure of this type can absorb a shock load arising from a hydraulic hammer 30 to 60 percent higher than a steady-state load and would probably be able to withstand a surge pressure of 400 to 500 psi. There are no data nor computations available to indicate that the surge was this high during the shutdown on Missile 9C.

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The Marmon flex joint had a high cost and high rejection rate due to fabrication problems. The Solar flex joint, which represents a procurement improvement item, was available prior to the 9C FRF, being used interchangeably with Marmon. Both parts had passed the design specification although the Solar joint had a larger margin above the specification. Releases were made to use only the Solar part on Missile 23D and on to simplify fabrication. Missile 23D was the incorporation point since this missile was on the assembly line at the time the decision was made.

It is not certain that either a Marmon or Solar flex joint or the pump itself is adequate for this type of shutdown. Instances are known where overspeed shutdowns at NAA have resulted in significant damage to pump assemblies with battleship-type inlet ducting installed.

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DEPARTMENT OF THE AIR FORCE
WASHINGTON, DC

27 August 2010

MEMORANDUM FOR: DEFENSE TECHNICAL INFORMATION CENTER

FROM: HAF/IMIO (MDR)
1000 Air Force Pentagon
Washington DC 20330-1000

SUBJECT: Mandatory Declassification Review (MDR) Air Force Case Number 10-MDR-148

DTIC number AD363166 was ordered from your agency for a MDR. The review has been completed and the document was downgraded to UNCLASSIFIED.

Address any questions concerning this review to the undersigned at DSN 222-9979 or COMM (703) 692-9979.

JOANNE MCLEAN
Mandatory Declassification Review Specialist

1 Atch
AFDO Memo, 26 Aug 10 w/
1st Page of Document # AD363166